# IT'S OK TO FEEL FRUSTRATED: HOW SOCIAL COMPARISON AND MOTIVATIONAL BELIEFS INFLUENCE STUDENTS' SELF-REGULATION

by

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## A THESIS SUBMITED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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#### Abstract

During the learning process, frustration can be a significant obstacle for students, particularly in a classroom, when learners perceive that their peers can solve a problem more easily. The processes and beliefs that enable students to control their thoughts and actions to achieve personal goals are referred to as self-regulation. Dweck (1986; 2000) posited that the beliefs individuals have about their abilities, in particular about their intelligence, described as either a fixed or growth mindset, may mediate their use of self-regulatory strategies. An extension of Dweck's research suggests that individuals also have beliefs about the amount of mental resources they have for exerting self-control (i.e., willpower) that are described as either limited or unlimited (Job, Dweck, & Walton, 2010).

The purpose of the current study was to investigate how students' beliefs about intelligence and willpower influenced their self-regulation during a potentially frustrating task with opportunities for social comparison. Participants in this study were public school students, aged 11 to 13 (N = 64; 40 female, 24 male), who were asked to solve puzzles in pairs. One student was given a solvable puzzle and the other was given an unsolvable puzzle. Students were not made aware of differences in the difficulty of the puzzle task before solving it. Questionnaires, observations, and performance on a cognitive task were used as measures of their beliefs, behaviours, emotions, and self-control.

Data were analyzed using correlations, independent samples t-tests, and analysis of variance. Results indicated that the implemented experimental procedures induced frustration: students in the unsolvable condition displayed and self-reported greater frustration than students in the solvable condition. In addition, results indicated that frustration does not necessarily induce self-control depletion: no statistical difference was found in students' self-control between conditions. However, students' self-regulation was influenced by their beliefs about intelligence: students who viewed their intelligence as fixed demonstrated significantly greater self-control depletion than students who viewed their intelligence as capable of growing. Finally, results suggested that the concept of willpower may not be fully understood by students at this age: no significant results were found for the influence of students' beliefs about willpower.

#### Preface

This thesis is submitted in partial fulfillment of the requirements for the degree of Masters of Arts in the Faculty of Graduate Studies, School Psychology. It is the original, unpublished, independent work of the author, Simon Lisaingo. I was solely responsible for the oversight of all aspects of the research project, including recruitment of participants, data collection, scoring, analysis, and interpretation of the results. I conducted this study under the supervision and guidance of my supervisory committee, Drs. Laurie Ford and Nancy Perry (co-supervisors). Ethical approval for this research was issued by the Behavioural Research Ethics Board at the University of British Columbia (certificate number: H14-02873; "An experimental approach to understanding self-regulation: How social comparison and students' implicit theories impact self-control depletion" [dissertation title].

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## List of Abbreviations

Attention deficit hyperactivity disorder
Behavioural Research Ethics Board
Contrast inhibition score
Contrast inhibition score with outlier modified
Executive functions
Fixed mindset belief about intelligence
Growth mindset belief about intelligence
Inhibition accuracy
Inhibition accuracy with outlier modified
Limited-resource theory belief about willpower
Belief about intelligence (Mindset)
Nonlimited-resource belief about willpower
Nonverbal negative affect
Psychoeducational Research & Training
Centre
University of British Columbia
Verbal negative affect
Belief about willpower

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## Dedication

This study is dedicated to my wife, Karmen Scott-Lisaingo, who has supported me during every step of my graduate path and throughout our time together.

My parents, the source of my growth mindset.

And, to the students I have and hope to support in overcoming their own personal challenges.

#### **Chapter One: Introduction**

#### Overview

School districts in North America are adopting and promoting a new education model for the 21<sup>st</sup> Century Learner (Cowan & Skalski, 2008). In this model, educators are recognizing the importance of problem solving strategies for overcoming novel challenges (Dumont, Istance, & Benavides, 2010). Negative emotions, such as frustration, can draw students' attention away from the learning process and interfere with problem solving (T. E. Brown, 2005). Frustration can be particularly elevated in contexts where students perceive their peers can solve a problem more easily (J. J. Seta, Seta, & Donaldson, 1991). How students respond to challenging situations has major implications on their functioning in the classroom.

Self-regulation is reflected in a learner's active process of monitoring and controlling metacognition, motivation, and behaviour (Zimmerman, 2008). Self-regulation is fundamental to problem solving. Students draw upon a diverse array of coping strategies to overcome challenging situations (Newman, 2002; Skinner & Zimmer-Gembeck, 2007). However, not all of the coping strategies students use allow them to succeed, e.g., negative self-talk, avoidance, and vocal venting can be counterproductive in a learning situation. In addition, emotions, such as frustration, can interfere with students' effective self-regulation of/for learning (Järvenoja & Järvelä, 2005; Normand & Croizet, 2013).

Historically, researchers have speculated that frustration can lead to a decrease or increase in learning (J. S. Brown & Farber, 1951; Child & Waterhouse, 1953). Students' frustration can be heightened when they work alongside a more successful peer on a high value task (J. J. Seta et al., 1991). The underlying mental processes of self-regulation during learning have been conceptualized as executive functions (Diamond, 2013). In particular, tasks that induce frustration or emotional arousal are often termed hot executive functions, e.g., Delay of Gratification, whereas those that are more cognitively-based are termed cool executive function tasks, e.g., the Stroop task (Zelazo, Qu, & Kesek, 2010).

Recent developments in neuroimaging and cognitive sciences have led to a better understanding of how exposure to certain situations that draw upon our selfcontrol lead to depletion of self-control and to self-regulatory failure on a secondary activity (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Wagner, Altman, Boswell, Kelley, & Heatherton, 2013). Thus, like a muscle, self-control can fatigue with use (Muraven & Baumeister, 2000).

Motivational beliefs that students have about their abilities have been shown to influence their self-control and academic success (Blackwell et al., 2007; Job, Walton, Bernecker, & Dweck, 2015). Dweck and colleagues (Dweck, 1986; Job, Dweck, & Walton, 2010) suggest that people's beliefs about their capabilities, either fixed or capable of growing, have an effect on their self-control. In the face of obstacles, children with a "fixed" belief about intelligence avoid difficult or challenging tasks, while children with a "growth" belief about intelligence embrace challenges as opportunities to learn (Dweck, 2006). Further, Job, Dweck, and Walton (2010) have demonstrated that individuals' belief about willpower, either limited or nonlimited, directly influences the effects of self-control depletion. Individuals with a nonlimited belief about willpower, i.e., those with the belief that their willpower does not deplete with use, show no difference in their persistence or accuracy on a measure of their self-control after completing a depleting versus non-depleting activity.

The next chapter provides a more comprehensive review of the current literature on the key factors that influence how students overcome novel challenges. First, in the present chapter, definitions of key terms are described. Then, the problem statement, goals, and research questions of the present study are presented. Lastly, the organisation of this thesis is detailed.

#### **Definition of Key Terms**

**Self-Regulation.** The term self-regulation has been used widely and diversely across various academic domains (Karoly, 1993). Generally, it refers to the processes that enable an individual to control thoughts and actions to achieve personal goals and respond to environmental outcomes (Vohs & Baumeister, 2011). It involves the regulation of cognition, motivation, emotion, and action towards a personal goal across contexts.

**Self-control.** In some fields (e.g., developmental and social cognitive), the term self-control has been used synonymously with self-regulation, self-discipline, willpower, effortful control, ego strength, and inhibitory control (Duckworth, Gendler, & Gross, 2014). To avoid confusion, in this study, self-control is defined more narrowly as an

individuals' ability to inhibit urges, behaviours, and emotions (Muraven & Baumeister, 2000). Self-control is an essential element of self-regulation. The term self-control will be used interchangeably with inhibitory control and willpower.

**Executive functions.** Executive functions (EF) are top-down mental processes necessary for purposeful, goal-directed problem-solving activities (Diamond, 2013; Miyake & Friedman, 2012). While executive functioning is similar to self-regulation, it does not typically account for the motivational aspects of self-regulation and has its roots in cognitive psychology (Hofmann, Schmeichel, & Baddeley, 2012).

**Beliefs about intelligence and willpower.** The specific motivational beliefs examined in the current study have been referred to using a variety of terms in the literature: implicit theories, self-theories, ability beliefs, motivational processes, core beliefs, personal beliefs, and mindsets (Dweck, 1986; 2000; 2008; 2012; Eccles & Wigfield, 2002; Vohs et al., 2008). These beliefs, previously referred to as implicit theories by Ross (1989), are knowledge structures that individuals create in order to explain the stability of their personal attributes, e.g., intelligence, personality, or willpower (Ross, 1989). For ease of interpretation, in the current study, implicit theories of intelligence are referred to as beliefs about intelligence with qualifiers of fixed and growth mindsets, and implicit theories about willpower are referred to as beliefs about willpower with qualifiers of limited- and nonlimited-resource theories.

**Emotion regulation.** Emotion regulation, also referred to as emotion-related selfregulation, describes the processes that enable an individual to regulate their emotions towards personal goals (Eisenberg & Spinrad, 2004). It differs from the effects of emotion, external regulation, and unintentional behaviour in that emotion regulation is intentional, driven by the individual, and used to affect one's own or others' behaviours.

**Frustration.** Frustration is the emotional response associated with the opposition to one's self-relevant goal-directed behaviour. In this study, it refers to the emotional experience of students when they are faced with challenging tasks they cannot solve.

**Social comparison.** Social comparison theory suggests that people compare themselves to others in order to evaluate themselves (Festinger, 1954). For instance, individuals may use the performance of a co-actor to evaluate their success or failure towards a goal.

#### **Problem Statement**

Three significant problems are identifiable in the current literature on self-control, self-regulation, and motivational beliefs. First, an empirical and naturalistic experimental procedure for understanding the impact of frustration and social comparison on self-control depletion is missing from the literature. Previous studies of frustration and emotion regulation utilize frustration tasks that often measure persistence (i.e., length of time) on a task in isolated laboratory environments without the influence of peers. A second and significant gap in the self-control and motivational beliefs literature is the absence of the incorporation of emotional regulation and social comparison. Third, the current studies on motivational beliefs only measure either beliefs about intelligence or willpower, but not both together (Erdley & Dweck, 1993; Job et al., 2010). The present study integrates various theoretical constructs (e.g., social comparison, EF, emotion regulation, and motivational beliefs) in hopes of providing further insights into the complex processes of self-regulation. In particular, how motivational beliefs may facilitate the use of self-regulatory strategies.

#### The Present Study

The purpose of the present study is to examine the relationships between motivational beliefs, self-control, and self-regulation in order to gain a better understanding of how students' beliefs about intelligence and willpower impact their self-control and self-regulation after a frustration-inducing event. The present research aims to explore the underlying processes involved in self-regulation, including: social comparison, self-control, emotion regulation, and motivational beliefs. This study will explore student responses about their beliefs about intelligence and willpower in efforts to understand which is more salient to negating the effects of self-control depletion.

The specific goals of the study will be to contribute to the discipline of psychology and the professional literature by providing:

- An experimental procedure that incorporates social comparison as an inducer of frustration in order to better understand the processes involved in self-control, emotion regulation, and self-regulation.
- An extension of prior studies on self-control depletion by examining the influence of a frustration-inducing event using upward social comparison.

 An examination of the influence of students' beliefs about intelligence and willpower on self-control and self-regulatory strategies after a frustration-inducing event in school-age children.

Research questions. In the present study, four research questions were posed:

(1) Does failing to complete a problem-solving task alongside a more successful same-age peer elicit self-reported feelings and behaviours associated with frustration?

Hypothesis: It was hypothesized that a student who is unable to complete the task alongside a peer who easily solves the task would demonstrate behaviours related to frustration and report more intense feelings of frustration than his or her more successful peer.

(2) Does failing to complete a problem-solving task alongside a successful same-age peer deplete self-control in an unsuccessful actor more than in a successful coactor?

Hypothesis: Based on the previous research on self-control depletion, it was hypothesized that students who were unsuccessful on an initial task involving self-control would subsequently perform more poorly on a second task requiring self-control compared to students who were successful at solving the initial task. It was hypothesized that the unsuccessful students' self-control would be depleted due to negative emotions (i.e., frustration) induced and/or heightened by observing their same-age peer successfully solve the task.

- (3) Do individual differences in students' beliefs about intelligence moderate the influence of self-control depletion?
  Hypothesis: Based on previous research, it was hypothesized that students who self-report a growth mindset would perform better on the self-control task after a frustration-inducing event compared to students who self-reported a fixed
- (4) Do individual differences in students' beliefs about willpower moderate the influence of self-control depletion?

mindset.

Hypothesis: Based on previous research, it was hypothesized that students with a nonlimited-resource theory would perform better on a measure of their selfcontrol after a frustration-inducing event compared to students who self-reported a limited-resource theory.

**Organization of thesis.** In Chapter Two, the current literature on emotion regulation, self-regulation, executive functions, self-control, and motivational beliefs that informed the development of this study is reviewed. In Chapter Three, the methods used to explore the above research questions are described. In Chapter Four, results of the current study are presented. Lastly, a discussion of the results, conclusions drawn from the current study, theoretical and practical implications, and future directions for research is discussed in Chapter Five.

#### Chapter Two: Review of the Literature

#### Overview

The following chapter explores in further detail the overview presented in Chapter One. First, research that has examined the influence of frustration and social comparison on emotion regulation in children is examined. Next, the role of selfregulation in overcoming challenges is discussed. Finally, a description of the relevant underlying mental processes that are potentially involved in self-regulation is provided: executive functions, self-control, and motivational beliefs.

#### **Frustration and Emotion Regulation**

**Frustration**. In the school classroom, the response some students have to difficult school-related tasks is described as frustration. Academic literature on the influence of frustration on learning is sparse and dated. Barker (1938) postulated that frustration may result in a reduction or an increase in the efficiency of cognitive abilities. In some cases, the introduction of mild frustration to a simple task may raise the cognitive demand of the task to a critical level that increases the efficiency of a person's cognitive abilities. When frustration is so great that it overwhelms a person's ability to focus on the task, this could lead to a reduction of one's cognitive level. Brown and Farber (1951) suggested that an increase in performance due to frustration may be a result of an increase in general level of motivation or in a person's drive to attain a goal. Frustration in this sense acts as a stimulus for performance. Child and Waterhouse (1953) examined these theories and concluded lower quality of performance after frustration was associated with self-reported maladaptive behaviours in daily life (e.g., preoccupation, aggression, self-aggression, and distractibility). Although these findings are dated, they suggest that people respond to frustration differently and possibly as a function of their personal characteristics. More importantly, they suggest that frustrating events may impact students' learning processes.

**Emotion regulation**. Research on emotion regulation refers to frustration in the context of emotional reactivity (Cole, Martin, & Dennis, 2004; Eisenberg & Spinrad, 2004). Being able to regulate emotional reactivity is important for coping with stressful events (Gross, 2013). Eisenberg and Sulik (2011) describe how emotion-related self-regulation can be either effortful or automatic. Emotional reactivity is described as an involuntary response or impulse, whereas effortful control of emotional behaviour, such

as the suppression of negative emotions, refers to conscious and wilful decisions by an individual. Eisenberg and Spinrad (2004) also point to the need to include goal orientation and intent into a more precise definition of emotion regulation. For instance, negative emotions (e.g., frustration) aroused when a self-relevant goal is impeded are different from situations where individuals express negative emotions in response to specific contexts (e.g., fear or anger) or events (e.g., anxiety). Given these nuances, the term frustration best captures the negative affect associated with effortful, goal-directed behaviour when students face challenging tasks.

Emotion regulation research with special populations have discussed the challenges associated with frustration and used innovative methods for inducing and measuring frustration in their participants. In explaining the underlying functions that impair individuals with attention-deficit disorder, Brown (2005) describes their challenges as managing frustration and modulating emotions. He explains that certain individuals have a very low threshold for frustration (e.g., a short fuse), while others have a chronic difficulty in regulating their emotions (e.g., difficulty modulating feelings of sadness or discouragement).

In examining the emotional competence of children with attention deficit hyperactivity disorder (ADHD), Scime and Norvilities (2006) examined the persistence and self-report ratings of frustration of children with ADHD after completing frustrating puzzles. They found that children with ADHD were more likely to report that they became frustrated during the puzzle tasks, as well as in general situations, than other children; however, no significant difference in persistence on the puzzle task was found. The researchers cited a limitation of their study being that children's task performance may have been enhanced by the novelty of the setting (i.e., laboratory) and the individual attention they received.

Similarly, Jahromi, Meek, and Ober-Reynolds (2012) observed the coping strategies children with high functioning autism used when faced with frustrating laboratory tasks. One of the tasks was an attractive toy in a locked transparent box. Another task was an unsolvable puzzle. In the frustration task, puzzle pieces of a larger puzzle were substituted for other pieces that made it unsolvable. Researchers coded observations to measure children's frustration: facial or bodily negativity, resignation, negative and nonnegative vocalizations, and coping strategies for emotion regulation.

Children with autism displayed significantly more avoidance and venting strategies than typical children, categorized under coping strategies for emotion regulation.

The research methods of the studies highlighted in this review demonstrate the challenges in capturing the effects of frustration on learning. Observational coding and self-reports stand out as commonly used measures of frustration. A limitation of these methods is that they only capture the explicit observable or participant-perceived influence of frustration as opposed to the potential implicit influence of frustration on students' later performance. Given the difficulty in observing or obtaining reports of frustration, few studies have measured this emotion. However, these studies indicate that children with ADHD and autism may have increased difficulty regulating their emotions when faced with frustrating tasks compared to typically developing children. Previous studies examining children's response to frustration have focused primarily on children with ADHD and autism.

**Social comparison**. During the learning process, frustration can be a significant obstacle for students (Huguet et al., 1999; Järvenoja & Järvelä, 2005; Normand & Croizet, 2013). One of the important sources of frustration in today's classroom is social comparison (Buunk, Kuyper, & van der Zee, 2005; J. J. Seta et al., 1991). Social comparison is an individual's tendency to evaluate themselves by comparing themselves with others (Festinger, 1954).

Researchers have found differences in students' emotional responses when students compare themselves to a better performing peer, upward social comparison, as opposed to a poorer performing peer, downward social comparison (Huguet et al., 1999; Normand & Croizet, 2013). The value an individual places on a task is also important for determining the level of frustration experienced by the individual in social contexts (J. J. Seta et al., 1991).

Seta and colleagues (Järvenoja & Järvelä, 2005; J. J. Seta et al., 1991) found that when students worked with a very superior co-actor on a high-value task, they selfreported being more frustrated and performed more poorly on a block-moving reaction time task than those students who worked with a slightly more superior co-actor on the same task. In addition, they found that, generally, students performed better and were less frustrated when they were alone rather than with a peer. Interestingly, they measured students' level of frustration by presenting them with several adjectives and

asked them to rate each based on their psychological state during their performance (e.g., 1 not very much, 10 a lot). A limitation of this study is its generalizability, as only undergraduate female participants were involved. Nonetheless, this research suggests there could be an influence of social comparison and frustration on students' performance. More research is needed to confirm and generalize these findings.

Upward social comparison has also been found to increase attentional focusing when a task is of high-value (Buunk et al., 2005; Huguet et al., 1999; Normand & Croizet, 2013). Huguet and colleagues found that individuals who completed a cognitively demanding task with an audience, performed better (faster reaction time, less inhibition) than individuals who performed the task alone. Other researchers have postulated that individuals draw upon heightened attentional focus when they fear being outperformed by a slightly superior peer on a self-important task (Festinger, 1954; Normand & Croizet, 2013).

#### Self-Regulation

**Defining self-regulation.** When individuals are faced with challenges, they rely on self-regulatory processes in order to achieve their personal goals. Self-regulation has been used widely in the academic literature: personality, motivation/emotion, social, clinical/abnormal, developmental, health, educational, and experimental psychology to name a few (Karoly, 1993). The literature on self-regulation is extensive but a clear definition of self-regulation is elusive (Dinsmore, Alexander, & Loughlin, 2008; Schunk, 2008). Generally, self-regulation refers to the internal and/or transactional processes that individuals use to control their actions, emotions, and cognition towards self-relevant goals across contexts (Vohs & Baumeister, 2011).

