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BELIEFS ABOUT SELF-CONTROL AND REGULATION: DO THEY MATTER FOR COLLEGE PERFORMANCE?

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BELIEFS ABOUT SELF-CONTROL AND REGULATION:
DO THEY MATTER FOR COLLEGE PERFORMANCE?

THESIS

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science in Education in the
College of Education at the University of Kentucky

By

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Lexington, Kentucky

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2018

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ABSTRACT OF THESIS

BELIEFS ABOUT SELF-CONTROL AND REGULATION: DO THEY MATTER FOR COLLEGE PERFORMANCE?

Students who are good self-regulators have higher motivation and achievement than those who are not. The beliefs students hold influence the goals they set, how they regulate learning, their motivation, and their subsequent actions. Beliefs about one's own willpower (the capacity to exert self-control in everyday life) have been shown to affect individuals' self-regulation. Willpower has been conceptualized as a limited resource that is easily depleted in demanding situations. However, some researchers have shown that individuals' beliefs about willpower capacity (i.e., as finite or abundant), and not their actual willful acts, are more predictive of self-regulated behavior. Researchers have similarly shown that students' beliefs in their personal self-regulatory capabilities predict self-regulation, and subsequently, academic achievement. This study explored the relationship between willpower beliefs, self-efficacy for self-regulation, academic self-regulation, and achievement among college students. Participants were undergraduate students ($N = 536$) enrolled in an introductory biology course in Fall 2017 at a southeastern U.S. university. Self-efficacy for self-regulation was significantly correlated with effort regulation, time and study environment regulation, and final course grade, while willpower mindset was not. Findings from this study suggest that efforts intended to boost students' self-regulatory self-efficacy might be a more worthwhile endeavor than teaching them that they can improve their willpower/self-control when supporting them in developing self-regulated learning skills.

KEYWORDS: beliefs, willpower, self-efficacy for self-regulation, self-regulation, college

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Chapter One: Introduction

Self-regulation is a broad construct that spans all levels of human functioning and has been empirically linked to many positive life outcomes, including school readiness, academic achievement, educational attainment, overall health, and social-emotional well-being (McClelland et al., 2018). A person's ability to regulate her life plays a significant role in the trajectory that individual's life takes. Montry et al. (2016) defined self-regulation as, "a complex, multicomponent construct operating across several levels of function (e.g., motor, physiological, social-emotional, cognitive, behavioral and motivational), which, in its broadest sense, represents the ability to volitionally plan and, as necessary, modulate one's behavior(s) to an adaptive end" (p. 1745). This definition emphasizes the idea that self-regulation is volitional/intentional, goal-directed, and requires that behavior be modified when necessary to accomplish goals. In essence, self-regulation is the way in which a person volitionally shapes his or her personal development.

Self-regulated learners are often characterized as being metacognitively engaged, motivated, proactive, and efficient in managing school-related responsibilities (Zimmerman, 2008). Self-regulation has been shown to predict school readiness and academic success (Wolters, 1998). Self-regulated learners have a variety of study strategies in their toolbox, are persistent, and make adjustments to their learning strategies when necessary (Zimmerman, Bandura, & Martinez-Pons, 1992). Self-regulated learning (SRL) researchers have sought to understand how students become self-regulated learners, attempting to identify the cognitive and metacognitive strategies

they are using, and how motivational beliefs play a role in self-regulated behavior (Zimmerman, 2008).

SRL is a cyclical process that involves setting educational goals, selecting and implementing strategies to achieve those goals, monitoring progress, making adjustments and seeking help when necessary, and reflecting on performance once the learning goal has been realized. Students who are self-regulated have increased motivation and higher academic achievement than their peers who do not self-regulate their learning (Zimmerman & Schunk 2001). Self-regulation skills have also been shown to be predictors of long-term academic success and completion rates. Students with superior self-regulation are more likely to graduate high school, complete college, and obtain education beyond a bachelor's degree (McClelland, 2018).

Navigating college is a critical time when the student has more autonomy in fashioning his or her educational and life trajectory. For many students, this is the first time they have been responsible for regulating themselves independently, rather than being externally regulated by parents, teachers, and other adults. Adapting to the college learning environment typically requires changes in self-regulatory behavior for a variety of reasons, including changes in weekly course schedules, larger class sizes, and different expectations from teachers. Many students find themselves navigating large introductory lecture courses at the start of their college career. Success in these courses is essential for them to make it to the upper division courses for their major, but successfully navigating these large introductory courses can be challenging. Students enrolled in these large introductory courses must be self-regulated to effectively adjust to the changes in teaching, curriculum, and study habits.

An extensive body of literature documents that the beliefs individuals hold affects how they regulate their lives, influencing the goals they set, their motivation, and their subsequent actions or behaviors (Usher, 2015). People hold beliefs about their capabilities, which are often context-specific, and more global beliefs about the nature of human attributes (commonly referred to as lay theories) (Job, Dweck, & Walton, 2010; Usher, 2015). Researchers investigating beliefs about the nature of human attributes have proposed that people differ in how they view the availability and depleteability of mental resources, theorizing that holding a belief that exerting self-control (exercising willpower) is energizing, rather than depleting, can be a motivational force (Job et al., 2010). Students' beliefs about the nature of self-control (willpower) and what they can do (self-efficacy) can both influence students' self-regulation and have consequences for their academic achievement. Studies have shown that students with high self-efficacy, and those who hold the lay theory that demanding tasks are energizing rather than depleting, have better self-regulation skills and higher grades (Klassen, Krawchuk, & Rajani, 2008; Job et al., 2015). However, no research to date has examined the joint influence of these two belief systems. Therefore, the goal of the present study is to examine how confidence beliefs about self-regulation and beliefs about the nature of willpower influence self-regulation and achievement in college learning. Specifically, in this thesis I will explore how self-efficacy for self-regulation and lay theories about willpower are related to each other and to students' self-regulation for learning and academic achievement in a large lecture introductory biology course.

Theoretical Framework

Social Cognitive Theory. Within the social cognitive theoretical framework, human functioning is motivated and regulated through a dynamic relationship between personal, behavioral, and environmental factors (Bandura, 1986). The bidirectional influence of these three factors on one another is referred to as triadic reciprocity. Personal factors, such as a student's beliefs about her capabilities for learning in a large lecture course, might influence where she sits in the classroom and how she interacts with the course content (behavioral), which might influence how her peers and instructor engage with her about biology (environmental).

