# AN EMPIRICAL EXAMINATION OF THE RELATIONSHIP BETWEEN SELF-REGULATION AND SELF-CONTROL

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An Empirical Examination of the Relationship between Self-Regulation and Self-Control

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## LIST OF SYMBOLS AND ABBREVIATIONS

CFI ……Comparative Fit Index

CI ……...Confidence Interval

Cohen's κ ……Estimate of Inter-rater Reliability

Cronbach's α ……...Estimate of Internal Consistency Reliability

*d* ……....Effect Size of the Difference between Means

*df* ……...Degrees of Freedom

*F* ……...Test Statistic for Analysis of Variance

*M* ……...Sample Mean

McDonald's ω ……Estimate of Scale Homogeneity

*n* ……...Sub-sample Size

*N* ……...Total Sample Size

*p* ……....Probability that Obtained Results Occurred due to Chance

*r* ……....Correlation Coefficient

$R^2$ ……..Percentage of Variance Accounted For by Given Variable(s)

R ……Reverse-Scored

RMSEA ……Root Mean Square Error Approximation

*S.D.* ……....Standard Deviation

*t* …… Test Statistic for the Difference between Means

$\chi^2$ ……...Chi-Square

## ABSTRACT

Self-regulation and self-control are motivational constructs involved in the process of goal pursuit (Karoly, 1993). Although investigators within and across various fields of psychology have used the terms interchangeably (e.g., Hofmann, Rauch, & Gawronski, 2007; Lord, Diefendorff, Schmidt, & Hall, 2009; Wood, 2005), theoretical work stemming from the clinical field suggests that they are distinct yet related constructs (e.g., F. Kanfer, 1970, 1977; F. Kanfer & Karoly, 1972). However, until now, the relationship between self-regulation and self-control had not been investigated empirically. In the current program of research, I delineated their relationship in two ways. First, I developed and evaluated new self-report measures that better match theoretical models of self-regulation and self-control. Participants ($N$ = 199) completed a battery of self-report questionnaires regarding personality, motivation, self-regulation, and self-control. The new measures had acceptable internal consistency and test-retest reliabilities, and displayed relationships expected for convergent and discriminant validity. Modeling techniques indicated that self-control and self-regulation are not strongly enough associated to fall under one higher-order factor, and that the relationship between the two constructs was best represented by a model in which self-control was associated with the self-regulatory stage of goal striving. Second, I evaluated the efficacy of a training session that included self-control techniques in addition to self-regulation skills, and compared outcomes to those from a self-regulation only training group, and a control group. One sample of undergraduate students ($N$ = 49) and one sample of day-shift employees ($N$=41) were included. Participants completed questionnaires twice daily for a

period of three weeks to report sleep-wake behavior, fatigue, affect, and productivity. Objective sleep measures also were obtained through the use of actigraphs, which monitor sleep-wake activity. The self-regulation training groups showed better goal adherence following the intervention compared to the control group, and the combined training groups had even better goal adherence than the self-regulation group. Positive affective changes were also reported among the training groups following the study period. The development of new measurement and training techniques, which better align with the theoretical formulations of self-regulation and self-control, will help to advance the theoretical work concerning these constructs, and could lead to improvement in workplace outcomes.

## SUMMARY

Self-regulation and self-control are motivational constructs involved in the process of goal pursuit (Karoly, 1993). Although investigators within and across fields of psychology have used the terms interchangeably, theoretical work stemming from the clinical field suggests that self-control refers to a distinct construct that operates in the context of self-regulation (e.g., Kanfer & Karoly, 1972). I evaluated the efficacy of a training intervention that included both self-regulation and self-control, compared to a training that only included self-regulation and to no training. Sleep duration was chosen as the target of training because lack of sleep has been associated with negative mental, physical, and work-related outcomes (Oginska & Pokorski, 2006; Perfect, Elkins, Lyle-Lahroud, & Posey, 2010; Spiegel, Leproult, & Cauter, 1999). Interventions were administered to participants with no sleep disorders, with the goal of increasing sleep duration on week nights. Participants in the combined self-regulation/self-control training group demonstrated better adherence to sleep duration goals during the intervention period, and reported more positive post-intervention changes compared to the self-regulation training group. Theoretical implications, practical applications, and directions for future research are discussed.

# CHAPTER 1

# INTRODUCTION

Self-regulation and self-control have been described as components of metacognitive activity through which individuals guide goal-directed behavior, affect, and cognition (Karoly, 1993). In this framework, self-regulation involves an ongoing process of guiding and adjusting behavior such that goals are achieved, whereas self-control refers to the alteration of a typical response in order to achieve or maintain goal-directed behavior. Both constructs are motivational, in that they represent efforts to alter or maintain the direction, intensity, and persistence of goal-directed behavior (R. Kanfer, 1990).

As the older of the two constructs, self-control originated within 19th century work on morality and ethics (Hickok, 1853). Development of this construct mirrored the progression of the field of psychology, through the eras of functionalism, psychoanalysis, and behaviorism, to current investigations in the field of neuroscience. In contrast, self-regulation has been a nascent construct, with roots in the work of Lewin (1936) and Woodworth (1929). The development and progression of each construct occurred in isolation until the joint consideration of both constructs in the field of clinical psychology in the 1970s (e.g., F. Kanfer, 1970; 1977).

Recently, the two terms have been used interchangeably among and across investigators. For example, Oaten and Cheng (2006a) explicitly stated that they used the terms interchangeably, as did Baumeister and Vohs (2004). A small group of researchers have argued that self-regulation and self-control should be considered as separate terms

which refer to distinct, but related concepts (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Kuhl & Fuhrmann, 1998; McCullough & Willoughby, 2009). These investigators made the distinction, similar to that made in the field of clinical psychology, that self-control was a specific case of self-regulation. However, the two constructs have yet to be distinguished empirically.

Researchers have begun to regard self-regulatory theories as "the dominant perspective for understanding motivation, particularly in applied areas of psychology" (Vancouver, Weinhardt, & Schmidt, 2010, p. 986). Consequently, the application of motivational concepts to the workplace has featured self-regulatory theories most prominently compared to other models of motivation (see Klein, 1989; Koenig, Van Eerde, & Burch, 2010; Vancouver & Day, 2005; J. B. Watson, 1925). However, theories of self-control have been included only implicitly in work-based research on emotional labor (e.g., Totterdell & Holman, 2003). Given that these two constructs refer to processes that have become critical for employee functioning in the modern work environment, I found it important to identify ways in which their applications within the workplace could be improved. Exploring the relationships between self-regulation and self-control may be beneficial not only in advancing their applications in various applied settings, but also in the further development of the theoretical formulations of each construct.

Two methods through which to empirically distinguish self-regulation and self-control as separate yet related constructs were explored in the present research. One way was through the development and evaluation of new self-report measures. These self-report measures were compared to one another and to other related constructs to assess

the construct space of each. A second way to distinguish the two was through training interventions, one of which involved self-regulation training, the other of which involved self-regulation and self-control training. In what follows, I describe the overarching goal of this dissertation and outline three specific objectives that addressed this goal. I discuss the relevant research literature and outline the current program of research that was designed to accomplish these objectives.

**Objectives**

The overarching goal that I sought to accomplish through this dissertation was to provide empirical evidence to support the theoretical argument that self-regulation and self-control are distinct yet related motivational constructs. This goal was accomplished through three objectives. First, I developed new self-report measures of self-regulation and self-control based on theoretical formulations from the clinical field. Second, I investigated the utility of a combined self-regulation and self-control training intervention in the pursuit of self-set goals, in comparison to self-regulation training alone and no training. Third, I applied the combined self-regulation and self-control training to an employee sample, with the goal of demonstrating the efficacy of this training within a working population.

**Measurement of Self-Regulation and Self-Control**

The first detailed theoretical accounts of self-regulation and self-control, both separately and in conjunction, stemmed from the field of clinical psychology, with a focus on behavior modification among clinical populations (F. Kanfer, 1970, 1975; F. Kanfer & Karoly, 1972; F. Kanfer & Phillips, 1970). Specifically, F. Kanfer (1977)

developed a two-stage model of self-control and a three-stage model of self-regulation, and offered a detailed description regarding their relationship to one another.

According to F. Kanfer's (1977) model, self-control consisted of two stages: decisional and protracted self-control. Decisional self-control referred to the point at which a decision was made between alternatives, typically assessed through the choice between two options. One option involved an immediate reinforcement and the other a delayed reinforcement. Choosing the delayed reinforcement demonstrated self-control. Protracted self-control involved "resistance to temptation or tolerance to pain over a prolonged interval, during which the conflicting response tendencies are continuously acting" (F. Kanfer, 1977, p. 22). In this stage, decisions were made continuously throughout a given time period to either continue with the current behavior, generally viewed as undesirable, or to stop and choose an alternative, typically more attractive behavior. This two-stage model resembled other authors' conceptualizations of both Stage 1 and Stage 2 self-control (e.g., Hartshorne, May, & Maller, 1929; Mischel, 1974; Rachlin, 2000), and empirical research was conducted during this time to explore the antecedents and correlates of each stage (e.g., Ebbesen, Bowers, Phillips, & Snyder, 1975; F. Kanfer, Stifter, & Morris, 1981; Meichenbaum & Goodman, 1971; Mischel, Ebbesen, & Zeiss, 1972; Mischel & Grusec, 1967; Toner, Holstein, & Hetherington, 1977).

F. Kanfer's (1977) model of self-regulation consisted of three stages, including 1) self-monitoring or self-observation, in which goal-related behavior was deliberately attended to; 2) self-evaluation, in which behavior was compared to a criterion or standard held by the individual; and 3) self-reinforcement, which consisted of the presentation of

either positive or aversive stimuli, depending on the outcome of stage two. A feedback loop carried information from Stages 2 and 3 and used this information as input to direct behavior going forward. Empirical findings have supported the utility of training interventions that included each of the three stages, as opposed to one or two stages in isolation, in leading to desired outcomes (e.g., better academic performance; Greiner & Karoly, 1976). This model depicted a closed-loop formulation of the way in which goal-directed behavior might unfold over time, similar to control models from the engineering field (Wiener, 1948). Control theory models are currently the most widely applied models of self-regulation, particularly within the work domain (R Kanfer, 2005), although researchers have posited a different number of stages. Currently, the most common conceptualization stems from Gollwitzer (1990), who posited four phases: goal establishment, planning, goal striving, and goal revision.

These formulations of self-control and self-regulation gave rise to the consideration of the relationship between the two constructs. From the clinical perspective, self-control was considered to be a type of self-regulation, implemented to "act counter to immediate contingencies" (F. Kanfer & Karoly, 1972, p. 406) or to "alter the probability of a problematic act" (F. Kanfer, 1975, p. 317). These statements regarding the occurrence of self-control in the context of self-regulation were based on theoretical formulations, and on empirical support for the models in isolation, but not empirical research of the models combined. The two constructs have not been researched in conjunction, nor has empirical evidence been provided to support their theoretical relationship.

Since the 1970s, many measures of both trait and behavioral self-regulation and self-control have been developed. To date, the most common method for assessing self-regulation and self-control has been as traits through self-report questionnaires (e.g., Capa-Aydin, Sungur, & Uzuntiryaki, 2009; Diehl, Semegon, & Schwarzer, 2006; Luszczynska, Diehl, Gutierrez-Dona, Kuusinen, & Schwarzer, 2004; Masse, Allen, Wilson, & Williams, 2006; Wilson, Charker, Lizzio, Halford, & Kimlin, 2005). This method suggests that there are stable, trait-like qualities underlying each construct. Think-aloud protocols (Hofer, 2004) and indirect outcome measures such as achievement (Kauffman, 2004) have been used to assess self-regulatory behaviors. Assessment of behavioral self-control primarily stems from the research area that applies a resource model to self-control, in which self-control has been inferred from indicators of task duration, performance, and/or reported fatigue (e.g., Baumeister, 2002; Muraven, Baumeister, & Tice, 1999; Muraven, Tice, & Baumeister, 1998).

After a close examination of extant trait measures of self-regulation and self-control, I found that they do not assess the constructs in accordance with the theoretical formulations outlined above. Instead, they represent a conglomeration of items pertaining to both self-regulation and self-control. Moreover, they are not separated into scales that assess the specific stages of each construct, but are mixed together to comprise general scales of self-regulation and/or self-control. The separate assessment of each stage of self-control and self-regulation has yet to be implemented among current self-report measures of either construct.

In sum, early models of self-regulation and self-control depicted each as separate processes involving specific stages. The most common way of measuring these

constructs of late has been through self-report measures. However, extant measures do not appear to match the theoretical formulations of each construct. Therefore, I worked to develop new measures that aligned better with theoretical models of self-regulation and self-control presented above.

**Self-Regulation and Self-Control Training**

A second way to obtain empirical evidence for the relationship between self-regulation and self-control was to compare the efficacy of a training session involving self-regulation alone with one that includes both self-regulation and self-control. Researchers who have taken this approach have explored the aspects of self-regulation and self-control that can be trained and improved upon, as opposed to the stable, innate qualities of the two constructs as traits. The literature has been varied in that some investigators have taken an individual differences approach (e.g., Tangney, Baumeister, & Boone, 2004), while others have combined this approach with an examination of contextual features (Rueda, Posner, & Rothbart, 2004). Those who have taken the combined approach have suggested that although both constructs have innate, heritable aspects, these processes are likely aided or inhibited through experience and environmental characteristics. Still others have adopted a training and development approach, focusing primarily on ways in which self-regulation and self-control can be taught and/or improved upon (Beier & Kanfer, 2010; Muraven et al., 1999).

Self-regulation and self-control interventions have been grounded in the training and development orientation, particularly in workplace environments. Employees have increasingly been given autonomy and control over many aspects of their work, requiring the implementation of self-regulation techniques on a regular basis. Therefore,

organizations have begun to value effective self-regulatory interventions because they may improve organizationally- relevant outcomes (Boekaerts, Maes, & Karoly, 2005; Converse & DeShon, 2009).

For approximately four decades, investigators have explored many conditions under which Stages 1 and/or Stage 2 of self-control could be improved upon. Early research focused on children, investigating variables that could be manipulated in order for children to either express a preference for more desirable, later rewards (Stage 1; e.g., Mischel & Grusec, 1967) or to wait longer to receive more desirable rewards (Stage 2; e.g., Mischel & Ebbesen, 1970). With regards to Stage 1 self-control, findings indicate that manipulation of positive affect, reward value, and explicit commitment are associated with greater preference for larger, later rewards (average $d = 1.89$). With regards to Stage 2, the delay period until the preferred reward was chosen could be lengthened by offering control over interim stimuli, removing the reward, or prompting distracting thoughts or activities during the delay period (average $d = 1.41$).

Recently, many researchers who have focused on improving self-control have adopted a resource model, finding that self-control practice over a period of time has been associated with a lower level of resource depletion after self-control exertion, compared to resource depletion prior to practice periods (Muraven, et al., 1999). In the work domain, researchers have recently taken interest in self-control over emotions; however, these studies have involved little training of emotional control strategies (Totterdell & Holman, 2003; Totterdell & Parkinson, 1999).

Self-regulation interventions began in the clinical domain with the development of F. Kanfer's (1977) three-stage model. As mentioned previously, empirical findings

supported the utility of training interventions that included each of the three stages, as opposed to one or two stages in isolation, in leading to desired outcomes (e.g., Greiner & Karoly, 1976). Research in the work domain has supported these findings, with single-construct interventions generally associated with a short-term change in the desired behavior, but deterioration back to baseline after a period of time (see Locke, Shaw, Saari, & Latham, 1981). More advantageous have been the multi-faceted interventions that address all stages of the self-regulatory model, such as self-management training (Frayne & Geringer, 2000; Frayne & Latham, 1987; Latham & Frayne, 1989) and the Productivity Measurement and Enhancement System (ProMES; Pritchard, Harrell, DiazGranados, & Guzman, 2008). These interventions have been associated with improvement of the targeted behavior, both directly following the intervention and also up to 19 months later, with meta-analytic results indicating an average productivity improvement of 1.16 standard deviation units following ProMES interventions.

Self-management training has focused on improving individual behavior, as opposed to group or team behavior which has been the focus of ProMES interventions. These interventions have included group training sessions over a period of time, with each session addressing a different aspect of self-regulation, including self-assessment, goal-setting, self-monitoring, identifying appropriate reinforcement or punishment, and maintenance. One-on-one sessions were implemented in the first self-management intervention to individualize the intervention and address specific concerns of each participant (Frayne & Latham, 1987); however in subsequent self-management studies, individual sessions were not included. Instead, daily diaries were used for employees to

track their own goals and to provide themselves with feedback regarding goal pursuit. Notably, neither the ProMES or self-management interventions addressed self-control.

In sum, investigators have demonstrated that self-regulation and self-control have trainable aspects that can be improved upon through targeted interventions (Frayne & Geringer, 2000; Frayne & Latham, 1987; Latham & Frayne, 1989; Muraven et al., 1999). However, to date, an intervention that includes treatment of both self-regulation and self-control has yet to be designed or implemented. One of the next steps in the development of these interventions was to design a training to address both self-regulation and self-control. Moreover, the exertion of self-control has been associated with fatigue (Muraven et al., 1998), emotional exhaustion (Schmidt, Neubach, & Heuer, 2007), and burnout in the workplace (Schmidt & Neubach, 2007; Schmidt et al., 2007). Based on these findings, a training that addresses the improvement of self-control, in the context of self-regulatory efforts towards an overarching goal, may aid in attainment of the goal in addition to the improvement of affective outcomes.

**Target of Training: Sleep Duration**

Of the many strengths of self-regulation and self-control interventions, one has stood out as being particularly valuable: the targeted behavior can be chosen based on need. These interventions have targeted many areas in which individuals have goals to change their behaviors, including weight loss, smoking cessation, decreasing absenteeism, improvement of financial monitoring, increasing exercise frequency, and the improvement of academic outcomes (Ciampolini, Lovell-Smith, & Sifone, 2010; Frayne & Latham, 1987; Jeffery et al., 1993; Kauffman, 2004; Kelly, Zuroff, Foa, &

Gilbert, 2010; Oaten & Cheng, 2006b, 2007). One area that has yet to be the target of a self-regulatory and/or self-control intervention is sleep duration.

Sleep duration has been shown to be an area in which personal habits have repeatedly affected both personal and organizational outcomes. According to a recent poll by the National Sleep Foundation (NSF), six in 10 Americans between the ages of 19 and 64 reported sleeping approximately 40 minutes less than their desired amount of sleep each week night ("Sleep in America poll: Communications and technology in the bedroom," 2011). Over 80% reported experiencing sleep problems such as waking up feeling un-refreshed, waking up during the night, difficulty falling asleep, and waking up early several days per week. Respondents indicated that not getting enough sleep affected their mood (85%), family life or home responsibilities (72%), social life (68%), and work (74%). Interestingly, approximately 70% of respondents in this poll indicated that their work and/or school schedules allow them to get an adequate amount of sleep each night, suggesting that poor sleep habits are not necessarily due to work or school demands.

Furthermore, over 50% of adults reported having driven while feeling drowsy, a behavior that could endanger the lives of the driver, passengers, and other drivers. According to the U.S. National Highway Traffic Safety Administration (NHTSA), sleepiness is a factor in approximately 100,000 reported car accidents annually, leading to 71,000 injuries and over $12.5 billion in financial losses each year ("Research on Drowsy Driving," 2011). Taken together, it appears that lack of sleep has been a prevalent problem with considerable consequences.

Researchers have found lack of sleep and poor sleep quality to be associated with negative outcomes in many domains. For example, among students, sleep loss has been associated with reluctance to extend effort ($r$ = .37), excessive drowsiness ($r$ = .36), and problems with concentration ($r$ = .28), while sleep loss among employees has been linked to problems with memory ($r$ = .26) and decision-making ($r$ = .22; Oginska & Pokorski, 2006). Gibson et al. (2006) found that sleep deprivation and excessive sleepiness were commonly reported by Canadian high school students (70% and 65%, respectively), and that those reporting greater sleepiness were more likely to report lower academic achievement ($OR$ = 1.17), fewer daytime activities ($OR$ = 1.16), and missing extracurricular activities ($OR$ = 1.16). Among adults, the typical amount of sleep obtained accounted for a small but significant portion of variance (2.4%) in overall psychological well-being (Hamilton, Nelson, Stevens, & Kitzman, 2007). Sleep debt has also been related to aspects of cognitive functioning, such as learning (Walker, 2008) and consolidation of memory (Wagner, Gais, Haider, Verleger, & Born, 2004). In contrast, individuals who reported getting enough sleep in the past week also reported greater levels of energy ($d$ = .76), life satisfaction ($d$ = .70), and success ($d$ = .75), compared to those who reported getting too little sleep (Groeger, Zijlstra, & Dijk, 2004).

Insufficient sleep has also been linked to poor health. Measures of sleep duration, sleep quality, and daytime sleepiness predicted a significant amount of incremental variance in reported health symptoms ($\Delta R^2$ = .26), above and beyond prediction from measures of stress and life experiences (Benham, 2010). Lack of sleep has also been related to increased levels of cortisol upon awakening ($r$ = .62; Perfect, Elkins, Lyle-

Lahroud, & Posey, 2010), and decreased glucose tolerance and metabolic functioning (Spiegel, Leproult, & Cauter, 1999).

Notably, lack of sleep has been associated specifically with negative work outcomes. A 2008 NSF poll indicated that approximately 30% of workers had fallen asleep at work in the past month due to inadequate sleep ("Sleep, Performance, and the Workplace," 2008). Among working populations, sleep debt has been positively associated with work stress and increased burnout (Ilene, Gimotty, Shea, & Bellini, 2006; Kageyama, Nishikido, Kobayashi, & Kawagoe, 2001). In U.S. news, the FAA was criticized regarding air-traffic controllers who fall asleep on the job, leading to grave safety concerns (e.g., M. Gibson, 2011). Taken together, it appears that lack of sleep has been associated with negative, and potentially dangerous, work outcomes.

Investigators have worked over the last several decades to address the gap between the amount of sleep that individuals actually get versus the amount they should be getting, suggesting that "improvement in sleep...require[s] that clients learn problem-solving and self-management skills" (Coates & Thoresen, 1979, p. 603). Self-regulatory interventions have been implemented in order to improve sleep habits; however, many have been conducted in the context of clinical therapy for sleep disorder patients. As a result, the interventions are heavily tailored towards each individual and his/her specific sleep-related problems, rather than providing a general intervention framework that could be successfully implemented across individuals in a larger population (e.g., Morin, Kowatch, Barry, & Walton, 1993). Many of these were also case studies, which further calls into question the generalizability of each session's content (e.g., Coates & Thoresen, 1979; Thoresen, Coates, Kirmil-Gray, & Rosekind, 1981).

Philbrick and Sherry (2003) recently conducted a study that fell more in line with a self-regulatory training that could be applicable to a broad range of individuals. The sleep habits of railroad dispatchers were tracked over a period of three months using wrist actigraphs. Participants worked with a researcher to set individual sleep-related goals after the first month. At the end of the study, the average amount of sleep obtained each night increased by 30 minutes; however, this value was not statistically significant. Moreover, the trajectory of change in sleep duration varied depending on the type of shift that the dispatchers were working.

This study had three primary limitations. First, although a coaching session was included to help participants set sleep-related goals, this session did not follow traditional goal-setting training sessions in which the specificity and difficulty of the goal was emphasized (Locke, 1966; Locke & Latham, 1990; Locke et al., 1981). Second, this intervention used feedback as the primary method through which to aid in the improvement in various sleep-related habits. Unfortunately, as other researchers have found (e.g., Bedny & Karwowski, 2006), interventions that primarily focuses on feedback, without treatment of the other stages of self-regulation, have not altered behavior significantly over time. Third, the authors reported that study participants may not have been motivated to change their sleep-related behaviors, though neither motivation nor goal orientation were assessed. While this study presented a good first step towards the implementation of a self-regulatory intervention within the domain of sleep regulation for individuals without sleep disorders, there were areas for improvement.

In sum, there may be many reasons for which an individual might want to increase the amount of sleep obtained each night. To date, interventions that have addressed sleep duration have focused either on clinical therapy techniques or have not included all stages of self-regulation. No interventions have been conducted that include self-control, or both self-regulatory and self-control training. These are all gaps that I sought to address.

**Program of Research**

In this section, I provide an overview of the preliminary study and the two experimental studies included in the current program of research. The preliminary study was designed to address the issues with extant measurement of self-regulation and self-control traits described above. The two experimental studies were conducted to assess the efficacy of a training intervention that covered both self-regulation and self-control techniques, compared to one that only covered self-regulation and to a control group. The training sessions focused on increasing sleep duration during the week among participants without sleep disorders.

**Preliminary study.** I first conducted a preliminary study to form new measures of self-regulation and self-control and to evaluate their psychometric properties. Three independent raters classified the items from extant measures based on the theoretical models presented above for both self-regulation and self-control. Using those classifications, I formed sub-scales for each construct, evaluated the internal consistency reliabilities and construct validity of each scale, and examined the intercorrelations.

The convergent and discriminant validity of extant measures of trait self-control and self-regulation have been evaluated by previous investigators (e.g., Diehl et al., 2006;

Park, Edmondson, & Lee, 2012; Tangney et al., 2004). In general, greater self-control has been associated with greater conscientiousness ($r$ = .54) and less neuroticism ($r$ = -.50), but has not been substantially associated with extraversion ($r$ = .09) or openness to experience ($r$ = .04; Tangney, et al., 2004). Impulse control scales have been used to measure self-control (e.g., Tangney, et al., 2004), suggesting that there has been considerable overlap in the meaning of the two constructs. Self-regulation has been positively associated with self-efficacy ($r$ = .50; Diehl, et al., 2006) and negatively associated with anxiety (r = -.30; Park et al., 2012), but was not expected to be associated with general sleepiness. I anticipated that relationships similar to those found in previous research would emerge in the preliminary study.