Self-regulatory processes enable individuals to cope with stressful and challenging events (Aspinwall & Taylor, 1997). Research on coping focuses primarily on the behaviours associated with self-regulation, such as: problem-solving, informationseeking, helplessness, escape, self-reliance, support-seeking, delegation, social isolation, and accommodation (Skinner & Zimmer-Gembeck, 2007). Young children typically use behavioural strategies for self-regulation (e.g., escape: playing with something fun), whereas older children use cognitive strategies (e.g., accommodation: thinking of something pleasant; Kopp, 1982). Effective and constructive coping occurs along with cognitive developments in children through improvements in problem solving, internalization of behavioural standards, and perspective taking (Skinner & Zimmer-Gembeck, 2007).

Zimmerman (2005) describes self-regulation as an interaction of personal, behavioural, and environmental triadic processes. Self-regulation is viewed as the planned and cyclical adaptations of self-generated thoughts, feelings, and actions that individuals use to attain their personal goals. In this view, self-regulation relies on students' self-beliefs and affective reactions to their performance in different contexts. Self-regulatory processes and beliefs are described within a three cyclical phases: forethought, performance or volitional control, and self-reflection processes. Individuals rely on self-control in the performance or volitional control phase of this model. A component of self-control is attention focusing, which describes strategies individuals use in order to concentrate and screen out distractions or ruminations.

**Studying self-regulation.** A challenge in the self-regulation literature is clearly defining and accurately measuring these complex constructs (Wagener, 2013; Winne & Perry, 2000). Recent reviews of the literature on self-regulation have called for a more integrative approach that incorporates research and methodologies from clinical psychology, cognitive science, and neuroscience (Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Effeney, Carroll, & Bahr, 2013; Hofmann et al., 2012). Some of the measures used in previous studies include interviews, behavioural observations, task performance, think-aloud, and self- and informant-report questionnaires (Dinsmore et al., 2008).

#### **Executive Functions and Self-Control**

**Executive functions.** The underlying mental processes that students rely on in the face of challenges and managing frustration have been conceptualized as executive functions (EF). EFs play an important role in reasoning, problem solving, and planning (Miyake, 2000). As with the term self-regulation, different perspectives on the nature of EFs exists (Barkley, 1997; Jurado & Rosselli, 2007; Zelazo, Carter, & Reznick, 1997). One perspective identifies three core aspects of EFs: working memory, inhibitory control, and cognitive flexibility (Diamond, 2013). Inhibitory control, the ability to inhibit or override habits or impulses, is most often linked to self-regulation (Hofmann et al., 2012); whereas, metacognition, which includes the ability to monitor learning, is thought to explain correlations between self-report measures of EF (Effeney et al., 2013).

Inhibitory control refers to an individual's ability to inhibit or override habits or impulses, often referred to as self-control (Bridgett et al., 2013; Duckworth et al., 2014).

Developmental and neuropsychological research on EFs has historically focused on the cognitive aspects of learners in neutral settings, while research on self-regulation has typically focused on individuals' regulation of emotion and motivation (Diamond, 2013). Only recently has research on EFs considered the influence of emotions. Zelazo (2010) describes tasks that are emotionally or motivationally significant (e.g., tempting, distracting, or frustrating tasks) as using hot EFs and tasks that are neutral or cognitively based (e.g., puzzle or paper-pencil tasks) as using cool EFs. Children's performance on tasks that draw on hot and cool EFs significantly differ (Hongwanishkul, Happaney, Lee, & Zelazo, 2005).

**Developmental considerations of executive functions.** The development of an inhibition mechanism parallels growth in the prefrontal cortex (Zelazo, Müller, Frye, & Marcovitch, 2003). Inhibitory control rapidly develops during the preschool years, in particular between the ages of three and five (S. M. Carlson & Wang, 2007). The development of the prefrontal cortex exhibits a similar pattern of rapid development during the early years (Casey, Tottenham, Liston, & Durston, 2005). Inhibitory control and emotion regulation are thought to develop in parallel (S. M. Carlson & Wang, 2007).

**Self-control.** Developmental, personality, social, and clinical psychology researchers have independently used the term self-control and self-regulation to describe similar processes (Duckworth et al., 2014). Recent articles have worked on integrating and differentiating the multiple frameworks of self-control and self-regulation (Bridgett et al., 2013; Duckworth & Kern, 2011). As mentioned, Zimmerman (2005) places self-control as a component in the performance phase of his cyclical model of self-regulation. Self-control, as conceptualized for the present study, refers to an individual's ability to inhibit urges, behaviours, and emotions (Muraven & Baumeister, 2000).

**Measuring self-control.** Given that the construct of self-control has been operationalized in research studies in many diverse ways, numerous measures of self-control are available (Baumeister et al., 1998; Tangney, Baumeister, & Boone, 2004; Vohs et al., 2008). A meta-analysis by Duckworth and Kern's (2011) meta-analysis offers evidence of convergent validity among various EF tasks and questionnaires that

measure self-control. The most commonly used EF tasks included: go/no-go tasks, Stroop tasks, and set-switching tasks. The authors found that questionnaires, although an indirect measure of EF, demonstrated the most uniform higher correlations over EF tasks. The authors speculated that there was insufficient evidence to support convergent validity of EF tasks due to the extent to which different tasks tap different processes and/or that their study lacked sufficient data to provide statistical significance; whereas, self- and informant-report questionnaires, which inherently asks respondents to provide judgements about behaviour across situations and observations, tend to more accurately measure the same construct. Considering these findings, these authors recommend the inclusion of both EF tasks and questionnaires in measuring self-control, especially for practical applications (e.g., psychoeducational assessment purposes). In the current study, the use of a direct and precise measure of self-control for research purposes provides an objective and complementary measure to indirect measures, such as observations and self-report.

The Stroop task, cited in over 700 studies, is considered as a measure selfcontrol (Duckworth et al., 2014; MacLeod, 1992). In this task, participants are presented written names of colours that are coloured incongruent to what is written in text (e.g., the word "blue" is written in red ink) as oppose to congruent text (e.g., the word "blue" written in blue ink). Participants must inhibit their response to read the written names, saying only the colour of the ink. The overall speed at which people respond to multiple items is measured, as well as the number of errors made. Research has consistently demonstrated slower performance on the incongruent condition over the congruent condition, termed the Stroop effect (MacLeod, 1991).

Another measure of self-control is the Delay of Gratification task (Mischel & Ebbesen, 1970). In this task, children must delay their internal desire to eat a treat (i.e., a marshmallow) in anticipation of receiving a greater number of treats. For those who perform poorly on this task, the desire to eat the treat overwhelms their ability to inhibit this urge. Correlational studies have shown that children who perform better on this task are better able to regulate their emotions and more likely to obtain more positive life outcomes (C. Carlson & Christenson, 2005; Mischel, Shoda, & Rodriguez, 1989; Moffitt et al., 2011).

The Delay of Gratification task is often referred to as a hot EF task (Zelazo, Carlson, & Kesek, 2008). Hot EF tasks involve meaningful self-relevant rewards or punishment that are emotionally or motivationally significant, as opposed to cool EF tasks such as the Stroop task. While there is an abundance of cool EF tasks, only a few measures of hot EF have recently emerged in the literature (Zelazo et al., 2010). This research highlights the influence of emotional contexts on the EF of children. It acknowledges that students' performance on cognitive tasks can be significantly influenced by their motivations or emotions.

**Self-control as a limited resource.** Interesting theories regarding self-control have emerged. Muraven and Baumeister (2000) posited that self-control acts like a muscle and like a muscle can be depleted with use. They found that when participants exerted self-control on one action (e.g., resisting a marshmallow), self-control performance on a second un-related action (e.g., Stroop task) was often impaired. For example, when participants were required to eat only radishes as opposed to chocolates on the first action, participants subsequently persisted for less time on unsolvable puzzles (the second action) than those who were allowed to eat the chocolate in the first action. Similarly, participants who were asked to suppress emotions while watching a comedic video clip on the first action solved fewer anagram puzzles on the second action than those who were not asked to suppress their emotions. These experiments indicate that two seemingly unrelated tasks (e.g., eating undesirable radishes and persistence on a puzzle) draw upon similar limited resources of self-control. This phenomenon has been replicated across contexts and participants, and has been referred to as self-control depletion, ego depletion, and limited resource model of self-control (Baumeister et al., 1998; Gailliot & Baumeister, 2007; Muraven & Baumeister, 2000; Tice & Wallace, 2000; Vohs et al., 2008). However, an emerging body of research suggests that motivational beliefs may moderate the depletion of selfcontrol across tasks (Baumeister & Vohs, 2007; Job et al., 2010). This is discussed further below.

#### **Motivational Beliefs**

**Beliefs about intelligence.** Dweck and colleagues posit that students' beliefs about their capabilities influence their school performance (Blackwell et al., 2007). Motivational beliefs, specifically those previously referred to as implicit theories, are

beliefs people develop about the stability of their abilities and characteristics (Ross, 1989). Dweck (2000; 2012) refers to these motivational beliefs as self-theories, implicit theories, ability beliefs, and mindsets in her research. As noted in Chapter One, for ease of interpretation in the current study, implicit theories are referred to more specifically as beliefs about intelligence<sup>1</sup> and willpower. In describing children's beliefs about intelligence, she has described them as fixed or growth mindsets. Her research indicates that students with a fixed mindset tend to avoid difficult or challenging tasks, yet students with a growth mindset seek challenges as learning opportunities (Dweck & Leggett, 1988).

Molden & Dweck (2006) mentioned in a review of research that the beliefs individuals have about themselves may moderate the use of self-regulatory strategies. Those with a fixed mindset, when faced with failure or challenge, may spend their cognitive resources suppressing negative emotions induced by their fear of being recognized as not "smart." Whereas, individuals with a growth mindset view challenges or failures as opportunities to learn and that recognize improvement will be realized through, for example, further focused attention and strategic effort. A meta-analytic review of motivational beliefs and self-regulation revealed that, across diverse achievement domains and populations, beliefs about intelligence predicted selfregulatory processes (i.e., goal setting, goal operating, and goal monitoring; Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013). Specifically, a growth mindset was associated with the use of self-regulatory strategies that aligned with a learning goal orientation. Motivational beliefs are relevant to self-regulation as they are the beliefs that allow students to thrive when faced with challenging learning tasks. More research is needed to clarify the link between the use of self-regulatory strategies and beliefs about intelligence.

**Beliefs about willpower.** Beliefs about willpower are an extension of beliefs about intelligence. They seek to explain individual differences in the depletion of selfcontrol and, in particularly, how people's belief about willpower can counter the notion

<sup>&</sup>lt;sup>1</sup> The term "intelligence" is used as opposed to a more general term, such as "ability", because this is wording used in the measure used in the current study (*Implicit Theories of Intelligence Scale for Children-Self Form*; Dweck, 2000).

that self-control is a limited resource. Job, Dweck, and Walton (2010) designed experiments to demonstrate that depletion of self-control is mediated by students' beliefs about willpower as either limited (limited-resource theory) or nonlimited (nonlimited-resource theory)<sup>2</sup>. Participants completed a six-item questionnaire about their beliefs about willpower (N = 42). All participants were asked to complete a task designed to teach a basic rule (i.e., crossing out the letters e on a page of text). Participants in the depletion condition were then asked to complete a second similar task with more complex rules (i.e., crossing out *e* only if followed by a vowel); whereas, participants in the non-depleting condition were asked to continue to follow the same rule. The Stroop task was used to measure their self-control depletion. Participants in the depletion condition were more likely to make mistakes on the Stroop task than those in the non-depleting condition. Students with a nonlimited-resource theory, i.e., those with the belief that willpower does not deplete, showed no difference in accuracy between the depleting and non-depleting task; however, students with a limitedresource theory, i.e., those with the belief that willpower can be depleted, were more likely to make mistakes after the depleting task. In other words, students who believe that their willpower is nonlimited demonstrate less self-control depletion than those who believe their willpower is limited. Longitudinal studies examining the influence of a nonlimited belief about willpower on self-regulatory demands of everyday life (e.g., time management, procrastination, eating habits, and spending) support these findings (Job, Walton, Bernecker, & Dweck, 2015).

In their research, Job and colleagues (2010) utilized a task that called upon students cool EF in order to follow complex rules. At the time of this thesis the author did not find research that has examined the possible influences of using a hot EF task with upward social comparison on students' self-control depletion and motivational beliefs about willpower. In addition, current research on motivational beliefs about willpower has been conducted without making links to students' beliefs about intelligence for which there is a broader base of research.

<sup>&</sup>lt;sup>2</sup> Abbreviation of the term "nonlimited-resource theory" as "nonlimited" is used as oppose to its grammatical alternative, "non-limited", in order to remain consistent with original term used in Job, Dweck, and Walton (2010).

The current study extends previous research on self-regulation, motivational beliefs of intelligence and willpower, and self-control through the incorporation of social comparison into experimental procedures, meant to induce feelings of frustration, in order to systematically examine key variables that influence students' self-regulation.

#### **Chapter Three: Methodology**

In this chapter, the methods of the present research study are described. First, the focus of the study is highlighted, followed by a description of the research design and pilot study. Next, the criteria and procedures for selecting and recruiting participants are described, along with the ethical considerations in conducting this study. This is followed by a description of the experimental procedures and measures administered. The chapter concludes with a description of the data analysis procedures used in this research study.

The main research questions addressed in this study are: (1) Does failing to complete a problem-solving task alongside a more successful same-age peer elicit self-reported feelings and behaviours associated with frustration? (2) Does failing to complete a problem-solving task alongside a successful same-age peer deplete self-control in an unsuccessful actor more than in a successful co-actor? (3) Do individual differences in students' beliefs about intelligence moderate the influence of self-control depletion? (4) Do individual differences in students' beliefs about students' beliefs about willpower moderate the influence of self-control depletion?

#### **Research Design**

The first research question was addressed using an experimental research design. An observational coding protocol and a self-report questionnaire, both developed specifically for the present study, were used with participants assigned to one of two conditions in which one condition was designed to induce frustration. These direct and indirect data sources provided opportunities for insights into the validity of the current study's position that one of the experimental conditions was intended to induce the emotion of frustration. Furthermore, it must be acknowledged that the current experimental design was conducted in a school setting, rather than a laboratory setting, whereby inherent challenges to ensuring internal validity (e.g., randomness) were taken into account and discussed below. Threats to internal validity in the current study included, but are not limited to: control over random assignment of participants, selection of participants, history of participants, and influence of testing, instrumentation, design contamination.

To address the above research questions, a factorial research design was used to examine the influence of three sources of self-control depletion:

- (1) Problem-solving puzzle task (solvable or unsolvable),
- (2) Beliefs about intelligence (fixed or growth), and
- (3) Beliefs about willpower (limited or nonlimited).

The dependent variable of this study was a measure of self-control completed by all participants. The independent variables for this study were the sources of self-control depletion described above (solvable or unsolvable, fixed or growth, and limited or nonlimited). The researcher manipulated the first variable, the problem-solving puzzle task, by presenting participants with either a solvable or unsolvable puzzle task meant to induce frustration. Students' beliefs about intelligence and willpower were assumed to exist within the sample. Based on previous research in the area, it was anticipated that the two beliefs about intelligence (fixed or growth) and willpower (limited or nonlimited) would be equally distributed in the population. According to Burnette, O'Boyle, VanEpps, Pollack, and Finkel (2013), these motivational beliefs are endorsed approximately equally across studies and populations.

#### **Pilot Study**

**Overview.** Prior to commencing the experimental procedure, a pilot study was implemented in order to practice and assess the functionality of the proposed experimental procedures. Its main purpose was to ensure standardization of procedures and developmental appropriateness of experimental conditions. It also served to ensure that experimental procedures were well-prepared and to clarify difficulties or challenges with procedures before entering schools. Research assistants were trained to administer a standardized measure of self-control and the complete set of experimental procedures, described below.

Components of the main study were piloted with four students in Grades 5 to 7 and four research assistants. These participants were recruited through personal requests to acquaintances of the researcher. Pilot study participants completed all experimental components during one 40-minute visit to the Psychoeducational Research & Training Centre (PRTC) at the University of British Columbia (UBC).

**Pilot Procedures.** Participants completed relevant steps of the main study, including: questionnaires that assessed students' beliefs about intelligence and willpower, an introduction to the study and task preparation, experimental conditions, post-study questionnaire, and debriefing. Participants were randomly assigned a

partner. They completed the beliefs about intelligence and willpower questionnaires independently in a private room provided for the study. In the room, a table was setup with a divider in the middle. Participant pairs sat across the table from one another with the divider between them. The researcher explained that they would be given the "same" puzzle task and follow-up task and that the tasks are very important for understanding their "thinking." They were encouraged to do their very best. A more detailed description of experimental procedures is described in the following subsections. At the end of the session, pilot study participants were debriefed about the deception used in the study and the true purpose of the study. The pilot study served to allow research assistants to review scoring and data entry procedures.

Lastly, research assistants coded and reflected on procedures and made suggestions for adaptations. As a result of the pilot study, the observational coding protocol was revised, instructions to participants were made clearer, stimulus diagrams were adapted, and questionnaire delivery adaptations were noted.

#### Main Study

**UBC Ethics and school district research approval.** Ethics approval was obtained from the Behavioural Research Ethics Board (BREB) at the UBC. This study complied with the guidelines for ethical research outlined in the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (2010).* 

Approval to conduct research in the targeted school district was obtained from the district level research committee through submission of appropriate proposal documents. The application included a description of the study and researcher, copies of questionnaires, and a description of the measures used in the study.

**Recruitment.** Three targeted school districts were approached for district-level research approval because of current and past relationships that the researcher had with these school districts that helped facilitate the recruitment process.

Once approval from BREB and school district administration was obtained, recruitment of an appropriate school was undertaken. Specific criteria for a participating school was required, including: (a) greater than two classrooms with Grade 6 or 7 students, and (b) not currently receiving specific beliefs about intelligence intervention/programs (i.e., growth mindset training) at the school for Grades 6 and 7 students. This information was obtained in part from a representative at the school

district office through examining available school-level information. Upon identifying potential schools, the school district contacted and informed school principals via email. The primary researcher followed up on these emails with recruitment letters (see attached, Appendix A), set up in-person meetings with principals to discuss the participation of their school in the study, and reviewed each school's suitability for this study.

Of the four schools that met research criteria, two schools responded to the request to meet in-person to discuss their participation. After discussions with the school principals, one school was chosen based on level of interest from teachers. The participating school was a French Immersion school with four Grade 6/7 classrooms (2 French Immersion classes, and 2 English classes) and one Grade 7 classroom (French Immersion).

Upon approval from the school principal, the researcher requested participation from Grade 6 and 7 teachers at the school. The researcher arranged individual meetings with Grade 6 and 7 teachers to discuss the details of the study and the level of disruption to their classrooms. Teachers met with the researcher to discuss student participation in the study (two meetings lasting approximately 10-20 minutes with each teacher) such as: allowing students to be pulled out of their classrooms to complete self-report questionnaires (approximately 15 minutes as a group), debriefing with students (approximately 20 minutes as a group), and experimental procedures (approximately 20 minutes per student). Teachers were offered a two-hour workshop on the topic of motivation and self-regulation as remuneration for the time they spent on study tasks.

Following recruitment of teachers to the study, the researcher delivered an oral presentation to the students in each participating classroom. The researcher described the project at a developmentally appropriate level for the participants (see Appendix B). Following this presentation, the researcher distributed study information, background questionnaire, and consent letters for students to take home to their parents/guardians concealed in an envelope (see Appendix C). The researcher delivered presentations near the end of the school day. Students were asked to return the consent forms to their teacher within two weeks. Those students who participated in the study were entered into a draw for ten-dollar gift cards. After the study was completed, teachers and

parents of participating students were offered a brief written summary of the completed study. In addition, at the end of the study, students taking part in the study were offered an opportunity to discuss strategies on how to best approach challenges.

**Participant screening.** Participants with limited English language abilities, specifically reading, were excluded from the study because students were required to be able to read and complete student questionnaires. Students with a diagnosed neurodevelopmental disorder (i.e., ADHD, generalized anxiety disorder, and autism spectrum disorder) were excluded from the study because of their significant deficits in attention and/or inhibition. The current study extends previous research that focused primarily on students with neurodevelopmental disorders. The above eligibility criteria were described in the introduction and description of the study in parent consent letters.