Bandura (2001) emphasized the role of personal agency in human functioning. This agentic perspective affirms that people exert some control over their life circumstances and do not function as mere byproducts of external events. The role individuals play in shaping their own experiences is largely influenced by the beliefs they hold about their ability to perform specific tasks or achieve particular goals. These capability beliefs, commonly known as self-efficacy, affect the goals people pursue, the effort they put forth, and their persistence when difficulties arise (Bandura, 1986). In the context of college learning, students judge how capable they are in a particular domain (e.g., biology learning, succeeding in a large lecture course, or completing a specific task for a class), and those judgments motivate them to set goals, plan a course of action to reach said goals, and then embark on achieving those goals. This cyclical process of self-regulation happens through both environmental and self-initiated influences.

Engaging in adaptive self-regulatory behaviors is empirically linked to greater academic success, but merely possessing an array of cognitive and metacognitive

strategies in and of itself is not enough. Students must also possess confidence in their abilities to self-regulate their learning. According to Bandura (1993), “Self-regulatory skills will not contribute much if students cannot get themselves to apply them persistently in the face of difficulties, stressors, and competing distractions. Firm belief in one’s self-regulatory skills provides the staying power” (p. 136).

Implicit Theories. Related to self-regulation and the concept of human agency is the deliberation about what human attributes are unchangeable and which are malleable. Carol Dweck (1988) popularized the notion that students hold different lay theories about certain human characteristics. These lay theories have been termed “implicit theories” (Blackwell, Trzesniewski, & Dweck, 2007). Dweck and colleagues (2007) proposed that some students hold implicit theories about the nature of intelligence. Some believe that intelligence is unchangeable and therefore hold a “fixed” mindset, and others believe intelligence is malleable and can be changed with effort, which is commonly referred to as a “growth” mindset. The mindsets that students hold have consequences when they faces academic challenges, which can affect how they self-regulate their learning. For example, if a student who holds a growth mindset regarding intelligence earns a bad grade on an exam then that student will be more likely to set new goals and try new strategies to achieve future learning goals because he/she believes that hard work and effort will help improve the next exam grade.

More recently, researchers investigating mindsets have proposed that people differ in how they view the availability and depleteability of mental resources (Job et al., 2010). This is a person’s lay theory about willpower, or willpower mindset. Job and colleagues (2015) theorized that holding a belief that exerting self-control (exercising

willpower) is energizing rather than depleting can be motivating and result in positive outcomes, including higher academic achievement. A fixed willpower mindset is the belief that willpower (or self-control) is like a tank of gas, and once the tank is empty, people are depleted of mental resources and no longer able to exert self-control on subsequent tasks that are mentally demanding. A growth willpower mindset, on the other hand, is the belief that exercising self-control activates more self-control resources. In other words, using self-control allows people to further develop their self-control abilities for future tasks, similar to building muscle (they are building their willpower). If students hold a fixed willpower mindset, they may believe they have reached the limit of their self-regulatory abilities and stop attempting to achieve their learning goal long before they have actually reached their limit. A student with a growth willpower mindset may, on the other hand, sustain self-regulation to accomplish learning goals.

Bandura's (1986) theory of human agency posits that people have choice (can exercise willpower), and can therefore somewhat control the direction and outcomes in their lives. Self-efficacy and agency are essential for successful human functioning. If students believe they are easily depleted when engaging in cognitive tasks, there would likely be a negative impact on their self-regulatory performance. Both social cognitive theory and implicit theories of intelligence emphasize the importance of beliefs when one regulates learning, with confidence beliefs in learning skills and beliefs that one can persevere with effort being correlated with higher academic achievement.

Chapter Two: Literature Review

Recent research has documented the importance of self-regulated learning skills for postsecondary academic success (Mega, Ronconi, & De Beni, 2013). Nevertheless,

college students are often overconfident in their knowledge and abilities and do not demonstrate the self-regulatory strategies needed to succeed (Dörrenbächer & Perels, 2016). Self-regulatory processes, such as goal-setting, self-monitoring, and self-evaluating, require that the student be aware and engaged at multiple levels of the learning process. The student must be able to interpret the learning task accurately, have a broad repertoire of learning strategies, know when to use appropriate strategies, and have a deep understanding of self to optimize learning (Kitsantas & Zimmerman, 2009).

Furthermore, researchers have found self-efficacy to be a significant predictor of motivation, self-regulation, and achievement (Zimmerman, 2000). Evidence suggests that self-efficacious students choose more challenging tasks, work harder, and persist longer than students who are less confident in their capabilities (Komarraju & Nadler, 2013). These broader self-theories include people's implicit beliefs about the nature of human attributes such as intelligence or their ability to exert willpower (Blackwell, Trzesniewski, & Dweck, 2007; Job, Dweck, & Walton, 2010).

Self-Efficacy for Self-Regulation

Self-efficacy is another prominent area of research to understand how student beliefs lead to self-regulated learning and academic achievement. Self-efficacy can be assessed generally ("I am confident I can graduate from college in four years"), or specifically to the domain in which it is being measured within ("I am confident that I can get an A on my first Introductory Biology exam"). This is done to ensure that the efficacy beliefs being assessed directly correspond to the context or task at hand (Schunk & Usher, 2011). Investigating student beliefs in the ability to self-regulate in a particular course is a course-specific approach to understanding self-efficacy.

Researchers have highlighted the importance of college students' self-efficacy on their self-regulatory behaviors and academic achievement (Zimmerman, 2000; Zusho et al., 2003). A number of studies have shown that high self-efficacy predicts self-regulation in a variety of ways, including goal orientations, task-value, strategy use, effort regulation, time management, and regulation of the study environment (Dunn & Lo, 2015; Zimmerman & Kitsantas, 2014; Zusho et al., 2003). Zimmerman and Kitsantas (2009) conducted a study seeking to understand the role homework plays in developing undergraduate students' self-regulation skills. They found that regular high-quality homework assignments play an important role in undergraduate students' development of self-regulation skills. That is, homework increased students' self-efficacy for self-regulation and their self-regulation behaviors (Zimmerman & Kitsantas, 2009).

Komaraju and Nadler (2013) investigated the relationship between implicit theories of intelligence and self-efficacy with a sample of undergraduate students. Results showed that students with low self-efficacy believed that intelligence was innate and unchangeable, and students with high self-efficacy were more inclined to believe intelligence could be changed with effort. The highly efficacious students in this study also achieved higher grades as a result of better effort regulation, including regulating their impulses (Komaraju & Nadler, 2013). Furthermore, Klassen et al. (2008) conducted two studies with undergraduate students highlighting the relationship between self-efficacy for self-regulation and procrastination behaviors among students. These researchers found that low self-efficacy for self-regulation was the most significant predictor of procrastination behaviors. In addition, the students with low self-efficacy for

self-regulation had lower GPAs than their peers with higher self-efficacy for self-regulation (Klassen et al., 2008).