Then, through factor analysis and structural equation modeling, I assessed the measurement models of each construct, and also the relationship between the two constructs. Regarding the measurement models, I anticipated that the items assessing each stage of self-regulation and self-control would load on their respective stage factors, with two correlated stage factors for self-control and four for self-regulation. I also expected that the stages of self-control and self-regulation would load on higher-order self-control and self-regulation factors, respectively. Regarding the structural relationship between the two higher-order factors, F. Kanfer's (1972; 1975) formulations of the relationship between self-regulation and self-control gave rise to two possible models, shown in Figures 1 and 2. In the first model (see Figure 1), self-regulation and self-control are depicted as separate, correlated factors. The higher-order factors of self-regulation and self-control are correlated, suggesting that self-regulation and self-control are related but that the stages of each are not. In the second model (see Figure 2), self-

control is shown as part of the goal striving stage of self-regulation. Self-regulation is the higher-order factor, with self-control and the stages of self-regulation as lower-order factors. The second model depicts self-control in the context of self-regulation, specifically as a component of goal striving, and I expected that this model would provide a better fit to the data.

*Figure 1.* Structural Model of Self-Regulation and Self-Control: Model 1

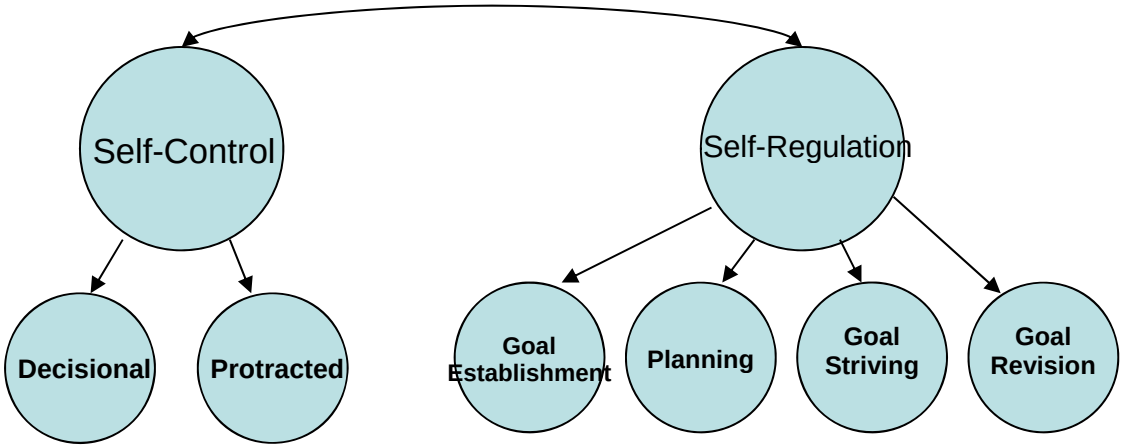
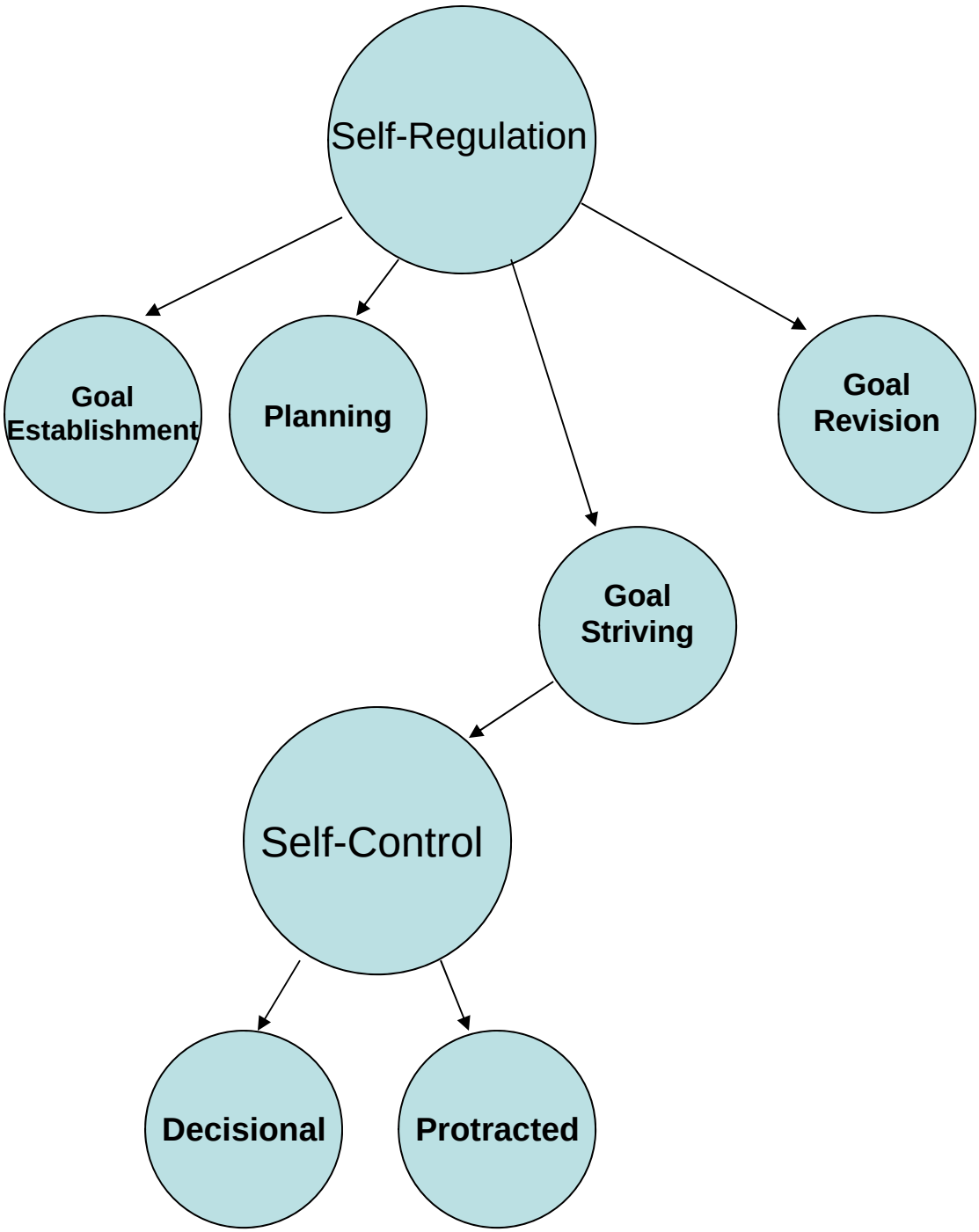


*Figure 2.* Structural Model of Self-Regulation and Self-Control: Model 2



**Two experiments.** In the two experimental studies, I investigated the efficacy of two training interventions in lengthening sleep duration during the week. During the three-week study, participants attended two lab sessions, completed daily online questionnaires, and wore wrist actigraphs to track sleep-wake behaviors. Participants were randomly assigned to one of three groups: a self-regulation and self-control training group, a self-regulation training group, and a control group. Training interventions occurred prior to Week 2. Samples each of students and full-time, day-shift employees were included to evaluate the utility of the training in two different populations.

I expected that adherence to self-set sleep duration goals would be better among the training groups, compared to the control group, and that the group receiving self-control training would demonstrate better goal adherence compared to the group that only received self-regulation training. I also anticipated that increased sleep duration would be associated with an improvement in outcomes that have been associated with sleep, such as subjective fatigue, affect, and productivity. In addition, research findings have indicated that the skills taught in self-regulation trainings have been shown to transfer to other domains (Frayne & Latham, 1987), such that self-regulatory skills learned for the purpose of improving a personal outcome could be applied to the improvement of a work outcome. Based on these findings, I also evaluated whether the skills learned during the training interventions could be applied to the work (employee sample only), academic (student sample), and personal domains.

**Summary.** The three studies included in the present program of research were designed to address the three objectives of this dissertation. First, I hoped to improve upon extant measures of self-regulation and self-control by developing self-report

measures based on theoretical formulations. Second, I designed an intervention that included both self-regulation and self-control to evaluate whether that training would have a greater impact on the targeted behavior and/or related outcome variables. I chose increasing sleep duration as the targeted behavior based on an identified lack of interventions for individuals without sleep-related disorders that focus on getting more sleep. Finally, I included a sample of full-time employed adults with the goal of demonstrating that the intervention could be applicable to multiple populations and that the training skills learned could be transferable to work-related goals. All of these objectives fall under the overarching goal of gathering empirical evidence to establish self-control as a construct that best fits in the context of self-regulation.

# CHAPTER 2

# PRELIMINARY STUDY

In this chapter, I describe the preliminary study that was conducted in order to develop and assess new measures of self-regulation and self-control. I begin with a discussion of an *a priori* power analysis, reliability criteria that were chosen to evaluate measures in this study, and a discussion of the effect sizes used to evaluate results. Then, I describe the methods of the study, including recruitment, procedure, and sample. Finally, I present the results in three parts. First, I present the extant measures that have been previously validated by other researchers. Second, I describe the development of new measures of self-regulation and self-control. Finally, I present results from the model testing of the self-regulation and self-control models posited.

## Power Analysis

Analyses in this study included an evaluation of psychometric properties of the scales, examination of bivariate correlations, assessment of interrater agreement, and model testing using confirmatory factor analysis (CFA) and structural equation modeling (SEM) techniques. As the CFA and SEM analyses were the most rigorous of the listed analyses, a power analysis was conducted to assess the required sample size for the proposed measurement and structural models. Brown (2006) recommended the Monte Carlo approach developed by Muthén and Muthén (2002) for SEM research, as Monte Carlo simulations allow the researcher to determine power in the context of the model(s) and data set.

Using Mplus, I conducted a series of simulations, specifying the model parameters of each proposed model, as well as the estimated size of these parameters. To ensure the stability of results, I specified 10,000 replications and compared sample sizes of 100, 150, 200, and 250 for each model. In keeping with the recommendations by Muthén and Muthén (2002), required sample size was determined using the following criteria: a) the bias of parameters and standard errors was less than 10% for all parameters in the model; b) the bias of standard error for the parameters of specific focus in the model was less than 5%; and c) coverage between .91 and .98, meaning "the proportion of replications for which the 95% confidence interval contains the true population parameter value" was between .91 and .98 (Brown, 2006, p. 424). Based on these simulations, I determined that a sample size of 200 participants was needed to provide reliable estimates of model parameters and model fit. Therefore, 205 participants were recruited with a goal of having 200 participants with completed questionnaires.

**Reliability Criteria**

Common methods for calculating the reliability of a measure include internal consistency reliability, test-retest reliability, and alternate form reliability. Given the cross-sectional design of the present study, internal consistency reliability was chosen to determine the reliability of the measures administered. Cronbach's alpha is commonly reported as an estimate of internal consistency reliability and provides an estimate of the average correlation among items on a measure. Higher alpha values indicate greater incorrelations among items. Researchers often use a predetermined threshold, often that stated by Nunnally (1978) of $\geq$.80 for developed measures or $\geq$.70 for new measures, to determine whether measures have adequate internal consistency reliability.

However, using a common rule of thumb does not allow for a consideration of the breadth or narrowness of the construct(s) being measured. Some constructs may have greater bandwidth, such that the items on a measure to assess a given construct may not be highly related to one another but could still contribute meaningfully to measurement of the construct. Moreover, coefficient alpha is also a function of the number of items in the measure and sample size. Consequently, the value of alpha will be inflated with a greater number of items and a larger sample size.

Based on this information, reporting coefficient alpha alone may not have allowed for an adequate assessment of the internal consistency reliability of each construct. Therefore, three different pieces of information were used to converge on the internal consistency reliability of each measure. First, Cronbach's alpha was calculated and reported for each measure to be able to compare the values obtained in the present study to those reported in previous studies. I expected that the internal consistency reliabilities obtained in this study would meet or exceed the alpha values reported in previous research.

Second, Ponterotto and Ruckdeschel (2007) provided alternate recommendations for coefficient alpha that also take sample size and the number of items on the scale into account. They provided a rating for ranges coefficient alpha with sample sizes of $N <$ 100, $N =$ 100-300, and $N >$ 300, and for $\leq$ 6, 7-11, and $\geq$ 12 items per scale. Their ratings of "excellent", "good", "moderate" or "fair" were assigned to measures in the present study. I also added a rating of "poor" when measures had alpha values that fell below their "fair" mark. I expected that measures in the current study would receive a rating of moderate or better.

Third, McDonald's ω was calculated to provide an estimate of scale homogeneity (Revelle & Zinbarg, 2009). Coefficient alpha implies that scale items are equally influenced by the scale true score, also called tau-equivalence (J. M. Graham, 2006). This assumption indicates that all items load on one general factor. McDonald's ω is a calculation of the loadings of each item on a general factor as a proportion of variance of the entire scale, thus providing an estimate of how homogeneous the scale items are. Revelle (1979) suggested a threshold of at least .50 to consider items as loading on a general factor; therefore, I used that threshold in the present study. All three of these criteria were used to determine whether the scales used in this study had acceptable internal consistency reliability. In cases that scales did not meet all three criteria, changes were made to the extant measures or additional measures of the construct(s) were included going forward.

**Effect Sizes**

In the social sciences, small, medium, and large associations, measured by Pearson's product-moment correlation, generally correspond to population values of .10, .30, and .50, respectively (Cohen, 1992; Cohen, Cohen, West, & Aiken, 2003). For effect sizes of the difference between means, the values associated with small, medium, and large effects are .20, .50, and .80, respectively. These thresholds were used in conjunction with tests for statistical significance in the present program of research. The terms "weak," "moderate," and "strong" were also used to describe small, medium, and large effect sizes, respectively.

**Methods**

**Recruitment.** Undergraduate students were recruited through Experimetrix, in-class announcements, and flyers posted in and around the Psychology building.

Participants were included if they were 18 years of age or older and spoke English as their native language.

**Procedure.** Eligible participants attended a 1.5-hour lab session, during which they completed the consent form and filled out a battery of self-report questionnaires. Following completion of these questionnaires, participants were given a debriefing statement. Participants earned 1.5 hour of research credit for participation in this study.

**Sample.** A total of 204 undergraduate students participated in the preliminary study. Five participants were over 5 standard deviations above the mean age and were excluded from further analyses. Aside from being significantly older than the group of included participants ($d$ = 2.89), the excluded participants did not differ from those that were included on any other study variable. A total of 199 participants were included in the analyses described below. The sample consisted of 98 men (49.2%) and 101 women (50.8%), ages 18-25 ($M$ = 20.35, $S.D.$ = 1.40).

**Results**

**Extant measures.** Scale characteristics for the personality and motivational measures that have been previously validated by other researchers were assessed. Skewness ranged from -1.12 to .97 and kurtosis ranged from -.69 to 1.24 for all measures except the Work Productivity and Activity Impairment Questionnaire, discussed below. These values were within acceptable range of what could be expected from a normal distribution, and the frequency plots for each variable did not indicate serious deviations from normality. Table 1 summarizes the scale characteristics of the extant measures that were administered, including the obtained internal consistency reliabilities, qualitative descriptions of reliabilities, and scale homogeneity estimates.

*Table 1*. Previously Validated Measures Administered in the Preliminary Study

| Measure | # of Items | Expected α | Observed α | Qualitative Descriptor of α[a] | Observed ω | Possible Range | Observed Range | *M* | *S.D.* |
|---|---|---|---|---|---|---|---|---|---|
| **Time-of-Day Preferences and Sleep Behaviors** | | | | | | | | | |
| **Morningness-Eveningness**[b] | 19 | .86 | .78 | Moderate | .76 | 16 - 86 | 25 - 66 | 43.57 | 7.91 |
| **Sleep Quality**[c] | 10 | .83 | .51 | Poor | .43 | 0-21 | 3-14 | 6.76 | 2.18 |
| **Sleepiness**[d] | 8 | .76 | .73 | Moderate | .76 | 0-24 | 0-17 | 8.18 | 3.68 |
| **Motivation**[b] | | | | | | | | | |
| **Mastery-Approach** | 3 | .87 | .81 | Excellent | .61 | 3 - 18 | 7 - 18 | 13.66 | 2.74 |
| **Mastery-Avoidance** | 3 | .89 | .68 | Fair | .44 | 3 - 18 | 4 - 18 | 11.95 | 2.96 |
| **Performance-Approach** | 3 | .92 | .89 | Excellent | .60 | 3 - 18 | 3 - 18 | 13.24 | 3.29 |
| **Performance-Avoidance** | 3 | .83 | .77 | Good | .46 | 3 - 18 | 3 - 18 | 13.47 | 3.45 |
| **Personality** | | | | | | | | | |
| **Subjective fatigue** | 11 | .89 | .88 | Excellent | .72 | 11 - 66 | 11 - 66 | 33.23 | 9.96 |
| **Positive Affect** | 9 | .90 | .89 | Excellent | .67 | 9 - 72 | 15 - 72 | 48.01 | 9.95 |
| **Negative Affect** | 10 | .84 | .86 | Excellent | .63 | 10 - 80 | 11 - 62 | 27.51 | 10.08 |
| **Conscientiousness** | 10 | .81 | .85 | Excellent | .72 | 10 - 60 | 15 - 58 | 43.28 | 7.72 |
| **Impulse Control**[e] | 10 | .80 | .76 | Moderate | .65 | 10 - 60 | 25 - 57 | 41.96 | 6.53 |
| **Self-Efficacy** | 10 | .81 | .83 | Good | .80 | 10 - 60 | 21 - 60 | 44.74 | 6.06 |
| **Extraversion** | 10 | .87 | .92 | Excellent | .74 | 10 - 60 | 10 - 60 | 36.43 | 10.67 |
| **Neuroticism** | 9 | .86 | .89 | Excellent | .71 | 9 - 54 | 11 - 53 | 26.01 | 8.38 |
| **Resourcefulness** | 10 | .83 | .85 | Excellent | .72 | 10 - 60 | 9 - 53 | 37.40 | 6.99 |
| **Perfectionism** | 9 | .84 | .80 | Good | .65 | 9 - 54 | 21 - 53 | 36.79 | 6.78 |
| **Curiosity** | 10 | .80 | .82 | Good | .71 | 10 - 60 | 19 - 60 | 42.98 | 7.15 |
| **Anxiety** | 10 | .80 | .81 | Good | .64 | 10 - 60 | 14 - 53 | 33.30 | 7.27 |

*Table 1 (continued)*

| Measure | # of Items | Expected α | Observed α | Qualitative Descriptor of α[a] | Observed ω | Possible Range | Observed Range | *M* | *S.D.* |
|---|---|---|---|---|---|---|---|---|---|
| **Openness**[e] | 10 | .82 | .76 | Moderate | .56 | 10 - 60 | 20 - 60 | 41.98 | 7.72 |
| **Unlikely Virtues**[d] | 17 | .76 | .79 | Good | .69 | 17 - 102 | 37 - 85 | 60.85 | 9.52 |
| **IPIP Self-Regulation/ Self-Control**[d] | 11 | .75 | .73 | Fair | .57 | 11 - 66 | 13 - 61 | 43.62 | 7.61 |

*Note*. $N = 199$. [a]Qualitative descriptions are provided by Ponterotto & Rockdeschel (2007) based on obtained alpha, *N*, and number of items. [b]A measure was added to assess these constructs. [c]Response scale was altered on part of this measure.. [d]Changes were not made to these measures. [e]Items were added to these measures.

***Fatigue***. The Chalder Fatigue Scale (CFS) developed by Chalder et al. (1993) was used to assess global, trait ratings of subjective fatigue. The original version consists of 14 items, with 6 items of mental fatigue and 8 items of physical fatigue. Responses were given in yes/no form. In the present study, 3 items were removed due to vagueness and the response scale was altered to be consistent with other trait measures administered. The current measure consisted of 11 items, 7 pertaining to physical symptoms of fatigue and 4 pertaining to mental symptoms. Responses were given on a Likert-type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). A composite score of overall fatigue was obtained by summing the scores of all items with higher scores indicating greater fatigue.

***Time-of-Day Preferences***. The Morningness-Eveningness Questionnaire (MEQ) measured variations in daily functioning attributable to circadian rhythm. Horne and Östberg (1976) adapted Oquist's original measure for use with English-speaking participants, and results presented by Posey and Ford (1981) suggest that this version is valid among U.S. college students. The MEQ consisted of 19 items regarding individual preferences of time of waking and bedtime, physical and mental performance, and alertness after waking and right before bedtime. Scores on the MEQ ranged from 16 (*extreme eveningness*) to 86 (*extreme morningness*). The response format for five items was altered from the original measure upon the suggestion of several investigators (Adan & Almirall, 1991; Neubauer, 1992), who found that the original response format resulted in skewed responses.

***Affect***. Affect was assessed with the Positive Affect and Negative Affect Scale (PANAS; D. Watson, Clark, & Tellegen, 1988). This scale consisted of 20 items, 10 of

which pertain to positive affect (PA) and the other 10 of which pertain to negative affect (NA). Participants responded to each item based on an 8-point Likert scale ranging from 1 (*not at all*) to 8 (*extremely*). Higher scores indicated higher levels of affect. One item from the PA scale was removed (*alert),* as it overlapped with items on the MEQ and CFS. Watson et al. (1988) reported that the correlation of the two scales at the trait level was weak (between -.12 and -.23), contributing to the discriminant validity of the scales and offering support for PA and NA as qualitatively different constructs. In the present study, trait PA and trait NA were weakly negatively correlated ($r = -.29$, $p < .05$).

***Motivation***. Recent research has demonstrated that individuals may not be motivated to alter their sleep-related behaviors (Philbrick & Sherry, 2003). Participants completed the Achievement Goal Orientation Questionnaire (Elliot & McGregor, 2001) to assess general goal orientation along two axes: performance – mastery and approach – avoidance. This measure consisted of 12 items total, with three items pertaining to each of the four quadrants of possible goal orientation. Questions focused on goals within a college setting, such as GPA score, course learning, and comparison among college students. Participants responded on a 6-point Likert-type scale from 1 (*very untrue of me)* to 6 (*very true of me).* Responses from the three items pertaining to each quadrant were averaged to form four scores on this measure.

***Productivity***. The Work Productivity and Activity Impairment (WPAI; Reilly, Zbrozek, & Dukes, 1993) questionnaire was included to assess general work productivity impairment attributable to insufficient sleep, as research suggests that less sleep is associated with difficulty in daytime functioning (Alapin et al., 2000). Two scores were calculated from this scale – the percentage of time spent on academic obligations that was

affected by lack of sleep (PALS), and the percentage of time spent on other activities (e.g., exercise, social events, errands) that was affected by lack of sleep (PAOTH). Additionally, there were two items regarding perceptions of productivity impairment in academic and other domains on a scale of 0 *(Lack of sleep had no effect on my school work/daily activities)* to 10 *(Lack of sleep completely prevented me from working/doing my daily activities).* These items were used as global, single-point estimates of self-reported productivity impairment in academic and other domains.

Because these scores from this scale were percentages and single-point ratings, internal consistency reliability could not be calculated. Instead, construct validity of the WPAI was evaluated through its relationship with other measures. PALS and PAOTH were positively associated ($r = .40$, $p<.05$) as expected, indicating a positive relationship between the percentage of time that lack of sleep affected productivity in academic and in other domains. PALS was also positively associated with the self-reported productivity impairment in the academic domain ($r = .21$, $p<.05$). Further, the percentage of time that lack of sleep affected academic work was positively associated with sleep quality ($r = .18$, $p<.05$), overall sleepiness ($r = .14$, $p<.05$), and trait fatigue ($r = .24$, $p<.05$), supporting findings by Alapin et al. (2000) that daily productivity impairment has been associated with impairment in sleep quality, overall sleepiness, and fatigue.

Participants reported spending approximately 25 hr on academic work over the past week ($M = 25.53$, *S.D.* = 14.25), missing a little over 1 hr from academic work due to lack of sleep ($M = 1.20$, *S.D.* = 2.00), and less than 1 hr from academic work due to other activities ($M = .50$, *S.D.* = 2.98). On a scale from 0 (*Not at all*) to 10 (*Extremely*), participants indicated that lack of sleep affected their productivity while doing school

work (*M* = 3.85, *S.D.* = 2.56) but not while engaging in other activities (*M* = 0.0, *S.D.* = 0.0).

***Sleep behaviors.*** The Epworth Sleepiness Scale (ESS; Johns, 1991) was designed to assess general sleepiness levels through reports of the likelihood of dozing off in various situations. A total of 8 scenarios were listed and each response is given on a 4-point scale, from 0 (*would never doze*) to 3 (*high chance of dozing*). Total possible scores range from 0 to 24, with lower scores indicating less general sleepiness.

The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989) was used to assess general sleep quality. The PSQI was a 19-item questionnaire designed to assess sleep habits over the past month. The measure consisted of seven components, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Component scale scores ranged from 0 (*no difficulty*) to 3 (*severe difficulty*). All subscale scores were summed to obtain a total sleep quality score, ranging from 0 to 21, with higher scores indicating greater sleep difficulty and scores beginning at 5 indicating minimal sleep disturbances.

***Personality.*** Researchers have suggested that there may be trait-like, individual differences in the effects of sleep debt, such as differences in vulnerability to sleep loss (van Dongen, Rogers, & Dinges, 2003). Several personality measures from the IPIP (http://ipip.ori.org) were included to assess other personality variables that might be related to sleep debt-related outcomes, and also to evaluate the convergent and discriminant validity of the new self-regulation and self-control measures. The self-regulation/self-control scale was also included to provide an extant measure for

comparison of the newly created measures. Responses for these scales ranged from 1 (*Very untrue of me*) to 6 (*Very true of me*).

Three trait composites were formed for the personality variables based on similar content of items, similar meaning across constructs, and positive bivariate correlations among scales. Similar composites have been created and implemented by previous researchers (e.g., R. Kanfer, Ackerman, & Heggestad, 1996) because they "allow for a more parsimonious representation of key personality…measures that may share communality than an approach that considers each trait in isolation" (Ackerman & Kanfer, 2009, p. 166). There are at least three benefits of combining the personality scales administered in the present study. First, by combining scales and increasing the total number of items in a composite scale, the internal consistency reliability will likely increase compared to the alpha values of the individual scales. Second, composites are likely to have greater construct validity, as greater construct space is captured by the composite measure compared to the single scales alone. Finally, using composite measures in future analyses reduced the number of variables analyzed, thus reducing Type I errors (i.e., rejecting the null hypothesis when it was true).