Teachers were asked to identify any students who demonstrate elevated behaviour levels related to challenges with inhibitory control or impulsivity (see Appendix D). No students were excluded based on these criteria. Teachers were also asked to identify specific students who they believed should not be paired together. These considerations were taken into account when forming pairs. Although these procedures may have influenced the randomness in the selection of participants, it was a necessary accommodation to performing research with students in schools.

#### **Participants**

Participants were aged 11 to 13 and drawn from Grades 6 and 7 classrooms from a school district outside of Vancouver, British Columbia, Canada. Data were collected during the Spring of 2015. This target age group was chosen in order to help ensure that inhibitory mechanisms (i.e., executive functions) were developed and participants had a high enough reading level to complete self-report questionnaires. Students were drawn from French Immersion (French and English spoken by students, i.e., bilingual) and English (regular stream, i.e., typically monolingual) classrooms. Given recent research indicating that bilinguals perform better on self-control tasks than monolinguals, language of instruction differences were analyzed along with sex differences (Bialystok, Craik, & Luk, 2008).

Initially, the study proposed recruitment of approximately 60 students to account for the number of variables in this study. The estimated number of participants was based on those used in similar research studies (Huguet et al., 1999; Job et al., 2010; J.

J. Seta et al., 1991) and recommendations concerning minimum numbers of participants needed to achieve sufficient statistical power (VanVoorhis & Morgan, 2007).

The sample comprised of five classrooms. In total, 132 consent letters were distributed to students for students to take to their parents and 75 letters were returned, resulting in a 57% response rate. Of these students, seven responses indicated that students had previous diagnoses (six with attention deficit hyperactivity disorder [ADHD] and one with generalized anxiety disorder [GAD]). Four of the seven parents of students with previous diagnoses requested that their child take part in some part of the study; therefore, these students were included as part of the solvable condition in order to minimize likelihood of frustration but were not included in final analyses. All 75 consent letters indicated consent for students to take part in the questionnaire component of the study. Thank you letters with a description of the deception procedures were sent home upon receipt of student consent letters. One parent declined to participate following receipt of this letter. All parents were telephoned to follow-up their confirmation and understanding of the deception procedures used in the study. The researcher was unable to contact two parents via telephone; therefore, these students were assigned to the solvable condition to minimize likelihood of frustration. During the study, one student was absent during the experimental component, and the data collected from two students were excluded due to improper implementation of study procedures. In total, 75 students completed the questionnaires, but 11 of the 75 students who returned consents were excluded from the experimental phase of the study for reasons described above. This resulted in a sample size of 64 students for the experimental phase of the study. Demographic information for participating students is provided in Table 1.

Participants were 40 females and 24 males. The average age of students was 12.40 years old (SD = .58 years). Students' ages ranged from ages 11 to 13 with 31.25% of students aged 11, 46.88% of students aged 12, and 21.88% of students aged 13. The majority of respondents indicated that students' ethnicity was either Canadian or European (78.13%) and spoke English at home (92.18%). Most students were enrolled in French Immersion (70.31%) as oppose to English core instruction (29.69%) at school. Parental education backgrounds indicated that the majority parents who responded received a high school diploma or further education, for instance: high

school diploma or equivalent (mothers, 0%, fathers, 3.13%), some college or trades (mothers, 18.75%; fathers, 28.13%), obtained a bachelor's degree (mothers, 29.69%; fathers, 29.69%), or obtained more than bachelors (mothers, 43.75%; fathers, 26.56%). This distribution of parental education level suggests that the current sample may be more educated than is typically in the general population.

### Table 1

Characteristic	Ν	%
Sex		
Male	24	37.50
Female	40	62.50
Other	0	0
Age (years)		
11	20	31.25
12	30	46.88
13	14	21.88
Ethnicity <sup>a</sup>		
Canadian/European	50	78.13
Asian	5	7.81
No response	9	14.06
Language of Instruction at School		
French Immersion	45	70.31
English core	19	29.69
Primary Language at Home <sup>b</sup>		
English	59	92.18
French	1	1.56
Other	3	4.69
No Response	1	1.56
Parent Education		
Mother		
Less than high school diploma	0	0
High school diploma/GED	0	0
Some college/trades	12	18.75
Bachelor's degree	19	29.69
More than bachelors	28	43.75
No response	5	7.81
Father		
Less than high school diploma	0	0
High school diploma/GED	2	3.13
Some college/trades	18	28.13
Bachelor's degree	19	29.69

Demographic Characteristics of Participants (N = 64)

More than bachelors	17	26.56
No response	8	12.50

Note. Percentages do not always add up to 100 due to rounding

<sup>a</sup>Open-ended ethnicity responses were coded as Canadian/Ethnicity (e.g., British, Canadian, Dutch-Canadian, Caucasian, European, German, French), Asian (e.g., Taiwanese, Chinese, Japanese, Chinese-Malaysian), or No response

<sup>b</sup>Open-ended ethnicity responses were coded as English, French, Other (e.g., German, Mandarin, Korean), or No response

#### **Main Study Procedures**

**Motivational beliefs questionnaire.** After recruitment and screening, students met with the researcher in small groups (15 to 20 students at a time) and were asked to complete a questionnaire about their beliefs about intelligence and willpower (see Appendix E)<sup>3</sup>. The researcher explained to participants that the purpose of the motivational beliefs questionnaire was to better understand the thoughts that students have about willpower and intelligence (terms were not described to students). The researcher asked students to take care in noticing differences in rating scales of the questionnaires when responding. They were asked to respond honestly to the questions, answer all the items, and not share their responses.

Prior to continuing with task presentation, the distribution of students' beliefs about intelligence and willpower was examined. An equal distribution of distinct motivational beliefs was important because they were used to assign students to the two experimental conditions. If the distribution was not relatively equal, randomization would create unequal groups which would potentially influence the power of statistical analyses. In the present study, unfortunately, a relatively equal distribution of beliefs about intelligence was not obtained (i.e., more students identified with a growth mindset than a fixed mindset); therefore, straight-forward random assignment to conditions was not possible. Purposive sampling techniques were used to assign participants to separate conditions, described below.

<sup>&</sup>lt;sup>3</sup> Documents in the appendix use the term "implicit theories of intelligence" or "implicit theories about willpower" as oppose to "beliefs about intelligence and willpower" because these were the terms used in the original documents submitted for ethics approval.

**Purposive sampling technique.** Participants were purposively assigned to the task conditions. Specifically, participants' beliefs about intelligence and willpower were used as criteria to assign them to Condition 1 or 2 in order to satisfy statistical requirements for analysis. While this was not ideal and potentially limited generalizability of the results, it allowed for analyses that address the presented research questions of this study.

All participant codes were entered into Microsoft Excel and assigned a randomized value. The sample size, at the time of purposive sampling, consisted of 67 students<sup>4</sup>. Step 1: In consideration of the student questionnaire responses and research hypotheses, participants were assigned to one of two conditions: solvable (n = 33) or unsolvable (n = 34, see Figure 1). Step 2: Given the distribution of participants with a growth (n = 50) and fixed (n = 17) mindsets, all students with a fixed mindset were assigned to the unsolvable condition. Implications of this decision on the validity of the results are discussed in Chapter Five. Step 3: Of the students with a fixed mindset already assigned to the unsolvable condition, eight of these students had a nonlimited-resource theory and nine had a limited-resource theory. With the remaining positions in the unsolvable condition (n = 17), nonlimited-resource theory and limited-resource theory students were randomly selected from students with a growth mindset.



Figure 1. Purposive Sampling Technique Decision Tree

<sup>&</sup>lt;sup>4</sup> Three students were later excluded, as described in the recruitment section.
To facilitate pairings of students, each research assistant was provided a list of students that would either be in the unsolvable or solvable condition, along with information about teachers' recommendations for pairings. When a student was absent or not available, the next student down their list was selected.

**Task presentation.** Prior to beginning, students were asked to provide individual verbal consent to participating in the study. They were also provided an opportunity to consent during debriefing of the study (see Appendix B). Pairs of students were brought to a classroom in the school and asked to sit at two desks facing each other with a small cardboard divider between them. Researchers sat 5-6 feet away from participants to observe students' facial and body expressions. The purpose of the study was not disclosed to the students in order to avoid influencing their performance and response to the experimental conditions. The researcher told students that they were given the "same" puzzle task and follow-up task and that the tasks were very important for testing their "thinking." In fact, each of the students was assigned the task that corresponded to their pre-assigned condition (i.e., one student was assigned the solvable puzzle, the other student was assigned the unsolvable puzzle). Students were asked to do their very best not to talk to one another during the first task, and not to share their experiences or information about the tasks with their peers. A second research assistant was in the room to record behavioural observations and administer the second task.

The task was a tangram puzzle (Slocum et al., 2004). The tangram puzzle initially seems very simple but can be very challenging due to the inclusion of specific geometrical shapes (e.g., parallelogram). The original puzzle is comprised of seven pieces that must be arranged into a square shape. As with other block moving tasks, it can be cognitively demanding task. In the current study, for the solvable condition, six puzzle pieces were used (two large triangles, one medium triangles, two small triangles and two squares); whereas, for the unsolvable condition, seven puzzle pieces were used (two large triangles, one small triangle, one square, and one parallelogram).

**Experimental conditions.** The student in the solvable condition was given an easy puzzle, while, the student in the unsolvable condition was given a puzzle task that could not be solved as a way of triggering frustration. If students asked questions during

the task, they were instructed to do their best with no assistance or additional information provided. If students began to explain or talk about their puzzle, they were reminded not to talk during the tasks. After the puzzle task, both students completed a self-control task to measure possible effects of self-control depletion.

Solvable condition. Once students completed their puzzles, the researcher congratulated them and provided them with another similarly easy puzzle to solve (e.g., "Good job that was quick! Try to make the next shape"). A number of versions of the puzzle task were available depending on the success of the participant. After 10 minutes, a different researcher took this student to another part of the room and administered the self-control task. If the student did not solve the puzzle within seven minutes, the researcher congratulated the student as if they did solve the puzzle to ensure their peer in the unsolvable condition observed them being more successful.

Unsolvable condition. The student in the unsolvable condition worked on the one unsolvable puzzle for 10 minutes. After 10 minutes, this student completed the selfcontrol task with one of the researchers. Note that procedures were put in place to ensure that if indications of emotional distress were observed in students the study would be immediately stopped, the student appropriately calmed, the student's teacher informed, and, if necessary, parents/guardians contacted via telephone. However, these procedures did not need to be implemented for any of the participants.

Self-Control Task. The primary researcher and research assistants alternated administration of the main frustration task and the self-control task to reduce any possible influences of the researcher on the results of the study. While students completed the puzzle tasks, the researchers used an observation coding protocol to record behaviours related to frustration and self-regulatory coping strategies (see Appendix G).

Student post-study questionnaire. Following the self-control task, students completed a post-study questionnaire (see Appendix H). This post-study questionnaire listed adjectives (e.g., frustrated, happy, competitive, etc.) and asked students to rate how much the words represented how they felt during the puzzle task (e.g., 1 not very much, 10 a lot). Students returned to their classroom after they completed this questionnaire.

**Debriefing.** Immediately following the post-study questionnaire, the researcher individually debriefed students about the true nature of the study. The researcher described how the pairs were not given the "same" puzzle tasks but rather one person had a puzzle that was solvable and the other person had a puzzle that was unsolvable. The researchers were trying to elicit an emotional response from students. The researcher explained that that the reason researchers deceived students was to learn about how people's beliefs can impact their learning. They were not really testing their thinking skills, as they were told at the onset of the study. In line with ethical standards for deception studies, students were given the opportunity to ask questions and withdraw from the study (see Appendix F).

After all participants completed the experimental component of the study, all students, who returned consent letters, were invited in groups of 10-15 to meet with the primary researcher. The purpose of this second debrief was to respond to additional questions students may have had and to discuss the relevance of the study to their lives in general (e.g., What are possible sources of frustrations? What are strategies for managing frustration?).

#### Measures

**Background Questionnaire.** Child and family background information was collected along with parent consent (see Appendix C). Questions asked about their child's age, spoken language at home, ability to read in English, possible medical diagnosis of neurodevelopmental disorders (ADHD, autism spectrum disorder, generalized anxiety disorder, or other), ethnic background, and parental education.

**Student Screening with Teacher.** Teachers were informally asked to identify students with difficulties in inhibitory and emotional control, see Appendix D. These questions were based on the *Behavior Rating Inventory of Executive Function* (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), a well-established research-based questionnaire that assesses executive functions. Teachers were also asked to identify possible pairings of students that may exacerbate or trigger past or potentially negative relationships between peers.

**Beliefs about intelligence.** The *Implicit Theories of Intelligence Scale for Children-Self Form* (Dweck, 2000) measured participants' beliefs about their intelligence as either fixed or growth mindset and was developed for children aged 10 and older as part of the student motivational beliefs questionnaire (Appendix E). For instance, participants who agreed with the statement, "Everyone has a certain amount of intelligence and we can't really do much to change it," fell in the fixed mindset group for beliefs about intelligence, whereas, students who disagree with the above statement, fell in the growth mindset group for beliefs about intelligence. The original scale is comprised of six questions students rated on a 6-point Likert scale (1 = strongly agree; 6 = strongly disagree). A recommended three-item version was used in the present study (Dweck, 2000).

The three-item *Implicit Theories of Intelligence Scale* is recommended in order to reduce confusion and repetitiveness (Dweck, Chiu, & Hong, 1995). Psychometric properties from six validation studies with undergraduate students using the three-item scale demonstrated high internal reliability and test-retest reliability ( $\alpha$  ranging from .94 to .98; test-retest reliability of .80; (Dweck et al., 1995). Psychometric properties of the *Implicit Theories of Intelligence Scale* were adequate for children aged 9 to 11 (internal consistency was adequate,  $\alpha$  = .71, with test-retest reliability of .64; (Erdley & Dweck, 1993).

In the present study, students' average beliefs about intelligence score was used to assign them to either a fixed or growth mindset group. An average score of 3.0 or below was classified as a fixed mindset, while an average score above 3.0 was classified as a growth mindset.<sup>5</sup> Cronbach's alphas for the current sample (N=75) was acceptable (3 items,  $\alpha$  = .730, M = 3.90, SD = 1.06; Lisaingo, 2015).

**Beliefs about willpower.** Job and colleagues (2010) first included a measure of beliefs about willpower in a study of adults. A German-version of the beliefs about willpower for children measure, currently in development, was provided for use in the present study by its primary author. The translated version for the current study followed guidelines set out by the International Test Commission (2005) for the translation of this

<sup>&</sup>lt;sup>5</sup> In Dweck, Chiu, & Hong (1995), students with average scores between 3.0 and 4.0 were excluded from analysis in order to ensure that only participants with clear theories were included. In the current study, given the limited number of participants and a greater interest in interpreting the influence of a clear fixed mindset, the cut-off score for a fixed mindset was set at 3.0 or below.

measure from German to English. Once translated, the validity of the translated measure for use with students in Canada was reviewed by academics in the field of educational and school psychology.

The items in this questionnaire assessed students' beliefs about the effects of mental exertion. Participants who agreed with the statement, "after a strenuous mental activity, you feel energized for further challenging activities", hold a nonlimited-resource theory of willpower; whereas, participants who disagreed with the above statement, hold a limited-resource theory of willpower. Participants who completed the adult version of this questionnaire rated items on a 6-point Likert scale (1 = not at all true; 6 = absolutely true). The children's version includes four questions that participants rate on a 5-point Likert scale, which ranged from not at all agree to strongly agree.

Psychometric properties of the *Implicit Theories of Willpower* were acceptable for a sample of sixty undergraduate students ( $\alpha$  = .89, with test-retest reliability greater than .77; Job et al., 2010). No statistical properties of the scale were available for children nor was psychometric information for the German-version provided by its primary author.

In the present study, students' average rating of the beliefs about willpower items were used to assign them to either a limited- or nonlimited-resource theory group. An average score of 2.5 or below was classified as a limited resource theory, while an average score above 2.5 was classified as a nonlimited-resource theory of willpower.<sup>6</sup> Psychometric properties for the adapted and translated version of this measure using the sample in the current study (N = 75) was low (4 items,  $\alpha = .654$ , M = 3.25, SD = .54); however, when items 2 and 3 were deleted, which were both reverse-worded items, it was acceptable (2 items,  $\alpha = 0.740$ , M = 3.11, SD = .30; Lisaingo, 2015). It is possible that students misinterpreted the reverse-worded items. For the purpose of this study, the 2-item version of the scale was used.

**Self-control measure.** Performance on a self-control task was the main behavioural dependent variable for this study. The Stroop task is a ubiquitous measure

<sup>&</sup>lt;sup>6</sup> In (Job et al., 2010), beliefs about willpower was treated as a continuous variable and analyzed using hierarchical regression. In the current study, procedures used were kept consistent with those used for categorization of beliefs about intelligence.

of self-control in the field of experimental psychology (Diamond, 2013; MacLeod, 1992). Many variations of this task have been used in experimental studies with varying procedures (Jensen, 1965).

A standardized measure of the Stroop task was used from the Delis-Kaplan *Executive Function System* (D-KEFS); the Color-Word Interference test (Delis, Kaplan, & Kramer, 2001). The Color-Word Interference test is comprised of four conditions: color naming, word reading, inhibition, and inhibition/switching. The first two conditions were intended to ensure that the participant was able distinguish and read colours. The participants' performance on the third condition, whereby the participant must inhibit their dominant response to read the colour name, served as a dependent variable in the present study. Performance on this task was measured by calculating a contrast inhibition score: taking the difference between completion time on the color naming condition and inhibition condition of the test. The contrast inhibition score was equivalent to measuring the Stroop effect. Another measure of performance is inhibition accuracy of the participant. Accuracy is determined by taking the probability of an error in the inhibition condition (i.e., number of incorrect colors named divided by the total number of items). The psychometric properties of D-KEFS Color-Word Interference are adequate for children aged 11 to 13 in the standardization sample with internal consistency for combined color naming and word reading ranging from 0.72-0.77, while test-retest reliability for the inhibition condition was 0.90.7

**Session observations.** In Condition 2, they were given an unsolvable puzzle designed to induce frustration. It was anticipated that the added component of social comparison, whereby they observe their peer experience success on the task, might trigger and/or heighten frustration.

An observational coding protocol was adapted for students of the current study based on observational procedures for negative affect in young children developed by Jahromi and colleagues (2012). Based on previous research, three observational coding categories were used during observation sessions: nonverbal negative affect

<sup>&</sup>lt;sup>7</sup> Analysis for internal consistency was not completed because the standardized self-control measure, D-KEFS Color-Word Interference, administered using iPads, did not provide accessible output of item-level data.

(e.g., facial expressions and body language), verbal negative affect (e.g., "I give up" or deep exhale), and coping strategies. See Appendix G for additional details on the administrative procedures developed for the observation coding protocol.<sup>8</sup> Non-verbal and verbal negative affect categories were coded using a 3-point scale (0 = no detectable, 1 = mild, and 2 = high) using partial interval recording during the 10-minutes students completed the puzzle task. Coping strategy classifications included in the observational protocol were goal-directed action, distraction, self-speech, vocal venting, social support, avoidance, and disruptive behaviour. Coping strategy behaviours were noted during observational sessions using 1-minute partial interval recording. Classification of strategies was completed during or immediately following the session by the one researcher. A secondary researcher reviewed observational notes and ratings of the observing researcher prior. Any disagreements or questions about ratings were discussed in order to ensure inter-rater agreement.

Following collection of session observations, behavioural notes were thematically coded to refine and analyze observed nonverbal and verbal negative affect, as well as coping strategies. All behavioural notes were entered into a shared spreadsheet. After initial codes were generated, at least one research assistant or the primary researcher reviewed and discussed the generated codes and scoring (Braun & Clarke, 2008; Ryan & Bernard, 2003). Table 2, summarizes the thematic coding definitions for observed verbal and nonverbal negative affect and coping strategies.

<sup>&</sup>lt;sup>8</sup> Documents in the appendix use the term "facial or bodily negativity" for "nonverbal negative affect" and "resignation" for "verbal negative affect" because these were the terms used in the original documents submitted for ethics approval.