Willpower Mindset

Willpower can be defined as a person's capacity to exert self-control in everyday life (Job, Dweck, & Walton, 2010). Considerable evidence supports the strength model of self-control, which suggests that willpower, or the ability to exert self-control, is a limited resource that is depleted with every act requiring further self-control (Baumeister, Vohs, & Tice, 2007). The inability to exert control on future tasks because someone has exhausted his or her mental resources is referred to as ego depletion (Baumeister et al., 2007). Self-regulation researchers support the strength model of self-control, finding in a series of laboratory experiments that when people experience ego depletion they have more difficulties self-regulating in everyday life (Job et al., 2015).

Recent research has refuted findings that willpower (or the capacity to exert self-control) is an easily depleted mental resource, discovering that a person's beliefs about willpower can moderate the effects of ego depletion (Job et al., 2010). Job and colleagues (2010) hypothesized that holding the belief that tasks requiring self-control are energizing, opposed to depleting, can prevent ego depletion and lead to sustained self-regulation. Through a series of four studies they found their hypothesis to be supported: in a sample of college students, holding the belief that willpower is abundant moderated the effects of ego depletion and led to sustained self-regulation on subsequent tasks that were designed to be mentally demanding (Job et al., 2010).

In another study, a sample of college students who were encouraged to adopt a growth mindset about willpower persevered in a strenuous mental task longer than the

participants holding a fixed view about willpower (Miller, Walton, Dweck, Job, & Trzesniewski, 2012). This experimental study shows that willpower mindset is malleable, at least in the short term.

Job et al. (2015) found that university who held a fixed mindset about willpower took longer breaks after an activity requiring self-control than their peers with a growth mindset. A follow-up experimental study revealed that participants (in this case, college students) who were led to adopt a fixed willpower mindset took longer breaks and were more inclined to sitting than the control group (Job, Bernecker, Miketta, & Friese, 2015). These findings suggest that there is a change in motivated behavior when participants hold a fixed mindset about willpower. Furthermore, a study conducted by Bernecker and Job (2015) hypothesized that when people experience a mentally demanding day, their beliefs about willpower predicted their self-regulated behavior the following day. Results from this study suggested that beliefs about willpower did indeed predict self-regulation in the days following demanding extensive self-regulation and self-control behavior.

Researchers investigating the strength model of self-control have found a relationship between the ingestion of glucose and cognitive and self-regulatory functioning, claiming that ingesting glucose can give people the boost needed to maintain sustained attention and self-control (Gailliot et al., 2007). Job and colleagues (2013) conducted a series of experiments investigating whether a participant's willpower mindset would affect how glucose affects his or her self-control behavior. Through a series of experiments, researchers found that those who held the belief that willpower was easily depleted (fixed willpower mindset), the glucose restored their self-control so they could sustain self-regulation on a series of tasks. However, when people endorsed the

view that willpower was abundant (growth willpower mindset), they maintained self-control and self-regulation on tasks regardless of whether they ingested glucose (Job et al., 2013).

The ability to exert self-control and regulate learning is important for sustained academic success. Moving out of the laboratory and into a real-world setting, researchers investigated whether having a growth mindset about willpower moderated the effects of ego depletion for college students when demands on their self-regulation were unusually high (Job et al., 2015). In this longitudinal study, researchers assessed students' willpower mindset, tracked the demands on self-regulation during the academic semester, self-regulation failures, and academic performance. They found that students who held a growth view of willpower exhibited better everyday self-regulation, including better time management, less procrastination, less impulsive spending, and healthier eating habits during times when there were considerable demands on their self-regulation. The students with the growth willpower mindset earned higher grades, which was mediated by better self-regulation when demands on their self-regulation were high. Students holding a fixed view about willpower experienced more self-regulatory failures, procrastinated more, and had more unhealthy eating habits when demands on their self-regulation were high, such as during the weeks leading up to finals (Job et al., 2015).

The studies conducted by Job and colleagues (2015) document that a growth willpower mindset can promote sustained self-regulation and higher grades for college students, but there are several limitations in this research worth noting. First, the sample sizes used in the studies mentioned are small (ranging from 50 to 191 participants). This body of research supports the theory that, "motivational factors can substantially affect

people's ability to recruit their cognitive resources to sustain learning over time (Miller et al., 2012, p. 1), but researchers need to investigate these psychological and motivational processes with larger samples to better understand the role willpower mindset play in the college classroom.

Statement of the Problem

College is a unique time in development when emerging adults are regulating their learning and their lives more independently, and the beliefs they hold can significantly influence their college success and capacity for lifelong learning. Although academic achievement is important, self-regulation skills translate beyond the walls of formal education. Zimmerman (2002) stated, "Self-regulation is important because a major function of education is the development of lifelong learning skills" (p. 66). Research examining willpower mindset and self-efficacy for self-regulation shows that each of these variables positively influences self-regulatory behaviors and academic achievement. However, no studies have examined these two variables together to understand how they collectively play a role in undergraduate students' motivation and learning. Both self-efficacy for self-regulation and mindset about willpower are theorized to foster agentic behavior, which empowers students to regulate their lives and their learning, particularly at a time when demands on their self-regulation might be unusually high, such as when they are transitioning to college life and learning.

Purpose of the Study

The broad purpose of this study is to examine the relationship between beliefs, self-reported self-regulation, and achievement for undergraduate students. Specifically, this study investigates how two belief systems, beliefs about willpower as an easily

depleted or plentiful mental resource and self-efficacy for self-regulation, relate to self-regulated learning behaviors, and subsequent academic achievement.

The following research questions (RQs) guided this investigation:

RQ1: What is the relationship between students' willpower mindset, their self-efficacy for self-regulation, their self-reported self-regulation behaviors, and their academic success in an introductory course for undergraduates?

RQ2: Do students who hold a growth mindset about willpower report having different self-efficacy beliefs about self-regulation, or different self-reported self-regulation behaviors than students who hold a fixed mindset about willpower?

Hypothesis 1 and 2: I hypothesize that having a growth willpower mindset and high self-efficacy for self-regulation will be positively correlated with self-reported self-regulated behaviors and grades. Furthermore, I expect to find that students who have low self-efficacy for self-regulation and who hold a fixed mindset about willpower will not be as self-regulated and will have lower grades. No existing research has explored the correlation between willpower mindset and self-efficacy for self-regulation, but given that both constructs measure self-control and effort beliefs, it is predicted that the two will be highly correlated.

RQ3: Are willpower mindset and self-efficacy for self-regulation jointly related to self-reported self-regulation and to students' grades?