The composites were as follows: a) conscientiousness composite, consisting of conscientiousness, impulse control, resourcefulness, self-efficacy, and unlikely virtues; b) neuroticism composite, consisting of neuroticism and anxiety; and c) openness composite, consisting of curiosity, extraversion, and openness to experience.[1] Composites were created using unit-weighted *z*-scores of the constituent scales. Internal

[1] Two personality scales were not included in these composites: perfectionism and self-regulation/self-control. The perfectionism scale did not fit well with any of the composites listed. The self-regulation/self-control scale was kept separately for comparison with the newly formed measures and also to avoid redundancy in measures when evaluating the convergent and discriminant validity of the newly formed measures.

consistency reliabilities were calculated for each composite and the composite was only kept if the coefficient alpha was greater than the alpha values of the constituent scales. Table 2 summarizes the properties of the composites, including reliability and homogeneity estimates, number of scales included, and the intercorrelations among composites.

*Table 2*. Personality Trait Composites and Their Intercorrelations in the Preliminary Study

| **Personality Trait Composites** | | | |
|---|---|---|---|
| **I. Conscientiousness**<br>Scales: Conscientiousness, impulse control, unlikely virtues, resourcefulness, self-efficacy<br>Number of scales = 5, α = .92, ω = .91 | | | |
| **II. Neuroticism**<br>Scales: Neuroticism and anxiety<br>Number of scales = 2, α = .91, ω = .87 | | | |
| **III. Openness**<br>Scales: Openness to experience, extraversion, curiosity<br>Number of scales = 3, α = .94, ω = .85 | | | |
| **Correlations among Personality Trait Composites** | | | |
| | 1 | 2 | 3 |
| **1. Conscientiousness** | | | |
| **2. Neuroticism** | -.61* | | |
| **3. Openness** | .41* | -.45* | |

*Note*. $N = 199$. $df = 198$. *$p<.05$.

**New measures of self-regulation and self-control.** The development of new measures of self-regulation and self-control progressed through four phases. The first phase included item selection, the second phase included an assessment of scales created from the first phase, the third phase consisted of further item retention analyses using CFA models, and the final phase included an evaluation of the structural relationships among self-regulation and self-control scales using SEM models.

In the first phase of item selection, I began by compiling items from extant measures with "self-regulation" and/or "self-control" in the title. A total of 18 scales contained 355 items. Items were reviewed for redundancy and overall relevance, yielding 178 unique and relevant items. All items were included in the questionnaire battery to allow the use both a top-down approach from theoretical models and a bottom-up approach using obtained data to select and retain items. Responses were given on a 6-point Likert-type scale ranging from 1 (*Not at all true of me)* to 6 (*Very true of me).*

Hardesty and Beardon (2004) noted the lack of consistency in the literature in the way in which researchers have used the opinions of experts to assist in item selection for new scales. They identified two dominant procedures, one of which involves assigning items to dimensions of multifaceted constructs. Using the two-stage model of self-control (F. Kanfer, 1977) and the four-phase model of self-regulation (Gollwitzer, 1990), three independent raters classified items into general and facet scales of self-regulation and self-control.

Agreement among raters is shown in Table 3. Agreement for classification into broad categories of self-regulation and self-control ranged from .54 to .60 (all $p < .05$). Agreement for classification into specific facet scales was somewhat lower, ranging from

.24 to .26 (all $p < .05$). Landis and Koch (1977) provided benchmarks for interpreting kappa values, with those between 0.21 and 0.40 indicating fair agreement, and those between 0.41 and 0.60 indicating moderate agreement. The authors note that the number of categories can affect the magnitude of kappa, such that kappa tends to be higher when fewer categories are involved. Therefore, the lower kappa values for the facet classifications was considered acceptable due to the larger number of categories for classification into the facets compared to classifying items into one of two categories of self-regulation or self-control.

*Table 3*. Consistency among Raters of Self-Regulation and Self-Control Items

| **Rater** | **Self-Regulation / Self-Control Classification** | | | **Facet Classification** | | |
|---|---|---|---|---|---|---|
| | % Agreement | κ | 95% CI | % Agreement | κ | 95% CI |
| **1 & 2** | 75.28% | .54* | 0.42 - 0.66 | 33.15% | .25* | 0.17 – 0.32 |
| **1 & 3** | 78.78% | .59* | 0.48 – 0.70 | 34.27% | .24* | 0.16 – 0.32 |
| **2 & 3** | 79.78% | .60* | 0.48 – 0.72 | 36.52% | .26* | 0.18 – 0.34 |
| **Average** | 77.95% | .58 | | 34.65% | .25 | |
| **All 3 Raters** | 66.85% | | | 16.29% | | |

*Note*. *N*=178 items. *$p < .05$.

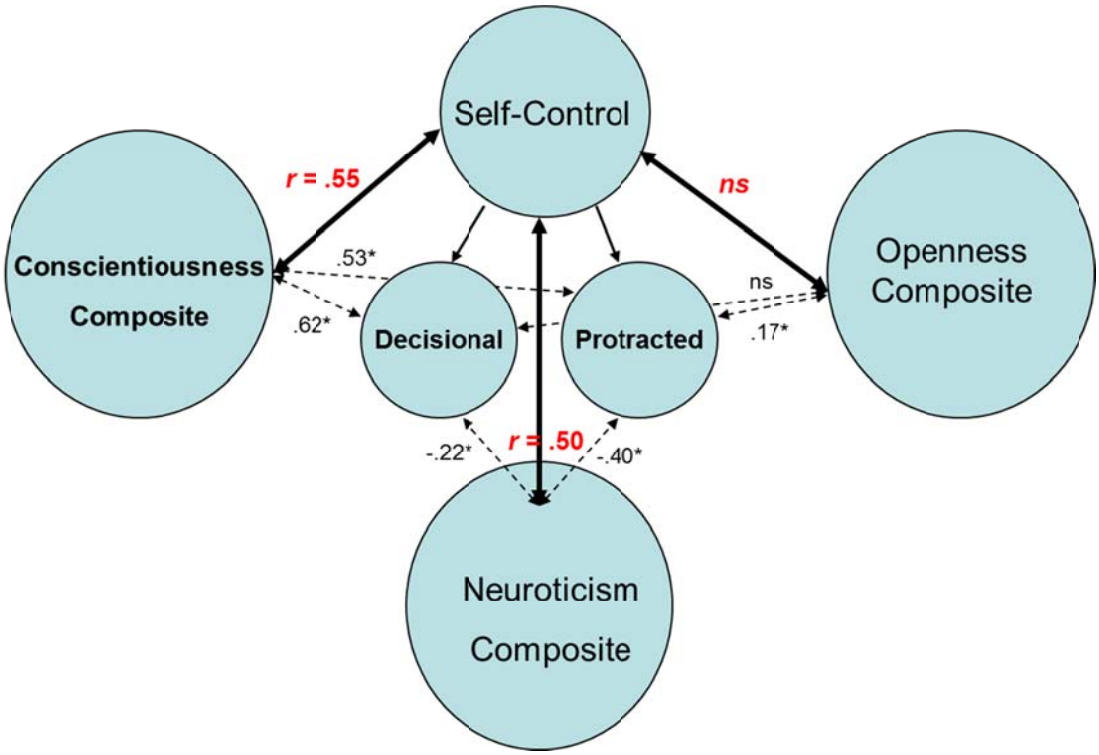
The next step was to decide which items to retain. Though there has been variation in the way researchers choose to retain items based on experts' classifications, the general consensus has been to retain the item if at least 60% of the judges assign the item to the same facet (Hardesty & Beardon, 2004). Therefore, items were kept if at least 2 of the 3 raters classified the item into the same facet.

The second phase consisted of an evaluation of the scales developed in phase one. All internal consistency reliabilities were over .80. Skewness ranges from -.65 to -.16 and kurtosis ranged from .09 to 2.08. These values were within acceptable range of what could be expected from a normal distribution, and the frequency plots for each variable did not indicate serious deviations from normality. Figures 3 and 4 display evidence of convergent and discriminant validity for the new scales of self-control and self-regulation, respectively. As shown in the figures, the stage scales of self-regulation and self-control largely demonstrated the expected relationships with scales included to determine convergent and discriminant validity.

Inter-scale correlations are shown in Table 4. The inter-facet correlations were all moderate to strong in magnitude and positive. For self-control, the correlation between the decisional and protracted scales was $r = .51$ ($p < .01$). For self-regulation, the correlations among the facets ranged from $r = .52$ through .77 (all $p < .01$). Based on the magnitude of the inter-facet correlations, I deemed it appropriate to proceed with confirmatory factor analyses to further evaluate the measurement models of the stages of the two constructs using these new measures.

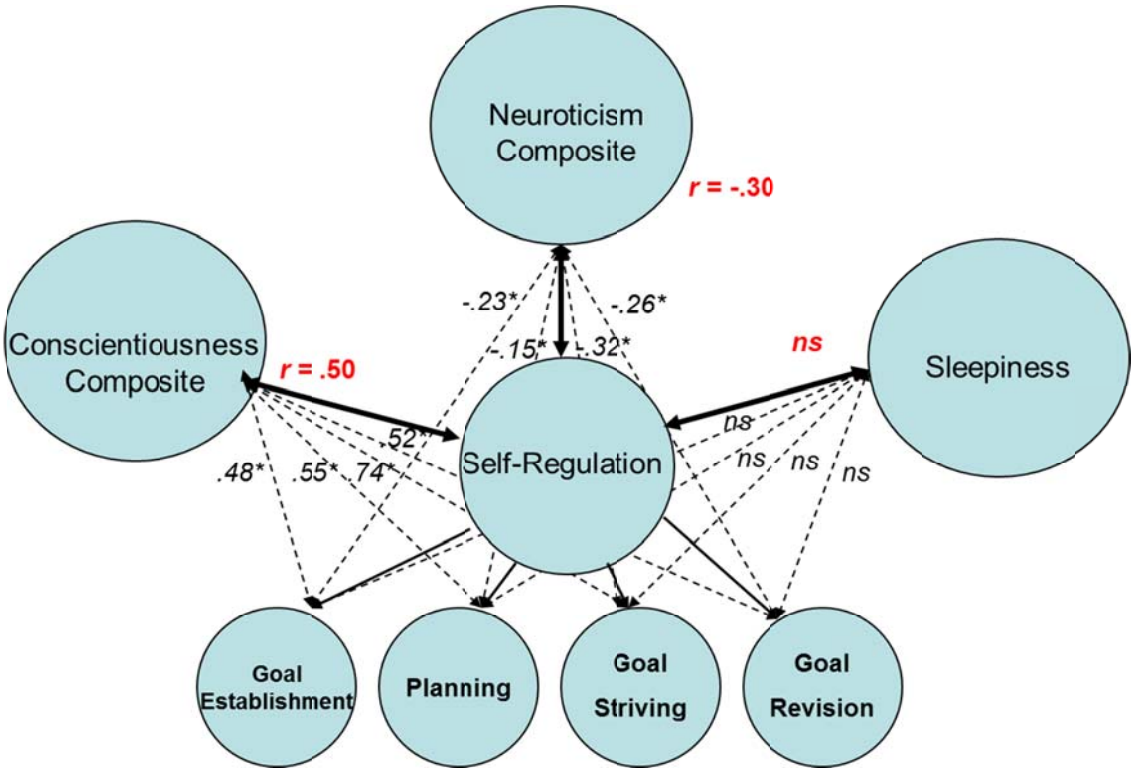
***Measurement models.*** Measurement models of self-regulation and self-control were evaluated using the scales developed up to this point of the development process.

*Figure 3*. Preliminary Evidence for Convergent and Discriminant Validity for the New Self-Control Scales




*Note*. Values in red indicate relationships that were reported in previous research, and values in black indicate what was found in the present study. *$p$<.05.

*Figure 4*. Preliminary Evidence for Convergent and Discriminant Validity for New Self-Regulation Scales




*Note*. Values in red indicate relationships that were reported in previous research, and values in black indicate what was found in the present study. *$p$<.05.

*Table 4*. Correlations among Self-Regulation and Self-Control Scales during Phase 2 of Scale Development

| | **Decisional Self-Control** | **Protracted Self-Control** | **Goal Establishment** | **Planning** | **Goal Striving** | **Goal Revision** |
|---|---|---|---|---|---|---|
| **Decisional Self-Control** | | | | | | |
| **Protracted Self-Control** | .51* | | | | | |
| **Goal Establish-ment** | .24* | .35* | | | | |
| **Planning** | .34* | .45* | .75* | | | |
| **Goal Striving** | .39* | .72* | .52* | .70* | | |
| **Goal Revision** | .17* | .35* | .77* | .73* | .57* | |

*Note*. $N = 199$. *$p < .05$.

Though the measurement models were first performed within a Confirmatory Factory Analysis (CFA) framework, the initial models did not provide a good fit to the data. As Brown (2006) stated, poor-fitting CFA models have been common in applied research and often need to be revised. Altering the model specifications following the initial CFA moves these analyses into what Brown (2006) called exploratory factor analysis within a CFA framework (E/CFA). E/CFA, he argued, could be considered an intermediate step between exploratory and confirmatory factor analysis, allowing the researcher to develop better fitting solutions. Jöreskog (1969) referred to this process as "relaxing" the original CFA model (p. 201). In these preliminary phases of model development, several

respecifications were made to the original models. Data from the experimental studies were used to conduct CFA analyses on the models of self-regulation and self-control developed here through an E/CFA framework.

*Self-control.* To assess the measurement model of self-control, one-factor and two-factor confirmatory factor analyses were performed. Four decisions and respecifications were made following a first look at these models. First, Mardia's kappa statistic for both models was greater than 5, meaning that the data were not distributed as multivariate normal for either model. This statistic indicates that there may be cases contributing to multivariate non-normality; however, there is no absolute value on which to make the judgment of whether a case is an outlier (Brown, 2006; Byrne, 2006). Therefore, cases were not excluded, but instead, robust statistics were interpreted. Second, as suggested by Hooper, Coughlan, and Mullen (2008), items with multiple $R^2$ values less than .10 were excluded (a total of 7 items), as this indicates high levels of error.

Third, several constraints were recommended for the error variances to improve model fit, including allowing three sets of item errors to covary. Though there has been some debate regarding whether it is appropriate to allow correlated error terms, Brown (2006) indicated that correlated errors may be necessary in the case of similarly-worded questionnaire items. Examination of the content of these items indicated that the content was sufficiently similar to allow these errors to covary (e.g., "I have trouble concentrating" and "I have more trouble concentrating than others seem to have."). Each set of covaried error variances loaded on the same factor; that is, it was not recommended for variable errors loading on different factors to covary. Finally, one split loading was

recommended for the two-factor model. The topic of split loadings has also been debated in the literature; however, Brown (2006) suggested that there may be indicators that have salient loadings on multiple factors. Split loadings for these indicators may allow the model to more closely approximate the relationship between variables and factors.

Following these adjustments, the two-factor model of self-control provided a better fit to the data (*CFI* = .93, *RMSEA* = .06, 90% *CI* = .05 - .07), compared to the one-factor model (*CFI* = .69, *RMSEA* = .13, 90% *CI* = .12 - .14; $\Delta\chi^2$= 426.677, $\Delta d.f.$ = 2, $\Delta CFI$ = .24), though did not quite meet conventional standards for a good fit (i.e., CFI $\geq$ .95, RMSEA $\leq$ .05). These findings suggest that the construct of self-control is more appropriately captured by the two stages of protracted and decisional self-control, as opposed to a single self-control factor. In the two-factor model, the correlation between the factors of decisional and protracted self-control was .42 ($p$<.05), suggesting that it was appropriate to proceed with a hierarchical model.

*Self-regulation.* Several CFA models were also performed to assess the model fit of a four-factor model of self-regulation. First, a one-factor model was performed, followed by a four-factor model. Similar to the initial considerations with the self-control models, multivariate normality, multiple $R^2$ values, error covariances, and split loadings were considered. Based on these considerations, robust statistics were interpreted, two variables were excluded, three pairs of item errors were set to covary, and two split loadings were specified.

Following these changes, the one-factor model did not fit the data well (*CFI* = .76, *RMSEA* = .00, 90% *CI* = .00 - .004). The four-factor model provided a better fit to the data (*CFI* = .91, *RMSEA* = .01, 90% *CI* = .00 - .013, $\Delta\chi^2$= 18.62, $\Delta d.f.$ = 6, $\Delta CFI$ =

.15), but did not meet the standards for good model fit. The correlations among factors in the four-factor models ranged from .36 to .58, all $p < .05$. Based on these correlations, I proceeded to test a hierarchical model to see if it would provide a better fit than the four-factor model.

***Structural models.***

*Self-control.* A hierarchical model of self-control was tested, with one higher-order factor and two lower-order factors. Results indicated that the higher-order model provided a better fit to the data than the two-factor model (*CFI* = .95, *RMSEA* = .03, 90% *CI* = .00 - .047, $\Delta\chi^2$= 11.379, $\Delta d.f.$ = 4, $\Delta CFI$ = .02), and met the standards of good model fit. Therefore, it appeared that the construct of self-control was best represented by a hierarchical model, with the latent factor of self-control at the top, and protracted and decisional self-control as lower-order factors.

*Self-regulation.* The hierarchical model of self-regulation, including one higher-order factor and four lower-order factors, did not provide a good fit to the data (*CFI* = .79, *RMSEA* = .00, 90% *CI* = 0.00 – 0.008). Factor loadings of the four lower-order factors on the higher-order self-regulation factor were between .51 and .76, all $p < .05$. However, based on the poor fit of the hierarchical model, the four-factor model best represented the relationship among the four stages of self-regulation though did not provide good fit to the data.

*Self-regulation and self-control.* To evaluate the relationship between self-regulation and self-control, the structural models tested were slightly modified from those originally hypothesized to reflect the appropriate measurement model of self-regulation. First, a one-factor model was tested. Second, a model was tested with self-control as an

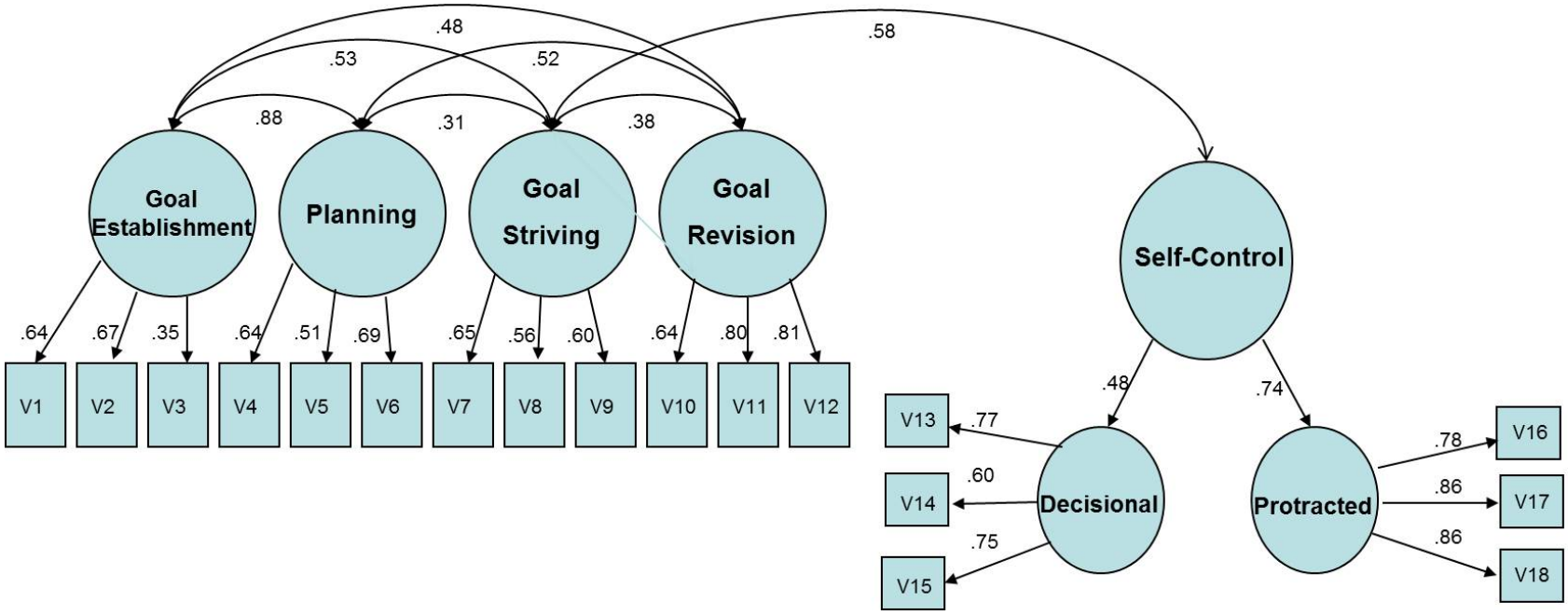
intercorrlated factor with the four self-regulation factors. Third, self-control was correlated with the goal striving factor of self-regulation. Finally, self-control was included as a factor under the goal striving factor.

Due to the large number of items included in these models combining self-regulation and self-control, models that included all of these items fit poorly. Based on a recommendation from CFA book author Brown (2006), the number of items was decreased to allow more accurate (i.e., less biased) parameter estimation of the structural paths (T. Brown, personal communication, January 23, 2012). Items with factor loadings greater than .70 and with no split loadings were selected. Based on recommendations that the number of items per factor should be at least 3, 3 items per factor were included in the models (Byrne, 2006; Loehlin, 2004).

The one-factor model fit the data poorly (*CFI* = .54, *RMSEA* = .14, 90% *CI* = .132 - .154). The second model with the higher-order factor of self-control correlated with the four factors of self-regulation provided better fit (*CFI* = .86, *RMSEA* = .04, 90% *CI* = .009 - .052). The third and fourth models provided a better fit than the second model and a similar fit to one another (*CFI* = .93, *RMSEA* = .06, 90% *CI* = .04 - .07, and *CFI* = .94, *RMSEA* = .05, 90% *CI* = .039 - .068, respectively). Figures 5 and 6 display results from these models.

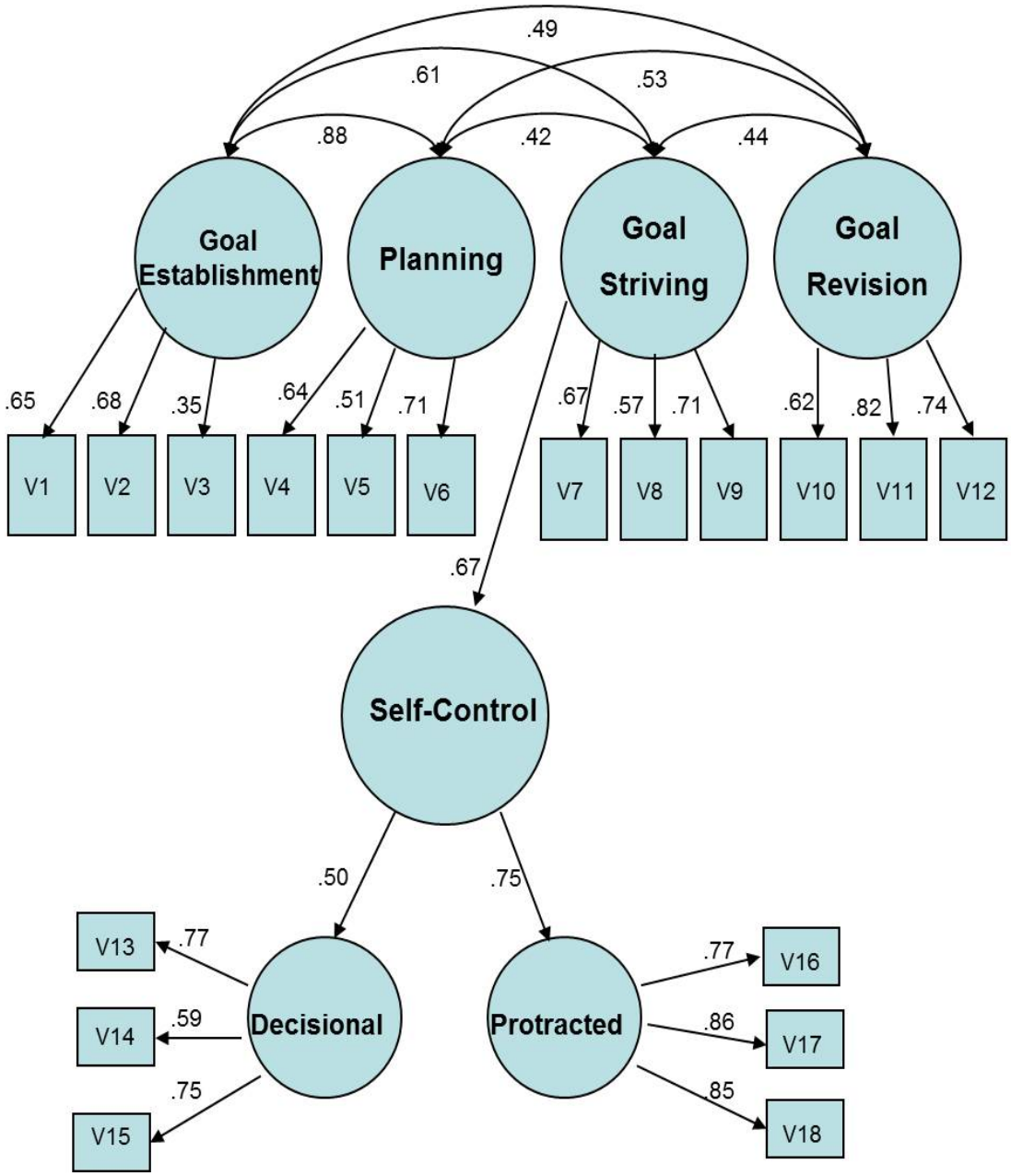
These results suggest that self-control fits best as a factor correlated with or loading on the goal striving facet of self-regulation, which aligns with theoretical predictions that self-control is most relevant during the goal striving phase of self-regulation. Therefore, a slightly altered version of Model 2 best fits the data in the present study.

*Figure 5*. Structural Model of the Relationship between Self-Regulation and Self-Control: Self-Control as a Higher-Order Factor Correlated with Goal Striving Facet of Self-Regulation




*Note*. $N = 199$. Standardized estimates are presented, consistent with the recommendations of Schreiber et al. (2006). All factor loadings, factor paths, and correlations were significant ($p < .05$).