### Table 2

Observed Negative Affect	
Verbal resignation	clear resignation or protest (e.g., saying 'I give up')
Breathing	heavy exhale(s)
Mouth	pursed lips, tightened jaw, biting lip
Body and Hands	body or hand movements (e.g., fists clenched, hands tapping, hunched shoulders)
Eyes	furrowed brows, eyes squinting
Facial flushing	cheeks turned red
Observed Coping Strategies	
Stops actions	stops goal directed action (e.g., stops manipulating puzzle pieces)
Alternative strategies	attempts to solve the problem in unique way (e.g., without using the
	puzzle pieces or, stacking pieces on diagram, etc.)
Distraction	turning one's attention away from task (e.g., plays with their clothing or chair.)
Self-speech	talking to oneself (e.g., talking or whispering strategies about the puzzle to self)
Vocal venting	releasing tension vocally (e.g., raising the volume of one's voice, singing)
Physical venting	exaggerated body or arm movement (e.g., banging or hitting the puzzle)
Peer support/comparison	attending to peer (e.g., trying to look at their peer)
Social-support	verbal or nonverbal assistance seeking from the researcher
Disruptive behavior	aggressive behaviour or excessive emotional expression
Avoidance	attempting to get out of one's seat, or moving away from the task
Other	other comfort-seeking (e.g., smiling, laughing)

Thematic Coding Definitions for Observed Negative Affect and Coping Strategies

**Post-study questionnaire.** The post-study questionnaire listed adjectives and asked students to rate how much the adjective represented how they felt during the puzzle task on a scale from 1 to 10 (1 = "not very much" to 10 = "a lot"; Appendix H). Several adjectives were listed, such as frustrated, happy, competitive, angry, and smart. The adjective of primary interest was "frustrated." This procedure was adapted from methods used by Seta and colleagues (1991).

### **Data Analysis**

Analyses were conducted using SPSS 21.0 (IBM Corporation, 2012). First, reliabilities for the measures highlighted above were calculated for the study population prior to completing experimental procedures and are reported above. Then, descriptive statistics were computed and measures of central tendency and data spread were examined. Next, zero-order correlations were used as the starting point to examine

relationships inherent in the data. Finally, independent sample t-tests and Analysis of Variance (ANOVA) were used to address the research questions (A. Lund & Lund, 2013). Of note, if data failed critical assumptions of the independent samples t-test (e.g., normality or significant outliers), the Mann-Whitney U test, a rank-based nonparametric test, was used (Gibbons & Chakraborti, 2014; Mann & Whitney, 1947; Ruxton, 2006).

**Research question 1.** Does failing to complete a problem-solving task alongside a more successful same-age peer elicit self-reported feelings and behaviours associated with frustration? Observations provided evidence about the extent to which participants experienced frustration during the unsolvable puzzle task, as well as insights into the types of self-regulatory strategies they used to cope with frustration. Nonverbal and verbal negative affect were interpreted as indicators of participants' level of frustration. The number of behaviours observed for each observational coding category were summed and then comparisons across conditions were made to determine whether participants in the unsolvable condition appeared more frustrated than the participants in the solvable condition.

An independent t-test analysis was used to determine the statistical significance of the difference. Evidence that students were using coping strategies was also observed and interpreted as indicative of the different types of self-regulatory strategies students utilize when they are challenged or frustrated. The post-study self-report questionnaire provided corroborating evidence about students' feelings and strategies.

**Research question 2.** Does failing to complete a problem-solving task alongside a successful same-age peer deplete self-control in an unsuccessful actor more than in a successful co-actor? Performance on the self-control measure was used as an indicator of participants' level of self-control depletion. Two measures were calculated from the self-control measure: contrast inhibition and inhibition accuracy. The contrast inhibition score was calculated by taking the difference in response time between participants' performance on the color-naming and inhibition items on the D-KEFS Color-Word Interference test. A greater mean difference indicates higher self-control depletion for contrast inhibition (i.e., less self-control available to complete the inhibition task after the color-naming task). Self-control depletion was also quantified using a measure of inhibition accuracy: the probability of an error in the inhibition condition (i.e., number of incorrect colors named divided by the total number of items). A lower inhibition accuracy score indicated more self-control depletion (i.e., less self-control available to complete the task).

Independent T-test analysis was used to compare participants' performance on the measure of self-control, administered after the puzzle task, across the solvable and unsolvable conditions. Based on previous research findings it was hypothesized that students in the unsolvable condition would demonstrate greater depletion on the selfcontrol measure than in the solvable condition.

**Research question 3.** Do individual differences in beliefs about intelligence moderate the influence of self-control depletion? Initially, a two-way analysis of variance (ANOVA) was planned in order to examine the influence of participants' beliefs about intelligence on self-control depletion. However, during the purposive sampling technique procedures, it was determined that all participants who identified with a fixed mindset would be placed in the unsolvable condition. Since no students with a fixed mindset were assigned to the solvable condition, the use of independent T-test analysis was most appropriate. Based on previous research findings it was hypothesized that students in the unsolvable condition with a fixed mindset will demonstrate greater selfcontrol depletion on the self-control measure than students in with a growth mindset.

Additional analyses of observed behaviours were implemented in order to gain insights into differences in participants' level of frustration and types of self-regulatory strategies students used to cope with frustration for those in the unsolvable condition. The number of behaviours observed for each observational coding category were summed and then comparisons of students' beliefs about intelligence were made to determine the types of strategies used and level of observed frustration between students with a fixed and growth mindset.

**Research Question 4:** Do individual differences in beliefs about willpower moderate influence self-control depletion? A two-way ANOVA was used to examine the influence of participants' beliefs about willpower on self-control depletion. The ANOVA was computed with non-equivalent groups with unequal sample sizes per group given the randomization of the samples. Table 3 summarizes the hypothesized outcomes and how the results were described. Based on previous research findings it was hypothesized that students in the unsolvable condition with an limited-resource theory about willpower would demonstrate greater self-control depletion on the self-control

measure than students in with a nonlimited-resource theory about willpower. It was also hypothesized that students in the solvable condition would demonstrate no difference in their self-control depletion between those with a limited and nonlimited-resource theory about willpower. The results of the analyses are presented in Chapter Four.

## Table 3

	Limited-resource theory	Nonlimited-resource theory
Solvable condition	H <sub>o</sub> : μ <sub>L</sub> =μ <sub>N</sub>	H <sub>o</sub> : μ <sub>N</sub> =μ <sub>L</sub>
Unsolvable condition	$H_o: \mu_L > \mu_N$	H <sub>o</sub> : μ <sub>N</sub> < μ <sub>L</sub>

Hypotheses for Factorial ANOVA Design for Beliefs about Willpower.

#### **Chapter Four: Results**

The purpose of this chapter is to present the results of how students' beliefs about intelligence and willpower influence their self-control after a frustration-inducing event. In this chapter, initial descriptive analyses and correlation analyses are presented, followed by data related to each of the research questions presented in Chapter One, as well as selected follow-up analyses.

#### **Descriptive Analyses**

Critical assumptions of tests used for answering research questions were reviewed at each stage of analyses, including assumptions for normality, homogeneity of variance, and outliers. A summary of ranges, means, and standard deviations for variables used in the study are displayed in Table 4. Characteristics of variables are summarized for the full sample, unsolvable condition, and solvable condition. Univariate variable characteristics were reviewed statistically using the Shapiro-Wilk test (Shapiro & Wilk, 1965) for the skewness and kurtosis values, and graphically using histograms, boxplots, and normal and detrended Q-Q plots. Summary of outlier modification and normality for each analysis is included in Appendix I. Histograms of variables in the unsolvable condition are provided in Appendix G. Unless otherwise stated, analyses met assumptions for outliers, normal distribution, and homogeneity of variances.

Screening for potential outliers was conducted using visual inspection of box plots (Osbored & Overbay, 2004). Significant outliers were individuals whose scores on particular measures were greater than three box lengths (i.e., interquartile range) from the edge of their box (i.e., upper/inner interquartile); and, moderate outliers were those which were one and a half box lengths from the edge. Genuinely unusual values, those not due to data entry error or measurement error, were modified with a replacement value that was less extreme (i.e., one value less the next largest/smallest value). Outlier identification was performed for each analysis as part of the analysis for critical test assumptions, including normality and homogeneity of variance. Inclusion of duplicated variables for contrast inhibition (outliers modified) and inhibition accuracy (outliers modified) were presented in Table 4 to illustrate the minimal influence of outlier modification on the resulting data analyses (i.e., significance was found for both modified and non-modified variables).

# Table 4

# Summary of Range, Means, and Standard Deviations.

	Full s	ample (N	= 64)	Sol	Solvable (n = 31)			Unsolvable (n = 33)		
Measure	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation	
Beliefs about Intelligence	1 - 2	1.77	.43	2 - 2	2.00	.00	1 - 2	1.55	.51	
Beliefs about Willpower	1 - 2	1.67	.47	1 - 2	1.77	.43	1 - 2	1.56	.50	
Contrast inhibition	7 - 58	28.08	10.85	11 - 58	29.97	12.60	7 - 50	26.3	8.73	
Contrast inhibition (Outliers modified)	10 - 58	28.03	10.49	11 - 58	29.97	12.60	10 - 42	26.21	7.80	
Inhibition accuracy	74 - 100	92.47	5.14	76 - 100	93.03	5.11	74 - 100	91.94	5.18	
Inhibition accuracy (Outliers modified)	83 - 100	92.75	4.35	85 - 100	93.32	4.30	83 - 100	92.21	4.39	
Nonverbal negative affect	0 - 9	4.00	2.93	0 - 9	2.65	2.75	0 - 9	5.27	2.52	
Verbal negative affect	0 - 7	.91	1.71	0 - 2	.26	.63	0 - 7	1.52	2.14	
Self-reported frustration	1 - 9	4.83	2.32	1 - 9	3.90	2.20	1 - 9	5.70	2.11	
Solvable/Unsolvable	0 - 1	1.52	.50	1 - 1	1.00	.00	2 - 2	2.00	.00	
Sex	1 - 2	1.62	.49	1 - 2	1.55	.51	1 - 2	1.70	.47	
Language of instruction	1 - 2	1.70	.46	1 - 2	1.65	.49	1 - 2	1.76	.44	

#### **Correlation Analyses**

Research questions were initially investigated using correlation analyses in order to examine zero-order relations among variables. Sex and language of instruction were also examined in order to assess their influence on the data. Correlations for the full sample and unsolvable conditions correlations are presented in Table 5 and 6, respectively. Interpretation of full sample correlations for beliefs about intelligence were not interpretable because there were no students with a fixed mindset in the solvable condition due to purposive sampling techniques.

In the full sample, there was a moderate positive correlation between level of self-reported frustration and nonverbal negative affect,  $r_s(64) = .282$ , p = .012. Sex was strongly correlated with contrast inhibition scores, nonverbal negative affect, and frustration,  $r_s(64) = .305$ , -.302, .292, p < .001, respectively. Language of instruction was not significantly correlated with any of the variables used in this study.

In the unsolvable condition, beliefs about intelligence were strongly correlated with inhibition accuracy for both modified and nonmodified variables,  $r_s(33) = .485$ , p < .001, but not for contrast inhibition scores. Sex was also moderately correlated with inhibition accuracy,  $r_s(33) = .354$ , p < .05, and strongly correlated with contrast inhibition,  $r_s(33) = -.413$ , p < .001. In other words, correlations suggested that male students experienced greater self-control depletion than female students. These relationships were explored in further detail in the sections below.

## Table 5

Predi	ctor <sup>2</sup>	1	2	3	4	5	6	7	8	9	10	11
1.	WPlabel	-										
2.	MSlabel	-	-									
3.	ContrastInhibScore	-	044	-								
4.	ContrastInhibScore (OutlierMod)	-	038	1.000**	-							
5.	InhibAcc	-	.358**	388**	387**	-						
6.	InhibAcc(OutlierMod)	-	.360**	387**	385**	1.000**	-					
7.	NonverbalNeg	-	386**	004	005	185	184	-				
8.	VerbalNeg	-	332**	063	067	050	048	.340**	-			
9.	Frustrated	-	135	258 <sup>*</sup>	255 <sup>*</sup>	.101	.100	.282*	.179	-		
10.	Sex	-	048	305**	302**	.101	.103	.335**	.092	.292**	-	
11.	Solvable/Unsolvable	-	536**	135	138	122	124	.449**	.390**	.394**	.153	-
12.	Language of instruction	-	117	035	039	244	246	.001	080	038	.132	.123

Spearman Correlations for the measures in the full sample  $(N=64)^{1}$ 

<sup>1</sup>\*p < 0.05 level (2-tailed), \*\*p < 0.01 level (2-tailed), and \*\*\*p < 0.001 level (2-tailed)

<sup>2</sup>WPlabel = Beliefs about willpower; MSlabel = Beliefs about intelligence; ContrastInhibScore = Contrast inhibition score;

ContrastInhibScore(OutlierMod) = Contrast Inhibition score with outliers modified; InhibAcc = Inhibition accuracy;

InhibAcc(OutlierMod) = Inhibition accuracy with outliers modified; NonverbalNeg = Nonverbal negative affect; VerbalNeg = Verbal negative affect; Frustrated = Self-reported frustration; Sex = Participant sex; Solvable/Unsolvable = Experimental condition

## Table 6

Predictor<sup>2</sup> 2 3 7 1 4 5 6 8 9 10 1. WPlabel -2. MSlabel -.027 -3. ContrastInhibScore -.039 -.205 4. ContrastInhibScore .999\*\* -.035 -.202 (OutlierMod) .485\*\* -.423\*\* 5. InhibAcc -.423\* -.126 .485\* -.423\*\* 1.000\*\* -.423\*\* 6. InhibAcc(OutlierMod) -.126 --.150 -.153 .015 7. NonverbalNeg -.402\* -.291 .015 -8. VerbalNeg -.075 -.195 -.160 -.167 .099 .099 .185 9. Frustrated .095 .175 -.185 -.178 .138 -.095 .028 .138 -.416\*\* -.413\*\* .513\*\* 10. Sex -.020 .354\* .354\* .078 .060 .109 -.108 11. Language of instruction -.199 -.090 .108 -.271 -.271 -.049 .056 -.185 .089

Spearman Correlations for the measures in the unsolvable condition  $(n=33)^{1}$ 

<sup>1</sup>\*p < 0.05 level (2-tailed), \*\*p < 0.01 level (2-tailed), and \*\*\*p < 0.001 level (2-tailed)

<sup>2</sup>WPlabel = Beliefs about willpower; MSlabel = Beliefs about intelligence; ContrastInhibScore = Contrast inhibition score;

ContrastInhibScore(OutlierMod) = Contrast Inhibition score with outliers modified; InhibAcc = Inhibition accuracy;

InhibAcc(OutlierMod) = Inhibition accuracy with outliers modified; NonverbalNeg = Nonverbal negative affect; VerbalNeg = Verbal

negative affect; Frustrated = Self-reported frustration; Sex = Participant sex; Solvable/Unsolvable = Experimental condition

#### **Research Questions**

Research Question 1. Does failing to complete a problem-solving task alongside a more successful same-age peer elicit self-reported feelings and behaviours associated with frustration? There were 31 participants in the solvable condition and 33 in unsolvable condition. A Mann-Whitney U test was run to determine if there were differences in observed behaviours and self-reported feelings of frustration between students in the solvable and unsolvable conditions (see Table 7). Students in the unsolvable condition displayed significantly more facial expressions and behaviors associated with negative affect than students in the solvable condition (Mdn = 5.00 and 2.00, respectively), U = 775, z = 3.561, directional, p < .001, r = .445. These students also self-reported more feelings of frustration (Mdn = 6.00) compared with peers in the solvable condition (Mdn = 3.00), U = 743, z = 3.127, directional, p = .001, r = .390.

Visual inspection of the histograms revealed dissimilar distributions of the verbal negative affect scores across conditions, which violates a critical assumption of the Mann-Whitney U test. Therefore, the difference in the distribution of scores using mean ranks, as opposed to medians, between groups was used for evaluating the results of the Mann-Whitney U test. Verbal expressions of negative affect for the unsolvable condition (mean rank = 26.23) were significantly higher than for the solvable condition (mean rank = 26.23), U = 706, z = 3.094, p = .002, r = .387. This difference in distribution may be due to the limited observations of verbal expressions of negative affect in either of the experimental conditions (unsolvable condition, range = 0-7, mean = 1.52; solvable condition, range = 0-2; mean = .26; 5 significant outliers based on boxplot). In other words, since only very few students (i.e., very low mean values) expressed verbal negative affect (e.g., saying "I give up"), a few students (i.e., significant outliers), who were more expressive, can significantly skew data and interpretation.

#### Table 7

Measure	Range	Full sample	Solvable	Unsolvable	Differences	Effect	
		Mean (n=64)	(n=31)	(n=33)	Mann Whitney	Size	
					U (sig.)	(r)	
Nonverbal neg. affect	0-9	4.00 (2.93)	2.65 (2.75)	5.27 (2.52)	775 (< .0005)**	.445	
Verbal neg. affect	0-7	.91(1.71)	.26 (.63)	1.52 (2.14)	706 (.001)*	.387	
Self-reported frustration	1-9	4.83 (2.32)	3.90 (2.20)	5.70 (2.11)	743 (.001)*	.390	
*p < 0.05 level (1-tailed), **p < 0.01 level (1-tailed), and ***p < 0.001 level (1-tailed)							

Means, Standard Deviations, and Differences between Measures of Frustration and Experimental Conditions

Session observation notes provided additional evidence for whether or not the experimental procedures induced frustration in the participants in the unsolvable condition. Session observations of student verbal and nonverbal expressions of negative affect were thematically coded based on researcher notes to clarify types of observed behaviours (see Figure 2). Based on these observations, visual inspection of bar charts, students in the unsolvable condition expressed higher levels of facial flushing (e.g., cheeks turned red), body and hands movements (e.g., fists clenched, hands tapping, hunched shoulders), and mouth movements (e.g., pursed lips, tightened jaw, biting lip) compared to their peers. Observations of the students coping strategies, see Figure 3, indicated no clear difference for most types of coping strategies used in the solvable versus unsolvable condition. Students in the unsolvable condition sought greater peer support than those in the solvable condition. Students in the solvable condition.



Figure 2. Observed Verbal and Nonverbal Negative Affect in the Full Sample (N = 64).



Figure 3. Observed Coping Strategies in Full Sample (N = 64).

Research Question 2. Does failing to complete a problem-solving task alongside a successful same-age peer deplete self-control in an unsuccessful actor more than in a successful co-actor? An independent-samples t-test was conducted to determine if there were differences in depletion of self-control as measured by students' inhibition accuracy and contrast inhibition scores (see Table 8). Across 64 cases, 2 variables, and 2 conditions (256 data points), five data points (2%) were identified as outliers. They were addressed by modifying outliers through replacing outlier values with one that was one point less extreme. After modifying outliers, the Shapiro-Wilk's test revealed that the self-control measures were normally distributed (p > .05). The Levene's test for equality of variances revealed homogeneity of variances (p = .798) for inhibition accuracy but not for contrast inhibition score (p = .010).

No significant difference was found for inhibition accuracy across conditions, t(62) = 1.022, directional, p = .156, d = .254. Similarly, no difference was found in students' contrast inhibition scores across conditions, t(50) = 1.423, directional, p = .080, with equal variance not assumed, d = .359.

Table 8

Means, Standard Deviations and Differences between Self-Control Measures and Experimental Conditions

Measure	Range	Full sample	Solvable	Unsolvable	Differences	Effect
		Mean (n=64)	(n=31)	(n=33)	Independent	Size
					T-test (sig.)	(d)
Inhibition accuracy	83-100	92.75 (4.35)	93.32 (4.30)	92.21 (4.39)	1.022 (.156)	.254
Contrast inhibition	10-58	28.03 (10.49)	29.97	26.21 (7.80)	1.423 (.080)	.359
			(12.60)			

\*p < 0.05 level (1-tailed), \*\*p < 0.01 level (1-tailed), and \*\*\*p < 0.001 level (1-tailed)

Research Question 3. Do individual differences in beliefs about intelligence moderate the influence of self-control depletion? Of the 33 participants in unsolvable condition, 15 had a fixed mindset and 18 had a growth mindset. An independent-samples t-test was run to determine if there were differences in inhibition accuracy between students with a fixed and growth mindset (Table 9). Students with growth mindset obtained statistically significantly higher scores on the measure of inhibition accuracy (M = 94.22, SD = 3.56) than students with fixed mindset (M = 89.80, SD = 4.14), a mean difference of 4.42, 95% CI [1.69 to 7.15], t(31) = 3.300, directional, p = .001, d = 1.15. In other words, students with a growth mindset experienced less selfcontrol depletion than students with a fixed mindset.