Hypothesis 3: No research has jointly examined these two belief systems. A study conducted by Zimmerman et al. (1992) revealed that self-efficacy for self-regulation in a college writing course accounted for 32% of the variance in final course grades. It could

be that willpower mindset and self-efficacy for self-regulation collectively account for a significant amount of the variance for self-regulation and for academic achievement.

Chapter Three: Method

Participants

Data were collected from undergraduate students ($N = 536$) enrolled in four sections of an introductory biology course at a large Southeastern university in the United States during the Fall 2017 semester. The primary instructors for each section of the course were different. Participants were primarily female (73%) and designated as college freshmen (50.9%). In terms of race and ethnicity, the majority identified as White/Caucasian (78.1%), 7.2% as Asian/Pacific Islander, 7.1% as African American, 3.2% as Hispanic/Latino, 0.9% as Middle Eastern, and 2.6% as Other. See Table 1 for a full description of study participants. This project was approved by the Institutional Review Board (IRB) in the fall of 2017 and students provided electronic consent to be included in the study (see Appendix A).

Procedure

Over the course of the semester students were surveyed six times. The Time 1 and Time 6 surveys were administered to students by their instructors online through the course management system. Instructors were provided a survey link by researchers, which they posted in the course management system asking students to participate for two bonus points. Students completed these surveys during their own time outside of class. A confidentiality statement in the survey explained to students that their responses would be confidential and that the results would help researchers understand more about how students learn biology.

Table 1

Description of Study Participants

Demographics	<i>N</i> = 538
University Class Designation	
Freshman	274
Sophomore	173
Junior	71
Senior	17
Other	3
Gender	
Women	393
Men	145
Race	
African American	38
Asian	39
Hispanic	17
White	420
Middle Eastern	5
American Indian	5
Other	14
Major	
Biology	196
Other	342

For the purposes of this study, I examined data collected using the Time 6 survey, which was distributed one week before the end of the semester. Participants provided consent authorizing researchers to use their survey responses and course grades at the end of the Time 6 survey. Five hundred and thirty-six participants (89%) of 599 students who took the Time 6 survey consented to the using their survey responses and grades.

Measures

Self-Efficacy for Self-Regulation. Student self-efficacy for self-regulation was measured using the Self-Efficacy for Learning Form (SELF) (Zimmerman & Kitsantas, 2007). I used 18 items of the 19-item scale which was created to assess student self-efficacy for self-regulation (See Appendix C). One item was removed from this scale because it asked students to evaluate how confident they are at being an effective study partner which was inconsistent with the remainder of the items on the survey, which tapped into how confident the student is at self-regulating independently. Students were asked to rate how true each statement was to them on a four-point scale of 1 (*Definitely False*) to 4 (*Definitely True*). Items within this scale were originally worded as questions and written with second person pronouns (e.g., “When a lecture is especially boring, can you motivate yourself to keep good notes?”). To maintain consistency across all scales in the entire survey I rewrote items as statements and used first person pronouns (e.g., “When a lecture is especially boring, I can still motivate myself to keep good notes.”) Prior research has shown this scale to have a relatively high internal consistency ($\alpha = .97$) (Zimmerman & Kitsantas, 2007). The scale maintained a relatively high internal consistency with this sample ($\alpha = .92$). Items were averaged to create a composite variable for self-efficacy for self-regulation ($M = 3.12, SD = 0.49$).

Willpower Mindset. Participants completed a 6-item subscale of the Implicit Theories of Willpower Scale focused on strenuous mental activity (Job et al., 2010). Students were asked to rate how much they agree or disagree on a four-point scale from 1 (*Strongly Disagree*) to 4 (*Strongly Agree*). On a 6-item scale, three items were written for individuals who endorse a fixed willpower mindset (e.g., “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again”) and three items were written for participants who might endorse a growth willpower mindset (“When you have been working on a strenuous mental task, you feel energized and you are able to immediately start with another demanding activity.”) (See Appendix B). Fixed willpower mindset items were reverse coded so that lower values represent more agreement with a fixed willpower mindset. Previous researchers have reported an alpha reliability coefficient for the strenuous mental activity subscale of .85 (Job et al., 2015). In the present study, the Cronbach’s alpha was .72. All items were averaged to create a composite variable for mindset about willpower ($M = 2.18$, $SD = 0.49$).

Student Self-Regulation. The Motivated Strategies for Learning Questionnaire (MSLQ) is a widely-used instrument to assess student self-regulation (Pintrich et al., 1993). The MSLQ contains fifteen subscales assessing motivational regulation, cognitive and metacognitive regulation, and resource management regulation. The two subscales within the resource management theme (Time and Study Environment Regulation and Effort Regulation) were used to assess self-regulation behaviors at Time 6. These subscales were chosen because college students consistently face self-regulatory struggles with maintaining a high level of effort during academic tasks, and with regulating their time efficiently (Klassen et al., 2008; Thibodeaux, Deutsch, Kitsantas, &

Winsler, 2017; Wolters, 1998). Participants indicated how true or false each statement was of them on a 4-point scale from 1 (*Definitely False*) to 4 (*Definitely True*). Sample items from each scale include, “I usually study in a place where I can concentrate on my course work” and “Even when course materials are dull and uninteresting, I manage to keep working until I finish.” Negatively worded items were reverse coded and a composite variable was created for each subscale (Effort Regulation, $M = 3.14$, $SD = 0.59$, $\alpha = 0.71$; Time and Study Environment, $M = 3.08$, $SD = 0.45$, $\alpha = 0.74$).

Academic Achievement. Academic achievement was measured using final course grade in introductory biology. The final course grades were provided by course instructors and were based on total points earned (650 points maximum).

Analyses

To investigate the relationship between self-efficacy for self-regulation, willpower mindset, time and study environment regulation, effort regulation, and achievement, I ran descriptive statistics to examine the means, standard deviations, minimum value, and maximum value for the composite variables. I then conducted a correlation analysis for all participants to view the relationship among the two belief variables, the two measures of self-regulation, and final course grade.

The second research question investigated whether students who hold a growth mindset about willpower report differences in self-efficacy beliefs about self-regulation, self-reported self-regulation behaviors, or grades compared to their peers who hold a fixed mindset about willpower. Students one standard deviation above the mean (2.67 and above on the 4-point scale) were identified as having a growth orientation, and students one standard deviation below the mean (1.69 units and below on a 4-point scale)

were identified as having a fixed orientation in regards to their willpower beliefs. Then I conducted four independent samples *t* tests to analyze the hypothesis that students holding a growth mindset about willpower have different self-efficacy for self-regulation, self-regulation behaviors, and academic achievement than the students holding the fixed view about willpower.