*Figure 6*. Structural Model of the Relationship between Self-Regulation and Self-Control: Self-Control as a Higher-Order Factor Loading on the Goal Striving Facet of Self-Regulation




*Note*. $N = 199$. Standardized estimates are presented, consistent with the recommendations of Schreiber et al. (2006). All factor loadings, factor paths, and correlations were significant ($p < .05$).

***Final self-regulation and self-control measures.*** Table 5 shows the scale characteristics of the modified scales based on the items excluded from these CFA models. All scales had internal consistency reliabilities greater than .80, qualitative descriptions of moderate or better, and homogeneity estimates over .63. Skewness ranged from -.71 to -.20 and kurtosis ranged from -.11 to 2.08. The correlation between decisional and protracted self-control was .44 ($p$<.05) and the correlations among self-regulation facets ranged from .56 to .77[2]. These scales had similar correlations to the other trait scales, as shown in Figures 3 and 4, used to demonstrate convergent and discriminant validity.

Table 6 displays the correlations among extant scales and these new measures of self-regulation and self-control. Correlations between the facets of self-control and those of self-regulation were all significant, ranging from .17 to .71. Strong cross-construct associations were found between goal striving with decisional ($r$ = .39, $p$<.05) and protracted self-control ($r$ = .71 $p$<.05), which aligned with theoretical expectations and the structural models described above. These new measures may be found in Appendix A.

**Revisions to Extant Measures**

For the majority of scales included in the preliminary study, reliability and homogeneity estimates met or exceeded the thresholds I set. For those scales that did not, I made several changes before administering this battery of questionnaires to the

[2] After correcting for attenuation, these values range from .67 to .94 with the strongest relationship between goal establishment and goal revision. Values over .90 may be arguably "too" high for the constructs to be considered meaningfully separate constructs; however, a three-factor model that combined goal establishment and goal revision did not fit the data well (*CFI* = .77, *RMSEA* = .076, 90% *CI* = .07 - .08).

*Table 5*. Scale Characteristics of New Self-Regulation and Self-Control Measures in the Preliminary Study

| Scale | # of Items | Possible Range | Observed Range | *M* | *S.D.* | α | Qualitative description of obtained α[a] | ω | Range of Item-Total Correlations |
|---|---|---|---|---|---|---|---|---|---|
| **Decisional Self-Control** | 7 | 7-42 | 13-41 | 28.91 | 5.71 | .80 | Good | .63 | 0.30 – 0.71 |
| **Protracted Self-Control** | 12 | 12-72 | 15-69 | 45.03 | 10.51 | .90 | Excellent | .77 | 0.40 – 0.83 |
| **Goal Establishment** | 9 | 9-54 | 12-51 | 37.25 | 6.28 | .81 | Good | .70 | 0.40 – 0.59 |
| **Planning** | 13 | 13-78 | 22-75 | 57.11 | 7.89 | .83 | Moderate | .76 | 0.33 – 0.67 |
| **Goal Striving** | 12 | 12-72 | 21-70 | 53.21 | 7.77 | .84 | Moderate | .77 | 0.36 – 0.64 |
| **Goal Revision** | 9 | 9-54 | 9-54 | 38.01 | 6.15 | .82 | Good | .73 | 0.45 – 0.58 |

*Note.* $N = 199$. [a]Qualitative descriptions are provided by Ponterotto & Rockdeschel (2007) based on obtained alpha, *N*, and number of items.

*Table 6*. Correlations among Extant Trait Scales and New Self-Regulation and Self-Control Measures from the Preliminary Study

| | FAT | MEQ | PA | NA | MAP | MAV | PAP | PAV | CON | NEU | OPEN | PER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FAT** | | | | | | | | | | | | |
| **MEQ** | -.33* | | | | | | | | | | | |
| **PA** | -.52* | .27* | | | | | | | | | | |
| **NA** | .48* | -.09 | -.29* | | | | | | | | | |
| **MAP** | -.18* | .30* | .33* | -.02 | | | | | | | | |
| **MAV** | .08 | .10 | .10 | .25* | .44* | | | | | | | |
| **PAP** | -.08 | -.01 | .13 | .12 | .08 | .19* | | | | | | |
| **PAV** | .20* | -.10 | -.13 | .05 | -.06 | .32* | .15* | | | | | |
| **CON** | -.51* | .26* | .56* | -.38* | .34* | -.03 | .12 | -.13 | | | | |
| **NEU** | .54* | -.18 | -.56* | .62* | .14 | .18* | .03 | .13 | -.61* | | | |
| **OPEN** | -.24* | .13 | .49* | -.26* | .29* | .00 | -.05 | -.04 | .41* | -.45* | | |
| **PER** | -.08 | .17* | .16* | .09 | .15* | .23* | .32* | .15* | .37* | .06 | -.06 | |
| **SRSC** | -.49* | .33* | .42* | -.38* | .26* | -.06 | .02 | -.11 | .55* | -.37* | .29* | .16* |
| **DEC** | -.31* | .22* | .14 | -.26* | .17* | -.01 | .01 | -.16* | .51* | -.20* | .00 | .09 |
| **PRO** | -.64* | .25* | .31* | -.36* | .22* | -.13 | .12 | -.12 | .58* | -.37* | .11 | .14 |
| **EST** | -.32* | .33* | .42* | -.14 | .38* | .14* | .17* | -.08 | .50* | -.24* | .38* | .30* |
| **PLA** | -.34* | .35* | .37* | -.11 | .32* | .15* | .23* | .07 | .55* | -.15* | .34* | .40* |
| **STR** | -.55* | .37* | .49* | -.18* | .37* | .11 | .29* | -.03 | .72* | -.29* | .30* | .39* |
| **REV** | -.28* | .26* | .48* | -.13 | .36* | .11 | .20* | .02 | .52* | -.26* | .40* | .30* |
| **SQ** | .42* | -.14* | -.25* | .35* | -.09 | .04 | -.03 | .08 | -.27* | .37* | -.13 | -.03 |
| **SLE** | .33* | -.11 | -.03 | .13 | -.12 | .10 | -.09 | .01 | -.19* | .08 | -.24* | -.10 |

*Table 6 (continued)*

| | SRSC | DEC | PRO | EST | PLA | STR | REV | SQ | SLE |
|---|---|---|---|---|---|---|---|---|---|
| **SRSC** | | | | | | | | | |
| **DEC** | .42* | | | | | | | | |
| **PRO** | .57* | .44* | | | | | | | |
| **EST** | .42* | .27* | .34* | | | | | | |
| **PLA** | .53* | .34* | .41* | .75* | | | | | |
| **STR** | .60* | .39* | .71* | .56* | .72* | | | | |
| **REV** | .41* | .17* | .32* | .77* | .73* | .59* | | | |
| **SQ** | -.21* | -.19* | -.35* | -.10 | -.06 | -.16* | -.05 | | |
| **SLE** | -.17* | -.18* | -.24* | -.11 | -.12 | -.15* | -.01 | .19* | |

*Note*. FAT = Subjective fatigue. MEQ = Morningness-Eveningness. PA = Positive affect. NA = Negative affect. MAP = Mastery approach. MAV = Mastery avoidance. PAP = Performance approach. PAV = Performance avoidance. CON = Conscientiousness Composite. NEU = Neuroticism Composite. OPEN = Openness Composite. PER = Perfectionism. SRSC = IPIP Self-regulation/Self-control. DEC = Decisional self-control. PRO = Protracted self-control. EST = Goal establishment. PLA = Planning. STR = Goal striving. REV = Goal revision. SQ = Sleep Quality. SLE = Sleepiness.

experimental study participants. A total of four changes were made to the extant measures.

First, because the internal consistency reliability of the MEQ was lower than expected based on previous research, an additional measure of time-of-day preferences was included in the experimental study to increase the validity of the time-of-day preference measurement. The Münich Chronotype Questionnaire (MCQ; Roenneberg, Wirz-Justice, & Merrow, 2003) was developed by a group of researchers in a large-scale European research network as another measure of human circadian rhythm (see Roenneberg et al., 2003). The MCQ consisted of 16 questions pertaining to sleeping and waking habits on work days and free days. The mid-sleep time point during free days (MSF) was calculated as the mid-point between bed time and wake time and used to determine an individual's chronotype, or time-of-day preference. An earlier MSF (e.g., 2am) indicated a greater preference for mornings than a later MSF (e.g., 6am). The mid-sleep time point from free days was chosen instead of on work or school days because sleep-wake times tend to be less constrained by work, family, and/or social obligations.

Second, four scales from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & DeGroot, 1990) were included to address the low (< .50) homogeneity estimates from two of the Achievement Goal Orientation scales. The MSLQ was developed to assess student motivation and self-regulated learning in the classroom and consists of three motivational scales and two cognitive scales. The motivational scales include self-efficacy ($\alpha$ = .89), intrinsic value ($\alpha$ = .87), text anxiety ($\alpha$ = .75). The cognitive scales include self-regulation ($\alpha$ = .74) and use of learning strategies ($\alpha$ = .83). For the experimental studies, the self-regulation scale was not

included because of the goal of developing a new measure of self-regulation. The self-efficacy scale consisted of 9 items regarding perceived confidence and competence in performance of class work. Text anxiety assessed the interference of worrisome thoughts during testing situations using 4 items. The 11 items on the intrinsic value scale pertained to intrinsic interest in coursework, a preference for mastery, and perceived importance of courses. Two items were excluded from the intrinsic value scale due to similarity with items on the achievement goal orientation questionnaire. The use of learning strategies scale consisted of 13 items regarding the use rehearsal and organization strategies in a learning environment. Responses were given on a 6-point Likert-type scale from 1 (*Very untrue of me)* to 6 (*Very true of me).*

Third, several items were added to the Impulse Control and Openness to Experience scales from the International Personality Item Pool (IPIP; Goldberg et al., 2006) using the Spearman-Brown prophecy formula. Finally, the response scale for several items on the Sleep Quality measure was made larger due to a restriction of range in the observed responses, in order to potentially yield greater variability in responses.

**Summary**

New measures of self-regulation and self-control were developed through a process involving item classification by three independent raters, reviewing item content, and evaluating item characteristics through both univariate and multivariate analyses. The new measures of self-regulation and self-control had adequate internal consistency reliability and homogeneity values, and demonstrated the expected relationships for convergent and discriminant validity. Examination of the constructs using E/CFA indicated that self-control was best represented as a higher-order factor with two lower-

order factors, and that self-regulation was best captured as a four-factor model with intercorrelated factors.

There were at least three limitations to these E/CFA results. First, while these models provided the best fit to the data compared to other models tested, several fell short of meeting criteria for a good fit to the data. Second, several decisions and respecifications were made to each model following a first look at model fit, bringing the analyses from confirmatory to exploratory within a confirmatory framework (Brown, 2006). While this approach may be necessary when first evaluating a model of new measures, it is possible that the respecifications were too specific to the data in the tested sample and will not replicate in other samples. Finally, there may be other models that fit the data as well or better as those tested here.

A preliminary look at the structural relationship between constructs was examined using SEM with an understanding of the limitations of the measurement model of self-regulation. When combining self-regulation and self-control, a model in which self-control was associated with the goal striving facet of self-regulation provided the best fit. This finding aligned with the prediction that self-control was a part of the self-regulatory process, and was specifically most applicable during the goal striving phase.

This study provides a good first step in the development of self-regulation and self-control scales that reflect theoretical models of each construct. While the structural model of self-control supported expectations that self-control is a higher-order construct, the hierarchical model of self-regulation did not provide a better fit than the four-factor model, nor did the four-factor model fully meet criteria for a good fit to the data. The facet scales for each construct demonstrated acceptable reliability and validity; however,

the self-regulation scales had several inter-correlations that may be too strong to consider some of the facets as separate, particularly after correcting for unreliability of the measures.

Three directions for future research are offered here to guide the further development and refinement of the models tested in the current study. First, another iteration of item selection and retention may result in scales with more specificity in construct measurement, particularly for the scales of self-regulation. Though there were several steps taken to select items in the present study, it may be beneficial to use another panel of raters to further converge on the appropriate item content and wording for each scale. Second, alternative models of self-regulation and self-control should be tested. For example, Lewin (1936) described goal setting and goal striving as two phases of goal-directed behavior. Since then, investigators have postulated a different number of phases in the self-regulatory process, ranging from three (F. Kanfer, 1975) to five (Karoly, 1993). Several alternative models were evaluated in the present study with fewer self-regulatory factors; however, the factor scales were developed in the framework of a four-factor model. Three-factor or five-factor models should be developed based on the specific content of the factors included, then tested. Third and finally, the models developed in this study should be tested among other samples to see if the results could be replicated, which would provide support for the current models. This final point will be undertaken in the experimental studies.

# CHAPTER 3

# TWO EXPERIMENTAL STUDIES

In this chapter, I describe the two experimental studies conducted to assess the self-regulation and self-control training interventions. I begin with a discussion of *a priori* power analyses and the reliability criteria that were chosen to evaluate the measures used. Then, I describe the methods of both studies, including recruitment, samples, and procedure. Finally, I present results for the student and employee samples separately and the two samples combined.

## Power Analyses

I conducted several *a priori* power analyses in order to determine the sample size required to detect each hypothesized effect size. I used G-power to determine the sample size for the analyses using the ordinary least squares (OLS) framework (Erdfelder, Faul, & Buchner, 1996). In order to detect the smallest hypothesized effect with a power level of .80, the required sample size was $N = 88$. However, due to recruitment and feasibility concerns, this sample size was obtained for the combined student and employee samples. A post hoc power analysis using G-Power indicated power ranging from .40 to .65 for the detected effects in the student sample and .35 to .59 in the employee sample. Due to the low power of the student and employee groups separately, some of the statistical analyses presented did not reach statistical significance at the .05-level but showed trends in the expected direction with *p*-values between .05 and .10. These results are presented along with associated effect sizes, though it is understood that these findings are not statistically significant. Because the level of power for the groups separately was lower than the

desired level of power, samples were combined and tested together for all hypotheses. Post hoc power for the combined sample ranged from .72 to .88 for detected effects.

**Reliability Criteria**

In keeping with the criteria chosen in the preliminary study, similar reliability criteria were chosen to evaluate measures in the experimental studies. Because these studies included both trait and state measures, and several trait measures were administered multiple times, I developed additional criteria to evaluate the state and repeated measures. For trait measures, I calculated Cronbach's alpha and used the guidelines presented by Ponterotto and Ruckdeschel (2007) to provide a qualitative description of the internal consistency reliability obtained. I also calculated McDonald's ω to provide an estimate of measure homogeneity.

With regards to state measures, test-retest reliabilities were calculated using Fisher's *r*-to-*z* transformation. Because state variables were expected to fluctuate over the course of the day and week, test-retest reliabilities of these variables were expected to be small in magnitude. A benchmark for the value of these reliabilities was not set, but I expected that the repeated measures would demonstrate positive, statistically significant intercorrelations.

As several traits were also assessed over a period of time, test-retest reliability was calculated via correlation for these traits. Similar to the state-level variables, I expected that there would be some fluctuation in the measurement of these constructs over time, although the relationships were expected to be large in magnitude given that traits should not fluctuate greatly over a three-week period. Therefore, I expected that the test-retest reliability among trait-level variables would be $\geq .50$.

## Methods

**Recruitment.** Undergraduate students were recruited through Experimetrix, in-class announcements, and flyers posted in and around the Psychology building. Employees were recruited through flyers posted around the Atlanta area and word-of-mouth. Interested individuals completed a screening questionnaire over the phone to determine eligibility. Students were included if they expressed a desire get at least 30 min more sleep per weeknight, were between the ages of 18 and 65, reported an average sleep time of 5 to 9 hours during the week, and were native English speakers. For employees, two additional inclusion criteria were applied: 1) full-time (35 hours per week or more) employment; and 2) day-shift (between the hours of 7am and 9pm) hours. Individuals were not included if they had been diagnosed with a sleep-related disorder or any medical diagnosis that might affect sleep-wake patterns; were currently taking prescription stimulants or sleep aids; anticipated unavoidable external circumstances that might have prevented fulfillment of sleep-related goals during the study period (e.g., newborn baby at home; chronically ill family member or roommate, vacation during the study period); or participated in the preliminary study (students only). Anyone who was ineligible was given contact information for several sleep clinics in the Atlanta area and was encouraged to speak with a physician regarding any sleep-related problems or concerns.

**Samples.**

***Students.*** During the screening process, 69 undergraduate students were interested and completed the phone screen. Two students were ineligible due to previous medical diagnosis of depression, which they felt caused interference with their sleep patterns. One student was eligible but was not currently taking a psychology course and

chose not to participate as a volunteer. One student reported taking prescription stimulants. Three students were eligible and signed up but did not attend the first study session. A total of 62 participants enrolled in the study, with 26 women (41.9%) and 36 men (58.1%). The age of participants ranged from 18 through 23 ($M$ = 20.26, $S.D.$ = 1.42).

Of these 62 participants, 13 were excluded from analyses for the following reasons: illness during study period (1), average baseline sleep time, as recorded by the actigraph, less than the 5 hour minimum requirement (5), and not properly following procedures (7)[3]. In a comparison of the excluded and included participants, the excluded group did not differ significantly from the included group on any study variables. There were no significant differences between groups on sleep-related information gathered on the screening questionnaire, including how much participants reported sleeping each night during the week, how much more sleep they would like to get, or how realistic it would be to get more sleep. There were also no significant differences on the average time spent sleeping during the first week of the study. The final sample consisted of 49 students ($N$ = 49), with 15 in the control group, 18 in the self-regulation training group, and 16 in the combined self-regulation/self-control group. The average age was 20.10 ($S.D.$ = 1.41), with 20 women (40.8%) and 29 men (59.2%).

***Employees.*** During the screening process, 61 employees completed a phone screen. Two callers were ineligible due to their work schedules falling outside of the required times, 4 were eligible but could not participate due to scheduled vacations and/or

[3] Those who did not follow procedures properly had multiple questionable daily questionnaires, in which it was clear that participants were rushing through them and/or not responding truthfully, and/or multiple questionable actigraph records, in which it was clear that participants did not wear the actigraph overnight but manually created a sleep log through the actigraph website.

work trips during study periods, and 8 were eligible and signed up but did not attend the first study session. A total of 47 participants enrolled in the study, with 28 women (59.6%) and 19 men (40.4%). Participants ranged in age from 23 through 61 years old, with an average age of 35.26 (*S.D.* = 11.13).

Of these 47 participants, 6 were excluded from future analyses for the following reasons: average baseline sleep time less than the 5 hour minimum requirement (1), attrition (2), and equipment malfunctions (3). In a comparing the excluded and included participants, there were two significant differences between groups. The retained group was higher on trait positive affect ($d$ = .19) and the excluded group scored higher on the unlikely virtues scale ($d$ = .07); however, these were small effect sizes. There were no significant differences between groups on sleep-related information gathered on the screening questionnaire, and there were no significant differences on the average time spent sleeping during the first week of the study.

The final sample consisted of 41 employees ($N$ = 41), with 15 in the control group, 13 in the self-regulation training group, and 13 in the combined self-regulation/self-control group. The average age was 35.88 ($SD$ = 11.50), with 26 women (63.4%) and 15 men (36.6%). These participants reported working in the following fields: education (26.8%), healthcare (19.5%), professional (e.g., finance, law, engineering; 19.5%), sales (7.3%), physical labor (7.3%), arts (4.9%), health & fitness (4.9%), and other (e.g., "consultant;" 9.8%).

**Procedure.** The experiments followed a mixed between- and within-subjects, repeated measures design using experience sampling methodology (ESM). Following the screening questionnaire, participants were randomly assigned to one of the three groups.

Two intervention groups followed an A-B-A design, while the control group followed an A-A-A-B design, with an option to complete the training at the end of the study. Data were collected through in-lab questionnaires and daily questionnaires administered over the Internet. The study duration was three weeks, with in-lab sessions at the beginning and end of the study period. Table 7 displays the layout of the study, including the timing of questionnaires and training sessions for each group. Four three-week study sessions were held between June and November of 2012.

Depending on group assignment, participants attended one of three 90-minute laboratory sessions on a Saturday morning, during which three things occurred. First, participants completed the consent form and a battery of trait questionnaires. The battery consisted of all of the measures in the preliminary study with the described changes and additions, and took between 45 and 60 minutes to complete. Second, participants received training for the online questionnaires. Finally, all participants received a Fitbit Ultra actigraph to use during the study and instructions regarding its use. The Fitbit used a MEMS 3-axis accelerometer to measure motion patterns and capture sleep-wake activity. This device was worn on the wrist while sleeping, similar to other actigraph devices. The Sunday following the initial lab session was considered a trial day to ensure that participants understand how to access the online questionnaires and use the Fitbits.

Participants in the treatment groups attended a 1-hour in-lab training session on the Saturday before Week 2 of the study. Training varied depending on which treatment group participants were in, with the self-regulation/self-control group receiving self-control training in addition to the training for self-regulation. The self-regulation training

*Table 7.* Experimental Study Design

| **Group** | **Prior to Week 1 (Saturday)** | **Week 1 (Sun-Fri)** | **Prior to Week 2 (Saturday)** | **Week 2 (Sun-Fri)** | **Week 3 (Sun-Fri)** | **After Week 3 (Saturday)** |
|---|---|---|---|---|---|---|
| Control | Self-Report Battery | Morning and Evening Questionnaires<br><br>Actigraph Reports | ---------- | Morning and Evening Questionnaires<br><br>Actigraph Reports | Morning and Evening Questionnaires<br><br>Actigraph Reports | Final Questionnaire<br><br>Trait Self-Regulation and Self-Control Measures<br><br>Option to complete Combined Training |
| Self-Regulation | Self-Report Battery | Morning and Evening Questionnaires<br><br>Actigraph Reports | Self-Regulation Training | Morning and Evening Questionnaires<br><br>Actigraph Reports | Morning and Evening Questionnaires<br><br>Actigraph Reports | Final Questionnaire<br><br>Option to complete Self-Control Training |
| Self-Regulation/ Self-Control | Self-Report Battery | Morning and Evening Questionnaires<br><br>Actigraph Reports | Combined Self-Regulation/ Self-Control Training | Morning and Evening Questionnaires<br><br>Actigraph Reports | Morning and Evening Questionnaires<br><br>Actigraph Reports | Final Questionnaire |

group only received self-regulation information. See the next section for detailed information regarding these sessions.

All participants were instructed to wear the Fitbit throughout the 3-week duration of the study on nights before weekdays (Sunday night through Thursday night), although they were also allowed to wear the device any other time they chose during the study period. Data from the Fitbits were obtained on a regular basis. All participants were asked to complete questionnaires online each weekday morning (Monday through Friday) within 30 minutes of getting out of bed and before bed on each weekday night (Sunday night through Thursday night). These questionnaires contained items pertaining to sleep duration, sleep quality, fatigue, affect, and productivity. During Week 2, treatment group participants were asked questions pertaining to the training session they attended. Week 3 was treated as a post-intervention assessment of participants in the treatment groups on their adherence to their sleep duration goals. Morning and evening questionnaires took approximately 5 minutes to complete. Daily requirements, including the online questionnaires and use of the Fitbit took approximately 15 minutes.

Participants attended a 30-minute lab session at the end of the three-week period. At this time, participants completed a final questionnaire regarding their experience using the Fitbit, their assessment of the training (for training groups only), and overall feelings of fatigue, productivity, concentration, and affect after the study as compared to before the study. Participants returned the Fitbits and received a debriefing form. Additionally, participants in the control group were offered the opportunity to engage in the full self-regulation/self-control training, and participants in the self-regulation group were offered the self-control module. Students earned up to 7 credits towards a psychology course for

participating in this research study; employees were compensated $50 for completion of the study.

Three features were incorporated to increase compliance with the daily questionnaire and Fitbit protocol. First, participants received daily reminders regarding which questionnaires to complete and when to complete them. Second, the online questionnaires were time-stamped, allowing for an assessment of whether or not questionnaires were completed on time. Finally, full research credit for students was given only for Fitbit records and questionnaires fully completed and completed in the designated time frames.

***Training Interventions.*** Training groups attended a 1-hour session prior to Week 2 to develop a plan for getting more sleep each weeknight over the upcoming week. In cases where participants could not attend the originally scheduled group training session, they were rescheduled for a time that was mutually convenient for them and the researcher. All training sessions were conducted between Friday afternoon and Sunday evening of the weekend prior to Week 2 and included between 2 and 12 participants. There were no significant differences in responses across sessions. The session was almost identical in the student and employee samples, except that the examples used and points for discussion were tailored to the sample.

*Self-regulation training*. The self-regulation training covered the four stages of self-regulation, including goal establishment, planning, goal striving, goal revision. For each stage, a brief description was given regarding its meaning. Stages 1 through 3 also included an interactive portion where participants filled out sections of a worksheet and then discussed as a group how the stages would be implemented.

In the goal establishment module, participants chose a specific sleep duration goal that they felt would be an improvement to the current amount of sleep they were getting, but also realistic given their daily obligations. Based on recommendations from the NSF (2011) and on empirical findings that greater health risks are associated with less than 7 hours and more than 9 hours of sleep each night (Kripke, Garfunkel, Wingard, Klauber, & Marler, 2002; Steptoe, Peacey, & Wardle, 2006), a suggested sleep duration goal of 8 hours was offered if participants were unsure of the length of sleep duration goal they should set. During the planning module, participants devised plans of when they would go to bed and wake up during the coming week in order to reach their sleep goals. In the module on goal striving, participants were asked to come up with three concrete strategies that they could use to follow through with their plans over the upcoming week.

Stage 4, goal revision, was explained in the training intervention but could not be applied until the self-regulation process began during Week 2. Daily questionnaires during Week 2 included questions whether initial goals, plans, and strategies were revised, and if so, the nature of the revisions. Of the 18 students and 13 employees assigned to the self-regulation training group, 5 (27.78%) students and 6 (46.15%) employees chose to participate in the optional self-control module at the end of the study.

*Self-regulation and self-control training group*. The combined self-regulation and self-control training covered the four stages of self-regulation, and also included the two stages of self-control. The training module for the stages of self-control followed a similar format as the first three self-regulation modules, with a description and an interactive portion. This module focused on anticipating problems that might arise when it came time to implement strategies and/or follow through with plans. Then, participants

described one method each of decisional and protracted self-control that they could use to address a potential problem and stay on track with plans and strategies in order to get the desired amount of sleep each night. Daily questionnaires during Week 2 included questions pertaining to the application of both self-regulation and self-control training content.