## Table 9

Means, Standard Deviations and Differences for full sample – Self-Control Depletion for Fixed and Growth Mindset in Unsolvable condition

Measure	Range	Full sample	Fixed	Growth	Differences	Effect
		Mean	(n=15)	(n=18)	Independent T-	Size
		(N=64)			test (sig.)	(d)
Inhibition accuracy	83-100	92.21 (4.39)	89.80 (4.14)	94.22 (3.56)	3.30 (.001)**	1.15
Contrast inhibition	10-42	26.21 (7.80)	28.27 (8.32)	24.50 (7.12)	1.40 (.086)	.487

\*p < 0.05 level (1-tailed), \*\*p < 0.01 level (1-tailed), and \*\*\*p < 0.001 level (1-tailed)

An independent samples T-test was run to determine whether students with a fixed mindset experienced more frustration in the unsolvable condition than students with a growth mindset (Table 10). Differences in frustration and nonverbal expressions of negative affect between students with a fixed and growth mindset were examined. No significant difference was found between self-reported frustration and nonverbal expressions of negative affect for those with a fixed and growth mindset.

## Table 10

Means, Standard Deviations and Differences in Beliefs about Intelligence for Unsolvable Condition

Measure	Range	Solvable Condition	Fixed (n=15)	Growth (n=18)	Differences T-Test (sig.)	Effect Size
		Mean			df=29	(d)
Nonverbal neg. affect	0-9	4.00 (.37)	6.00 (.58)	4.67 (.62)	1.55 (.132)	2.38
Frustration	1-9	4.83 (.29)	5.33 (.50)	6.00 (.54)	.899 (.375)	1.29

Session observation notes provided additional evidence for whether or not the experimental procedures induced differences in frustration or self-regulatory strategies for participants with a fixed or growth mindset in the unsolvable condition. Session observations of students' nonverbal and verbal expressions of negative affect were thematically coded and examined (see Figure 4). Based on these observations, visual

inspection of bar charts, students in the unsolvable condition with a fixed mindset demonstrated no clear difference in nonverbal and verbal expressions of negative affect compared to those with a growth mindset. Observations of the students' coping strategies, Figure 5, indicated that students in the unsolvable condition with a fixed mindset sought greater peer support than those with a growth mindset. Students with the growth mindset used slightly greater alternative strategies (e.g., attempts new or unique way to solve the puzzle) than those with a fixed mindset.



*Figure 4*. Observed Nonverbal and Verbal Negative Affect in the Unsolvable Condition (n = 33).



*Figure 5.* Observed Coping Strategies in the Unsolvable Condition (n = 33).

Research Question 4: Do individual differences in beliefs about willpower moderate influence self-control depletion? A two-way ANOVA was conducted to examine the effects of condition and beliefs about willpower on inhibition accuracy (Table 11). Residual analysis was performed to test for the assumptions of the two-way ANOVA. Two outliers were detected, which were modified for the analyses of this question, see Appendix I. Residuals were normally distributed (p > .05) and there was homogeneity of variances (p = .742). The solvable-nonlimited condition had a non-normal distribution (Shapiro-Wilk statistic=.881, p=.009).

There was no significant interaction between experimental conditions and beliefs about willpower score,  $F(1, 60) = 2.227 \ p = .141$ , partial  $\eta^2 = .036$ . The main effect of experimental conditions and beliefs about willpower were not significant, F(1, 60) = 2.217, p = .14, partial  $\eta^2 = .036$ , and F(1, 60) = 1.48, p = .228, partial  $\eta^2 = .024$ , respectively.

### Table 11

Simple Main Effects of Experimental Conditions and Beliefs about Willpower

Beliefs abou	t Willpower	Simple Main	Main
Limited (n=21)	Nonlimited (n=43)	Effects	Effects

Conditions	Solvable (n=31)	95.86 (3.29)	92.42 (5.14)	F(1, 60) = 3.07, p = .085	F(1, 60) =
	Unsolvable (n=33)	92.07 (4.65)	92.42 (4.65)	F(1, 60) = .047, p = .829	.14
Simple Main Effects		F(1, 60) = 3.20, p = .079 F(1, 60) = .000, p = .998			
Main Effects		<i>F</i> (1, 60) = 1.	48, <i>p</i> = .228		

Visual examination of interaction effects indicated a disordinal interaction (i.e., interactions that overlap or crossover); therefore, simple main effects were explored to examine interaction effects. All pairwise comparisons were run for each simple main effect with reported 95% confidence intervals, summarized in Table 11 and Figure 4. The simple main effect of beliefs about willpower on mean inhibition accuracy score for those in the solvable and unsolvable condition were not statistically significant, *F*(1, 60) = 3.07, *p* = .085, partial  $\eta^2$  = .049, and, *F*(1, 60) = .047, *p* = .829, partial  $\eta^2$  = .001, respectively. There was also no significant difference for experimental conditions and limited and nonlimited beliefs about willpower, *F*(1, 60) = 3.20, p = .079, partial  $\eta^2$  = .051, and, *F*(1, 60) = .000, p = .998, partial  $\eta^2$  = .000, respectively.



*Figure 6.* Inhibition Accuracy as a Function of Experimental Conditions and Beliefs about Willpower

**Sex differences.** Mean scores, variability, and sex differences were explored for the full sample, as well as the unsolvable condition (Tables 12 and 13). For the purpose

of these descriptive analyses, Mann-Whitney U analyses were performed for all variables that were not normally distributed and Independent Samples T-test were used for those with normal distributions.

In the full sample, including participants in both the solvable and unsolvable conditions, female students demonstrated significantly higher self-control depletion (as indicated by lower contrast inhibition) than did male students, t(62) = 2.251, non-directional, p = .028, as well as significantly higher nonverbal negative affect than did male students, F(62) = 670.00, p = (.008).

In the unsolvable condition, female students demonstrated significantly less selfcontrol depletion (as indicated by lower contrast inhibition mean values, t(31) = 2.43, non-directional, p = .021, and higher mean values for inhibition accuracy, t(31) = 2.31, non-directional, p = .028) and self-reported frustration, F(31) = 188.00, non-directional, p = .003, than did male students. No statistical significance was found for sex differences for beliefs about intelligence or willpower, nonverbal negative affect, or selfreported frustration.

## Table 12

Measure	Range	Full sample Mean	Boys (n=24)	Girls (n=40)	Sex Differences T-Test (sig.)	Sex Differences Mann Whitney U (sig.)
Beliefs about intelligence	1-2	1.28	1.83	1.83		484.00 (.937)
Beliefs about willpower	1-2	1.68	1.67	1.68		484.00 (.937)
Contrast inhibition	10-68	36.52	40.88	33.90	2.37 (.021)*	
Contrast inhibition	14-68	36.48	40.63	34.00	2.25 (.028)*	
(Outliers modified)						
Inhibition accuracy	74-100	92.47	91.67	92.95		537.50 (.421)
Inhibition accuracy	83-100	92.75	92.04	93.18		538.50 (.431)
(Outliers modified)						
Nonverbal neg. affect	0-9	4.00	2.75	4.75		670.00 (.008)**
Verbal neg. affect	0-7	.91	.54	1.13		524.50 (.465)
Frustration	1-9	4.83	3.96	5.35		646.00 (.020)*

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Means	Standard	Deviations	and Sex	Differences	for Full	Samnle
mound,	otunuuru	Deviations		Differences	101 1 411	Gumpic

\*p < 0.05 level (2-tailed), \*\*p < 0.01 level (2-tailed), and \*\*\*p < 0.001 level (2-tailed)

## Table 13

Means, Standard Deviations and Sex Differences for Unsolvable Condition

		Unsolvable	Povo	Cirlo	Sex	Sex Differences
Measure	Range	Condition	(n-10)	(n-22)	Differences	Mann Whitney
		Mean	(11-10)	(11-23)	T-Test (sig.)	U (sig.)
Beliefs about	1-2	1.55	1.50	1.57		112.50 (.733)
intelligence						
Beliefs about willpower	1-2	1.82	1.80	1.82		118.00 (.923)
Contrast inhibition	10-49	33.85	38.80	31.70	2.53 (.017)*	
Contrast inhibition	14-49	33.79	38.20	31.87	2.43 (0.021)*	
(Outliers modified)						
Inhibition accuracy	86-98	91.94	88.80	93.30		165.50 (.047)*
Inhibition accuracy	86-98	92.21	89.70	93.30	2.31 (.028)*	
(Outliers modified)						
Nonverbal neg. affect	0-9	5.27	4.80	5.48		130.50 (.550)
Verbal neg. affect	0-7	1.52	.90	1.78		125.50 (.660)
Frustration	2-9	5.70	4.10	6.39		188.00 (.003)**

\*p < 0.05 level (2-tailed), \*\*p < 0.01 level (2-tailed), and \*\*\*p < 0.001 level (2-tailed)

#### **Chapter Five: Discussion**

#### Overview

The primary goal of this study was to better understand the processes involved in self-regulation by examining whether and how students' beliefs about intelligence and willpower influence their experience of frustration and levels of self-control during and after a challenging task. The chapter begins with a summary of the results for each research question. This is followed by a more general discussion of the major findings and consideration of the study's strengths and limitations. The chapter concludes with a discussion of implications for future practice and research.

### **Discussion of Research Questions' Key Findings**

**Research question #1.** As hypothesized, results of the present study suggest that failing to solve a problem-solving task alongside a more successful peer can trigger self-reported feelings and observed behaviours associated with frustration. Students who were assigned the unsolvable puzzle demonstrated significantly greater facial and verbal expressions and body language reflecting negative affect compared to those given the solvable puzzle. They also self-reported significantly greater frustration in the unsolvable condition. Researchers observational notes indicated that students in the unsolvable condition demonstrated facial flushing and subtle body, hand, and mouth movements indicative of negative affect (e.g., slumping, clenched fist, or pursed lips) that were not observed for students in the solvable condition.

A variety of coping strategies were observed and coded, these included: stops actions, alternative strategies, distraction, self-speech, vocal venting, physical venting, peer support, social support, disruptive behaviour, and avoidance. The strategies that students in the solvable condition were observed using the most often were social support (e.g., looking at researcher) and alternative strategies (e.g., attempts to solve the problem in unique way). Students in the unsolvable condition were observed using peer and social support the most often. These findings suggest that students in the solvable condition were engaged in checking their performance with the researcher (i.e., checking to see if they had the correct puzzle answer); whereas, students in the unsolvable condition were actively engaged in social comparison with their peer (i.e., comparing their performance to the performance of their peer by trying to look at their

peer's progress or facial expressions) as well as checking with the researcher. Additionally, the researchers anecdotally noted that observations of students' frustrations occurred immediately following their peer solving of the solvable puzzle task. Together these findings demonstrate how social comparison can trigger or exacerbate students' experience of frustration in a challenging situation. It provides support for the incorporation of social comparison into the experimental design.

The term negative affect was used in the current study to describe the facial, body, and verbal expressions of emotions elicited by students in order to be consistent with prior research (Carver & Scheier, 2011; Diener, Larsen, & Levine, 1985; Gross, 1998). Given the context and circumstances that aroused the emotion whereby students were unable to complete a self-relevant goal (i.e., completing the puzzle), the use of a more specific emotional description, frustration, was used for the self-report measure. Current findings provide support for and extends the perspectives of Eisenberg and Spinrad (2004) that a more precise definition of emotion regulation is needed. The literature typically does not specify what emotions are aroused unintentionally or automatically from contexts (e.g., fear) or events (e.g., anxiety) from those that are elicited based on an individuals' goal orientation and preconceived expectations (i.e., frustration). Recent research by Pekrun, Vogl, Muis, and Sinatra (2016) highlight how emotions can differ based on the focus of the learner's attention (e.g., frustration as an epistemic emotion, "I should be able to solve this puzzle but I can't", or as an achievement emotion, "I just can't solve the puzzle"). Future research may benefit from identifying and studying specific emotions that are aroused during the learning process in order to better target potential interventions. For instance, the influence of positive affect (e.g., feeling happy) may differ from feelings of success and accomplishment (e.g., pride) during the learning process.

Research with students with disabilities (i.e., ADHD and autism spectrum disorder; (Jahromi et al., 2012; Scime & Norvilitis, 2006) have demonstrated that they display significantly greater facial/body and verbal expressions of negative affect compared to students without disabilities. Participants in the current study were "typical" learners and demonstrated only minor facial clenching or flushing and little to no verbal expressions of negative affect although they self-reported high levels of frustration in the

unsolvable condition. These findings suggest students without disabilities may either have a greater ability to control their emotions or they experience less emotional arousal than students with disabilities. Further inquiry including students with disabilities and larger sample size would provide additional support for this comparison and greater generalizability to school environments.

**Research question #2.** Unexpectedly, students in the unsolvable condition did not demonstrate more self-control depletion than students in the solvable condition. Despite students being more frustrated in the unsolvable condition, based on observations and self-reported feelings, findings suggest that students' self-control was not significantly influenced by the experimental procedures, specifically the unsolvable puzzle task. These results stand in contrast to prior research on self-control, which found that when seemingly unrelated tasks draw upon similar levels of self-control, depletion of self-control for the second task may occur (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven & Baumeister, 2000). It is possible that the initial task in the present study did not draw on students' self-control because the experimental procedures did not request or require students to limit or restrain their emotions (i.e., students were not told to inhibit their expression of emotions, rather only not to speak to their peer). Previous research indicates that certain types of emotion regulation does induce self-control depletion. In Baumeister, Heatherton, and Tice (1998), asking participants to inhibit their emotions as they watch an emotionally provoking (e.g., funny or sad) video produced self-control depletion. In Bruyneel, Dewitte, Franses, and Dekimpe (2009), asking participants to read negative affect inducing scripts (i.e., being sad or lonely stories) and to imagine themselves in the story did not lead to self-control depletion; however, when participants were asked to list their negative thoughts as they completed the task (i.e., attempt to regulate their mood), self-control depletion was observed. In the current study, it was unclear whether or not students attempted to inhibit their expressions of emotions (i.e., frustration) or other behaviour. Future studies may benefit from asking students whether or not they attempted to hold back their emotions. Another explanation may be that the effect of self-control depletion was not strong enough to induce a significant result. The current findings imply that self-control is not necessarily depleted when an individual becomes frustrated or emotionally

aroused but rather that depletion is likely more directly related to the exertion of selfcontrol. In this sense, the expression of negative affect (i.e., frustration) alone does not lead to self-control depletion.

Correlational analyses did not indicate a significant relationship between observations verbal and nonverbal expressions of negative affect and students' selfreport of frustration for students in the unsolvable condition. It is possible that researchers' observation of students' level of frustration may not have matched students' perceptions of their frustration. For example, researchers may have observed only minor facial negativity (e.g., furrowed eyebrows) but the student may have actually experienced a high level of internal frustration. This is consistent with research that has examined the influence of student self-judgement and self-report compared to their actual performance in learning tasks (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001; Winne & Jamieson-Noel, 2002). These findings suggest that, overall, students may not be fully aware of their own emotions and its influence or that observations of negative affect are not necessarily accurate measures of experienced frustration. Future studies may benefit from examining students' accuracy and consistency in estimating their emotions.

**Research question #3.** As hypothesized, students in the unsolvable condition with a fixed mindset demonstrated greater depletion of self-control than students with a growth mindset, but they did not demonstrate a significant difference in self-reported and observed frustration compared to students with a growth mindset. Importantly, findings suggest that students with a growth mindset are not impervious to the experience and expression of frustration but rather expend less self-control during and after the initial task, potentially allowing for greater self-control on a secondary task.

These findings provide support for the link between motivational beliefs and selfregulatory strategies. During self-regulation, individuals with a fixed mindset likely focus primarily on suppression of thoughts about failure or coping with their negative emotions. Current findings suggest that this suppression of negative thoughts may impact their self-control and deplete this limited resource (Muraven and Baumeister, 2000). Students with a growth mindset likely focus less on suppression of emotions and

thoughts but rather on employing adaptive self-regulatory strategies (Burnette et al., 2013).

These findings also provide support for a "mechanistic revision of the resource model of self-control", as proposed by Inzlicht and colleagues (Inzlicht & Schmeichel, 2012; Inzlicht, Gervais, & Berkman, 2015; Inzlicht, Legault, & Teper, 2014a). In this model, it is proposed that self-control depletion is mediated by both motivation and attention. For example, although an unrelated self-control task may deplete self-control, motivational messages, such as self-affirmation, have been shown to improve self-control on a secondary self-control task (Schmeichel & Vohs, 2009). In this sense, it is possible that a students' growth mindset may be able to negate the depleting effects of frustration through the use of positive self-messages about their failure (e.g., "I can do this, I just need to try something different"). However, given that frustration alone did not produce self-control depletion, differences in self-control may be better explained by students' fixed mindset self-messages (e.g., "I must not be smart, I am no good at these"), which may have had a greater depleting effect on self-control than frustration alone.

These findings also support both prior and current research that suggests that the experience of failure does not necessarily result in negative consequences. There are potentially benefits of exposing students to failure. Rohrkemper and Corner (1988) suggest that challenging students in a supportive classroom context allows students to learn to how to respond flexibly and adaptively to stressful events. Research on "productive failure", where students generate solutions to novel problems prior to receiving instruction, support the benefits of these experiences (Holmes, Day, Park, Bonn, & Roll, 2013; Kapur, 2012; Kapur & Bielaczyc, 2011; Westermann & Rummel, 2012). For instance, Kapur (2012) provided students learning mathematics with either direct instruction or productive failure. Students in the productive failure condition were first asked to generate their own solution without guidance. Students who experienced productive failure performed better on conceptual understanding and transfer than students who were taught by direct instruction. In this sense, challenging situations or unique situations where students experience failure may support their development of productive learning processes and produce positive learning outcomes.

Additional analyses of students' coping strategies revealed that students with a fixed mindset sought greater peer support than those with a growth mindset in the unsolvable condition and students in the growth mindset used slightly greater alternative strategies (e.g., attempts new or unique way to solve the puzzle) than those with a fixed mindset. While these analyses supported the studies overall findings, they were supplementary to the primary analyses, meant to provide insights into the specific types of strategies students used. Comparisons were made based on the summed frequency of the observed coping strategies for all individuals; therefore, if one student exhibited multiple instances of a specific coping strategy (e.g., peer support), the overall frequency for that strategy could be artificially amplified. Future research may benefit from developing and standardizing more rigorous direct and indirect methods for quantifying and tracking the types of coping strategies that students use during a problem-solving task.

**Research question #4.** Unexpectedly, individual differences in beliefs about willpower did not moderate the influence of self-control depletion. In reviewing students' responses to beliefs about intelligence and willpower questionnaires, the reliability of the measure was not as strong as for the beliefs about willpower questionnaire. In particular, the inclusion of reverse items and translated items may have impacted its reliability. In addition, in reviewing students' written definitions of intelligence and willpower, 21 students responded that they did not know how to define willpower and only two students did not know how to define intelligence. Willpower is perhaps a construct not fully understood or discussed at this developmental age, and hence students' responses to items had no clear relationship with their self-control depletion. Alternatively, the sample size for the nested groups used in the ANOVA were insufficient to produce significant results. Future studies may provide a better explanation for the current findings through the inclusion of a larger sample and comparisons of various age groups in order to identify when this construct becomes more established. In addition, future studies may explore ways to improve the reliability of the translated version of this questionnaire used with children.

#### **Discussion of Major Findings across Research Questions**

Sex and language differences. Female students reported more frustration than males in the unsolvable condition but researchers did not observe sex differences in facial expressions or body language. In the full sample, female students both demonstrated greater facial and body expressions of negative affect and self-reported greater frustration than male students. Preliminary findings suggest that females are perhaps more likely to experience and report their negative feelings than boys.