The third research question in this study sought to determine whether self-regulatory self-efficacy and willpower mindset jointly predicted time and study environment regulation, effort regulation, and academic achievement. Three multiple linear regression analyses were calculated to examine the relationship between the independent variables (mindset and self-efficacy) and each dependent variable of interest (i.e., time and study regulation, effort regulation, and achievement).

Chapter Four: Results

Means and standard deviations for self-efficacy for self-regulation, willpower mindset, effort regulation, and time and study environment for the full sample are displayed in Table 2. Students reported relatively high confidence in their self-regulatory capabilities ($M = 3.12$, $SD = 0.49$), their self-reported effort regulation ($M = 3.14$, $SD = 0.59$), and their time and study environment regulation ($M = 3.08$, $SD = 0.45$). On the willpower mindset scale (also a four-point scale), lower values represent a stronger endorsement of a fixed view about one's willpower. Therefore, students reported endorsing more of a fixed mindset about willpower more often than a growth mindset ($M = 2.18$, $SD = 0.49$).

I first sought to examine the relationship between students' willpower mindset, their self-efficacy for self-regulation, their self-reported self-regulatory behaviors (which

Table 2

Descriptive Statistics for Variables

Variable Name	<i>N</i>	<i>M</i>	<i>SD</i>	Minimum	Maximum
Self-Efficacy for Self-Regulation	536	3.12	0.49	1.00	4.00
Willpower Mindset	527	2.18	0.49	1.00	4.00
Effort Regulation	521	3.14	0.59	1.00	4.00
Time & Study Environment	521	3.08	0.45	1.38	4.00

includes effort regulation and time and study environment regulation), and their final course grade in an introductory biology course.

Self-efficacy for self-regulation had a positive and significant relationship with willpower mindset, the two measures of behavioral regulation (effort regulation and time and study environment regulation), and course grades (see Table 3). Self-efficacy for self-regulation, effort regulation, and time and study environment regulation were all positively and significantly associated with final course grades. These results indicate that students who have higher self-efficacy for self-regulation, and who report adaptively regulating their learning, earn higher grades. Students who report that willpower is a plentiful resource also report higher self-efficacy for self-regulation, although this correlation was weak ($r = .15, p < .01$). Willpower mindset was not significantly related to measures of behavior regulation (effort regulation and time and study environment regulation) or final course grade (See Table 3).

Using a series of independent t tests, I investigated whether self-efficacy for self-regulation, self-reported self-regulation behaviors, and final course grade differed for students who endorse a fixed versus growth mindset about their willpower. Noted previously, students who reported 1 SD above the mean of the composite variable for willpower mindset were labeled as having a growth mindset (2.67 points and above) and students 1 SD below were labeled as holding a fixed mindset (1.69 points and below). Results revealed, that students who hold a growth mindset about the nature of willpower reported higher self-regulatory self-efficacy and being better at regulating their effort and study time and environment (see Table 4). There were no statistically significant

Table 3

Correlations Between Variables

Variable Name	Self-Efficacy for Self-Regulation	Willpower Mindset	Effort Regulation	Time & Study Environment
Self-Efficacy for Self-Regulation				
Willpower Mindset	.15**			
Effort Regulation	.49**	.01		
Time & Study Environment	.52**	.04	.64**	
Course Grade	.36**	.01	.29**	.28**

differences in final course grade for students who have a fixed or growth view of mindset.

Independent samples *t* test was revealed that students holding a growth view had higher self-efficacy and more adaptive self-reported self-regulation behaviors. There was a statistically significant effect when examining mean differences in self-regulatory self-efficacy beliefs for students with a growth ($n = 50$) versus fixed ($n = 99$) mindset, the, $t(147) = -3.02, p = .003$. The assumption of homogeneity of variances was tested and satisfied using Levene's test, $F(147) = 3.23, p = .07$. Cohen's *d* was estimated at .24 for self-efficacy for self-regulation among students with a growth versus fixed mindset, which is a small effect size (Cohen, 1992). In addition, I found a statistically significant difference in time and study environment regulation for students who held a fixed ($M = 3.11, SD = 0.44$), or growth ($M = 3.31, SD = 0.40$) willpower mindset, $t(146) = -2.55, p = .012, d = .21$. The same statistically significant results held when examining the differences in self-reported effort regulation for students with a growth ($M = 3.39, SD = .55$) versus fixed ($M = 3.17, SD = .58$) mindset (see Table 4). I found no statistically significant differences in final course grades for students who held a fixed ($M = 82.37, SD = 9.36$) or growth ($M = 84.31, SD = 8.99$) willpower mindset, $t(146) = -1.21, p = .23$.

In my final analytic step, I used regression analysis to investigate the joint contribution made by self-efficacy for self-regulation and willpower mindset to the three outcomes of interest (effort regulation, time and study environment regulation, and final course grade). I regressed time and study environment regulation, effort regulation, and final course grade on self-efficacy for self-regulation and willpower mindset in three simultaneous multiple regressions. The three regressions were each significant and

Table 4

Mean Differences for Key Variables as a Function of Mindset

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Self-Efficacy for Self-Regulation				-3.02	.003	.24
Growth	50	3.36	.42			
Fixed	99	3.08	.57			
Effort Regulation				-2.28	.024	.18
Growth	49	3.40	.55			
Fixed	99	3.17	.58			
Time and Study Regulation				-2.55	.012	.21
Growth	49	3.31	.40			
Fixed	99	3.11	.44			
Final Course Grade				-1.21	.230	.11
Growth	50	84.31	8.99			
Fixed	98	82.37	9.36			

Note. Growth represents participants whose willpower mindset score was 1 *SD* or greater than the mean. Fixed represents participants who responded 1 *SD* or lower than the mean.

similar in their findings (see Table 5). Only self-efficacy for self-regulation was a significant predictor in each model. Self-regulatory self-efficacy and willpower mindset explained 26.8% of the variance in time and study environment regulation, [$R^2 = .27$, $F(2, 518) = 94.9$, $p < .001$], 24.5% of the variance in effort regulation [$R^2 = .25$, $F(4, 135) = 45.67$, $p < .001$], and 13.3% of the variance in final course grade [$R^2 = .13$, $F(2, 523) = 39.95$, $p < .001$], which can be seen in Table 5.

Chapter Five: Discussion

In this study, I explored the relationships between college student beliefs, self-regulation, and course grades in an introductory biology course. The findings from this study provide evidence that, in an introductory biology course, context-specific motivational beliefs about self-regulation are associated with academic self-regulation and course grades, while lay beliefs about the nature of willpower were not. The results of this study integrate two separate streams of self-regulation research examining beliefs, with the intention of providing theoretical clarity between implicit theory and social cognitive research. In addition, this research will inform undergraduate instructors about how students' beliefs affect the self-regulation choices they make in the college classroom.