*Control group*. The control group did not receive a training intervention, but daily feedback regarding sleep-wake activities was available through the actigraph reports online. At the end of the three-week study period, the control group was given the option to complete the combined self-control and self-regulation training. As a result, there were no questions on the daily questionnaires that pertained to the training intervention for the control group. Of the 15 students and 15 employees assigned to the control group, 5 (33.33%) students and 1 (6.67%) employee chose to participate in the optional training at the end of the study.

**Results**

The analyses to assess my *a priori* hypotheses proceeded in four stages. First, baseline differences across the three groups and four sessions for each sample were assessed to rule out any pre-existing differences in these variables across groups and sessions. I also examined baseline differences between samples. Second, a missing values analysis was conducted to evaluate the amount of missing data and to impute missing values from missed daily questionnaires and Fitbit records. The details of this analysis are presented in Appendix B. Third, I evaluated the trait, state, and intervention-related measures administered throughout the study. Fourth, I tested the proposed hypotheses using the analyses described. Each section of the analyses includes results from the student, employee, and the combined samples.

**Assessment of baseline differences.** Several one-way analysis of variance (ANOVA) tests were conducted to explore whether there were significant differences in baseline measures of major study variables across the three treatment groups and four sessions for each sample. Then, independent groups *t*-tests were conducted to assess differences between samples. Major study variables included current amount of sleep time, desired amount of sleep time, fatigue, positive and negative affect, and productivity. I examined information obtained on the screening questionnaire, Fitbit records, trait questionnaires, and daily state reports. Because of the number of comparisons, the *p*-value was set to < .003 to decrease the chances of making a Type 1 error.

***Students.*** There were no significant differences across groups or sessions on items reported on the screening questionnaire, including average amount of sleep, desired amount of sleep, or how realistic it would be to get more sleep. Sleep records as measured by the Fitbit revealed no significant baseline differences on any sleep-related records across groups or sessions. There were no baseline differences across groups or sessions on the measured variables assessed via the daily online questionnaires during Week 1.

From the battery of trait questionnaires, there were no significant differences on major study variables across groups. However, Session 4 differed significantly from the other three sessions on trait negative affect (*d*s range from .65 to 1.72 with the largest difference between Session 1 and Session 4, all $p < .003$). Within Session 4, there were no significant differences across training groups; however, because negative affect was involved in several study hypotheses, this session was evaluated separately from Sessions 1-3 to assess whether a different pattern of results emerged. In cases where similar

patterns across sessions were demonstrated despite these baseline differences, sessions were combined to boost statistical power. If Session 4 demonstrated a different pattern of results, it was noted in the results and presented separately from the other three sessions.

***Employees.*** There were no significant baseline differences across sessions or groups on screening questionnaire or baseline Fitbit data. There were significant differences on daily average morning fatigue and average positive affect, such that Session 4 had lower morning fatigue and higher positive affect compared to the other sessions; however, further examination revealed that these differences were likely driven by the difference in responses on early and late questionnaires. Neither across-session comparisons of on-time nor across-session comparisons of late questionnaires resulted in significant differences, suggesting that retrospective reports of subjective fatigue and affect resulted in a different response pattern. These differences were removed when missing and late data were imputed (see Appendix B).

On the battery of trait questionnaires administered during the first lab session, there were no significant differences across groups on major study variables. However, one significant difference emerged across sessions with participants in Session 3 reporting greater negative affect than those in Sessions 2 and 4 ($d$s = .88 and 1.61, respectively; all $p < .003$). When conducting analyses, this session was treated similarly to Session 4 from the student sample.

***Combined samples.*** Several analyses were conducted to evaluate differences between samples before combining them for hypothesis testing. First, there was a significant difference in age ($t$ (88) = 3.89, $p < .001$, $d$ = 1.93), with mean age of the employee sample of 36.08 (*S.D.* = 11.44) and the mean age of the students of 20.12 (*S.D.*

= 1.41). There was also a significant difference in time-of-day preferences, with the students demonstrating a greater preference for evenings than the employees ($t$ (88) = 3.89, $p < .001$, $d = .81$). This difference follows the expected shift in circadian rhythms from adolescence to adulthood (Taillard, Philip, Chastang, & Bioulac, 2004), and was not expected to have a differential impact on adherence to sleep duration goals. There were no other significant trait differences.

When looking at the Fitbit data, there were no baseline differences between the samples in how much time was spent in bed or spent sleeping during Week 1. However, on the daily questionnaires, the employee sample reported lower evening fatigue during Week 1 than the student group ($t$ (88) = 2.06, $p < .001$, $d = .43$). Due to these baseline differences, I compared the pattern of results from employees and students before combining samples. Because the patterns of results were similar for each hypothesis despite several baseline differences, samples were combined to boost statistical power and assess significance of results with a larger sample.

**Measures**

**Trait measures.** A description of the extant trait-level measures may be found in the measures section for the preliminary study. Table 8 contains information regarding these measures from the student, employee, and combined samples, including the mean, standard deviation, observed range, internal consistency reliability, and homogeneity estimate for each measure except the WPAI. Skewness ranged from -1.05 to .96 and kurtosis from -.82 to .95. These values were within acceptable range of what could be expected from a normal distribution, and the frequency plots for each variable did not indicate serious deviations from normality. Correlations among these trait measures are

*Table 8*. Descriptive Statistics, Observed Range, and Internal Consistency Reliabilities for Trait Measures from Experimental Studies

| | | | | **Students (*N* = 49)** | | | | **Employees (*N* = 41)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Measure** | # of Items | Expected α | Possible Range | Observed α (Qualitative Descriptor[a]) | Observed ω | Observed Range | *M (S.D.)* | Observed α (Qualitative Descriptor[a]) | Observed ω | Observed Range | *M (S.D.)* |
| **Time-of-Day Preferences and Sleep Behaviors** | | | | | | | | | | | |
| **Morningness-Eveningness** | 19 | .86 | 16 - 86 | .75 (Moderate) | .75 | 30-65 | 43.69 (7.31) | .85 (Excellent) | .81 | 30-68 | 50.90 (10.23) |
| **Sleep Quality** | 10 | .83 | 0 - 21 | .55 (Poor) | .73 | 4-13 | 7.88 (1.96) | .35 (Poor) | .45 | 4-15 | 7.93 (2.28) |
| **Sleepiness Scale** | 8 | .76 | 0 - 24 | .66 (Fair) | .75 | 2-15 | 8.51 (3.15) | .74 (Good) | .77 | 1-16 | 8.00 (3.83) |
| **Motivation** | | | | | | | | | | | |
| **Mastery-Approach** | 3 | .87 | 3 - 18 | .78 (Excellent) | .63 | 8-18 | 13.47 (2.49) | .74 (Excellent) | .62 | 10-18 | 15.05 (2.38) |
| **Mastery-Avoidance** | 3 | .89 | 3 - 18 | .67 (Moderate) | .26 | 5-17 | 12.24 (2.88) | .74 (Excellent) | .46 | 3-16 | 9.63 (3.25) |
| **Performance-Approach** | 3 | .92 | 3 - 18 | .91 (Excellent) | .56 | 3-18 | 12.80 (3.70) | .69 (Good) | .54 | 7-18 | 13.85 (2.51) |
| **Performance-Avoidance** | 3 | .83 | 3 - 18 | .80 (Excellent) | .42 | 3-18 | 12.51 (3.87) | .71 (Good) | .35 | 3-17 | 10.71 (3.78) |
| **Test Anxiety** | 4 | .75 | 6-24 | .84 (Excellent) | .52 | 4-24 | 14.20 (4.76) | .85 (Excellent) | .58 | 4-22 | 9.46 (4.32) |
| **Cognitive Strategy Use** | 13 | .83 | 13-78 | .66 (Poor) | .56 | 37-67 | 53.57 (6.84) | .67 (Poor) | .64 | 48-75 | 62.32 (5.89) |
| **Motivational Composite** | 16 | .72 | --[b] | .79 (Good) | .74 | --[b] | --[b] | .81 (Good) | .76 | --[b] | --[b] |
| **Personality** | | | | | | | | | | | |
| **Subjective fatigue** | 11 | .89 | 11 - 66 | .81 (Excellent) | .70 | 20-53 | 36.69 (7.70) | .86 (Excellent) | .69 | 14 – 52 | 35.44 (9.48) |

*Table 8 (continued)*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Positive Affect** | 9 | .90 | 9 - 72 | .84 (Excellent) | .63 | 21-63 | 45.04 (8.31) | .80 (Excellent) | .62 | 36 – 63 | 49.80 (7.33) |
| **Negative Affect** | 10 | .84 | 10 - 80 | .81 (Excellent) | .60 | 15-52 | 27.84 (8.94) | .84 (Excellent) | .75 | 11 – 42 | 23.20 (6.86) |
| **Conscientiousness Composite** | 57 | --[c] | --[b] | .89 (Excellent) | .83 | --[b] | --[b] | .91 (Excellent) | .87 | --[b] | --[b] |
| **Neuroticism Composite** | 19 | --[c] | --[b] | .91 (Excellent) | .87 | --[b] | --[b] | .89 (Excellent) | .85 | --[b] | --[b] |
| **Openness Composite** | 30 | --[c] | --[b] | .85 (Excellent) | .70 | --[b] | --[b] | .92 (Excellent) | .86 | --[b] | --[b] |
| **Perfectionism** | 17 | .76 | 17 - 102 | .86 (Excellent) | .74 | 20-51 | 36.06 (7.17) | .85 (Excellent) | .75 | 24 – 51 | 35.39 (6.75) |
| **IPIP Self-Regulation/ Self-Control** | 11 | .75 | 11 - 66 | .64 (Poor) | .52 | 28-59 | 42.78 (6.31) | .75 (Moderate) | .61 | 30 - 59 | 45.85 (7.13) |

| | | | | **Combined Samples ($N$ = 90)** | |
|---|---|---|---|---|---|
| **Measure** | # of Items | Expected α | Possible Range | Observed α (Qualitative Descriptor[a]) | Observed ω |
| **Time-of-Day Preferences and Sleep Behaviors** | | | | | |
| **Morningness-Eveningness** | 19 | .86 | 16 - 86 | .83 (Good) | .80 |
| **Sleep Quality** | 10 | .83 | 0 - 21 | .44 (Poor) | .91 |
| **Sleepiness Scale** | 8 | .76 | 0 - 24 | .70 (Moderate) | .76 |
| **Motivation** | | | | | |
| **Mastery-Approach** | 3 | .87 | 3 - 18 | .78 (Excellent) | .61 |
| **Mastery-Avoidance** | 3 | .89 | 3 - 18 | .73 (Good) | .25 |
| **Performance-Approach** | 3 | .92 | 3 - 18 | .84 (Excellent) | .56 |
| **Performance-Avoidance** | 3 | .83 | 3 - 18 | .76 (Excellent) | .39 |

*Table 8 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| **Test Anxiety** | 4 | .75 | 6-24 | .88 (Excellent) | .53 |
| **Cognitive Strategy Use** | 13 | .83 | 13-78 | .75 (Moderate) | .64 |
| **Motivational Composite** | 16 | .72 | --[b] | .89 (Excellent) | .83 |
| **Personality** | | | | | |
| **Subjective fatigue** | 11 | .89 | 11 - 66 | .84 (Excellent) | .70 |
| **Positive Affect** | 9 | .90 | 9 - 72 | .84 (Excellent) | .64 |
| **Negative Affect** | 10 | .84 | 10 - 80 | .83 (Excellent) | .66 |
| **Conscientiousness Composite** | 57 | --[c] | --[b] | .90 (Excellent) | .89 |
| **Neuroticism Composite** | 19 | --[c] | --[b] | .91 (Excellent) | .86 |
| **Openness Composite** | 30 | --[c] | --[b] | .89 (Excellent) | .88 |
| **Perfectionism** | 17 | .76 | 17 - 102 | .85 (Excellent) | .74 |
| **IPIP Self-Regulation/ Self-Control** | 11 | .75 | 11 - 66 | .70 (Moderate) | .57 |

*Note.* [a]Qualitative descriptions are provided by Ponterotto & Rockdeschel (2007) based on obtained alpha, *N*, and number of items. [b]Values not applicable for these scales. [c]Expected values for these scales were not known.

*Table 9*. Correlations among Trait Scales from Student Experimental Study

| | FAT | MEQ | MSF | PA | NA | MAP | MAV | PAP | PAV | TA | CSU | MOT | CON | NEU | OPEN | PER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FAT** | | | | | | | | | | | | | | | | |
| **MEQ** | -.36* | | | | | | | | | | | | | | | |
| **MSF** | .31 | -.28* | | | | | | | | | | | | | | |
| **PA** | -.45* | .34* | .03 | | | | | | | | | | | | | |
| **NA** | .38* | -.19 | .30* | -.04 | | | | | | | | | | | | |
| **MAP** | -.15 | .02 | .04 | .21 | .02 | | | | | | | | | | | |
| **MAV** | .14 | .21 | -.10 | .03 | ..22 | .36* | | | | | | | | | | |
| **PAP** | .19 | -.37* | .15 | -.19 | .33* | .26 | .08 | | | | | | | | | |
| **PAV** | .19 | .06 | .04 | -.11 | .22 | .11 | .51* | .27* | | | | | | | | |
| **TA** | .38* | .01 | .09 | -.22 | .39* | .26 | .60* | .20 | .54* | | | | | | | |
| **CSU** | -.08 | .23 | .03 | .32* | .09 | .29* | .39* | -.18 | .29* | .30* | | | | | | |
| **MOT** | -.17 | .00 | .00 | .27 | .00 | .42* | -.06 | .24 | -.11 | -.03 | .31* | | | | | |
| **CON** | -.36* | .31* | -.09 | .45* | -.35* | .34* | -.15 | -.23 | -.37* | -.26 | .21 | .47* | | | | |
| **NEU** | .52* | -.24 | .21 | -.51* | .55* | .13 | .22 | .46* | .39* | .46* | -.10 | -.03 | -.39* | | | |
| **OPEN** | -.18 | .20 | -.10 | .36* | .13 | .04 | -.11 | -.49* | -.22 | .02 | .40* | .32* | .36* | -.19 | | |
| **PER** | .02 | ..03 | .02 | .00 | .29 | .31* | .18 | .52* | .12 | .13 | .10 | .51* | .25 | .42* | -.09 | |
| **SRSC** | -.63* | .42* | -.09 | .35* | -.32* | .11 | -.13 | -.28* | -.26 | -.31* | .02 | .30* | .56* | -.36* | .26 | .15 |
| **DEC** | -.15 | .18 | .12 | .21 | -.12 | .36* | .06 | -.15 | -.18 | .13 | .09 | .20 | .58* | -.02 | .17 | .16 |
| **PRO** | -.58* | .42* | -.15 | .32* | -.33* | .40* | .02 | -.12 | -.28* | -.30* | .11 | .35* | .55* | -.27* | .13 | .12 |
| **EST** | -.35* | .48* | -.19 | .38* | -.06 | .34* | .20 | -.22 | -.03 | .21 | .47* | .36* | .54* | -.05 | .44* | .28* |
| **PLA** | -.16 | .39* | -.05 | .39* | .03 | .53* | .36* | -.17 | .01 | .25 | .60* | .48* | .49* | .06 | .46* | .38* |
| **STR** | -.44* | .44* | -.09 | .56* | -.02 | .58* | .11 | -.07 | -.13 | .01 | .25* | .45* | .65* | -.10 | .38* | .34* |
| **REV** | .01 | .16 | .01 | .32* | .25 | .35* | .22 | .05 | .13 | .41* | .49* | .47* | .37* | .17 | .42* | .40* |
| **SQ** | .30* | -.14 | -.02 | -.26 | .16 | -.06 | -.12 | .20 | .24 | .15 | -.11 | -.01 | -.17 | .33* | -.08 | .15 |
| **SLE** | .05 | -.01 | .30* | .09 | .16 | .23 | .02 | .19 | .08 | .05 | .12 | .14 | .06 | .07 | -.13 | .09 |

*Table 9 (continued)*

| | SRSC | DEC | PRO | EST | PLA | STR | REV | SQ |
|---|---|---|---|---|---|---|---|---|
| **SRSC** | | | | | | | | |
| **DEC** | .37* | | | | | | | |
| **PRO** | .53* | .28 | | | | | | |
| **EST** | .32* | .20 | .44* | | | | | |
| **PLA** | .21 | .24 | .51* | .81* | | | | |
| **STR** | .39* | .23 | .66* | .76* | .72* | | | |
| **REV** | -.01 | .22 | .17 | .73* | .74* | .57* | | |
| **SQ** | -.19 | -.02 | -.35* | -.11 | -.19 | -.18 | -.05 | |
| **SLE** | -.03 | .20 | .29* | .14 | .14 | .22 | .15 | -.09 |

*Note*. *N* = 49. FAT = Subjective fatigue. MEQ = Morningness-Eveningness. MSF = Mid-sleep time point on free days. PA = Positive affect. NA = Negative affect. MAP = Mastery approach. MAV = Mastery avoidance. PAP = Performance approach. PAV = Performance avoidance. TA = Text Anxiety. CSU = Cognitive Strategy Use. MOT = Motivational Composite. CON = Conscientiousness Composite. NEU = Neuroticism Composite. OPEN = Openness Composite. PER = Perfectionism. SRSC = IPIP Self-regulation/Self-control. DEC = Decisional self-control. PRO = Protracted self-control. EST = Goal establishment. PLA = Planning. STR = Goal striving. REV = Goal revision. SQ = Sleep quality. SLE = Sleepiness.

*Table 10*. Correlations among Trait Scales from Employee Experimental Study

| | FAT | MEQ | MSF | PA | NA | MAP | MAV | PAP | PAV | TA | CSU | MOT | CON | NEU | OPEN | PER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FAT** | | | | | | | | | | | | | | | | |
| **MEQ** | -.37* | | | | | | | | | | | | | | | |
| **MSF** | .17 | -.76* | | | | | | | | | | | | | | |
| **PA** | -.59* | .40* | -.24 | | | | | | | | | | | | | |
| **NA** | .34* | -.26 | .16 | -.12 | | | | | | | | | | | | |
| **MAP** | -.13 | .29 | -.34* | .18 | -.25 | | | | | | | | | | | |
| **MAV** | .25 | -.09 | .09 | -.07 | .11 | .33* | | | | | | | | | | |
| **PAP** | -.02 | -.01 | -.21 | -.01 | .21 | .32* | .30 | | | | | | | | | |
| **PAV** | .11 | .02 | .02 | -.13 | .07 | .17 | .30 | -.09 | | | | | | | | |
| **TA** | .35* | -.31* | .27 | -.42* | .25 | .03 | .45* | .22 | .53* | | | | | | | |
| **CSU** | -.11 | .31 | -.31 | .14 | -.34* | .48* | -.02 | .05 | .05 | -.12 | | | | | | |
| **MOT** | -.44* | .32* | -.33* | .43* | -.47* | .72* | .07 | .30 | -.19 | -.38* | .49* | | | | | |
| **CON** | -.46* | .20 | -.18 | .40* | -.38* | .19 | -.26 | .17 | -.37* | -.48* | .23 | .59* | | | | |
| **NEU** | .56* | -.36* | .11 | -.52* | .49* | -.03 | .24 | .17 | .17 | .51* | -.15 | -.36* | -.66* | | | |
| **OPEN** | -.13 | .20 | .01 | .45* | -.30 | .06 | -.08 | -.21 | -.06 | -.26 | .23 | .30 | .31* | -.35 | | |
| **PER** | -.03 | -.18 | .02 | -.18 | -.02 | .20 | .07 | .35* | -.11 | .07 | .26 | .21 | .38* | .20 | -.21 | |
| **SRSC** | -.19 | .28 | -.27 | .28 | -.13 | .29 | .15 | .40* | -.31* | -.18 | .25 | .50* | .51* | -.23 | .03 | .20 |
| **DEC** | -.15 | -.07 | -.04 | -.04 | -.28 | .16 | -.14 | .32* | -.16 | -.03 | .17 | .47* | .43* | -.24 | -.06 | .25 |
| **PRO** | -.35* | .20 | -.19 | .23 | -.21 | .16 | -.20 | .14 | -.45* | -.47 | -.02 | .44* | .50* | -.40* | -.06 | .02 |
| **EST** | -.05 | .16 | -.29 | .20 | -.12 | .64* | .15 | .11 | .11 | -.14 | .41* | .52* | .26 | -.02 | .27 | .13 |
| **PLA** | -.26 | .21 | -.25 | .18 | -.27 | .45* | -.02 | .25 | -.29 | -.27 | .50* | .62* | .63* | -.20 | .23 | .40* |
| **STR** | -.41* | .27 | -.27 | .46* | -.19 | .33* | -.11 | .18 | -.27 | -.44* | .36* | .58* | .56* | -.28 | .18 | .22 |
| **REV** | -.14 | .43* | -.42* | .31 | -.38* | .52* | .08 | .05 | -.07 | -.26 | .70* | .60* | .45* | -.23 | .37* | .27 |
| **SQ** | .14 | .05 | -.18 | -.20 | -.10 | .01 | .01 | .04 | .10 | -.06 | .06 | -.02 | -.24 | .19 | -.04 | -.31* |
| **SLE** | .49* | -.30 | .17 | -.22 | .26 | -.14 | -.03 | -.12 | -.03 | .12 | -.19 | -.26 | -.25 | .43* | -.04 | .00 |

*Table 10 (continued)*

| | SRSC | DEC | PRO | EST | PLA | STR | REV | SQ | SLE |
|---|---|---|---|---|---|---|---|---|---|
| **SRSC** | | | | | | | | | |
| **DEC** | .33* | | | | | | | | |
| **PRO** | .52* | .33* | | | | | | | |
| **EST** | .15 | -.01 | .16 | | | | | | |
| **PLA** | .46* | .27 | .44* | .63* | | | | | |
| **STR** | .51* | .21 | .62* | .49* | .72* | | | | |
| **REV** | .50* | .09 | .15 | .64* | .63* | .54* | | | |
| **SQ** | .06 | .09 | .14 | .06 | -.10 | .00 | -.03 | | |
| **SLE** | -.15 | -.09 | -.26 | .03 | -.18 | -.30 | -.20 | .17 | |

*Note*. *N* = 41. FAT = Subjective fatigue. MEQ = Morningness-Eveningness. MSF = Mid-sleep time point on free days. PA = Positive affect. NA = Negative affect. MAP = Mastery approach. MAV = Mastery avoidance. PAP = Performance approach. PAV = Performance avoidance. TA = Text Anxiety. CSU = Cognitive Strategy Use. MOT = Motivational Composite. CON = Conscientiousness Composite. NEU = Neuroticism Composite. OPEN = Openness Composite. PER = Perfectionism. SRSC = IPIP Self-regulation/Self-control. DEC = Decisional self-control. PRO = Protracted self-control. EST = Goal establishment. PLA = Planning. STR = Goal striving. REV = Goal revision. SQ = Sleep quality. SLE = Sleepiness.

*Table 11*. Correlations among Trait Scales from Combined Experimental Study Samples

| | FAT | MEQ | MSF | PA | NA | MAP | MAV | PAP | PAV | TA | CSU | MOT | CON | NEU | OPEN | PER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FAT** | | | | | | | | | | | | | | | | |
| **MEQ** | -.36* | | | | | | | | | | | | | | | |
| **MSF** | .23* | -.64* | | | | | | | | | | | | | | |
| **PA** | -.50* | .43* | -.25* | | | | | | | | | | | | | |
| **NA** | .36* | -.29* | -.35* | -.15 | | | | | | | | | | | | |
| **MAP** | -.15 | .26* | -.30* | .27* | -.16 | | | | | | | | | | | |
| **MAV** | .21* | -.12 | .25* | -.13 | .26* | .18* | | | | | | | | | | |
| **PAP** | .09 | -.12 | -.10 | -.08 | .23* | .31* | .08 | | | | | | | | | |
| **PAV** | .16 | -.06 | .17 | -.18 | .22* | .05 | .46* | .09 | | | | | | | | |
| **TA** | .35* | -.30* | .41* | -.39* | .42* | -.01 | .61* | .10 | .57* | | | | | | | |
| **CSU** | -.12 | .42* | -.43* | .36* | -.21* | .46* | -.07 | .01 | .02 | -.16 | | | | | | |
| **MOT** | -.28* | .35* | -.49* | .42* | -.30* | .60* | -.24* | .32* | -.25* | -.41* | .59* | | | | | |
| **CON** | -.41* | .31* | -.26* | .46* | -.40* | .33* | -.28* | -.04 | -.41* | -.42* | .31* | .53* | | | | |
| **NEU** | .52* | -.36* | .30* | -.55* | .56* | -.03 | .31* | .30* | .35* | .53* | -.26* | -.29* | -.52* | | | |
| **OPEN** | -.16 | .29* | -.23* | .45* | -.14 | .15 | -.21* | -.28* | -.20 | -.25* | .43* | .42* | .38* | -.32* | | |
| **PER** | .02 | -.09 | .05 | -.09 | .18 | .23* | .13 | .44* | .03 | .11 | .11 | .27* | .29* | .34* | -.15 | |
| **SRSC** | -.34* | .39* | -.28* | .36* | -.29* | .25* | -.08 | .02 | -.32* | -.32* | .23* | .44* | .56* | -.35* | .19 | .16 |
| **DEC** | -.14 | .09 | -.12 | .11 | -.29* | .29* | -.15 | .03 | -.23* | -.10 | .23* | .37* | .52* | -.19 | .10 | .13 |
| **PRO** | -.47* | .34* | -.24* | .32* | -.32* | .33* | -.15 | .00 | -.39* | -.41* | .15 | .41* | .54* | -.35* | .09 | .07 |
| **EST** | -.19 | .31* | -.28* | .36* | -.07 | .51* | .12 | -.07 | .02 | -.01 | .47* | .42* | .41* | -.07 | .40* | .23* |
| **PLA** | -.23* | .34* | -.26* | .34* | -.15 | .53* | .06 | .03 | -.18 | -.10 | .57* | .55* | .58* | -.12 | .39* | .37* |
| **STR** | -.42* | .38* | -.24* | .54* | -.12 | .51* | -.06 | .04 | -.22* | -.22* | .39* | .48* | .62* | -.21* | .32* | .28* |
| **REV** | -.08 | .36* | -.30* | .37* | -.05 | .47* | .03 | .09 | -.02 | .00 | .60* | .54* | .44* | -.06 | .44* | .32* |
| **SQ** | .21* | -.02 | -.09 | -.22* | -.05 | -.02 | -.04 | .08 | .09 | .09 | -.05 | -.02 | -.19 | .25* | -.05 | -.07 |
| **SLE** | .30* | -.19 | .23* | -.08 | .21* | .02 | .02 | .05 | .04 | .11 | -.06 | -.09 | -.11 | .23* | -.09 | .05 |

*Table 11 (continued)*

| | SRSC | DEC | PRO | EST | PLA | STR | REV | SQ | SLE |
|---|---|---|---|---|---|---|---|---|---|
| **SRSC** | | | | | | | | | |
| **DEC** | .35* | | | | | | | | |
| **PRO** | .54* | .33* | | | | | | | |
| **EST** | .23* | .14 | .34* | | | | | | |
| **PLA** | .37* | .29* | .50* | .74* | | | | | |
| **STR** | .46* | .25* | .65* | .67* | .72* | | | | |
| **REV** | .28* | .21* | .20 | .70* | .70* | .58* | | | |
| **SQ** | -.06 | .07 | -.11 | -.00 | -.14 | -.09 | -.04 | | |
| **SLE** | -.11 | -.01 | -.01 | .05 | -.05 | -.03 | -.04 | .05 | |

*Note*. *N* = 90. FAT = Subjective fatigue. MEQ = Morningness-Eveningness. MSF = Mid-sleep time point on free days. PA = Positive affect. NA = Negative affect. MAP = Mastery approach. MAV = Mastery avoidance. PAP = Performance approach. PAV = Performance avoidance. TA = Text Anxiety. CSU = Cognitive Strategy Use. MOT = Motivational Composite. CON = Conscientiousness Composite. NEU = Neuroticism Composite. OPEN = Openness Composite. PER = Perfectionism. SRSC = IPIP Self-regulation/Self-control. DEC = Decisional self-control. PRO = Protracted self-control. EST = Goal establishment. PLA = Planning. STR = Goal striving. REV = Goal revision. SQ = Sleep quality. SLE = Sleepiness.

displayed in Tables 9, 10, and 11 for the student, employee, and combined samples, respectively. Below, I provide information regarding the trait measures that were added based on findings from the preliminary study, along with the WPAI and the new measures of self-regulation and self-control.