Results also indicate that sex differences were significant for both measures of self-control (i.e., inhibition accuracy and contrast inhibition) in the unsolvable condition. This was unexpected. Self-control was more depleted in male students than female students on both measures. Interestingly, although females self-reported greater frustration, males were impacted greatest by self-control depletion. One possible explanation for this difference is that males initially had less self-control than female students or that female students typically demonstrate less self-control depletion (Baroun & Alansari, 2006; Mekarski, Cutmore, & Suboski, 1996).

Another possible explanation for this difference is that females more readily acknowledged and recognized their emotions of frustration without inhibition, whereas male students ignored or inhibited their feelings which may have led to greater selfcontrol depletion on the follow-up task. These findings may be considered consistent with research on stereotype threat which describes the influence of societal factors for a group on their performance. For example, females, who fear they will do poorly at a math task, will ultimately perform poorer on math tasks (Mangels, Good, Whiteman, Maniscalco, & Dweck, 2012; Spencer, Steele, & Quinn, 1999). Stereotypes of emotionality have been shown to extend from adulthood to young children: females are believed to be more emotional than males, specifically for sadness and fear (Birnbaum & Croll, 1984; Fabes, Eisenberg, & Eisenbud, 1993). Stereotype threats related to the emotion of frustration was not found in the literature. It is possible that given that the current task was not framed as a math task, no stereotype threat occurred for female students, but rather an unintended stereotype threat occurred for male students when placed alongside a peer. The male students, in order to avoid being viewed as emotional, perhaps inhibiting their expression of emotions. By inhibiting their emotions

on the puzzle task, it subsequently depleted their self-control for the measure of selfcontrol.

Language differences were examined as part of the current study because student participants were drawn from a French Immersion school, where some students were registered in French Immersion (70%) and others were not (30%). French Immersion students are typically those who speak English as their primary language at home and are encouraged by teachers to speak French at school full-time. This differs from students who speak French as their primary language at home (i.e., Francophone). Their proficiency in the French language was not assessed as part of the current study. Nonetheless, given recent research suggesting that bilingual students perform better on self-control measures than monolinguals, this variable was explored (Bialystok et al., 2008; Esposito, Baker-Ward, & Mueller, 2013). The current findings did not demonstrate any significant relationship between students in French Immersion and English core. Perhaps the differences between bilingual and monolingual students' language abilities may not be equivalent to previous studies. Alternatively, the influence of students' motivational beliefs on self-control depletion was stronger than the influence of language of instruction. The influence of bilingualism, which was not the primary area of interest of the current study, is potentially an area of further exploration.

**Frustration and Self-regulation.** Findings from the present study contribute to our understanding of how students' beliefs about intelligence influence self-control and frustration. In the present study novel experimental procedures for inducing frustration by incorporating social comparison were developed, implemented, and evaluated. Current findings suggest that self-control is not necessarily depleted due to the expression of frustration. Although students with both fixed and growth mindsets experienced frustration, this study's findings suggest students with a growth mindset. Findings also suggest that the construct of beliefs about willpower may not be appropriate for school-age children.

Evidence and support for the inclusion of motivational beliefs in the understanding and models of executive functioning, self-control, and self-regulation is provided by the results of the study. Research on hot EF (Zelazo et al., 2010) points to a need to understand how children's performance on EF tasks can be influenced by emotionally or motivationally significant tasks. The experimental design of the current study provides a model for which a hot EF task can be studied through the incorporation of social comparison and a follow-up measure of self-control. In the current study, selfcontrol was used as an indicator of the influence of students' motivational beliefs and frustration on their ability to self-regulate.

Motivational beliefs are often described as important motivational processes for individuals during the learning process (Dweck, 1986; Eccles & Wigfield, 2002). The findings provide insights into the complex processes that occur when students selfregulate towards a self-relevant goal – capturing the various aspects of self-regulation: metacognition, motivation, and strategic action. In the current study, students' selfreported feelings of frustration indicate that the goal of completing the puzzle before their peer was a self-relevant goal (i.e., they would likely not self-report frustration if it was not self-relevant). Students were using their metacognition to identify their goal and compare their performance to their peer which led to their frustration. Students used various strategies (i.e., strategic action) to achieve their goal of completing the puzzle. More importantly, students' motivational beliefs mediated their use of adaptive and effective strategies. Students with a fixed mindset experienced greater self-control depletion than students with a growth mindset. In the cyclical model of self-regulation proposed by Zimmerman (2013), self-control is an important component in the performance phase of self-regulation; therefore, with fewer cognitive resources students with a fixed mindset may have been less able to employ adaptive strategies. While recent theories of self-control have proposed the inclusion of motivation and attention (Inzlicht, Schmeichel, & Macrae, 2014b), theories and models of self-regulation provide an established and more inclusive framework for which to understand the complex aspects of how students approach challenges through their use of goal setting, social comparison, motivational self-messages, self-control, and adaptive coping strategies. Limitations and Strengths of the Study

**Limitations.** Several limitations were identified in the discussion of the research findings. To strengthen the interpretation of the results, this study would benefit from replication with a larger sample size, taking into consideration a variety of other

variables in order to rule out possible interactions (i.e., age, sex, language, clinical/nonclinical populations, upward/downward social comparison, and sampling distribution). Of note, despite the limited sample size, a significant result with a large effect size was obtained for the difference in self-control depletion between students with a fixed and growth mindset. As previously mentioned, a larger sample size may have revealed a greater number of significant relationships amongst variables possibly providing further explanatory information. For instance, the inclusion of different age and sex groups would allow for a greater understanding of the influence of these variables on selfregulation (e.g., knowing if self-control depletion occurs across different ages, or if sex differences occur for self-control depletion at different age groups). A larger sample size would also allow for more robust analyses such as hierarchical or multiple regression, as well as completion of the intended ANOVA analyses for the research question related to beliefs about intelligence.

A second relevant limitation of the current study was the distribution of participants through purposive sampling techniques. Because there were very few students who presented with a fixed mindset, a decision was made to assign all of these students to the unsolvable condition. This may have had implications for the resulting data. It is possible that students with a fixed mindset inherently had less inhibition than students with a growth mindset and hence the depletion in self-control observed may represent an overall low level of self-control in these participants. To explore this possibility additional analyses were conducted but not included in the current study. These results revealed that there was no significant relationship between teachers' ratings of students' inhibition and emotional control and students' ratings of their beliefs about intelligence. Nonetheless, future research may benefit from incorporating a premeasure of self-control. The current study assumed that students had a relatively normal distribution of initial self-control/inhibition, necessary for drawing conclusions about self-control depletion. This assumption is not uncommon amongst previous research studies of self-control depletion (Hagger et al., 2010; Muraven & Baumeister, 2000), but should be tested.

Thirdly, a number of limitations were inherent in the experimental procedures used in the current study. For instance, the variability in the time taken to solve the
puzzle and quantity of puzzles completed in the solvable condition may have impacted students' level of frustration. This variability may have induced different levels of frustration in their peer depending on when their peer solved the puzzle and how many puzzles their peer completed. Future studies may consider determining a method to standardize the time in which the successful peer solves the puzzle.

Another limitation was the absence of considerations for upward and downward social comparison on students' expectations of success. Experimental procedures did not consider students' relationships with their more successful peer (i.e., different grade, classroom, peer relations, etc.), which could have impacted their level of frustration. For example, if a student perceived their peer as usually more successful than them self, they may expect not to be able to solve the puzzle and hence not become frustrated. Future research may consider asking students about their relationship and perception of their peer, as well as their perceived expectation of solving the puzzle before their peer. Nonetheless, for the purposes of this study, greater importance was placed on whether or not students in the unsolvable condition were more frustrated compared to the solvable condition.

Additionally, the current study took place with pairs of students in an empty classroom. Students' behaviours or emotions may not be representative of their typical classroom response, where many other peers are present. It is possible that some students did not view the completion of the puzzle task as a self-relevant goal or lacked interest to solve the puzzle. To explore this further, researchers asked students to describe their thoughts, feelings, and strategies used during the puzzle task as open-ended questions in order to clarify if students were actually frustrated by the study procedures. Analyses of these results are not included in the current study. These additional results suggest that students in the unsolvable condition were indeed frustrated and demonstrated greater negative coping strategies.

Other possible limitations of the experimental design related to deception procedures. Researchers were required to disclose the true nature of the study to students immediately following their participation in the study. It is possible that students may have told their peers that they would be given either a solvable and unsolvable puzzle. However, when students were asked, none of the students seemed to know

about the study (e.g., one student said his peer would not tell him). Future studies may need to reconsider disclosing this to younger students. Another component of the deception procedures involved "force-solving" students who were in the solvable condition (i.e., congratulating them for solving the puzzle even though they did not solve it). It was noted that these students became confused and potentially frustrated. For the current study, it was important to do so in order to prevent loss of participant data. Future studies may reconsider the need to implement this procedure.

The psychometric properties of the beliefs about willpower scale used in the current study may need further exploration. This was the first use of the translated version for children in a research study. Future studies may need to explore ways to improve the reliability of the questionnaire (e.g., eliminating or re-wording reversed items). In addition, as part of the current study, the researchers treated the variables of the motivational beliefs questionnaires as categorical as oppose to continuous variables based on the theoretical and historical use of beliefs about intelligence and willpower. Additional analyses, not included in the results section, indicated that significance was found with either the categorical or continuous variables but future studies may need to reconsider their use.

**Strengths.** The current study met most of its initial goals and thus has provided several novel and informative contributions to the existing literature. One of the initial goals of the study, which was met, was to implement a novel experimental procedure that incorporated social comparison as a trigger for frustration in order to better understand the processes involved in self-control, emotion regulation, and self-regulation/SRL.

A few strengths of the experimental setup were noted. For instance, the short divider used was effective because students could see each other's faces but not the puzzle. Especially, when students in the solvable condition were "force-solved." Student in unsolvable puzzle were able to see the joy/happiness of the solvable student. This is in contrast to similar studies, where peers are sometimes in another room or they are playing against a computer (Eisenberger, Jarcho, Lieberman, & Naliboff, 2006; Muraven & Baumeister, 2000). The experimental setup induced frustration by asking some students to complete an unsolvable puzzle alongside a peer. Students expected to be

able to solve the puzzle and thought it was the same as their peers. Additionally, the use of the standardized measure of self-control using Pearson Q-interactive on iPads was an effective means of collecting data. It allowed for convenient data storage, immediate data conversion/checking, and audio recording/checking. The experimental setup, with its incorporation of social comparison and self-control, is a novel contribution to the academic literature. The current study contributes to the growing academic literature on hot EF by providing a novel hot EF task. Future research might use the current study's experimental procedures to map the brain areas activated when students become frustrated.

The current research was deliberately conducted in schools in order to strengthen its social validity. Students who participated in the study were more likely representative of students in regular classrooms than those who may volunteer for a laboratory study. Also, complexities of typical student relationships were innately incorporated as part of the study. Consistent with research on conducting research in schools, schools served as an excellent source of participants for studying students' cognitive development (Alibali & Nathan, 2010). Conducting research in schools aided in obtaining a high response rate and decreased experimental mortality. For instance, for the current study, there were very few missing data points due to the availability of student participants at the school. A large school was sought in order to ensure a large sample of students that could be assigned to groups in order to strengthen statistical analyses; nonetheless, as noted above, working in schools also limited control over variables and true random assignment due to considerations for pairing.

Despite limited sample size, one of the strengths of the current study was in the collection of multiple sources of data in order to inform study findings. For instance, observations and self-ratings scales were used to determine levels of frustration, ratings scales were used to determine students' beliefs about intelligence and willpower, and a standardized measure of self-control was implemented to determine self-control depletion. Possible additional sources of information related to frustration for future studies may be to incorporate physiological measures of frustration (e.g., heart rate, skin conductance, or breathing rate; Drachen, Nacke, & Yannakakis, 2010; Ducharme, Wharff, Hutchinson, Kahn, & Gonzalez-Heydrich, 2011; Lewis, Hitchcock, & Sullivan,

2004). These measure could potentially provide a more objective measure of students' level of frustration.

Further, in using multiple sources of data, the current study systematically explored the influence of specific variables in each research question: solvable versus unsolvable conditions on students' frustration and self-control depletion, as well as the influence of fixed versus growth mindsets and nonlimited- versus limited-resource theories on self-control depletion. A strength of the current study was its ability to isolate these variables and determine their individual effect on students' frustration or selfcontrol depletion. A classroom-based study with multiple students could make it difficult to isolate these factors. Findings were also strengthened through the incorporation and consideration of various psychological constructs (emotion regulation, social comparison, executive functions, and motivational beliefs) in the design of the study and interpretation of its results. The use of multiple sources of data allowed for broader and richer interpretation of the findings.

## **Implications for Practice**

The findings from the present study have a number of implications for practitioners (including teachers, school psychologists, and counselors) and students in schools. Current results emphasize the need for practitioners to be informed about the influence of students' beliefs about intelligence, emotions, and social comparison.

Parents also need to understand how children with fixed or growth mindset may experience frustration differently. Specifically, they may differ in the types of selfthoughts and, ultimately, available cognitive/coping resources (i.e., self-control) to put toward the immediate or, especially, follow-up tasks. The current study's findings add to the growing academic support for promoting a growth mindset with students. For instance, process-oriented specific praise about how students can work on overcoming challenges, rather than focusing on innate abilities, can help promote a growth mindset. Both parents and teachers need to heed the motivational messages they send.

Teachers, working with students in classrooms, should not avoid offering students difficult challenges. Although some teachers may be weary of frustrating their students, frustration, even failure, may be an important factor in the learning process that helps students learn and practice management of their emotions. Teachers can use these opportunities to teach students about effective and adaptive strategies for overcoming challenges and managing their emotions.

For practitioners working with students in one-on-one contexts, such as school psychologists or counselors, it may be important to not only monitor and observe students' emotions as they take on challenging tasks but also to talk to them about their thinking process and self-thoughts in order to gain some insights into their motivational beliefs. These conversations can help practitioners develop more effective interventions for students and better recommendations to parents and teachers.

#### Implications for Research

The current study set out to examine relationships between students' motivational beliefs, self-control, and self-regulation in order to gain a better understanding of how beliefs about intelligence and willpower impact their self-control and self-regulation after a frustration-inducing event. In order to examine these relationships, experimental procedures were developed, pilot tested, implemented, and analyzed. While a number of limitations were noted and suggestions for improvements made, these procedures contribute an empirical and naturalistic experimental procedures that can be used for understanding the impact of frustration and social comparison in future studies. It differs from previous emotion regulation studies related to self-control in its specific induction of goal-oriented emotional arousal (i.e., frustration) and its focus on typically developing children. Its strength is in its similarities to classroom situations whereby students are faced with challenges that are not easily solvable (e.g., academic testing or problems) or where peer comparisons are central (e.g., peer conflicts).

These experimental procedures were developed in order to extend and fill in gaps in the self-control and motivational beliefs literature. Specifically, the incorporation questionnaires examining beliefs about intelligence and willpower provided insights about their relationships to the self-regulatory processes employed by students. Through the use of direct and indirect measures, current findings provide empirical support for the self-regulatory processes that enable students with a growth mindset to better overcome challenges. It highlights the need to examine specifically how students take on situations that induce emotions such as frustration, and the beliefs or other

factors that enable them to effectively use adaptive self-regulatory strategies. In addition, current findings point to the need for future research to examine the developmental age at which understandings and beliefs about willpower develop in school-age children.

Overall, the current research has responded to the gaps and suggestions of previous literature to work towards a more unified measure of self-regulation that incorporates various perspectives from across the study of psychology. It also highlights the need for more direct measures and clinical tools that assess students' responses to specific emotionally arousing events and challenges that students may encounter in the learning process. This research will better prepare students for the possible challenges they may face. The next step for similar research is to refine the current measures and explore more ecologically valid tools that could potentially be used in classroom settings as well as the development of interventions that utilize and build upon the findings of the current study.

# Conclusion

In the current study, the beliefs, abilities, and skills (i.e., beliefs about intelligence and willpower, executive functions, and coping strategies) students use to overcome failure (i.e., self-regulation) specifically in situations when their emotions may interfere (i.e., emotion regulation, specifically frustration, a rarely studied aspect of learning) were examined. Current findings suggest that, although students may become frustrated when faced with challenges, it is their motivational beliefs about their abilities, in particular their intelligence, that help them overcome their challenges. Fortunately, these motivational beliefs can be taught and shaped through messages teachers or schools communicate to their students. Through gaining better understand of the mechanism for adaptive and maladaptive functioning, practitioners and researchers can develop better ways to support students. Ultimately, a better understanding and operationalization of the problem can lead to better solutions.

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Appendix A: Teacher and School Recruitment letters



a place of mind THE UNIVERSITY OF BRITISH COLUMBIA Faculty of Education Vancouver Campus Educational & Counselling Psychology, And Special Education XXX XXX XXXX

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# Understanding Self-Regulation Study Teacher Recruitment Letter

Dear Grade 6 or 7 Teacher,

We are writing in hopes that you will allow us to invite the parents of students in Grades 6 and 7 at your school to take part in a research study that we are conducting with students in your school. This study is the thesis study for the student co-investigator Mr. Simon Lisaingo, titled *"An Experimental Approach to Understanding Self-Regulation: How Social Comparison and Students' Implicit Theories Impact Self-Control Depletion."* 

You are receiving this letter because your principal gave his permission for us to contact you as a Grade 6 or 7 teacher. The purpose of this study is to learn more about how students approach challenging tasks alongside a same age peer. Fundamental to problem-solving and coping with challenging situations processes and strategies students use for self-regulation. However, not all students use positive self-regulatory strategies that allow them to achieve academic success. Therefore, we believe that greater understanding of how students' beliefs and feelings impact their self-regulation in challenging situations is important to explore. By understanding the thinking processes that contribute to their effective self-regulation, we hope to improve programs, methods, and teaching practices to help students succeed in novel and/or challenging circumstances.

Your willingness to work with us is very important for the completion of this study. Participation in our project will help us better understand how students use self-regulation and their self beliefs to overcome challenges. As a thank-you for taking part in our study, we would like to offer a two-hour workshop on the topic of motivation and self-regulation/self-regulated learning, whenever is most convenient for teachers at the schools who take part in our study. In addition, the researchers are available to talk with groups of students, at the student or teacher request, regarding strategies on how to best approach situations that are challenging or frustrating for them.

If you are interested in working with us, we will arrange to meet with your classroom and explain the project to your students. Obtaining student consent to take part in the study is also important for us as we believe they would appreciate being involved in this type of research. After speaking with students about the project, students will take home parent information packets, these include: parent letters of invitation, consent forms, and a background information questionnaire. Parents with interest may return their parent information packets back with their child to you, the teacher, in an envelope provided by the researcher. We are available for faceto-face meetings with you or the parents of students in your classroom as needed to share more about the project. In addition, we will contact all the parents of the students who express interest in taking part in the study to more fully explain the project and what will occur when we work with their student.

There are three main parts to the study: 1) the first part involves the parent or guardian

completing some background questions about their child; 2) the second part involves you, the teacher talking with the researcher to discuss students' current level of self-regulation in the classroom, and 3) the third part involves the student completing a list of questions about learning, a series of challenging tasks, and a debriefing session. Our project design makes it important to try to have information from students, parents and teachers.

# *I. The parent part of our study:*

Parents taking part in this study will provide consent for their child's involvement in this study and complete some background questions about their child. The parent questionnaire will take about 10 minutes. Parents are welcome to contact us with any questions throughout the study.

# *II.* The teacher part of our study:

As the classroom teacher, we require your support in arranging a time to speak to students in your classroom and distribute parent information packages. Once parental written consent and student verbal consent is obtained, we will arrange times to meet with you to discuss students' current level of self-regulation (i.e. their ability to control their impulses and emotions) in the classroom (approximately 10-20 minutes). In addition, we will arrange another meeting for you to review our list of students for whom we have consent in order to identify any pairings that might be difficult due the relationships between the selected students (approximately 10-20 minutes). During the student involvement of this study, we will arrange with you, the teacher, for mutually agreeable times to remove students from your class to complete the study.

# *III. The child part of our study:*

Students in your classroom will take part in the study by completing a questionnaire, experimental tasks, and a debriefing session. Students will complete these study components while they are at school. We will work with teachers to find times that does not interfere the least with classroom activities. The study components that involve students will take **approximately one hour**, but will be done in three sessions of varying length. The researcher working with students has experience working with school-age children in classroom and situations where they are challenged, and will not ask students to do anything they are not comfortable completing.