Self-Efficacy and Willpower Mindset Relationship

The first objective of my study was to examine how these different control beliefs and self-regulatory beliefs are related to one another. Because these belief systems both tap into the broader realm of self-theories, I hypothesized that they would be positively correlated with one another. I found a positive but weak relationship between self-efficacy for self-regulation and willpower mindset. Considering these two beliefs systems

Table 5

Regression Analyses for Independent and Dependent Variables

Variable	Time and Study Environment		Effort Regulation		Final Course Grade	
	β	<i>SE</i>	β	<i>SE</i>	β	<i>SE</i>
Self-Efficacy for Self-Regulation	.52*	.35	.50*	.05	.37*	.83
Willpower Mindset	-.05	.34	-.07	.05	-.05	.83
R^2	.27		.25		.13	
F	97.95*		84.22*		39.95*	

* $p < .01$

are positively correlated with one another they could be tapping into similar motivational processes. If students believe that their willpower is not a highly limited mental resource, meaning that it is abundant and easily replenished, they also have a heightened belief in their ability to regulate their learning. It was a bit surprising that the magnitude of this correlation was not higher. Job and colleagues (2015) found that trait self-control and willpower mindset were weakly correlated with one another, and attributed this to the idea that growth oriented individuals are not naturally born self-regulators who have exceptional self-control abilities but rather they put forth the effort when it is required. One explanation for my findings could be similar. Perhaps students who believe willpower is abundant are not automatically more confident in their ability to self-regulate because of circumstances in their environment. For example, a college freshman enrolled in a large lecture introductory course might endorse a growth orientation but her confidence may waiver since she is still acclimating to college learning.

Another reason for this finding could be differences in the way items are worded. For example, a willpower mindset item stated, “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again,” and a self-efficacy for self-regulation item stated, “When I feel moody or restless during studying, I can focus my attention well enough to finish assigned work” (Job et al., 2010; Zimmerman & Kitsantas, 2007). The willpower mindset items were written in a second-person point of view, while the self-efficacy items were written in a first person point of view. In addition, the wording of the implicit theories of willpower scale are abstract and use language that most college students do not encounter on a regular basis so they might be

cognitively burdensome in a survey. This could explain the relatively low magnitude of the correlation between self-regulatory self-efficacy and willpower mindset.

Willpower Mindset and Self-Regulation

Job et al. (2015) reported that holding the belief that tasks requiring self-control are energizing, rather than depleting, prevent ego depletion and promote sustained every day self-regulation among college students. My findings did not support this conclusion. Willpower mindset was not significantly related to self-reported self-regulated learning behaviors. Several notable measurement differences could account for these inconsistent conclusions. Studies linking willpower beliefs to self-regulation have measured everyday self-regulation through self-reported self-regulatory failures whereas I measured self-regulation specifically in terms of learning and academics. Job et al. (2015) asked college students to report how many times over the previous week they procrastinated on academic work, ate unhealthy foods, managed their time poorly, spent too much money, and failed to control their emotions. On the other hand, I measured self-regulation by asking students to report on how they manage their time in relation to school work, the effort they expend on academics, and how they manage their study environments.

Generality Versus Specificity of Measures

Even though willpower mindset was not related to self-regulation behaviors, self-efficacy for self-regulation told a different story. Self-efficacy for self-regulation was associated with self-regulated learning. Given that self-efficacy is highly predictive of actual behavior, this finding is not surprising (Bandura, 1986).

As it is currently conceptualized, willpower mindset is a belief system that can be applied to many domains of life. It is a general belief that engaging in cognitively

demanding tasks either drains or activates more mental resources regardless of what setting the person is in. Self-efficacy for self-regulated learning, on the other hand, is situated within the specific context of formal learning. Implicit theory researchers have suggested that mindset items should be measured within a single domain because people can take on a fixed versus growth mindsets depending on the specific contexts they are in (Blackwell et al., 2007). In short, people are on a continuum of holding growth and fixed views depending on what they are doing and where they are doing it, and do not fall cleanly into dichotomous categories. Similarly, a growth or fixed willpower mindset can apply to different areas of life, with people either believing or not believing that they are capable of maintaining their self-control efforts depending on the context.

Considering that people may hold a different mindset within different domains, future research on willpower beliefs should consider assessing these mindsets within the domain of interest, like learning in an introductory biology course.

Growth and Fixed Willpower Mindset

Although the correlation analysis suggests no relationship between willpower mindset and self-regulation and grades, when I examined individuals at extreme ends of the spectrum another pattern emerged. Students with a growth mindset about willpower were more confident that they could self-regulate, were better at managing their study time and environment, and reported putting more effort into regulating their learning, but did not earn higher grades than did their peers who held a fixed willpower view. These findings seem to suggest that those who view willpower as a fixed component of their nature, stop short at regulating their learning in certain ways, and may feel less capable of regulating their lives. Past studies have proposed that, in some cases, self-regulatory

failures that could be seen as a result of ego-depletion may not be from true ego-depletion but from the beliefs one holds about their mental resources. I found evidence that supports this since students who endorsed a fixed view reported less adaptive self-regulated learning behaviors. These findings are consistent with prior research examining willpower mindset, with the exception of grades. Contrary to my findings, Job et al. (2015) found that students with a growth view were better at self-regulating and also earned higher grades.

Motivational Beliefs and Final Course Grades

It is interesting that there was no difference in final course grades for students who report holding a growth or fixed view about willpower. This is not what has been found in previous research that has linked willpower mindset to academic achievement (Job et al., 2015). In my study, even if students stop short at regulating their learning as a result of a fixed mindset about willpower, they still performed as well as their peers with a growth mindset, and felt more confident in regulating their learning. Previous studies have used grade point average (GPA) to assess achievement, however, I used final course grade in a large introductory biology course as the outcome of interest. Future studies should replicate existing research, assessing achievement using both GPA and course grades to see if the same pattern emerges. My study participants were enrolled in a large lecture introductory biology course. Therefore, future research should examine willpower mindset and self-efficacy for self-regulation for students enrolled in both introductory and upper-division courses. Beliefs about self-regulation and willpower may evolve over time, or impact self-regulation and academic success differently once a student has adjusted to the expectations of college learning.