***MSLQ.*** Four scales from the Motivated Strategies for Learning were administered, including test anxiety, cognitive strategy use, self-efficacy, and intrinsic values. Following the procedures of R. Kanfer et al. (1996), a motivational composite was formed by combining the self-efficacy and intrinsic values scales. The test anxiety scale and motivational composite had acceptable internal consistency reliability values and homogeneity estimates; however, the cognitive strategy use scale had a low alpha for the student and experimental studies ($\alpha$ = .66 and .67, respectively), which was labeled as "poor" for the number of items and *N* (Ponterotto & Ruckdeschel, 2007).

***MCQ.*** A second measure of time-of-day preferences was added to obtain a more accurate measurement of participants' chronotypes. The mid-sleep time points for week nights and weekend nights were calculated. These values were positively correlated with one another (*r*s = .39 and .66, $p < .05$), suggesting that sleep patterns during the week were moderately related to weekend sleep preferences for both samples. Additionally, the mid-sleep time point on weekends was negatively correlated with the MEQ ($r = -.64$, $p < .05$) for the combined sample, indicating that participants with greater morningness preferences reported earlier bed and waking times on weekends. These values provided evidence of convergent validity for the MCQ.

***WPAI.*** The WPAI was included to assess general productivity impairment attributable to insufficient sleep. Students reported spending between 4 and 80 hours (*M*

= 22.51, *S.D.* = 12.73) on academic obligations during the 7 days before the study started. On average, participants reported missing academic work due to lack of sleep for 1.51 (*S.D.* = 2.89) hours and missing academic work for other reasons (e.g., holidays, vacation) for .29 (*S.D.* = .87) hours. On a scale of 0 (*Lack of sleep had no effect)* to 10 (*Lack of sleep completely prevented me from…)*, students indicated that lack of sleep had a moderate effect on their schoolwork productivity (*M* = 5.00, *S.D.* = 2.04) and on their ability to engage in other activities (*M* = 4.41, *S.D.* = 2.15). During the week prior to the study, 6.11% of time that should have been spent on academic work was missed due to lack of sleep, and 1.09% of school time was missed due to other activities.

Employees reported working an average of 38.32 (*S.D.* = 16.27) hours during the 7 days before the study. On average, participants reported missing work due to lack of sleep for 1.07 (*S.D.* = 2.09) hours and missing work for other reasons (e.g., holidays, vacation) for 1.78 (*S.D.* = 3.77) hours. On a scale of 0 (*Lack of sleep had no effect)* to 10 (*Lack of sleep completely prevented me from…)*, employees indicated that lack of sleep had a moderate effect on their work productivity (*M* = 3.39, *S.D.* = 2.45) and on their engagement in other activities (*M* = 3.49, *S.D.* = 2.37). During the week before the study, 2.93% of time that should have been spent working was missed due to lack of sleep, and 4.56% of work time was missed due to other activities.

***New Self-Regulation and Self-Control Measures.*** Table 12 contains the scale characteristics for the new self-regulation and self-control measures and the IPIP self-regulation / self-control scale for comparison. Skewness ranged from -.10 to .27 and kurtosis from -.48 to .03 for the new measures. The internal consistency reliabilities all fell between .63 and .90. This range was greater than that observed in the preliminary

*Table 12*. Scale Characteristics of New Self-Regulation and Self-Control Measures in Experimental Studies at Time 1

| Scale | # of Items | Possible Range | Students (*N* = 49) | | | | | Employees (*N* = 41) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Observed Range | *M* *(S.D.)* | α | ω | Range of Item-Total Correlations | Observed Range | *M* *(S.D.)* | α | ω | Range of Item-Total Correlations |
| **Decisional Self-Control** | 7 | 7-42 | 20-39 | 28.51 (3.96) | .63[5] | .62 | .01 – .52 | 21-39 | 30.46 (4.08) | .66[4] | .62 | .17 – .58 |
| **Protracted Self-Control** | 12 | 12-72 | 21-62 | 42.98 (9.13) | .90[1] | .80 | .12 – .85 | 27-61 | 46.34 (8.67) | .87[1] | .77 | .34 – .76 |
| **Goal Establishment** | 9 | 9-54 | 27-48 | 36.91 (4.79) | .68[3] | .65 | .13 – .59 | 30-49 | 38.17 (4.38) | .67[4] | .69 | .02 – .66 |
| **Planning** | 13 | 13-78 | 40-71 | 55.32 (6.48) | .75[3] | .72 | .16 – .61 | 45-77 | 58.53 (7.13) | .81[2] | .77 | .19 – .64 |
| **Goal Striving** | 12 | 12-72 | 38-68 | 52.73 (7.12) | .85[1] | .81 | .31 – .70 | 41-66 | 55.07 (5.85) | .78[2] | .78 | -.04 – .68 |
| **Goal Revision** | 9 | 9-54 | 26-48 | 37.41 (5.15) | .73[2] | .67 | .30 – .61 | 31-54 | 40.07 (4.59) | .74[2] | .74 | .17 – .60 |
| **IPIP Self-Regulation / Self-Control** | 11 | 11-66 | 28-59 | 42.78 (6.31) | .64[5] | .52 | -.11 – .54 | 30-59 | 45.85 (7.13) | .75[3] | .61 | .19 – .64 |

*Table 12 (continued)*

| Scale | # of Items | Possible Range | Combined ($N$ = 90) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Observed Range | *M (S.D.)* | α | ω | Range of Item-Total Correlations |
| **Decisional Self-Control** | 7 | 7-42 | 20-39 | 29.40 (4.11) | .66[4] | .62 | .08 – .54 |
| **Protracted Self-Control** | 12 | 12-72 | 21-62 | 44.51 (9.03) | .88[1] | .78 | .25 – .80 |
| **Goal Establishment** | 9 | 9-54 | 27-49 | 37.89 (4.63) | .68[3] | .66 | .07 – .59 |
| **Planning** | 13 | 13-78 | 40-77 | 56.79 (6.94) | .79[2] | .75 | .25 – .65 |
| **Goal Striving** | 12 | 12-72 | 38-68 | 53.80 (6.64) | .82[2] | .80 | .32 – .70 |
| **Goal Revision** | 9 | 9-54 | 28-54 | 38.62 (5.05) | .74[2] | .71 | .29 – .60 |
| **IPIP Self-Regulation / Self-Control** | 11 | 11-66 | 28-59 | 44.18 (6.84) | .70[3] | .57 | .09 – .51 |

*Note.* Superscripts denote qualitative descriptions as provided by Ponterotto & Rockdeschel (2007) based on obtained alpha, *N*, and number of items as follows: [1] – Excellent, [2] – Good, [3] – Moderate, [4] – Fair, [5] – Poor.

study, in which the coefficient alphas were all above .80. These values were associated with qualitative descriptors of moderate or better for all but the decisional self-control scale across samples and the goal establishment scale in the employee sample. In comparison, the Cronbach's alpha value of the IPIP scale fell below the threshold for "fair" among the student sample. Additionally, the homogeneity estimates for the new scales across the samples were $\geq$.50 and were greater than those obtained for the IPIP scale. In sum, all but one of the new measures met or exceeded the reliability thresholds that I set across the samples for determining the adequacy of a measure. The IPIP scale also met the reliability criteria I set in two of the three samples.

For the student sample, correlations among the new scales ranged from .17 (*ns*) through .81 ($p < .05$), as shown in Table 9. The correlation between decisional and protracted self-control was .28 ($p = .06$). In an examination of convergent and discriminant validity of the new self-control scales, these subscales were positively related to the conscientiousness composite (*r*s = .54 and .55, respectively), and were not significantly correlated to the openness composite. The protracted scale was negatively related to the neuroticism composite ($r = -.27$, $p < .05$); however the decisional scale was not ($r = -.02$, *ns*). The correlations among self-regulation facets ranged from .57 to .81[4]. These scales were positively correlated with conscientiousness, (*r*s range from .37 to .65) and non-significantly related to sleepiness. However, they were not significantly related to the neuroticism composite (*r*s range from -.10 and .17, respectively), or the constituent scale of this composite, despite expectations of significant negative correlations.

[4] After correcting for attenuation, these values ranged from .72 to 1.11 with the strongest relationship between goal establishment and planning, similar to that found in the preliminary study. Values of .90 and greater indicate substantial overlap between constructs, to the point where the distinction between the two may not be meaningful.

For the employees, correlations among these scales ranged from -.01 (*ns*) through .72 ($p < .05$), as shown in Table 10. The correlation between decisional and protracted self-control was .33 ($p < .05$). Decisional and protracted self-control were positively related to the conscientiousness composite (*r*s = .43 and .50, respectively), and were not significantly correlated to the openness composite. The protracted scale was negatively related to the neuroticism composite ($r = -.40$, $p < .05$); however the decisional scale was not ($r = -.24$, *ns*). The correlations among self-regulation facets ranged from .49 to .72[5]. In an examination of convergent and discriminant validity, three of these scales were positively correlated with conscientiousness, (*r*s range from .45 to .63), with the goal establishment scale showing a similar trend ($r = .26$, *ns*). As expected, none of these scales were significantly related to sleepiness. However, they were expected to be negatively associated with the neuroticism composite but were not (*r*s ranged from -.02 and -.28). Overall, for both samples, the new self-regulation and self-control scales appeared to have the expected discriminant validity, but the convergent validity was demonstrated only in part.

**Training session measures.** Tables 13 through 16 summarize information from each intervention module of the training sessions from the student, employee, and combined samples, including goal establishment, planning, goal striving, and anticipating problems for participants who completed the training sessions. Participants did not fill out a worksheet for the revision module because revisions occurred once the self-regulation process began. Within samples, there were no significant differences across

[5] After correcting for attenuation, these values ranged from .67 to .91 with the strongest relationships between goal establishment and revision and also planning and goal striving. Again, values of .90 and greater indicate substantial overlap between constructs, to the point where the distinction between the two may not be meaningful.

*Table 13*. Goal Establishment Module of Training Intervention from Experimental Study

| Group | Item | Students | | Employees | |
|---|---|---|---|---|---|
| | | Min - Max | *M* *(S.D.)* | Min - Max | *M* *(S.D.)* |
| **Self-Regulation (*n* = 18 students; *n* = 13 employees)** | Current Average Amount of Sleep[a] | 300 – 480 | 410.28 (46.48) | 300 – 510 | 416.15 (57.05) |
| | Sleep Needed to feel Refreshed[a] | 420 - 690 | 501.67 (57.11) | 420 – 600 | 498.46 (48.28) |
| | Sleep Goal for Upcoming Week[a] | 420 – 600 | 485.56 (41.16) | 360 – 540 | 474.23 (46.45) |
| | Amount of Sleep Increase[a] | 30 – 120 | 75.28 (26.87) | 30 – 150 | 60.38 (33.94) |
| | Realistic Goal[b] | 4 – 5 | 4.94 (.24) | 4 – 6 | 5.31 (.63) |
| | Improvement to Current Status[b] | 5 – 6 | 5.56 (.51) | 5 – 6 | 5.69 (.48) |
| | Confidence in Goal Attainment[c] | 3 – 7 | 5.50 (.99) | 4 – 7 | 6.08 (.95) |
| **Self-Control (*n* = 16 students; *n* = 13 employees)** | Current Average Amount of Sleep[a] | 330 – 480 | 426.88 (37.63) | 300 – 510 | 384.23 (56.64) |
| | Sleep Needed to feel Refreshed[a] | 450 – 540 | 500.63 (28.40) | 405 – 560 | 469.17 (36.23) |
| | Sleep Goal for Upcoming Week[a] | 420 – 570 | 487.50 (37.15) | 390 – 510 | 444.23 (33.28) |
| | Amount of Sleep Increase[a] | 30 – 120 | 66.25 (26.17) | 30 – 90 | 62.31 (25.13) |
| | Realistic Goal[b] | 4 – 6 | 5.13 (.62) | 4 – 6 | 5.38 (.65) |
| | Improvement to Current Status[b] | 5 – 6 | 5.88 (.34) | 5 – 6 | 5.85 (.38) |

*Table 13 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| | Confidence in Goal Attainment[c] | 5 – 8 | 5.75 (.93) | 5 – 7 | 6.00 (.71) |
| **Control[d]** **(*n* = 5 students; *n* = 1 employee)** | Current Average Amount of Sleep[a] | 330 – 450 | 398.00 (47.65) | 480 | 480.00 (--[e]) |
| | Sleep Needed to feel Refreshed[a] | 420 – 540 | 480.00 (47.43) | 540 | 540.00 (--[e]) |
| | Sleep Goal for Upcoming Week[a] | 420 – 480 | 450.00 (30.00) | 510 | 510.00 (--[e]) |
| | Amount of Sleep Increase[a] | 30 – 90 | 52.00 (24.90) | 30 | 30.00 (--[e]) |
| | Realistic Goal[b] | 4 – 5 | 4.80 (.45) | 6 | 6.00 (--[e]) |
| | Improvement to Current Status[b] | 5 – 6 | 5.60 (.55) | 6 | 6.00 (--[e]) |
| | Confidence in Goal Attainment[c] | 6 – 7 | 6.20 (.45) | 8 | 8.00 (--[e]) |

| | | **Combined Samples** | |
|---|---|---|---|
| **Group** | **Item** | Min -Max | *M* *(S.D.)* |
| **Self-Regulation** **(*n* = 18 students; *n* = 13 employees)** | Current Average Amount of Sleep[a] | 300 – 510 | 412.74 (50.35) |
| | Sleep Needed to feel Refreshed[a] | 420 – 690 | 500.32 (52.76) |
| | Sleep Goal for Upcoming Week[a] | 360 – 600 | 480.81 (43.07) |
| | Amount of Sleep Increase[a] | 30 – 150 | 68.06 (32.13) |
| | Realistic Goal[b] | 4 – 6 | 5.10 (.47) |

*Table 13 (continued)*

| | | | |
|---|---|---|---|
| | Improvement to Current Status[b] | 5 – 6 | 5.61 (.50) |
| | Confidence in Goal Attainment[c] | 3 – 7 | 5.74 (.99) |
| **Self-Control (*n* = 16 students; *n* = 13 employees)** | Current Average Amount of Sleep[a] | 300 – 510 | 404.66 (47.13) |
| | Sleep Needed to feel Refreshed[a] | 405 – 560 | 488.21 (34.41) |
| | Sleep Goal for Upcoming Week[a] | 390 – 570 | 469.14 (40.27) |
| | Amount of Sleep Increase[a] | 30 – 120 | 64.48 (25.33) |
| | Realistic Goal[b] | 4 – 6 | 5.24 (.64) |
| | Improvement to Current Status[b] | 5 – 6 | 5.86 (.35) |
| | Confidence in Goal Attainment[c] | 5 - 8 | 5.86 (.83) |
| **Control[d] (*n* = 5 students; *n* = 1 employee)** | Current Average Amount of Sleep[a] | 330 – 480 | 411.67 (54.19) |
| | Sleep Needed to feel Refreshed[a] | 420 – 540 | 490.00 (48.99) |
| | Sleep Goal for Upcoming Week[a] | 420 – 510 | 460.00 (36.33) |
| | Amount of Sleep Increase[a] | 30 – 90 | 48.33 (24.01) |
| | Realistic Goal[b] | 4 – 6 | 5.00 (.63) |
| | Improvement to Current Status[b] | 5 – 6 | 5.67 (.52) |
| | Confidence in Goal Attainment[c] | 6 – 8 | 6.50 (.84) |

*Note.* [a]In minutes. [b]On a scale from 1 (*Strongly disagree*) to 6 (*Strongly agree*). [c]On a scale from 1 (*Not at all*) to 8 (*Extremely*). [d]From participants who completed the optional full training session at the end of Week 3. [e]This information was not available because the *n* for this group was 1.

*Table 14*. Planning Module of Training Intervention from Experimental Study

| Group | Plan | Sum of plans and ratings for Week 2 | | |
|---|---|---|---|---|
| | | **Students** | **Employees** | **Combined Samples** |
| **Self-Regulation (*n* = 18 students; *n* = 13 employees)** | | Sum of plan frequencies across Week 2 (% of *n* * 5) | | |
| | Go to bed earlier | 84 (93.3%) | 61 (94%) | 145 (93.5%) |
| | Go to bed later | 0 (0.00%) | 2 (3%) | 2 (1.29%) |
| | Go to bed at the same time | 6 (6.67%) | 2 (3%) | 8 (5.16%) |
| | Wake up earlier | 12 (13.30%) | 20 (31%) | 32 (20.64%) |
| | Wake up later | 27 (30.00%) | 14 (22%) | 41 (26.45%) |
| | Wake up at the same time | 51 (56.67%) | 31 (48%) | 82 (52.90%) |
| | | Mean ratings of plans (*S.D.*) | | |
| | Realistic plans[a] | 4.67 (.59) | 4.92 (.64) | 4.78 (.61) |
| | Confidence in plan follow-through[b] | 5.06 (1.16) | 6.54 (.78) | 5.73 (.99) |
| **Self-Control (*n* = 16 students; *n* = 13 employees)** | | Sum of plan frequencies across Week 2 (% of *n* * 5) | | |
| | Go to bed earlier | 71 (88.75%) | 56 (86%) | 127 (87.59%) |
| | Go to bed later | 0 (0%) | 5 (7.7%) | 5 (3.45%) |
| | Go to bed at the same time | 9 (11.25%) | 4 (6.15%) | 13 (8.97%) |
| | Wake up earlier | 16 (20%) | 14 (22%) | 30 (20.69%) |
| | Wake up later | 23 (28.75%) | 21 (32%) | 44 (30.34%) |

*Table 14 (continued)*

| | | | | |
|---|---|---|---|---|
| | Wake up at the same time | 41 (51.25%) | 30 (46%) | 71 (48.97%) |
| | | Mean ratings of plans (*S.D.*) | | |
| | Realistic plans[a] | 5.06 (.57) | 5.23 (.73) | 5.13 (.64) |
| | Confidence in plan follow-through[b] | 5.88 (1.09) | 6.54 (.78) | 6.18 (.95) |
| **Control[c] (*n* = 5 students; *n* = 1 employee)** | | Sum of plan frequencies across Week 2 (% of *n* * 5) | | |
| | Go to bed earlier | 21 (84%) | 5 (100%) | 26 (86.67%) |
| | Go to bed later | 0 (0%) | 0 (0%) | 0 (0%) |
| | Go to bed at the same time | 4 (16%) | 0 (0%) | 4 (13.33%) |
| | Wake up earlier | 2 (8%) | 0 (0%) | 2 (6.67%) |
| | Wake up later | 7 (28%) | 0 (0%) | 7 (23.33%) |
| | Wake up at the same time | 16 (64%) | 5 (100%) | 21 (70%) |
| | | Mean ratings of plans (*S.D.*) | | |
| | Realistic plans[a] | 4.60 (.55) | 6.00 (n/a) | 5.24 (.30) |
| | Confidence in plan follow-through[b] | 5.80 (.45) | 8.00 (n/a) | 6.80 (.25) |

*Note.* [a]On a scale of 1 (*Strongly disagree*) to 6 (*Strongly agree*). [b]On a scale of 1 (*Not at all*) to 8 (*Extremely*). [c]From participants who completed the optional full training session at the end of Week 3.

*Table 15*. Frequency of Strategies Listed and Mean Ratings of Confidence in Strategies during Goal Striving Module of Training Intervention from Experimental Studies

| | Students | | | |
|---|---|---|---|---|
| **Strategy** | Self-Regulation (*n* = 18) | Self-Control (*n* = 16) | Control[a] (*n* = 5) | Total[b] |
| **Time management related to daily work** | 17 | 11 | 6 | 34 |
| **Set a wind-down schedule and/or alarm** | 10 | 11 | 1 | 22 |
| **Limit technology before bed and/or during day** | 8 | 7 | 2 | 17 |
| **Limit caffeine and/or consume earlier in day** | 4 | 4 | 0 | 8 |
| **Finish exercise earlier in the day** | 3 | 4 | 1 | 8 |
| **Finish eating meals and/or drinking liquids earlier in the evening** | 5 | 2 | 1 | 8 |
| **Time management related to other (e.g., hobbies, chores)** | 3 | 2 | 2 | 7 |
| **Improve sleeping environment** | 2 | 3 | 0 | 5 |
| **Other (e.g., drink tea in the morning)** | 3 | 0 | 2 | 5 |
| **Time management related to family/ friends/ roommates** | 1 | 3 | 0 | 4 |
| **Exercise more often** | 0 | 2 | 0 | 2 |
| **Limit alcohol intake** | n/a | n/a | n/a | n/a |
| **Total** | 56 | 49 | 15 | 120 |
| **Confidence in strategy use[c]** | 5.89 (.83) | 5.88 (.96) | 5.60 (.55) | |

*Table 15 (continued)*

| Strategy | Employees | | | |
|---|---|---|---|---|
| | Self-Regulation ($n$ = 13) | Self-Control ($n$ = 13) | Control[a] ($n$ = 1) | Total[b] |
| **Time management related to daily work** | 1 | 5 | 0 | 6 |
| **Set a wind-down schedule and/or alarm** | 14 | 10 | 2 | 26 |
| **Limit technology before bed and/or during day** | 6 | 9 | 0 | 15 |
| **Limit caffeine and/or consume earlier in day** | 1 | 2 | 0 | 3 |
| **Finish exercise earlier in the day** | 3 | 0 | 0 | 3 |
| **Finish eating meals and/or drinking liquids earlier in the evening** | 2 | 2 | 0 | 4 |
| **Time management related to other (e.g., hobbies, chores)** | 9 | 6 | 0 | 15 |
| **Improve sleeping environment** | 2 | 0 | 0 | 2 |
| **Other (e.g., drink tea in the morning)** | 2 | 4 | 0 | 6 |
| **Time management related to family/ friends/ roommates** | 2 | 6 | 1 | 9 |
| **Exercise more often** | 0 | 0 | 0 | 0 |
| **Limit alcohol intake** | 1 | 0 | 0 | 1 |
| **Total** | 43 | 44 | 3 | 90 |
| **Confidence in strategy use[c]** | 5.92 (.76) | 6.31 (.86) | 8.00 (n/a) | |

*Note.* [a]From participants who completed the optional training at the end of the study. [b]In some cases, more than three strategies were listed; total number of strategies may exceed $n$*3. [c]On a scale from 1 (*Not at all*) to 8 (*Extremely*).