Some of the tasks used in this study may be challenging for students. These tasks include both puzzles and verbal activities. The researchers will debrief with the students immediately after completion of the questions and tasks. If a student returns to class noticeably upset, teachers will be asked to inform the researcher immediately or make a note and inform the researcher at their most convenient time. The researcher will contact parents at his/her earliest convenience. Although unlikely, if the participant and/or the parent or teacher indicates on-going anxiety, frustration, or distress as a result of the experimental procedures, the Principal Investigator of the study, Dr. Laurie Ford, a certified school psychologist, will be available to consult and plan appropriate referral if needed.

Parents, teachers, and student will receive a brief summary of the study findings when they are available. Efforts will be made throughout to engage your student and show appreciation for their contribution towards possibly helping other students. Most student will likely find the problem-solving activities to be fun, even the challenging tasks. As a thank you for student participation, at the end of student involvement part of the study, we will enter their names of participating students into a draw for a small prize.

It is very important to us that students' right to privacy is respected. All information collected as part of this research study will be kept confidential. No **individual information will be reported and no parent or child will be identified by name** in any reports about the completed study.

If you are interested in taking part or would like to learn more about the study and what is involved, please contact Simon Lisaingo by phoning the research project office at XXX-XXX-XXXX

or by sending us an email at <XXXXXX@XXXXXX.XXX>.

Sincerely,

Laurie Ford, PhD Associate Professor Principal Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX Simon Lisaingo, B.Ed M.A. Student Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX

Nancy Perry, PhD Professor Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX



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## Understanding Self-Regulation Study Principal Recruitment Letter

Dear Principal,

We are writing in hopes that you will allow us to invite the students in Grades 6 and 7 at your school to take part in a research study that we are conducting. This study is the thesis study for the student co-investigator, Mr. Simon Lisaingo, titled "An Experimental Approach to Understanding Self-Regulation: How Social Comparison and Students' Implicit Theories Impact Self-Control Depletion."

You are receiving this letter because your school has a number of Grade 6 and 7 classrooms that are suitable for this study. The purpose of this study is to learn more about how students approach challenging tasks. Fundamental to problem-solving and coping with challenging situations are processes and strategies students use for self-regulation. However, not all students use positive self-regulatory strategies that allow them to achieve academic success. Therefore, we believe greater understanding of how students' beliefs and feelings impact their self-regulation in challenging situations is important to explore. By understanding the thinking processes that contribute to effective self-regulation, we hope to improve programs, methods, and teaching practices to help students succeed in novel and/or challenging circumstances.

Your willingness to work with us is very important for the completion of this study. As a thankyou for taking part in our study, we will offer a two-hour workshop on the topic of motivation and self-regulation/self-regulated learning to teachers at your school. In addition, at the end of the study, students taking part in the study will be offered an opportunity to discuss strategies on how to best approach situations that are challenging or frustrating for them.

If you and the grade 6 and 7 teachers at your school are interested in working with us, we will meet individually with classroom teachers to explain the project. Then we will arrange to meet with students in their classrooms to describe the study and see if they are interested in taking part. Obtaining parent and student consent to take part in the study is essential. After speaking with students about the project, students will take home parent information packets, these include: parent letters of information and invitation, consent forms, and a brief background information questionnaire. Parents with interest may return the signed consent forms and questionnaires to their child's teacher in an envelope provided by the researcher. We will be available for face-to-face meetings with you, the teachers, or the parents of students in your school if they would like more information about the project than is provided in the information packets. We will also contact the parents who given consent for their students to take part in the study by phone to more fully explain all aspects of the study.

There are three main parts to the study: 1) the first part involves the parent or guardian completing some background questions about their child; 2) the second part involves the teacher talking with the researcher to better understand students' current level of self-regulation in the classroom, and 3) the third part involves the student completing some questions about

learning, a series of puzzle and verbal tasks, and a debriefing session. Our project design makes it important to try to have information from students, parents, and teachers.

## *I. The parent part of our study:*

Parents taking part in this study will provide consent for their child's involvement in this study and complete some background questions about their child. The parent questionnaire will take about 10 minutes. Parents are welcome to contact us with any questions throughout the study. In addition, we will contact all the parents of the students who express interest in taking part in the study to more fully explain the project and what will occur when we work with their child.

## *II.* The teacher part of our study:

Classroom teachers will support the researcher in arranging a time for the researcher to speak to students and to distribute parent information packages. Once parental written consent and student verbal consent is obtained, teachers will discuss with the researcher to better understand students' current level of self-regulation in the classroom. This meeting will identify students who may not be suitable for participation in the study and to limit potential negative outcomes. During the student involvement of this study, we will arrange with teachers for mutually agreeable times for the students to leave their classroom and take part in the study.

# III. The child part of our study:

Participating students will take part in the study by completing a questionnaire, challenging task, and a debriefing session. Students will complete these study components while they are at school. We will work with teachers to find times that do not interfere with classroom activities. The study components that involve students will take **approximately one hour in total**, but will be done in three sessions of varying length. The researchers working with students has experience working with school-age children in classroom and situations where they are challenged, and will not ask students to do anything they are not comfortable completing.

Some of the tasks used in this study may be challenging for some students. These tasks include both puzzles and verbal activities. The researcher will talk with all students immediately after they complete the tasks. If the researcher notices any concerns, they will notify the teacher. Although it is not anticipated, further, if a student returns to class and is later noticeably upset, teachers will be asked to inform the researcher immediately or make a note and inform the researcher at their most convenient time. The researcher will contact the teacher and parents for follow up as soon as possible. Although unlikely, if the participant and/or the parent or teacher indicates on-going anxiety, frustration, or distress as a result of the experimental procedures, the primary supervisor of the study, Dr. Laurie Ford, a certified school psychologist, will be available to consult and plan appropriate referral.

Parents, teachers, and students will receive a brief summary of the study findings when they are available if they desire. Efforts will be made throughout to engage the student and show appreciation for their contribution towards possibly helping other students. Most students will likely find the problem-solving activities to be fun, even the challenging tasks. As a thank you for student participation, at the end of student involvement part of the study, we will enter their names of participating students into a draw for a small prize. In addition, the researchers are available to talk with groups of students, at the student or teacher request, regarding strategies on how to best approach situations that are challenging or frustrating for them.

It is very important to us that the family's right to privacy is respected. All information collected as part of this research study will be kept confidential. No **individual information will be reported and no parent or child will be identified by name** in any reports about the completed study.

If you are interested in allowing us to talk with teachers and in turn recruit student participants or would like to learn more about the study and what is involved, please contact Simon Lisaingo by phoning the research project office at XXX-XXX-XXXX or by sending us an email at <XXXXXX@XXXXXX.XXX>.

Sincerely,

Laurie Ford, PhD Associate Professor Principal Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX Simon Lisaingo, B.Ed M.A. Student Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX

Nancy Perry, PhD Professor Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX Appendix B: Student Verbal Consent



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# Understanding Self-Regulation Study Student Verbal Consent

Principal Investigator:	Laurie Ford, PhD, Department of Educational & Counselling Psychology & Special Education, XXX-XXX-XXXX
Co-Investigators:	Simon Lisaingo, B.Ed, Department of Educational & Counselling Psychology & Special Education, XXX-XXX-XXXX Nancy Perry, PhD, Department of Educational & Counselling Psychology & Special Education, XXX-XXX-XXXX
Project Office:	XXX-XXX-XXXX

(Note: Given that students, who are 11 to 13 years old, are likely capable of understanding verbal information and provide consent to their participation, it is believed that these students will be able to provide verbal consent. The following script will be reviewed verbally with students in the classroom before consents are sent home for parents and before they begin the study after parent consent has been obtained. The following will serve as an outline for that discussion. The researcher may adjust slightly as needed depending on the developmental and comfort level of the student. Initial verbal consent will be confirmed by obtaining the students signature before the first session with students (i.e. student questionnaire). This script or a variation of it, will be reviewed verbally with the students before each student involvement. Formal written consent will also be obtained from students at the end of a debriefing session with students.)

# **Initial Verbal Consent Script**

## About the Study

- We are researchers from the University of British Columbia. We are interested in how students approach challenging tasks. We are asking if you would like to be in a study, about how students solve challenges.
- Research studies are projects that researchers use to understand and explore questions they have about the world. For this study, we are interested in how students solve challenging problems.
- For you as students, this study will involve answering some questions, completing some activities (e.g. puzzles), and meeting with the researcher at the end. In total, you will be working with the researcher outside of your classroom for **about one hour**, but at three different times.

## **Request for Participation**

- We are asking students like you, in Grades 6 and 7, if you want to take part in the study, and to help us better understand how students solve problems. You have to be at least 11 years old. You also have to speak, understand, and read English.
- Whether or not you take part in this study is up to your parents or guardians, and you. If your parents decide that it's ok for you to do the study, then they have to sign the study

permission form. You will have to give the signed form back to your teacher. We hope that you will want to do the activities with us, but no one has to do anything that they don't want to do. If you don't want to be in the study, it's ok.

## Privacy and Confidentiality

- For this study, it is really important that you not talk about what you do in the study while it is taking place. For example, you would not or should not share the questions or answers about a classroom test with your friends. Just the same we ask that if you participate, you not share what you did in this study with your friends. After the study is complete, we will meet in small groups and talk about the study. After this last session, you can freely talk about the study with your friends if you wish.
- What you tell us, and how you did on some of the activities, is private. We won't tell anyone how you did. When we talk to other people about the study, we will talk about the how students did generally without naming or identifying any students.

## What is Involved?

- There are three main parts to the study: 1) the first part involves your parent answering some questions about you; 2) the second part involves the teacher, with your permission, with us how you learn in the classroom, and 3) the third part involves students, you, completing a list of questions about learning, a series of activities, and then meeting with one of the researchers to talk about the study. Activities will involve solving puzzles and completing a colour naming game. When we do the activities, we can take breaks if you need to. The three activities will take you out of class for about 20 minutes each time. If you don't feel like doing the activities or want to stop, it's ok.
- We cannot guarantee that all the activities will all be fun.

## Benefits of Involvement

- It would be great if you can help and take part in this research study. We want to better understand how students solve challenging problems. By taking part in this study, you can help us and others better understand how students learn and take on challenges.
- Most students find the problem-solving activities fun. If you decide to do the study, after we
  are done, we will enter your name into a draw for a small prize. This is to say thank-you for
  your help.

# Further Questions

- If you have questions, you can ask me, Simon, your teacher, or your parents. Your teacher and your parents will have my phone number and email. They can contact me at any time.
- If you do want to take part in this study and understand the things I talked about, you can pick up a parent information package from your teacher and take it home to your parents or guardians. If you do not wish to participate, that is O.K. as well.

## **Initial Student Verbal Consent**

## (To be completed by each student <u>after parental consent has been received, but prior to</u> student involvement, Part Three)

## Completed by Researcher:

# 1.A. In developmentally appropriate language, verbally explain and review each of the following aspects of informed consent with the potential participant. 1.B. Check off each item after it has been explained to the student.

# 1.C. Answer any questions that the potential participant may have.

- □ Who you are (researcher with UBC)
- □ What is a study and purpose of this study (to understand how students approach on challenging tasks)
- □ Parental Consent (your parents have said that it is ok, but it's ok for you to say no)
- Child Consent (it is your choice, and nothing bad will happen if you say no)
- □ Study Child Requirements (communicate both teacher questionnaire and student tasks)
- □ Study Risks and Benefits (may or may not be fun for you)
- Privacy / Confidentiality (all answers to be secret, don't use any names of children)
- □ Voluntary Participation (you can take breaks or stop at any time)

#### Completed by Researcher:

2.A. Ask the below questions to evaluate if consent is truly informed and voluntary.

2.B. If the student provides an appropriate response (that indicates understanding of the related aspect of informed consent), tick the related box.

- 2.C. If the student does not provide a response that is appropriate, re-explain the related concept and then re-ask the question. If an appropriate response cannot be obtained for each question, consent is not informed. Make relevant notes, and confer with study primary investigator before commencing any further study activities.
  - □ Do you understand what a study is?
  - □ Who gets to decide whether students take part in the study?
  - Does anything happen to the students who say no to the study?
  - □ For students in this study, what are they asked to do?
  - □ For students in this study, what are some good and bad things that might happen when they do the study?
  - □ What does it mean that your answers are "private"?
  - □ If you take part, can you change your mind or stop at any time?

#### **Completed by Student:**

3. Ask the student to make a checkmark in one of the two boxes. Tell them that we will ask them again later, whether they want to be in the study (in case they change their mind).

<b>NO</b> , I do not want to be in the s	YES- I want to be in the study.	
	YES - My teacher can do the checklist	
	YES - I want to do the Thinking Skills activities	
Student's Name: S	udent's Signature:	
Date:	_	

Appendix C: Parents/Guardian Consent letters



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#### Understanding Self-Regulation Study Letter of Invitation

Dear Parent/Guardian,

We are writing to invite you to allow your child to take part in a research study that we are conducting with students at your child's school. This study is the thesis study for the student co-investigator Mr. Simon Lisaingo, titled "An Experimental Approach to Understanding Self-Regulation: How Social Comparison and Students' Implicit Theories Impact Self-Control Depletion."

You are receiving this letter because you have a child attending Grade 6 and 7. The purpose of this study is to learn more about how students approach challenging tasks alongside a same age peer. Taking a part in our project will help us gain a better understanding of the thinking processes that help students be successful in school and life.

Taking part in the study is voluntary and will not affect any services you receive from your student's school or school district. You and your child will also have the right to withdraw from the study at any time without any consequences.

There are three main parts to the study: 1) the first part involves you, the parent or guardian, completing some background questions about your child; 2) the second part involves the teacher talking with the researcher to better understand students' current level of self-regulation in the classroom, and 3) the third part involves the student, your child, completing a list of questions about learning, a series of tasks, and a debriefing session. Information from students parents and teachers is important for completion of this study.

#### *I. The parent part of our study:*

To help us better understand your child, you will be asked some questions about your child's background: your child's experience with self-regulation programs and any previous diagnoses; your relationship with your child; and, family background. The parent questionnaire will take about 10 minutes. Your responses are completely voluntary. If any a question makes you feel uncomfortable, you may skip that question. You are always welcome to contact us with any questions. In addition, we will contact all the parents of the students who express interest in taking part in the study to more fully explain the project and what will occur when we work with their student.

#### II. The teacher part of our study:

If you agree for you and your child to take part in the study, with your permission, we will talk with your child's teacher to discuss your child's current level of self-regulation (i.e. their ability to control their impulses and emotions) in the classroom and with their peers to help decide the best pairings for our study groups.

#### III. The child part of our study:

Allowing your child to take part in the study means that they will complete all student components of this study: questionnaire, a series of puzzle and verbal tasks, and debriefing session. We will complete the study while they are at school. We will work with your child's teacher to find a time that does not interfere too much with classroom activities. The study components that involve your child will take **approximately one hour**, but will be done in three sessions of varying length. The person

working with your child will have experience working with students his/her age, and will not ask your child to do anything they are not comfortable completing.

Some of the tasks used in this study may be challenging for some students. These tasks include both puzzles and verbal activities. Although unlikely, if your child becomes noticeable or excessively upset, the researcher will take appropriate steps to assure that your child is supported and calmed, and his/her teacher and yourself (parent/guardian) are informed. Again while unlikely, the researchers are available to talk with the teachers if the student is or becomes upset after they return to the classroom.

As a thank-you for your time, if interested, you will receive a brief summary of the study findings. The teacher of your child will be offered a workshop on how they can best support students in their classroom. Efforts will be made throughout to engage your child and show appreciation for their contribution towards possibly helping other students. As a thank-you to students participating in this study, their names will be entered in a draw for a small prize. In addition, the researchers are available to talk with groups of students, at the student or teacher request, regarding strategies on how to best approach situations that are challenging or frustrating for them.

It is very important to us that your family's right to privacy is respected. All information collected as part of this research study will be kept confidential. No individual information will be reported and no parent or child will be identified by name in any reports about the completed study.

If you are interested in allowing your child to part or would like to learn more about the study and what is involved, you may contact us by phoning the research project office at XXX-XXX-XXXX or by sending us an email at <XXXXX@XXXXX>.

If you do wish to have your student potentially to take part in our project please complete the attached consent form and background questionnaire, and return it to your child's teacher in the enclosed envelop. If based on the information from you and the teacher, your child is eligible for the study, we will work with the teacher to complete the procedures of the study.

If you do decide to allow your child to take part in this study and at any time have any concerns about your treatment or your rights as a person taking part in a study, you may contact the Research Subject Information Line in the UBC Office of Research Services at the University of British Columbia at XXX-XXX-XXXX.

Sincerely,

Laurie Ford, PhD Associate Professor Principal Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX Simon Lisaingo, B.Ed M.A. Student Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX Nancy Perry, PhD Professor Co-Investigator Dept of Educational and Counselling Psychology and Special Education University of British Columbia XXX-XXX-XXXX XXXXXX@XXXXX.XXX



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## Understanding Self-Regulation Study Consent Form for Child Involvement and Parent Questionnaire

Principal Investigator:	Laurie Ford, PhD, Department of Educational & Counselling Psychology & Special Education, (XXX) XXX-XXXX
Co-Investigators:	Simon Lisaingo, B.Ed, Department of Educational & Counselling Psychology & Special Education, (XXX) XXX-XXXX Nancy Perry, PhD, Department of Educational & Counselling Psychology & Special Education, (XXX) XXX-XXXX
Project Office:	(XXX) XXX-XXXX

Dear Parent/Guardian,

Please read the attached information letter and following consent form carefully. This is a request for you and your child to take part in our research study. If after reading this letter, you would like to take part and allow your child to take part in this research study, please sign one copy of the consent form and return it to your child's teacher (\_\_\_\_\_\_). Keep the other copy for your records. This study is the thesis study for the student co-investigator Mr. Simon Lisaingo. It is titled, "An Experimental Approach to Understanding Self-Regulation: How Social Comparison and Students' Implicit Theories Impact Self-Control Depletion."

## Purpose:

The purpose of this study is to examine how students' beliefs about their abilities affect their motivation and self-regulation when they are faced with challenging tasks. Self-regulated learning describes the processes and strategies that enable students to achieve their learning goals, even when tasks are difficult. Understanding the factors that influence students self-regulated learning is important for helping them to successfully and adaptively meet challenges they are certain to face both in and out of school.

## **Research Study Participation:**

- 1. Giving permission for your child to participate in the study means that you allow us to work with your child to complete the student components of this study: a questionnaire, a series of puzzle and verbal tasks, and a brief debriefing session. We will complete these parts of the study while your child is at school. We will work with your child's teacher to find a time that does not interfere with classroom activities. The study parts that involve your child will take **approximately one hour**, but will be done in three sessions of varying length. The person working with your child will have experience working in schools with children the same age as your child, and will not ask your child to do anything s/he does not want to do.
- 2. Taking part in this part of the study means that you will be asked to complete some background questions about: your child's experience with self-regulation programs and any previous diagnoses; parent relationship with child; and, family background. The parent questionnaire will

take about 10 minutes. Your responses will help us better understand your child and inform the outcomes of the study. If any of the questions makes you feel uncomfortable, you may skip that question. You are always welcome to contact us with any questions.

- 3. If you agree for you and your child to take part in the study, with your permission, we will talk with your child's teacher and discuss your child's current level of self-regulation (i.e. their ability to control their impulses and emotions) in the classroom and with their peers.
- 4. You understand that some of the tasks used in this study may be challenging for some students. These tasks include both puzzles and verbal activities. Although unlikely, if your child becomes noticeable or excessively upset, the researcher will take appropriate steps to assure that your child is supported and calmed, and his/her teacher and yourself (parent/guardian) are informed.
- 5. You or your child taking part is voluntary and will not affect any services that you or your family receive from the school or school district. You and your child have the right to withdraw from the study at any time and you and your child have the right to not answer any of the questions.
- 6. The information you give us is confidential. No individual information will be reported and no parent, child, teacher, or school will be identified by name in any reports about the study. The only people who will have access to the information you give us are the researchers working on this project.
- 7. As a thank-you for your time, if interested, you will receive a brief summary of the study findings. The teacher of your child will be offered a workshop on how they can best support students in their classroom with self-regulation. Efforts will be made throughout to engage your child and show appreciation for their contribution towards possibly helping other students. As a thank-you to students participating in this study, their names will be entered in a draw for a small prize. In addition, students taking part in the study will be offered an opportunity to discuss strategies on how to best approach challenges at the end of the study.
- 8. If at any time you have any concerns about you or your child's treatment or rights as a person who takes part in our project, you may contact the Research Subject Information Line in the UBC Office of Research Services at the University of British Columbia at (604) 822-8598.
- 9. If you have questions or would like more information about the research project before giving consent for your child to participate, you may contact us by phoning the research project office at 604-822-4602 or by sending us an email at <simon.lisaingo@alumni.ubc.ca>.
- 10. If you give consent for your child to take part in our study, we will send you a short letter with some additional information about the study and also give you a phone call to make sure you understand what we will do in the study and answer any questions.