Fostering Self-Efficacy for Self-Regulation

By examining the joint relationship between willpower mindset and confidence in self-regulation I sought to understand which of these two types of beliefs would be a stronger predictor of self-reported academic self-regulation and final course grade. Self-efficacy was the only significant predictor of effort regulation, time and study environment regulation, and course grades. This suggests that self-efficacy for self-regulation matters more than a lay theory about willpower when students manage their time and student environment, regulate the effort they put into their learning, and ultimately what grades they receive in an introductory biology course. Prior research suggests that self-efficacy for self-regulated learning increases motivation, self-regulation, and achievement for college students (Zimmerman & Kitsantas, 2009). The findings in my study support these relationships. Willpower mindset showed significant difference for students at extreme ends of the spectrum, however, most students fell somewhere in the middle and could not be labeled as holding a fixed or growth mindset.

There was a strong relationship among self-efficacy for self-regulation, self-regulation, and grades throughout several levels of analysis, whereas this pattern did not hold true for willpower mindset. These findings suggest that interventions intended to boost student self-efficacy might be a better way to promote self-regulatory behaviors and academic achievement rather than trying to teach people that they can grow their willpower/self-control. Social cognitive theory posits that self-efficacy is raised or lowered through four sources (mastery experiences, vicarious experiences, social persuasions, and emotional and physiological state), with mastery being the most powerful predictor of efficacy beliefs (Bandura, 1997). Individuals interpret their

experiences, and these interpretations contribute to their efficacy beliefs. When students experience success, this raises self-efficacy which can affect how they perform on future tasks in a current course, or in future courses within a particular subject.

If instructors seek to boost self-regulatory self-efficacy they might consider intentionally asking students to set learning goals, monitor the progress toward those goals, and reflect on the final outcome. This would give students mastery experiences in each phase of the self-regulated learning cycle. Another possible way to promote student beliefs in their regulatory capabilities is to allow them to see peers successfully self-regulate their learning, and make sure their self-regulatory process is transparent. If a student sees that someone similar to them can successfully regulate their learning in a large lecture introductory biology course, she will feel more confident in her ability to do so. Finally, social persuasions can be used to promote efficacy beliefs in self-regulation, but should be used with intentionality. It is important to note that the sources of self-efficacy vary in their influence on self-regulation and academic achievement depending on the context and salient factors of the students (Usher & Pajares, 2008). Future research should seek to discover how students evaluate their experiences in introductory college courses in order to understand how self-efficacy for self-regulation is developed.

Student Agency and Effort

One consistent message from both the social cognitive theory and implicit theories literature is the importance of delivering the message to students that ability, regardless of domain, is both controllable and malleable (Bandura, 2001; Job et al., 2015). Fostering this belief involves praising effort instead of ability. In the realm of willpower mindset and self-efficacy for self-regulation, students will not develop

adaptive beliefs or confidence that allows them to successfully regulate their lives and learning if they believe these skills are beyond their control.

Limitations

This study has several limitations, including methodological issues. First, I relied on self-report to assess self-regulatory behaviors. Whether the association between growth mindset and self-regulation behavior translates into true behavioral regulation is unknown. Researchers should consider assessing self-regulation using alternative methods to self-report, considering some people may not readily admit to self-regulatory failures. Second, the scales used have many limitations. Extensive psychometric work has been conducted on the SELF scale, used to assess self-regulatory self-efficacy, but this is not the case for the scale used to assess willpower mindset. Therefore, a logical next step is for researchers to examine the psychometric properties of the implicit theories of willpower scale to determine if it is a reliable and valid instrument. Third, to create consistency in the student survey and reduce the cognitive burden for the participants, I made adaptations to the scales including changing some items from second to first person, and using all instruments on a four-point scale, which in some cases, was different from their original design. Finally, this study used cross-sectional data. The self-report survey was distributed to students one week prior to their final exam. This design did not permit me to investigate the lingering effects of one's willpower mindset across an entire semester.

Summary

I began this study by asserting that beliefs help people regulate their lives. Indeed, Bandura's social cognitive theory (1986) is founded on this premise that the beliefs

people hold are powerful forces in how they regulate what they do. Newer to literature on self-regulation is the idea that people hold an implicit theory about how much control they have in different areas of life (their willpower mindset) and that these beliefs are associated with how people regulate their lives. One of the primary goals of this study was to determine if students' lay theories (mindset) about the nature of human functioning, specifically willpower mindset, or their self-efficacy about their ability to regulate their learning mattered more when it comes to actual self-regulation and achievement in an introductory level college course. I hypothesized, based on previous self-efficacy and willpower mindset research, that willpower beliefs and self-efficacy for self-regulation would both be associated with more adaptive self-regulation behaviors and academic achievement, but in the undergraduate student group I sampled this was not the case. Willpower mindset was only associated with self-regulation and achievement for students at extreme ends of the spectrum, but no differences existed among the majority of students. Willpower mindset research is still in a nascent stage, and this study takes a preliminary step in understanding how these beliefs contribute to self-regulation within the context of post-secondary learning. Although this study cannot fully answer questions about how beliefs about self-control drive motivation and self-regulation, it confirms the assertion that cultivating self-efficacy in college students is a worthwhile endeavor when promoting self-regulation.

Appendix A – IRB Consent Form

Consent to Participate in a Research Study

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

As part of your BIO 148 class, you just completed a survey about your study habits and beliefs about learning biology. You are being invited to take part in this research study because you are enrolled in a biology class. All students' survey responses are used for internal UK purposes. By signing this consent form, you are giving your permission for UK researchers to include your responses for possible external research purposes. You are also giving UK researchers permission to include your grade information in their analysis.

WHO IS DOING THE STUDY?

The people in charge of this study are Cara Worick, a graduate student in the department of Educational Psychology, and Dr. Ellen Usher from the Department of Educational Psychology. There may be other people on the research team assisting at different times during the study.

WHAT IS THE PURPOSE OF THIS STUDY?

By doing this study, we hope to learn more about how students' metacognitive awareness, self-regulation, and motivation affect academic performance in an introductory biology course. Understanding where self-regulatory failures occur and how motivation contributes to learning in undergraduate biology might permit the

recommendation of techniques that would help students better monitor their performance in class and perform better in courses like BIO 148.

ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?

Even though all students completed the survey as part of your BIO 148 classes, students under the age of 18 should not give permission to researchers to use their information for external research purposes.

WHAT WILL YOU BE ASKED TO DO?