*Table 16*. Frequency of Anticipated Problems and Mean Ratings of Confidence in Self-Control Methods from Self-Control Module of Training Intervention from Experimental Studies

| **Problem** | **Students** | | | |
|---|---|---|---|---|
| | Self-Regulation[a] (*n* = 5) | Self-Control (*n* = 16) | Control[a] (*n* = 5) | Total Freq[b] |
| **Distractions from technology** | 4 | 9 | 3 | 16 |
| **Procrastinating strategies (e.g., homework, exercise, wind-down schedule)** | 2 | 10 | 2 | 14 |
| **More/unanticipated work** | 2 | 9 | 2 | 13 |
| **Distractions from friends/social activities** | 3 | 6 | 3 | 12 |
| **Not feeling tired** | 1 | 1 | 0 | 2 |
| **Spending more time than planned on hobbies** | 0 | 2 | 0 | 2 |
| **Other** | 0 | 1 | 0 | 1 |
| **Losing track of time** | 0 | 0 | 0 | 0 |
| **Distractions from family/home obligations** | 0 | 0 | 0 | 0 |
| **Total** | 12 | 38 | 10 | 60 |
| **Mean ratings of confidence in problems anticipated and methods of self-control (*S.D.*)** | | | | |
| **Problems anticipated[c]** | 5.60 (1.52) | 5.87 (.89) | 5.60 (.55) | |
| **Decisional self-control[d]** | 3.80 (1.79) | 5.31 (1.14) | 5.60 (1.52) | |
| **Protracted self-control[e]** | 5.80 (2.17) | 5.94 (.85) | 5.20 (2.17) | |

*Table 16 (continued)*

| Problem | Employees | | | |
|---|---|---|---|---|
| | Self-Regulation[a] (*n* = 6) | Self-Control (*n* = 13) | Control[a] (*n* = 1) | Total Freq[b] |
| **Distractions from technology** | 3 | 6 | 1 | 10 |
| **Procrastinating strategies (e.g., homework, exercise, wind-down schedule)** | 1 | 4 | 0 | 5 |
| **More/unanticipated work** | 3 | 4 | 0 | 7 |
| **Distractions from friends/social activities** | 2 | 4 | 0 | 6 |
| **Not feeling tired** | 1 | 0 | 0 | 1 |
| **Spending more time than planned on hobbies** | 1 | 2 | 0 | 3 |
| **Other** | 0 | 0 | 0 | 0 |
| **Losing track of time** | 1 | 1 | 0 | 2 |
| **Distractions from family/home obligations** | 1 | 1 | 1 | 3 |
| **Total** | 13 | 22 | 2 | 37 |
| **Mean ratings of confidence in problems anticipated and methods of self-control (*S.D.*)** | | | | |
| **Problems anticipated[c]** | 5.67 (1.51) | 6.15 (1.57) | 6.00 (n/a) | |
| **Decisional self-control[d]** | 4.83 (.98) | 6.38 (.87) | 8.00 (n/a) | |
| **Protracted self-control[e]** | 5.67 (.82) | 5.69 (1.32) | 7.00 (n/a) | |

*Table 16 (continued)*

*Note*. [a]From participants who completed optional trainings at the end of the study. [b]Participants were allowed to list multiple potential problems; total frequency of each problem could be as high as *n**3. [c]On a scale of 1 (*Not at all*) to 8 (*Extremely*), participants reported their confidence in having anticipated the majority of problems that could arise in the coming week. [d]On a scale of 1 (*Not at all*) to 8 (*Extremely*), participants reported their confidence in their abilities to implement decisional self-control when problems arise. [e]On a scale of 1 (*Not at all*) to 8 (*Extremely*), participants reported their confidence in their abilities to implement protracted self-control when problems arise.

groups on responses provided during the training sessions. Results from the knowledge test and training evaluation are included below.

***Knowledge test.*** At the end of the training sessions, all participants completed a brief knowledge test to assess whether the concepts presented were understood. The test given to the self-regulation group consisted of 10 multiple-choice items and the test given to the self-control group consisted of the same 10 items plus two additional items pertaining to the self-control module. This test took participants approximately five minutes to complete. Students and employees from both training groups, on average, scored over 90% and no participant scored below a 73%. Because all student and employee participants who participated in the training session during the study scored over a 70%, which has been used in academic settings as a cutoff value for passing a test, I concluded that all training participants understood the material that was presented during the interventions.

***Evaluation.*** Participants also completed a training evaluation at the end of each training session. The evaluation was comprised of 9 questions pertaining to the relevance of the content covered, the clarity of presentation, whether participants felt they could apply the training to reach their sleep goals, and whether participants would recommend the training to others. Responses were provided on a scale from 1 (*Strongly disagree*) to 6 (*Strongly agree*), with higher scores indicating a better evaluation of the training session. The average score was 5.06 (*S.D.* = .48) across student groups and 5.46 (*S.D.* = .31) across employee groups, indicating a positive evaluation of the training sessions.

**Daily measures.** In this section, I describe the results of the actigraph reports and the daily questionnaires that participants completed in the mornings and evenings

throughout the study. These questionnaires included subjective reports of states, sleep quality, and daily activities relevant to sleep such as caffeine intake and napping. Training groups were asked questions regarding revision of goals, plans, strategies, and/or methods each day during Week 2, and during Week 3, they were asked about goal revision only.

***Objective measure of sleep-wake behaviors.*** Actigraphy captures sleep habits through the measurement of movement in a particular limb, typically the wrist. Participants were asked to wear a Fitbit actigraph device on their wrist each night before a weekday during the study period. The Fitbit captured how long it took a person to fall asleep, how many times the person moved overnight, the length of time spent sleeping, and the length of time spent in bed. Tables 17, 18, and 19 display the descriptive statistics and test-retest reliabilities for all student, employee, and combined sample Fitbit measures across the study period broken down by group. There were no significant differences in baseline measures across groups for any sample. Test-retest reliabilities were expected to be small in magnitude, and the test-retest reliabilities for the measure of time spent sleeping, which was involved in several hypotheses, met the threshold of being statistically significant for all three weeks in the combined sample.

***Subjective measures of sleep-wake behavior.*** Recently, researchers have recommended the use of objective measures of sleep-wake behaviors over subjective measures, based on the mixed findings regarding the accuracy of subjective reports (Carney, Lajos, & Waters, 2004; Hagger, 2010; Lauderdale, Knutson, Yan, Liu, & Rathouz, 2008; Werner, Molinari, Guyer, & Jenni, 2008). In the present study, the measure of sleep duration as captured by the Fitbit was strongly correlated with students'

*Table 17*. Means, Standard Deviations, and Test-Retest Reliabilities for Actigraph Measures from Student Experimental Study

| | **Time Spent Sleeping (Min)** | | | **Time Spent in Bed (Min)** | | | **Time to Fall Asleep (Min)** | | | **# of Movements** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) |
| **Control (*n* = 15)** | 411.05 (74.47) | 402.71 (63.99) | 395.50 (73.70) | 453.60 (67.82) | 444.48 (63.15) | 437.00 (73.41) | 15.78 (9.76) | 15.89 (12.83) | 12.21 (4.54) | 10.88 (5.44) | 12.02 (5.40) | 12.27 (4.36) |
| **Self-Regulation Training Group (*n* = 18)** | 409.93 (45.17) | 433.30 (43.60) | 436.26 (43.24) | 444.80 (47.43) | 476.90 (46.18) | 473.96 (37.96) | 12.12 (5.17) | 18.34 (9.70) | 14.80 (6.18) | 9.88 (7.37) | 13.07 (6.75) | 13.10 (7.30) |
| **Self-Regulation/ Self-Control Training Group (*n* = 16)** | 421.59 (55.68) | 452.13 (57.06) | 431.78 (31.95) | 463.97 (82.59) | 493.84 (67.79) | 465.74 (57.74) | 15.89 (11.79) | 20.94 (16.08) | 16.26 (11.76) | 11.83 (5.05) | 12.16 (4.69) | 11.52 (5.17) |
| **Test-retest reliabilities (*n* = 49)** | *r* = .32 | *r* = .43 | *r* = .34 | *r* = .27 | *r* = .42 | *r* = .24 | *r* = .33 | *r* = .38 | *r* = .11 | *r* = .52 | *r* = .41 | *r* = .40 |

*Note.* Descriptive statistics and test-retest reliabilities are based on imputed data set. Reliabilities are based on *r*-to-*z* transformed correlation coefficients.

*Table 18*. Means, Standard Deviations, and Test-Retest Reliabilities for Actigraph Measures from Employee Experimental Study

| | **Time Spent Sleeping (Min)** | | | **Time Spent in Bed (Min)** | | | **Time to Fall Asleep (Min)** | | | **# of Movements** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) |
| **Control (*n* = 15)** | 425.29 (37.70) | 425.21 (44.44) | 389.31 (59.89) | 467.08 (42.46) | 467.57 (40.22) | 429.07 (61.83) | 13.79 (9.62) | 14.04 (10.54) | 12.41 (10.21) | 13.06 (7.20) | 11.82 (5.85) | 10.42 (5.02) |
| **Self-Regulation Training Group (*n* = 13)** | 412.51 (32.47) | 433.66 (24.31) | 414.93 (43.28) | 452.22 (36.34) | 469.10 (37.76) | 462.21 (53.15) | 11.82 (8.51) | 13.19 (6.37) | 11.47 (8.20) | 9.83 (4.45) | 10.56 (6.80) | 12.62 (8.00) |
| **Self-Regulation/ Self-Control Training Group (*n* = 13)** | 400.09 (39.54) | 416.09 (44.66) | 403.95 (45.50) | 433.65 (46.17) | 446.21 (42.99) | 441.59 (42.75) | 11.77 (9.81) | 11.63 (7.98) | 7.49 (3.20) | 10.28 (4.46) | 11.83 (6.01) | 11.54 (4.40) |
| **Test-retest reliabilities (*n* = 41)** | *r* = .29 | *r* = .16 | *r* = .19 | *r* = .30 | *r* = .10 | *r* = .23 | *r* = .44 | *r* = .20 | *r* = .25 | *r* = .46 | *r* = .47 | *r* = .56 |

*Note.* Descriptive statistics and test-retest reliabilities are based on imputed data set. Reliabilities are based on *r*-to-*z* transformed correlation coefficients.

*Table 19*. Means, Standard Deviations, and Test-Retest Reliabilities for Actigraph Measures from Combined Experimental Samples

| | **Time Spent Sleeping (Min)** | | | **Time Spent in Bed (Min)** | | | **Time to Fall Asleep (Min)** | | | **# of Movements** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) | Week 1 *M* (*S.D.*) | Week 2 *M* (*S.D.*) | Week 3 *M* (*S.D.*) |
| **Control (*n* = 30)** | 418.17 (58.44) | 413.96 (55.33) | 392.40 (66.06) | 460.34 (56.02) | 456.03 (53.33) | 433.04 (66.81) | 14.79 (9.58) | 14.96 (11.57) | 12.31 (7.77) | 11.97 (6.37) | 11.91 (5.53) | 11.34 (4.71) |
| **Self-Regulation Training Group (*n* = 31)** | 411.01 (39.74) | 433.45 (36.24) | 427.32 (43.86) | 447.91 (42.63) | 473.63 (42.36) | 469.03 (44.51) | 11.99 (6.64) | 16.18 (8.73) | 13.40 (7.17) | 9.86 (6.22) | 12.02 (6.78) | 12.89 (7.47) |
| **Self-Regulation/ Self-Control Training Group (*n* = 29)** | 411.95 (49.49) | 435.97 (54.14) | 419.30 (40.40) | 450.37 (54.95) | 472.49 (61.92) | 454.91 (52.14) | 14.04 (10.96) | 16.76 (13.71) | 12.33 (9.09) | 11.13 (4.78) | 12.01 (5.23) | 11.08 (4.78) |
| **Test-retest reliabilities (*n* = 90)** | *r* = .28 | *r* = .28 | *r* = .25 | *r* = .26 | *r* = .26 | *r* = .22 | *r* = .36 | *r* = .33 | *r* = .18 | *r* = .49 | *r* = .44 | *r* = .45 |

*Note.* Descriptive statistics and test-retest reliabilities are based on imputed data set. Reliabilities are based on *r*-to-*z* transformed correlation coefficients.

subjective reports of sleep-wake recall recorded on the daily questionnaires (*r*s = .74, .78, and .78 within Weeks 1 through 3, respectively), and with employees' subjective reports (*r* = .66, .71, and .53 within Weeks 1 through 3, respectively). Note that these associations may be inflated due to participants' ability to view actigraph measures on the Internet. Although participants were asked to use only their recall to respond to the online questionnaires, it is possible that some participants viewed the actigraph measure prior to taking the questionnaire and used that information to respond to the subjective recall items.

***Subjective reports of states, sleep quality, and daily activities relevant to sleep.*** Self-reported measures of fatigue, affect, sleep satisfaction, sleep quality, and technology use before bed and during sleep time were obtained on the morning questionnaire. The evening questionnaire included questions regarding fatigue, daily productivity, time spent napping during the day, and caffeine intake throughout the day. Tables 20 through 24 summarize the daily reports from the student, employee, and combined samples. Fisher's *r*-to-*z* transformation was implemented using the imputed data sets (see Appendix B) to obtain the test-retest reliabilities of the daily assessments.

***Intervention-related reports.*** Training groups were asked to report about each module of self-regulation and/or self-control each day. They first indicated whether or not they met their sleep duration goal. If the goal was met, they reported which plans, strategies, and/or self-control methods aided in meeting the sleep goal; if the goal was not met, they indicated what happened with their plans, strategies, and/or self-control methods. Tables 25 through 29 contain information from the daily reports of training-related information across groups and samples.

*Table 20*. Means, Standard Deviations, and Average Test-Retest Reliabilities for State Fatigue Measurement in Experimental Studies

| | | **Students (*n* = 49)** | | **Employees (*n* = 41)** | | **Combined Samples (*n* = 90)** | |
|---|---|---|---|---|---|---|---|
| **Time Point** | **Week** | *M (S.D.)* | Test-Retest Reliability | *M (S.D.)* | Test-Retest Reliability | *M (S.D.)* | Test-Retest Reliability |
| **Morning** | 1 | 3.19 (.78) | .59 | 3.05 (1.01) | .72 | 3.12 (.89) | .65 |
| | 2 | 2.94 (.79) | .53 | 2.85 (.68) | .67 | 2.90 (.74) | .56 |
| | 3 | 2.93 (.91) | .69 | 2.91 (.70) | .76 | 2.92 (.81) | .70 |
| | 1-3 | 3.02 (.83) | .58 | 2.94 (.80) | .57 | 2.98 (.81) | .56 |
| **Evening** | 1 | 3.36 (.77) | .52 | 3.00 (.75) | .50 | 3.19 (.78) | .51 |
| | 2 | 3.10 (.94) | .66 | 2.61 (.76) | .60 | 2.87 (.89) | .65 |
| | 3 | 3.17 (1.06) | .76 | 2.97 (.90) | .67 | 3.08 (.99) | .72 |
| | 1-3 | 3.21 (.92) | .60 | 2.86 (.80) | .50 | 3.05 (.89) | .57 |
| **Morning-Evening** | 1 | 3.27 (.74) | .52 | 3.03 (.77) | .36 | 3.16 (.76) | .44 |
| | 2 | 3.02 (.82) | .54 | 2.73 (.65) | .46 | 2.89 (.76) | .50 |
| | 3 | 3.05 (.94) | .65 | 2.94 (.69) | .39 | 2.99 (.83) | .54 |
| | 1-3 | 3.21 (.83) | .54 | 2.90 (.70) | .36 | 3.01 (.78) | .45 |

*Note.* Descriptive statistics and test-retest reliabilities are based on imputed data set. Reliabilities are based on *r*-to-*z* transformed correlation coefficients.

*Table 21.* Means, Standard Deviations, and Average Test-Retest Reliabilities for State Positive Affect and Negative Affect Measurement for Experimental Study Samples

| | | **Students (*n* = 49)** | | **Employees (*n* = 41)** | | **Combined Samples (*n* = 90)** | |
|---|---|---|---|---|---|---|---|
| **Measure** | **Week** | *M (S.D.)* | Test-Retest Reliability | *M (S.D.)* | Test-Retest Reliability | *M (S.D.)* | Test-Retest Reliability |
| **Positive Affect** | 1 | 2.86 (1.24) | .79 | 3.27 (1.50) | .75 | 3.04 (1.37) | .74 |
| | 2 | 2.73 (1.37) | .85 | 3.10 (1.38) | .77 | 2.90 (1.38) | .85 |
| | 3 | 2.75 (1.51) | .89 | 2.51 (.99) | .83 | 2.64 (1.30) | .89 |
| | 1-3 | 2.77 (1.32) | .79 | 2.96 (1.16) | .65 | 2.86 (1.35) | .79 |
| **Negative Affect** | 1 | 2.04 (.77) | .69 | 1.71 (.69) | .66 | 1.89 (.75) | .68 |
| | 2 | 1.82 (.66) | .62 | 1.61 (.59) | .64 | 1.72 (.63) | .61 |
| | 3 | 1.70 (.51) | .71 | 1.54 (.52) | .65 | 1.63 (.51) | .66 |
| | 1-3 | 1.85 (.60) | .60 | 1.62 (.57) | .63 | 1.75 (.59) | .60 |

*Note.* Descriptive statistics and test-retest reliabilities are based on imputed data set. Reliabilities are based on *r*-to-*z* transformed correlation coefficients. Positive and negative affect were assessed during the morning questionnaires.

*Table 22*. Means, Standard Deviations, and Test-Retest Reliabilities for Daily Productivity Impairment in Experimental Studies

| | | Students (*n* = 49) | | | Employees (*n* = 41) | | |
|---|---|---|---|---|---|---|---|
| **Measure** | **Week** | *M* *(S.D.)* | Min - Max | *r* | *M* *(S.D.)* | Min - Max | *r* |
| **Time spent on daily work**[a] | 1 | 336.50 (142.18) | 82.50 – 724.96 | .55 | 460.35 (97.10) | 215.88 – 713.75 | .33 |
| | 2 | 351.49 (142.37) | 90.00 – 692.50 | .57 | 474.69 (102.49) | 187.50 – 696.25 | .25 |
| | 3 | 328.96 (138.70) | 0.00 – 585.00 | .55 | 470.96 (108.37) | 219.00 – 625.00 | .35 |
| **Time missed from daily work**[a] | 1 | 18.13 (36.27) | 0.00 – 180.00 | .18 | 12.05 (23.48) | 0.00 – 75.00 | .26 |
| | 2 | 14.30 (24.79) | 0.00 – 135.00 | .37 | 11.61 (27.68) | 0.00 – 165.00 | .26 |
| | 3 | 14.02 (34.82) | 0.00 – 225.00 | .59 | 15.56 (30.06) | 0.00 – 112.40 | .10 |
| **Percentage of time missed from work due to lack of sleep** | 1 | 4.80 (9.54) | 0.00 – 46.00 | .31 | 2.50 (4.57) | 0.00 – 16.00 | .23 |
| | 2 | 4.40 (7.67) | 0.00 – 34.00 | .25 | 2.28 (5.58) | 0.00 – 33.00 | .16 |
| | 3 | 4.46 (1.24) | 0.00 – 78.00 | .69 | 3.49 (6.70) | 0.00 – 25.00 | .02 |
| **Daily work or academic productivity impaired by lack of sleep**[b] | 1 | 3.11 (1.99) | 0.00 – 8.50 | .53 | 2.50 (1.78) | 0.00 – 6.50 | .35 |
| | 2 | 2.98 (2.11) | 0.00 – 9.72 | .55 | 1.67 (1.79) | 0.00 – 7.21 | .48 |
| | 3 | 2.40 (2.11) | 0.00 – 8.75 | .61 | 1.81 (1.78) | 0.00 – 8.81 | .47 |

*Table 22 (continued)*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Other productivity impaired by lack of sleep[b]** | 1 | 2.70 (1.83) | 0.00 – 7.25 | .54 | 2.50 (2.09) | 0.00 – 8.75 | .57 |
| | 2 | 2.44 (1.97) | 0.00 – 9.40 | .52 | 1.77 (1.67) | 0.00 – 7.35 | .45 |
| | 3 | 2.04 (1.95) | 0.00 – 8.75 | .64 | 1.87 (1.90) | 0.00 – 8.75 | .45 |

| | | **Combined Samples (*n* = 90)** | | |
|---|---|---|---|---|
| **Measure** | **Week** | *M (S.D.)* | Min - Max | *r* |
| **Time spent on daily work[a]** | 1 | 411.01 (142.47) | 82.50 – 724.96 | .62 |
| | 2 | 407.61 (139.50) | 90,00 – 696.25 | .50 |
| | 3 | 393.65 (143.91) | 0.00 – 625.00 | .54 |
| **Time missed from daily work[a]** | 1 | 15.36 (31.09) | 0.00 – 180.00 | .17 |
| | 2 | 13.08 (26.03) | 0.00 – 165.00 | .31 |
| | 3 | 14.71 (32.57) | 0.00 – 225.00 | .25 |
| **Percentage of time missed from work due to lack of sleep** | 1 | 3.75 (7.37) | 0.00 – 46.00 | .31 |
| | 2 | 3.43 (6.84) | 0.00 – 34.00 | .25 |
| | 3 | 4.01 (10.16) | 0.00 – 78.00 | .70 |

*Table 22 (continued)*

| | | | | |
|---|---|---|---|---|
| **Daily work or academic productivity impaired by lack of sleep[b]** | 1 | 2.83 (1.91) | 0.00 – 8.50 | .45 |
| | 2 | 2.38 (2.07) | 0.00 – 9.72 | .54 |
| | 3 | 2.13 (1.98) | 0.00 – 8.81 | .54 |
| **Other productivity impaired by lack of sleep[b]** | 1 | 2.61 (1.94) | 0.00 – 8.75 | .55 |
| | 2 | 2.14 (1.86) | 0.00 – 9.40 | .52 |
| | 3 | 1.97 (1.91) | 0.00 – 8.75 | .53 |

*Note*. Values based on imputed data set. [a]Time in minutes. [b]Response scale ranged from 0 (*Had no effect*) to 10 (*Completely prevented me from doing work/other activities*).

*Table 23*. Means, Standard Deviations, and Test-Retest Reliabilities for Additional Daily Measures in Experimental Study Samples

| | | Students (*n* = 49) | | | Employees (*n* = 41) | | |
|---|---|---|---|---|---|---|---|
| **Measure** | **Week** | *M* (*S.D.*) | Min - Max | *r* | *M* (*S.D.*) | Min - Max | *r* |
| **Daily caffeine intake**[a] | 1 | 82.01 (83.20) | 0.00 – 360.00 | .61 | 136.04 (97.33) | 0.00 – 344.00 | .62 |
| | 2 | 82.20 (74.58) | 0.00 – 244.00 | .64 | 149.15 (98.65) | 0.00 – 365.49 | .69 |
| | 3 | 79.34 (12.66) | 0.00 – 302.68 | .71 | 145.32 (112.73) | 0.00 – 521.33 | .76 |
| **Time spent napping during the day**[b] | 1 | 16.15 (24.87) | 0.00 – 135.00 | .18 | 9.37 (3.14) | 0.00 – 93.00 | .21 |
| | 2 | 19.93 (32.19) | 0.00 – 132.00 | .22 | 13.04 (3.07) | 0.00 – 78.00 | .06 |
| | 3 | 16.11 (22.34) | 0.00 – 114.00 | .18 | 18.22 (4.40) | 0.00 – 135.93 | .22 |
| **Sleep Quality**[c] | 1 | 2.65 (.37) | 1.60 – 3.20 | .06 | 2.60 (.55) | 1.00 – 3.60 | .42 |
| | 2 | 2.77 (.38) | 1.60 – 3.60 | .12 | 2.75 (.39) | 1.40 – 3.80 | .21 |
| | 3 | 2.72 (.40) | 1.80 - 3.71 | .15 | 2.73 (.39) | 1.60 – 3.60 | .15 |
| **Sleep Satisfaction**[d] | 1 | 2.45 (.47) | 1.40 – 3.60 | .19 | 2.51 (.54) | 1.00 – 3.60 | .35 |
| | 2 | 2.69 (.42) | 1.60 – 3.60 | .13 | 2.73 (.47) | 1.40 – 3.60 | .28 |
| | 3 | 2.64 (.49) | 1.59 – 3.73 | .27 | 2.68 (.44) | 1.60 – 3.60 | .21 |

*Table 23 (continued)*

| | | Combined Samples (*n* = 90) | | |
|---|---|---|---|---|
| **Measure** | **Week** | *M* *(S.D.)* | Min - Max | *r* |
| **Daily caffeine intake**[a] | 1 | 106.63 (93.40) | 0.00 – 360.00 | .60 |
| | 2 | 112.70 (92.18) | 0.00 – 365.49 | .69 |
| | 3 | 109.40 (105.08) | 0.00 – 521.33 | .74 |
| **Time spent napping during the day**[b] | 1 | 13.06 (22.96) | 0.00 – 135.00 | .19 |
| | 2 | 16.79 (27.29) | 0.00 – 132.00 | .23 |
| | 3 | 17.07 (25.05) | 0.00 – 135.93 | .17 |
| **Sleep Quality**[c] | 1 | 2.63 (.46) | 1.00 – 3.60 | .23 |
| | 2 | 2.76 (.38) | 1.40 – 3.80 | .16 |
| | 3 | 2.72 (.39) | 1.60 - 3.71 | .14 |
| **Sleep Satisfaction**[d] | 1 | 2.50 (.50) | 1.00 – 3.60 | .25 |
| | 2 | 2.71 (.44) | 1.40 – 3.60 | .19 |
| | 3 | 2.65 (.47) | 1.59 – 3.73 | .24 |

*Note*. Values based on imputed data set. [a]In milligrams. [b]Time in minutes. [c]Response scale ranged from 1 (*Very bad*) to 4 (*Very good*). [d]Response scale ranged from 1 (*Very unsatisfied*) to 4 (*Very satisfied*).