# Understanding Self-Regulation Study Consent to Participate in this Research Project

I. Willingn Please	ess to Complete Parent Questionnaires check one of the following:					
	Yes, I agree that my child may take part in this project and <b>I am willing</b> to take part by completing the parent questionnaire.					
	While, I agree that my child may take part in this project, I do not want to take part by					
	completing the parent questionnaire.					
II. Consen Please	t to for Your Child Teachers to Complete Teacher Questionnaire check one of the following:					
	Yes, I agree to let my child take part in this project and I agree to let the teacher talk with you about my child's self-regulation at school.					
	While, I agree that my child may take part in this project, I do not agree for the teacher to talk with you about about my child's self-regulation at school.					
III. Consel Please	<b>nt for Child Involvment in the Study</b> check one of the following: Yes, I agree that my child may take part in this project. I understand that you will also ask for consent from my child.					
Parent's/ Parent's/ Date: Child's N Child's B Your Phon more fully	Guardian's signature (please sign): Guardian's name (please print your name): ame: ame: irth Date: e Number (if we have any follow-up questions about your questionnaire and so we can explain the project):					
Your Phon	e Number:Suggested Time(s) to Call:					

#### Understanding Self-Regulation Study Background Questionnaire for Parents

Thank you for your willingness to take part in this study. Please take a few minutes to answer a few questions about your child, your family, and your background. If you are uncomfortable answering a question, it is okay to skip the question.

#### **General Family Questions**

Please answer the following questions for your child.

- 1.) What is your child's age? \_\_\_\_Years\_\_\_\_Months
- 2.) What is your child's sex? \_\_\_\_\_ Male \_\_\_\_\_ Female \_\_\_\_\_ Other
- 3.) What is your family's ethnic background?

4.) What is the primary language spoken in your home?

5.) Please complete the following checklist about your family background (family members living with your child):

Caregiver 1 (circle: mother father other):	Caregiver 1 (circle mother father other):
Less than Grade 12	Less than Grade 12
□High School Diploma or Equivalent	High School Diploma or Equivalent
□Some College/Trades/University	□Some College/Trades/University
Apprenticeship/Trades Certificate	Apprenticeship/Trades Certificate
Some College/Trades/University	Some College/Trades/University
□Bachelors Degree	□Bachelors Degree
☐More than Bachelors	More than Bachelors

#### **Child Information**

- 1.) Does your child speak, understand, and write in English?Yes \_\_\_\_\_ No\_\_\_\_\_
- 2.) Has your child been involved in any particular programs related to Self-Regulation?

Yes \_\_\_\_\_ No\_\_\_\_\_ If yes, please describe the type of program they attend (e.g., child care centre, home daycare, preschool program, mindsets)?\_\_\_\_\_

3.) Has your child been formally diagnosed by a medical doctor or a psychologist with attentiondeficit/ hyperactivity disorder (ADHD), generalized anxiety disorder, or autism spectrum disorder (ASD)?

	Yes	_No
If yes, please describe whether you think your child will be able to comple	ete the study	y
components, in particular, completion of challenging tasks along side a s	ame age pe	er.

If no, is there anything else that you think might be relevant for us to know about your child,

#### Additional Information [Optional]

1. What are your child's greatest strengths?

2. What are some of your child's challenges?

3. How does your child respond to challenging situations?

Appendix D: Teacher Questionnaire Emotion and Inhibition


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#### Understanding Self-Regulation Study Student Screening with Teachers

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#### Part I: Screening Individual Students Self-Regulation

- Inhibition. Considering the students in your classroom, using the list of students in your classroom who we received consent to take part in the study, please identify any students who demonstrate highly elevated behaviour levels related to challenges with inhibitory control or impulsivity. For example, does the student "always" or "often": need to be told "no" or "stop that", does not think before doing, frequently interrupt others, is impulsive, gets out of seat at the wrong times, gets out of control more than friends, acts too wild or "out of control", does not think of consequences before acting, and gets in trouble if not supervised.
- Emotional Control. Considering the students in your classroom, using the list of students in your classroom who we received consent to take part in the study, please identify any students who demonstrate highly elevated behaviour levels related to challenges with emotional control. For example, does the student "always" or "often": overreact to small problems, has explosive/angry outbursts, has outbursts for little reason, mood changes frequently, reacts more strongly to situations than other children, angry/tearful outbursts are intense but end suddenly, small events trigger big reactions, and becomes upset too easily.

#### Part II: Student Pairings

We will be pairing students up for the purpose of this research study. Based on your knowledge of the students in your classroom and the classrooms involved in this study, please let the researcher know if any possible pairings may exacerbate or trigger past or potentially negative relationships between peers. Please note: you will have an opportunity to review final student pairs to be used in this study, before we begin the study with the students.

Appendix E: Motivational Beliefs Questionnaire

### The Implicit Theories of Intelligence Scale for Children-Self Form

#### (For Children Age 10 and older)

Read each sentence below and then circle the one number that shows how much you agree with it. There are no right or wrong answers. \*

1. You have a certain amount of intelligence, and you really can't do much to change it.

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

2. Your intelligence is something about you that you can't change very much.

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

3. You can learn new things, but you can't really change your basic intelligence.

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

\*The above questionnaire was obtained from,

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development.* New York, NY: Psychology Press.

### **Additional Questions\***

Please use your own words to answer the following questions:

What does "intelligence" mean to you?

What does "willpower" mean to you?

\*Additional questions based on work by,

Mueller, C.M., & Dweck, C.S. (1997) as cited in Dweck, C. S. (2000). Self-theories: Their role in motivation, personality, and development. New York, NY: Psychology Press.

### The Implicit Theories of Willpower Scale for Children-Self Form (translated version)

The current scale is in development by Dr. Veronika Job based on a published adult version (Job, Dweck & Walton, 2010). A copy of this questionnaire was made available in German for use in the present study. Permission to translate and use the following scale was obtained from its primary author, Dr. Job.

#### Reference

Job, V., Dweck, C. S., & Walton, G. M. (2010). Ego depletion—is it all in your head?: implicit theories about willpower affect self-regulation. *Psychological Science*, 21, 1686–1693.

#### The Implicit Theories of Willpower Scale for Children-Self Form (translated)

Imagine you have just done your homework for half an hour. The assignments were difficult and you had to think a lot.

How true are the following statements for you?

1. "Because I have already completed a few difficult assignments, it's now <u>easier</u> for me to continue with my other assignments."

Not at all true	Not really	Kind of	Quite	Absolutely
	true	true	true	true

2. "Because I have already completed a few difficult assignments, it's now <u>more difficult</u> for me to continue with my other assignments."

Not at all true	Not really	Kind of	Quite	Absolutely
	true	true	true	true

3. "Because I have completed a few difficult assignments, I'm now tired and need a break before I can think about anything difficult again."

Not at all true	Not really	Kind of	Quite	Absolutely
	true	true	true	true

4. "Because I have completed a few difficult assignments, I'm now feeling strong and energized and can easily continue to think about difficult stuff."

Not at all true	Not really	Kind of	Quite	Absolutely
	true	true	true	true

Appendix F: Student Refusal of Consent



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### Understanding Self-Regulation Study Post-study Student Consent

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[We will review this verbally with the student and adjust the language, as needed, to their developmental level and understanding. We will check for understanding throughout this debrief section and allow them to ask questions throughout as well as at the end.]

### **Debriefing Session**

### Re-explain the Study

- As you know, we are researchers from the University of British Columbia. We were interested in how students approach challenging tasks. We asked if you would like to be in a study, about how students solve problems.
- In this study, you were involved in answering some questions, and completing some activities (e.g. puzzles).

### **Disclosure Pertinent Information**

- While the purpose of the study we explained to you was accurate, we left out some detail so that you acted without bias (meaning, we didn't want your thoughts to affect what you did during the study) when you were given the puzzle. We wanted to understand how students act and respond to really challenging puzzles when another student is next to them.
- When we gave you and another student a puzzle activity and made it seem that they were the same puzzle, they were actually different puzzles. One was meant to be easily solvable and the other was not possible to be solved (i.e. it was unsolvable). If you felt frustrated or found it difficult, we meant to create those feelings. If you felt bad or it bothered you that the other person solved the puzzle before you, we are sorry that you felt this way. We hope you understand that this was an important part of our study.
- We are happy to answer questions you have about our study.

#### Privacy and Confidentiality

- As we mentioned before, your names and how you did on these activities will be kept private. All of our documents used a special student code that does not identify who you are to anyone but us, the researchers. When we talk to other people about the study, we will talk about the how students did generally without names or any way of identifying you.
- Now that you know about the truth about the study, we ask that you do not tell your friends or anyone about the details of the study. I hope you understand why it is important that you not tell anyone, because then they won't react truthfully.
- After everyone in this study has taken part in it, we will give you a chance to meet in small groups and talk about possible strategies you could use to take on difficult challenges or problems. After this, you will be able to talk freely about the study with your friends or family.
- Right now, we are giving you the opportunity to refuse your initial agreement to take part in this study. What this means is that we won't use any of the information we collected from your taking part in this study. (Show student consent form, and complete it with them)

#### Benefits of Involvement

- Again, thank you so much for helping us out. We really think your involvement will help us, help teachers and researchers understand how students take on challenges.
- Whether or not you decided to stay a part of this study, we will enter your name into our draw. We will do this draw now as a thank you for helping us out.

#### **Further Questions**

- If you have questions, you can ask me, Simon, your teacher, or your parents, who have my phone number and email.
- If you don't have any further questions at this time, you may go back to class. I will be around after for the next half hour, if you have any questions you want to ask me.

#### Understanding Self-Regulation Study Post-study Student Consent

(To be completed by each student after participation in study procedures.)

I \_\_\_\_\_\_\_ understand the purpose of this study, and how my involvement in this study will be used. I understand that researchers gave one student a puzzle that could not be solved, and another student an easy to solve puzzle. I understand that my name and how I did will be kept private and confidential. If I decide not to be part of this study, nothing bad will happen and information about me will not be used for this study.

**NO**, I do not want to be in the study

□ **YES**- I want to be in the study.

Student's Name: \_\_\_\_\_\_ Student's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Appendix G: Observational Coding Protocol

#### Observational Coding Protocol: Observational Categories

**Facial or bodily negativity.** Facial or bodily negativity are coded as no detectable facial/bodily negativity (0), mild facial/bodily negativity (1), or high facial/bodily negativity (2).

- (0) No detectable facial/bodily negativity (e.g. facial indicators: brows, nose and mouth relaxed position; bodily movements: age-appropriate sitting posture)
- (1) Mild facial/bodily negativity (e.g. facial indicators: brows slanting down or drawn together, wrinkled nose, straight mouth or lips drawn tightly shut; bodily movements: slumped shoulders or putting hands to head; turns red in cheeks)
- (2) High facial/bodily negativity (heightened levels of facial or bodily frustration, e.g. prolonged facial or bodily indicators with exaggerated movements)

**Resignation.** Verbal and non-verbal resignation behaviors are coded as no detectable resignation (0), mixed resignation (1), or clear resignation or protest (2).

- (0) No detectable resignation (e.g. student working quietly on puzzle task with maintained focus, or expression of enjoyment)
- (1) Mixed resignation (e.g. vocalizing exasperation while still working on the puzzle or by a low level of engagement behavior)
- (2) Clear resignation or protest (completely giving up for that interval , e.g. not working on the puzzle task, saying 'I give up')

**Coping strategies**. Behavioural coping strategies are noted during observational sessions, and classification of the strategies is completed during or after the session. Possible coping strategies that may be observe include:

- 1) STOPS Goal-directed action (strategic efforts, e.g. manipulating puzzle pieces) MARK if stops goal directed action
- 2) Alternative strategies (e.g. attempts to solve the problem without using the puzzle pieces, e.g., using fingers to measure diagram, stacking pieces on diagram, etc.)
- 3) Distraction (e.g. turning one's attention away from task towards something else; plays with their clothing or chair.)
- 4) Self-speech (self-talk, e.g. talking or whispering strategies about the puzzle to self)
- 5) Vocal venting (releasing tension vocally, e.g., raising the volume of one's voice, singing)
- 6) Physical venting (e.g. banging or hitting the puzzle)
- 7) Peer support/comparison: orientation to peer/experimenter (e.g. trying to look at their peer or experimenter in a support-seeking manner)
- 8) Social-support: verbal assistance seeking (e.g. asking peer or experimenter for help)
- 9) Disruptive behavior (e.g. aggressiveness, throwing a tantrum)
- 10) Avoidance (e.g. attempts to get out of one's seat, moving away from the task)
- 11) Other-directed comfort seeking (e.g. seeking physical comfort from the experimenter or parent).

### **Observational Coding Protocol: Session Observation Recording Form**

Student ID:	Date:	Beginning Time:	
Researcher:		Ending time:	

Time*	Facia	al or Bodily Negativity	Res	ignation	Coping strategies	Other behaviours
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

General Comments:

\*(1 min partial interval recording)

Appendix H: Post-study Questionnaire

On a scale from 1 to 10, answer the following questions.

While	l was	completing	the	puzzle,	l felt
-------	-------	------------	-----	---------	--------

1. <b>Нарру</b>									
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot
2. Frustra	ted								
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot
3. Compe	titive								
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot
4. Angry									
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot
5. <b>Smart</b>									
1 Not at all	2	3 <	4	5	6	7	8	9	10 A Lot
6. Nervou	S								
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot
7. Tired									
1 Not at all	2	3 <	4	5	6	7	8 >	9	10 A Lot

\_\_\_\_\_

### **Optional:**

While I was completing the puzzle, I felt...

and, I was thinking ...

### Thinking about your day to day life:

When I am faced with challenging situations, I usually...

To help me when I feel frustrated or upset, I usually try to...

\*The Post-Study Questionnaire is based on a similar questionnaire used by J. J. Seta, Seta, and Donaldson (1991).

\_\_\_\_\_

# Appendix I: Outlier Modification and Normality

Outlier Modifications and Considerations for Full sample, solvable condition and unsolvable condition.

List of Outlier Modifications and Considerations
Inhibition Accuracy for the solvable condition: Case 33 (RRRC033), genuinely unusual
value (score 76), not due to data entry error or measurement error (Student was forced
solved at 7 minutes, may have impacted results). Decided to modify the outlier by
replacing the outlier's value with one that is less extreme (i.e., the next largest value
instead); in this case, the lowest value for InhibAcc in Solvable is 86, so make it 85.
Inhibition Accuracy for unsolvable condition: Case #06 (RRAM006) outlier, not extreme,
not measurement error, genuinely unusual value (observational note: student with Fixed
mindset, observations indicate student turned red). Decided to modify outlier by one point
less than lowest value (84) therefore change InhAcc to 83. As a result, Inhibition accuracy
was found to be normally distributed, as assessed by Shapiro-Wilk's test ( $p > .05$ )."
Contrast Inhibition score for unsolvable condition: Case #11 (RRAM011) with a score of 7,
minimum for group was 11, therefore changed value to 10; Case #31 (RRRC031) with a
score of 8, minimum for group was 11, therefore changed value to 10; Case #42
(RRMB042) with a score of 50, maximum for group was 41, therefore changed value to
42.

Resignation for full sample: 5 major outliers. Decided to interpret with caution.

Measure	Shapiro Wilks	Significance (df = 64)	Descriptor
Beliefs about Intelligence	0.525	0	Non-normal
Beliefs about Willpower	0.592	0	Non-Normal
Contrast Inhibition	0.972	0.156	Normal
Contrast Inhibition (Outliers modified)	0.969	0.107	Normal
Inhibition Accuracy	0.908	0	Non-normal
Inhibition Accuracy (Outliers modified)	0.957	0.026	Non-normal
Facial/body Negativity	0.925	0.001	Non-normal
Resignation	0.594	0	Non-normal
Self-reported Frustration	0.947	0.008	Non-normal
Sex	0.613	0	Non-normal
Language of instruction	0.574	0	Non-normal

### Normality for Full Sample

# Normality for Solvable Condition

Measure	Shapiro	Significance	Descriptor
	Wilks	(df = 31)	
Beliefs about Intelligence			
Beliefs about Willpower	0.519	0	Non-normal
Contrast Inhibition	0.959	0.274	Normal
Contrast Inhibition (Outliers modified)	0.959	0.274	Normal
Inhibition Accuracy	0.894	0.005	Non-normal
Inhibition Accuracy (Outliers modified)	0.932	0.051	Normal
Facial/body Negativity	0.852	0.001	Non-normal
Resignation	0.453	0	Non-normal
Self-reported Frustration	0.931	0.047	Non-normal
Sex	0.635	0	Non-normal
Language of instruction	0.607	0	Non-normal

# Normality for Unsolvable Condition

Measure	Shapiro	Significance	Descriptor
	Wilks	(df = 33)	F
Beliefs about Intelligence	0.635	0	Non-normal
Beliefs about Willpower	0.629	0	Non-normal
Contrast Inhibition	0.961	0.275	Normal
Contrast Inhibition (Outliers modified)	0.966	0.385	Normal
Inhibition Accuracy	0.905	0.007	Non-normal
Inhibition Accuracy (Outliers modified)	0.956	0.201	Normal
Facial/body Negativity	0.932	0.041	Non-normal
Resignation	0.728	0	Non-normal
Self-reported Frustration	0.939	0.065	Non-Normal
Sex	0.579	0	Non-normal
Language of instruction	0.534	0	Non-Normal

# **RESEARCH QUESTION 3**

### List of Outlier Modifications and Considerations

**Case #06 (RRAM006)** outlier, not extreme, not measurement error, genuinely unusual value (observational note: student with Fixed mindset, observations indicate student turned red). Decided to modify outlier by one point less than lowest value (84) therefore change InhAcc to 83. As a result, Inhibition accuracy was found to be normally distributed, as assessed by Shapiro-Wilk's test (p > .05)." [Used same variable for Inhibition Accuracy as previous research question – no difference]

### Normality for Unsolvable Condition - Fixed Mindset

Measure	Shapiro Wilks	Significance	Descriptor
Self-control measure:	.961	.703	Normal
Contrast Inhibition (Outliers modified)			
Self-control measure: Inhibition Accuracy (Outliers	.954	.585	Normal
modified)			

#### Normality for Unsolvable Condition - Growth Mindset

Measure	Shapiro Wilks	Significance	Descriptor
Self-control measure: Contrast Inhibition (Outliers	.935	.101	Normal
removed)			
Self-control measure: Inhibition Accuracy (Outliers modified)	.928	.176	Normal

### **RESEARCH QUESTION 4**

### List of Outlier Modifications and Considerations

- Solvable Limited: No9 (RRNP071) moderate outlier, changed to next highest 92, change 86->91
- Unsolvable Limited: No.12 (RRAM006) extreme significant outlier, next lowest 86, change 74->85
- Solvable Nonlimited, and Unsolvable-Nonlimited: no outliers

Normality for Inhibition Accuracy for Beliefs about Willpower and	Experimental Condition
---	------------------------

Measure		Outliers	Shapiro	Significance	Descriptor
		(boxplot analysis)	Wilks		
	Solvable -	No9 (RRNP071)	.916	.440	Normal
Self-control	Limited				
measure:	Unsolvable	No.12 (RRAM006)	.948	.523	Normal
Contrast	- Limited				
Inhibition	Solvable -	None	.881	.009	Non-Normal
(modified for	Nonlimited				
Q4)	Unsolvable-	None	.929	.166	Normal
	Nonlimited				



# Appendix J: Histograms of the Unsolvable Condition measures









Histogram S/U= Unsolvable Output Out