Over the course of the semester you completed two online surveys and brief, in-class questionnaires related to your biology class. You will not be asked to do anything in addition to the surveys you have already completed. If you agree to allow researchers to use information from the surveys you completed over the course of the semester in BIO 148, and your course grades, you will need to consent at the bottom of this page. If you are under the age of 18, your responses will not be included in the study and you should click that you do not consent at the bottom of this page. Your responses will be used to help researchers understand how students learn biology. Your responses to survey questions will be combined with other institutional student data.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

This consent form is simply asking to analyze questions that you already completed as part of your BIO 148 classes. The questions were answered on a secure, online survey

platform. We would also like to access some additional information about you as a student that the University of Kentucky uses for internal purposes. This information would include demographic information, student records, such as GPA, and degree program, and campus facilities records, such as residence hall assignment of use of student academic support services like The Study or The Writing Center. By indicating your consent, you are granting the Registrar's Office permission to disclose your institutional data to the investigator of this study. Your information will only be used for research purposes. Importantly, we will not disclose your personal information to your professors, your parents, or any external parties. Your part in the study will conclude at the end of the fall 2017 semester.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

There are no known risks or discomforts as a result of your participation in this research study, nor will you benefit directly from taking part in this study. By consenting to participate, you will allow us to access your responses and your course grades.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

You will not get any personal benefit from taking part in this study.

DO YOU HAVE TO TAKE PART IN THE STUDY?

Including your survey responses in our analyses is completely voluntary. You will not lose any benefits or rights you would normally have if you choose not to include your responses. As a student, if you decide not to include your responses, your choice will have no effect on your academic status or grade in the class.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to be included in the analysis, there are no other choices just select that you do not consent.

WHAT WILL IT COST YOU TO PARTICIPATE?

There are no costs associated with taking part in the study.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will not receive any rewards or payment for taking part in the study.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

We do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the research team that you were in this study or what information we collected about you in particular. All personally identifying information will be removed from grades and questionnaire data and a numeric ID known only to the researchers will be used to identify you. Your responses will be combined with those of other students in the course when findings are reported. However, we may be required to show information which identifies you to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky. We will make every effort to keep private all research records that identify you to the extent allowed by law.

Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company's Terms of Service and Privacy policies.

WHAT ELSE DO YOU NEED TO KNOW?

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state, and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?

If you have any questions or concerns about this study or if any problems arise, please contact Cara Worick at the University of Kentucky at cara.worick@uky.edu or by phone at 859-257-4017, or Dr. Ellen Usher at ellen.usher@uky.edu.

By checking "I consent" I understand that I am agreeing to allow the information from my surveys and academic records in this class to be given to the research team for research purposes as described in this consent form, the same as if I were physically signing the form.

I consent

I do not consent

Appendix B – Implicit Theories of Willpower Measure

Item Name	Item Description
	The next few questions have been written to investigate your ideas about willpower. Willpower is what you use to resist temptations, to stick to your intentions, and to remain in strenuous mental activity. There are no right or wrong answers. We are interested in your ideas. Using the scale below, please indicate how much you agree or disagree with each of the following statements.
Willpower1	Strenuous mental activity exhausts your resources, which you need to refuel afterwards (e.g. through taking breaks, doing nothing, watching television, eating snacks). (REVERSE)
Willpower2	After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again. (REVERSE)
Willpower3	When you have been working on a strenuous mental task, you feel energized and you are able to immediately start with another demanding activity.
Willpower4	Your mental stamina fuels itself. Even after strenuous mental exertion, you can continue doing more of it.
Willpower5	When you have completed a strenuous mental activity, you cannot start another activity immediately with the same concentration because you have to recover your mental energy again. (REVERSE)
Willpower6	After a strenuous mental activity, you feel energized for further challenging activities.

Note. Items administered at the end of the course.

Appendix C – Self-Efficacy for Self-Regulation Measure

Item Name	Item Description
Thinking back to your previous classes in either high school or college, tell us how true or false each statement is for you by selecting the option that best describes you.	
SEforSRL1	When I miss one of my classes, I can find another student who can explain the lecture notes as clearly as my teacher did.
SEforSRL2	In previous classes when my teacher’s lecture is very complex, I can write an effective summary of my original notes before the next class.
SEforSRL3	When I have trouble studying my class notes because they are incomplete or confusing, I can revise and rewrite them clearly.
SEforSRL4	When I am taking a course covering a huge amount of material, I can condense my notes down to just the essential facts.
SEforSRL5	When trying to understand a new topic, I can make connections between old and new concepts to remember them well.
SEforSRL6	When problems with friends and peers conflict with schoolwork, I can keep up with assignments.
SEforSRL7	When I feel moody or restless during studying, I can focus my attention well enough to finish assigned work.
SEforSRL8	When I find myself getting increasingly behind in a new course, I can increase my study time sufficiently to catch up.
SEforSRL9	When I discover that my homework assignments for the semester are much longer than expected, I can change my other priorities to have enough time for studying.
SEforSRL10	When I have trouble recalling an abstract concept, I can think of a good example that will help me remember it on the test.
SEforSRL11	When I have to take a test in a school subject I dislike, I can find a way to motivate myself to earn a good grade.
SEforSRL12	When I am feeling depressed about a forthcoming test, I can find a way to motivate myself to do well.
SEforSRL13	When my last test results were poor, I can figure out potential questions before the next test that will improve my score greatly.
SEforSRL14	When I am struggling to remember technical details of a concept for a test, I can find a way to associate them together that I am sure I will remember.
SEforSRL15	When I think I did poorly on a test I just finished, I can go back to my notes and locate all the information I forgot.

SEforSRL16	When I had to “cram” at the last minute for a test, I feel confident I can begin my preparation for the next test much earlier so I won’t need to cram the next time.
SEforSRL17	When I have trouble understanding my instructor’s lecture, I can clarify the confusion before the next class meeting by comparing notes with a classmate.
SEforSRL18	When a lecture is especially boring, I can still motivate myself to keep good notes.

Note. Items administered at the end of the course.

Appendix D – Self-Regulation of Time and Study Environment Measure

Item Name	Item Description
Tell us how true or false each statement is for you by selecting the option that best describes you.	
BehaviorReg1	I usually study in a place where I can concentrate on my course work.
BehaviorReg2	I make good use of my study time for this course.
BehaviorReg3	I find it hard to stick to a study schedule. (REVERSED)
BehaviorReg4	I have a regular place set aside for studying.
BehaviorReg5	I make sure I keep up with the weekly readings and assignments for this course.
BehaviorReg6	I attend class regularly.
BehaviorReg7	I often find that I don't spend very much time on this course because of other activities. (REVERSED)
BehaviorReg8	I rarely find time to review my notes or readings before an exam. (REVERSED)

Note. Items administered at the end of the course.

Appendix E - Self-Regulation of Effort Measure

Item Name	Item Description
Tell us how true or false each statement is for you by selecting the option that best describes you.	
EffortReg1	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do. (REVERSED)
EffortReg2	I work hard to do well in this class even if I don't like what we are doing.
EffortReg3	When course work is difficult, I give up or only study the easy parts. (REVERSED)
EffortReg4	Even when course materials are dull and uninteresting, I manage to keep working until I finish.

Note. Items administered at the end of the course.

References

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