*Table 24.* Frequency and Duration of Technology Use during the Hour before Bed across Weeks for Experimental Study Samples

| | | Students (*n* = 49) | | Employees (*n* = 41) | |
|---|---|---|---|---|---|
| **Type of Technology** | **Week** | Total Freq[a] | Duration[b] *M* (*S.D.*) | Total Freq[c] | Duration[b] *M* (*S.D.*) |
| **Music** | 1 | 34 | 7.83 (13.74) | 14 | 2.76 (6.10) |
| | 2 | 21 | 5.21 (11.43) | 3 | 0.22 (1.05) |
| | 3 | 19 | 4.56 (10.93) | 2 | 0.08 (0.49) |
| **Internet (non-homework or work related)** | 1 | 143 | 23.04 (17.99) | 109 | 15.84 (13.25) |
| | 2 | 104 | 19.52 (17.90) | 68 | 14.51 (14.61) |
| | 3 | 94 | 19.67 (20.21) | 71 | 15.54 (17.87) |
| **Texting on cell phone** | 1 | 88 | 8.90 (13.41) | 31 | 2.22 (4.74) |
| | 2 | 68 | 5.06 (6.51) | 11 | 0.86 (3.14) |
| | 3 | 48 | 5.58 (11.74) | 5 | 0.49 (1.46) |
| **Talking on cell phone** | 1 | 5 | .60 (2.05) | 24 | 3.28 (9.60) |
| | 2 | 6 | 1.08 (3.56) | 19 | 2.40 (6.04) |
| | 3 | 2 | .10 (.54) | 18 | 2.35 (6.79) |
| **Watching TV** | 1 | 70 | 14.55 (19.63) | 97 | 20.65 (18.41) |
| | 2 | 55 | 13.89 (18.51) | 79 | 21.90 (19.60) |
| | 3 | 51 | 14.84 (19.48) | 78 | 27.24 (21.13) |
| **Playing games** | 1 | 22 | 3.48 (7.18) | 13 | 1.02 (2.89) |
| | 2 | 11 | 1.36 (3.73) | 15 | 0.87 (2.70) |
| | 3 | 15 | 3.21 (9.91) | 11 | 1.82 (5.55) |

*Table 24 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| **Other** | 1 | 10 | 1.43 (3.94) | 19 | 3.00 (9.76) |
| | 2 | 11 | 1.90 (5.43) | 17 | 2.33 (7.43) |
| | 3 | 3 | .61 (3.67) | 14 | 1.72 (6.80) |

| | | **Combined Samples (*n* = 90)** | |
|---|---|---|---|
| **Type of Technology** | **Week** | Total Freq[d] | Duration[b] *M* (*S.D.*) |
| **Music** | 1 | 48 | 5.52 (10.26) |
| | 2 | 24 | 2.94 (6.70) |
| | 3 | 21 | 2.52 (6.17) |
| **Internet (non-homework or work related)** | 1 | 252 | 19.76 (15.83) |
| | 2 | 172 | 17.23 (16.40) |
| | 3 | 165 | 17.79 (19.14) |
| **Texting on cell phone** | 1 | 119 | 5.85 (9.46) |
| | 2 | 79 | 3.14 (4.97) |
| | 3 | 53 | 3.26 (7.06) |
| **Talking on cell phone** | 1 | 29 | 1.82 (5.49) |
| | 2 | 25 | 1.68 (4.69) |
| | 3 | 20 | 1.13 (3.39) |
| **Watching TV** | 1 | 167 | 17.33 (19.07) |
| | 2 | 134 | 17.54 (19.01) |

*Table 24 (continued)*

| | | | |
|---|---|---|---|
| **Watching TV** | 3 | 129 | 20.49 (20.23) |
| **Playing games** | 1 | 35 | 2.36 (5.23) |
| | 2 | 26 | 1.14 (3.26) |
| | 3 | 26 | 2.58 (7.92) |
| **Other** | 1 | 29 | 2.14 (6.59) |
| | 2 | 28 | 2.10 (6.34) |
| | 3 | 17 | 1.12 (5.10) |

*Note.* [a]Total number of possible frequencies of each type of technology was 245 (49*5 nights). [b]In minutes. [c]Total possible frequency of each type of technology was 205 per week (41*5 nights).

Reports of Week 2 Daily Differences between Actual Sleep Time and Goal Sleep Time for Training Groups for amples

| Students | | | | Employees | | | | Combined Samples | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *M* | *S.D.* | *33rd %ile* | *66th %ile* | *M* | *S.D.* | *33rd %ile* | *66th %ile* | *M* | *S.D.* | *33rd %ile* | *66th %ile* |
| -63.75 | 109.03 | -60.00 | -30.00 | -33.08 | 47.41 | -47.60 | -7.60 | -54.48 | 89.74 | -60.00 | -30.00 |
| -15.94 | 61.97 | -1.95 | 16.10 | 2.30 | 77.77 | 0.00 | 11.20 | -3.27 | 56.40 | -0.50 | 19.00 |
| -30.00 | 79.65 | -60.00 | 0.00 | -17.92 | 60.81 | -43.40 | -8.70 | -33.10 | 86.72 | -33.00 | 0.00 |
| -15.59 | 85.89 | -30.00 | 0.00 | -29.17 | 59.99 | -28.55 | 2.90 | -21.00 | 70.75 | -30.00 | 0.00 |
| -30.56 | 95.22 | -40.95 | 0.00 | -36.92 | 60.74 | -37.60 | 0.00 | -35.54 | 80.76 | -47.15 | 0.00 |
| -32.06 | 51.74 | -55.46 | -2.46 | -27.06 | 43.33 | -35.70 | -5.93 | -27.54 | 50.36 | -45.75 | -1.00 |
| -56.88 | 116.34 | -75.60 | 0.00 | -43.08 | 60.61 | -60.00 | -15.20 | -46.21 | 91.43 | -60.00 | -2.00 |
| -20.31 | 68.27 | -46.95 | 3.30 | 12.31 | 46.31 | -5.70 | 23.60 | -10.17 | 72.25 | -16.50 | 8.00 |
| -20.63 | 114.54 | -20.85 | 2.20 | -37.50 | 99.40 | -30.00 | -6.30 | -19.46 | 93.79 | -21.45 | 1.40 |
| -14.06 | 64.76 | -60.00 | 2.20 | -28.08 | 46.53 | -47.60 | 12.60 | -20.54 | 62.08 | -42.90 | 0.70 |
| -27.67 | 61.35 | -30.00 | -2.20 | -44.50 | 47.98 | -80.55 | -22.20 | -31.96 | 60.11 | -30.00 | 0.00 |
| -27.66 | 37.42 | -49.56 | -14.46 | -23.37 | 30.63 | -41.90 | -3.80 | -25.58 | 34.11 | -45.27 | -9.72 |

nutes. Negative values indicate less sleep than sleep goal. Positive values indicate more sleep than sleep goal.

*Table 26*. Total Frequencies and Percentages of Week 2 Plan Implementation and Interference for Experimental Study Samples

| | | **Sleep Goal Met[a]** | | **Sleep Goal Not Met[b]** | | | |
|---|---|---|---|---|---|---|---|
| **Sample** | **Group** | Sleep *Freq* (%[c]) | Woke *Freq* (%[c]) | Late *Freq* (%[c]) | Early *Freq* (%[c]) | Int *Freq* (%[c]) | Fol *Freq* (%[c]) |
| **Students** | **Self-Regulation (*n* = 18)** | 30 (73%) | 19 (46%) | 30 (61%) | 9 (18%) | 13 (27%) | 7 (14%) |
| | **Self-Control (*n* = 16)** | 23 (62%) | 20 (54%) | 27 (63%) | 5 (12%) | 11 (26%) | 6 (14%) |
| **Employees** | **Self-Regulation (*n* = 13)** | 19 (76%) | 9 (36%) | 25 (63%) | 4 (10%) | 7 (18%) | 6 (15%) |
| | **Self-Control (*n* = 13)** | 22 (65%) | 23 (68%) | 17 (55%) | 7 (23%) | 13 (42%) | 2 (6%) |
| **Combined Samples** | **Self-Regulation (*n* = 31)** | 49 (74%) | 28 (42%) | 55 (62%) | 13 (15%) | 20 (22%) | 13 (15%) |
| | **Self-Control (*n* = 29)** | 55 (77%) | 43 (61%) | 44 (59%) | 12 (16%) | 24 (32%) | 8 (11%) |

*Note.* Participants could endorse both options when goals were met and up to all four options when goals were not met. Sleep = Went to sleep at the planned time. Late = Woke up at the planned time. Woke = Went to sleep later than planned. Early = Woke up earlier than planned. Int = Someone or something else interfered with implementation of sleep plans. Fol = Followed through with plans but still was not able to reach goal sleep time. [a]When the sleep goal was met, which plans were helpful in reaching the goal. [b]When the sleep goal was not met, what happened with plans to get into bed and out of bed at certain times. [c]Percentages based on number of nights goals were and were not met, respectively.

*Table 27*. Frequency of Strategy Use and Means of Strategy Effectiveness for Experimental Study Samples during Week 2

| | | Sleep Goal Met[a] | | | |
|---|---|---|---|---|---|
| **Sample** | **Group** | 1 Strategy<br>Freq (%[c]) | 2 Strategies<br>Freq (%[c]) | 3 Strategies<br>Freq (%[c]) | Strategy Effectiveness[d]<br>*M* (*S.D.*) |
| **Student** | **Self-Regulation (*n* = 18)** | 18 (44%) | 13 (32%) | 10 (24%) | 5.57 (1.60) |
| | **Self-Control (*n* = 16)** | 13 (35%) | 19 (51%) | 5 (16%) | 5.77 (.75) |
| **Employee** | **Self-Regulation (*n* = 13)** | 8 (30%) | 11 (42%) | 10 (38%) | 6.08 (1.24) |
| | **Self-Control (*n* = 13)** | 10 (30%) | 10 (30%) | 13 (43%) | 6.08 (1.33) |
| **Combined Samples** | **Self-Regulation (*n* = 31)** | 26 (39%) | 24 (36%) | 20 (30%) | 5.80 (1.44) |
| | **Self-Control (*n* = 29)** | 23 (33%) | 29 (41%) | 18 (26%) | 5.91 (1.01) |

*Table 27 (continued)*

| | | Sleep Goal Not Met[b] | | | | | |
|---|---|---|---|---|---|---|---|
| **Sample** | **Group** | Strategies did not work<br>Freq (%[e]) | Did not use strategies<br>Freq (%[e]) | Could not have used strategies<br>Freq (%[e]) | Intend to revise strategies<br>Freq (%[e]) | Other<br>Freq (%[e]) | Strategy Effectiveness[d]<br>*M* (*S.D.*) |
| **Student** | **Self-Regulation (*n* = 18)** | 68 (46%) | 49 (33%) | 7 (5%) | 1(1%) | 3 (2%) | 3.91 (1.49) |
| | **Self-Control (*n* = 16)** | 55 (43%) | 41 (32%) | 24 (19%) | 2 (2%) | 0 (0%) | 4.60 (1.66) |
| **Employee** | **Self-Regulation (*n* = 13)** | 47 (40%) | 21 (18%) | 14 (12%) | 0 (0%) | 11 (9%) | 4.40 (2.25) |
| | **Self-Control (*n* = 13)** | 41(43%) | 27 (28%) | 15 (16%) | 4 (4%) | 1 (1%) | 4.49 (1.40) |
| **Combined Samples** | **Self-Regulation (*n* = 31)** | 115 (43%) | 70 (26%) | 21 (7%) | 1 (.37%) | 14 (5%) | 4.13 (1.84) |

*Table 27 (continued)*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Self-Control (*n* = 29)** | 96 (43%) | 68 (30%) | 39 (17%) | 6 (3%) | 1 (.44%) | 4.55 (1.54) |

*Note.* [a]When the sleep goal was met, which strategies were helpful in reaching the goal. [b]When the sleep goal was not met, what happened with strategies to help get into bed and out of bed at certain times. [c]Percentage out of total number of times sleep goal was reached during Week 2. [d]On a scale of 1 (*Not at all*) to 8 (*Extremely*). [e]Percentage out of total number of times sleep goal was not reached during Week 2 times three strategies.

*Table 28*. Frequency of Anticipated Problems and Using Self-Control Methods from Self-Control Training Groups in Experimental Study Samples during Week 2

| | | **Sleep Goal Met**[a] | | |
|---|---|---|---|---|
| **Group** | Problem(s) Not Encountered | Problem(s) encountered and methods helped attain sleep goal | | |
| | Freq (%[c]) | Method 1 Used<br>Freq (%[d]) | Method 2 Used<br>Freq (%[d]) | Both Methods Used<br>Freq (%[d]) |
| **Student Self-Control**<br>**(*n* = 16)** | 37 (46%) | 8 (22%) | 8 (22%) | 9 (24%) |
| **Employee Self-Control**<br>**(*n* = 13)** | 20 (31%) | 8 (24%) | 3 (9%) | 11 (33%) |
| **Combined Sample Self-Control**<br>**(*n* = 29)** | 57 (39%) | 16 (23%) | 11 (15%) | 20 (29%) |

*Table 28 (continued)*

| | | **Sleep Goal Not Met[b]** | | | | |
|---|---|---|---|---|---|---|
| **Group** | Problem(s) Not Encountered | Problem(s) Encountered and were part of the reason sleep goal was not met | | | | |
| | Freq (%[c]) | Method(s) used but did not work<br>Freq (%[e]) | Could have used method(s) but did not<br>Freq (%[e]) | Could not have used method(s)<br>Freq (%[e]) | Intend to revise method(s)<br>Freq (%[e]) | Other<br>Freq (%[e]) |
| **Student Self-Control (*n* = 16)** | 37 (46%) | 12 (28%) | 12 (28%) | 7 (16%) | 1 (2%) | 0 (0%) |
| **Employee Self-Control (*n* = 13)** | 20 (31%) | 14 (44%) | 18 (56%) | 5 (14%) | 8 (22%) | 0 (0%) |
| **Combined Sample Self-Control (*n* = 29)** | 57 (39%) | 26 (36%) | 30 (42%) | 12 (15%) | 9 (12%) | 0 (0%) |

*Note.* [a]When the sleep goal was met, which methods of self-control were helpful in reaching the goal. [b]When the sleep goal was not met, what happened with self-control methods. [c]Percentage of total nights for all participants. [d]Percentage of total nights that sleep goal was met for all participants. [e]Percentage of total nights that sleep goal was not met for all participants.

*Table 29*. Revision Reports from Training Groups in Experimental Studies during Weeks 2 and 3

| | | | Students | | | | Employees | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Week** | **Day** | Revise Goal *Freq* | Revise Plans *Freq* | Revise Strategies *Freq* | Revise Methods *Freq* | Revise Goal *Freq* | Revise Plans *Freq* | Revise Strategies *Freq* | Revise Methods *Freq* |
| **Self-Regulation (*n* = 18 students; *n* = 13 employees)** | 2 | 2 | 2 | 1 | 2 | -- | 1 | 2 | 0 | -- |
| | | 3 | 3 | 1 | 0 | -- | 5 | 3 | 1 | -- |
| | | 4 | 2 | 1 | 1 | -- | 1 | 2 | 0 | -- |
| | | 5 | 3 | 1 | 0 | -- | 1 | 1 | 1 | -- |
| | | Sum | 10 | 4 | 3 | -- | 8 | 8 | 2 | -- |
| | 3 | 1 | 2 | -- | -- | -- | 2 | -- | -- | -- |
| | | 2 | 5 | -- | -- | -- | 2 | -- | -- | -- |
| | | 3 | 2 | -- | -- | -- | 2 | -- | -- | -- |
| | | 4 | 1 | -- | -- | -- | 1 | -- | -- | -- |
| | | 5 | 1 | -- | -- | -- | 0 | -- | -- | -- |
| | | Sum | 11 | -- | -- | -- | 7 | -- | -- | -- |
| **Self-Control (*n* = 16 students; *n* = 13 employees)** | 2 | 2 | 3 | 0 | 0 | 1 | 3 | 1 | 0 | 0 |
| | | 3 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 0 |
| | | 4 | 2 | 1 | 0 | 0 | 2 | 0 | 1 | 0 |
| | | 5 | 3 | 1 | 0 | 0 | 3 | 1 | 1 | 0 |
| | | Sum | 10 | 2 | 0 | 1 | 10 | 3 | 2 | 0 |
| | 3 | 1 | 2 | -- | -- | -- | 0 | -- | -- | -- |
| | | 2 | 3 | -- | -- | -- | 0 | -- | -- | -- |
| | | 3 | 4 | -- | -- | -- | 0 | -- | -- | -- |
| | | 4 | 0 | -- | -- | -- | 0 | -- | -- | -- |

*Table 29 (continued)*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5 | 4 | -- | -- | -- | 0 | -- | -- | -- |
| | Sum | 13 | -- | -- | -- | 0 | -- | -- | -- |

| | | | Combined Samples | | | |
|---|---|---|---|---|---|---|
| **Group** | **Week** | **Day** | Revise Goal *Freq* | Revise Plans *Freq* | Revise Strategies *Freq* | Revise Methods *Freq* |
| **Self-Regulation (*n* = 18 students; *n* = 13 employees)** | 2 | 2 | 3 | 3 | 2 | -- |
| | | 3 | 8 | 4 | 1 | -- |
| | | 4 | 3 | 3 | 1 | -- |
| | | 5 | 4 | 2 | 1 | -- |
| | | Sum | 18 | 12 | 5 | -- |
| | 3 | 1 | 4 | -- | -- | -- |
| | | 2 | 7 | -- | -- | -- |
| | | 3 | 4 | -- | -- | -- |
| | | 4 | 2 | -- | -- | -- |
| | | 5 | 1 | -- | -- | -- |
| | | Sum | 18 | -- | -- | -- |
| **Self-Control (*n* = 16 students; *n* = 13 employees)** | 2 | 2 | 6 | 1 | 0 | 1 |
| | | 3 | 4 | 1 | 0 | 0 |
| | | 4 | 4 | 1 | 1 | 0 |
| | | 5 | 6 | 2 | 1 | 0 |
| | | Sum | 20 | 5 | 2 | 1 |
| | 3 | 1 | 2 | -- | -- | -- |
| | | 2 | 3 | -- | -- | -- |

*Table 29 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| | 3 | 4 | -- | -- | -- |
| | 4 | 0 | -- | -- | -- |
| | 5 | 4 | -- | -- | -- |
| | Sum | 13 | -- | -- | -- |

*Note*. Dash marks indicate that those revision questions were not posed to that group at that time.

To summarize the contents of these tables, in the combined sample, one-third of training participants reported meeting their sleep goals on four of the five nights during Week 2. When goals were met, participants reported that they went to sleep at the planned time more often than waking up at the planned time, and that they used all three strategies with similar frequency. Problems that required self-control arose approximately 60% of the time, and the use of both self-control methods was reported with the greatest frequency when goals were met. When goals were not met, participants reported going to bed later than planned with the greatest frequency, and that the strategies they devised did not work for them. When problems arose that required self-control, participants reported that they could have used their self-control methods but did not with the greatest frequency.

**Final questionnaire.** At the end of the study, participants completed a final questionnaire regarding their experience in the study. One employee participant did not complete the final questionnaire. All participants were asked about their experience using the actigraphs. They were also asked to retrospectively report general sleep-wake information from the past three weeks, including sleep time, sleep quality, sleep satisfaction, and nap time. Training groups reported their satisfaction with the training they received, and whether they felt the skills learned could be applicable to academic and interpersonal domains. All participants were asked whether they would participate if no compensation were provided. Tables 30 and 31 display the descriptive statistics of these reports, including the averages across all three groups and averages of just the training groups. There were no significant differences across training groups on the ratings provided except for those noted below.

*Table 30*. Retrospective Evaluation of Training Sessions and Actigraph over the Study Period for Experimental Study Samples

| Item | Students | | | | | Employees | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Training Group | | | Averages | | Training Group | | | Averages | |
| | Control ($n$ = 15) $M$ (*S.D.*) | SR ($n$ = 18) $M$ (*S.D.*) | SC ($n$ = 16) $M$ (*S.D.*) | All Groups $M$ (*S.D.*) | Training Groups $M$ (*S.D.*) | Control ($n$ = 13) $M$ (*S.D.*) | SR ($n$ = 13) $M$ (*S.D.*) | SC ($n$ = 13) $M$ (*S.D.*) | All Groups $M$ (*S.D.*) | Training Groups $M$ (*S.D.*) |
| **Satisfaction with Fitbit**[a] | 6.73 (.70) | 6.56 (.86) | 6.94 (.93) | 6.73 (.84) | 6.74 (.90) | 6.50 (1.40) | 6.31 (1.75) | 6.23 (1.24) | 6.35 (1.44) | 6.27 (1.49) |
| **Use Actigraph in the Future**[a] | 2.93 (1.22) | 3.78 (1.77) | 4.00 (2.25) | 3.59 (1.83) | 3.88 (1.98) | 4.00 (2.54) | 4.92 (2.22) | 5.15 (2.30) | 4.68 (2.36) | 5.04 (2.22) |
| **Recommend Fitbit**[a] | 6.40 (1.35) | 6.72 (1.07) | 6.00 (1.75) | 6.39 (1.41) | 6.38 (1.46) | 6.57 (1.70) | 6.31 (2.14) | 5.92 (2.14) | 6.27 (1.96) | 6.12 (2.10) |
| **Training Satisfaction**[a] | --[c] | 5.78 (1.35) | 5.75 (1.48) | --[d] | 5.76 (1.39) | --[c] | 6.31 (1.44) | 6.38 (.65) | --[d] | 6.35 (1.09) |
| **Recommend Training**[a] | --[c] | 5.39 (1.50) | 5.19 (1.60) | --[d] | 5.29 (1.53) | --[c] | 5.69 (2.21) | 6.23 (1.42) | --[d] | 5.96 (1.84) |
| **Training Assisted in Reaching Sleep Goals**[b] | --[c] | 4.56 (.92) | 4.13 (.81) | --[d] | 4.35 (.88) | --[c] | 4.08 (1.44) | 5.00 (1.00) | --[d] | 4.54 (1.30) |
| **Apply Training to Academic Endeavors**[b] | --[c] | 4.17 (1.02) | 4.23 (.84) | --[d] | 4.19 (.93) | --[c] | 4.28 (1.09) | 4.46 (1.39) | --[d] | 4.36 (1.23) |
| **Apply Training to Interpersonal Endeavors**[b] | --[c] | 3.93 (1.12) | 4.00 (1.18) | --[d] | 3.96 (1.13) | --[c] | 4.33 (1.15) | 4.31 (1.65) | --[d] | 4.32 (1.40) |

*Table 30 (continued)*

| Item | Students | | | | | Employees | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Training Group | | | Averages | | Training Group | | | Averages | |
| | Control ($n$ = 15) *M* (*S.D.*) | SR ($n$ = 18) *M* (*S.D.*) | SC ($n$ = 16) *M* (*S.D.*) | All Groups *M* (*S.D.*) | Training Groups *M* (*S.D.*) | Control ($n$ = 13) *M* (*S.D.*) | SR ($n$ = 13) *M* (*S.D.*) | SC ($n$ = 13) *M* (*S.D.*) | All Groups *M* (*S.D.*) | Training Groups *M* (*S.D.*) |
| **Participate without Compensation**[a] | 2.53 (1.41) | 3.50 (1.38) | 4.13 (1.63) | 3.41 (1.58) | 3.79 (1.51) | 6.23 (1.69) | 6.23 (1.83) | 5.69 (2.21) | 6.05 (1.89) | 5.96 (2.01) |

*Note*. SR = Self-regulation training group. SC = Combined self-regulation and self-control training group. [a]Responses provided on a scale of 1 (*Not at all*) to 8 (*Extremely*). [b]Responses provided on a scale of 1 (*Strongly disagree*) to 6 (*Strongly agree*). [c]Questions not posed to this group. [d]Could not average across all groups.

*Table 31*. Retrospective Reports of Sleep-Wake Information for the Experimental Study Samples

| | Students | | | | |
|---|---|---|---|---|---|
| | Training Group | | | Averages | |
| **Item** | Control ($n$ = 15) $M$ (*S.D.*) | SR ($n$ = 18) $M$ (*S.D.*) | SC ($n$ = 16) $M$ (*S.D.*) | All Groups $M$ (*S.D.*) | Training Groups $M$ (*S.D.*) |
| **Sleep Time Wk1**[a] | 406.00 (73.37) | 424.44 (43.69) | 441.44 (112.20) | 424.35 (79.89) | 432.44 (82.34) |
| **Sleep Time Wk2**[a] | 408.00 (70.63) | 463.06 (43.02) | 481.94 (100.78) | 452.37 (78.96) | 471.94 (75.25) |
| **Sleep Time Wk3**[a] | 416.00 (65.01) | 463.28 (51.56) | 471.50 (117.09) | 451.49 (83.89) | 467.15 (87.29) |
| **Nap Time Wk1**[a] **(*n* = 5)** | 60.00 (73.49) | 112.50 (37.75) | 30.00 (45.00) | 60.00 (60.75) | 60.00 (58.10) |
| **Nap Time Wk2**[a] **(*n* = 4)** | 72.00 (65.73) | 22.50 (28.72) | 55.00 (47.17) | 52.19 (50.76) | 43.18 (43.03) |
| **Nap Time Wk3**[a] **(*n* = 7)** | 84.00 (53.67) | 30.00 (34.64) | 56.14 (45.98) | 58.31 (47.85) | 46.64 (42.46) |
| **Sleep Quality Wk1**[b] | 1.60 (.51) | 1.61 (.70) | 1.44 (.63) | 1.55 (.61) | 1.53 (.66) |
| **Sleep Quality Wk2**[b] | 1.60 (.51) | 1.78 (.55) | 1.81 (.40) | 1.73 (.49) | 1.79 (.48) |
| **Sleep Quality Wk3**[b] | 1.73 (.70) | 1.89 (.58) | 1.81 (.54) | 1.82 (.60) | 1.85 (.56) |
| **Sleep Satisfaction Wk1**[c] | 1.40 (.74) | 1.50 (.71) | 1.50 (.73) | 1.47 (.71) | 1.50 (.71) |
| **Sleep Satisfaction Wk2**[c] | 1.40 (.74) | 1.83 (.38) | 1.88 (.50) | 1.71 (.58) | 1.85 (.44) |

*Table 31 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| **Sleep Satisfaction Wk3[c]** | 1.80 (.56) | 1.83 (.62) | 1.87 (.62) | 1.84 (.59) | 1.85 (.61) |

| | **Employees** | | | | |
|---|---|---|---|---|---|
| | **Training Group** | | | **Averages** | |
| **Item** | Control ($n$ = 15) $M$ (*S.D.*) | SR ($n$ = 13) $M$ (*S.D.*) | SC ($n$ = 13) $M$ (*S.D.*) | All Groups $M$ (*S.D.*) | Training Groups $M$ (*S.D.*) |
| **Sleep Time Wk1[a]** | 450.00 (91.90) | 402.00 (65.34) | 390.00 (84.10) | 415.13 (83.72) | 396.35 (74.12) |
| **Sleep Time Wk2[a]** | 442.50 (52.21) | 424.85 (64.96) | 441.54 (91.00) | 436.45 (69.44) | 433.19 (77.93) |
| **Sleep Time Wk3[a]** | 437.14 (59.67) | 424.62 (78.04) | 435.77 (97.89) | 432.62 (77.72) | 430.19 (86.92) |
| **Nap Time Wk1[a] ($n$ = 5)** | 40.00 (69.28) | --[d] | 7.50 (15.00) | 21.43 (44.88) | 7.50 (15.00) |
| **Nap Time Wk2[a] ($n$ = 4)** | 60.00 (103.92) | --[d] | 30.00 (60.00) | 42.86 (75.21) | 30.00 (60.00) |
| **Nap Time Wk3[a] ($n$ = 7)** | 40.00 (69.28) | --[d] | 17.50 (15.00) | 27.14 (43.10) | 17.50 (15.00) |
| **Sleep Quality Wk1[b]** | 1.86 (.54) | 1.54 (.78) | 1.46 (.66) | 1.63 (.67) | 1.50 (.71) |
| **Sleep Quality Wk2[b]** | 1.86 (.54) | 1.77 (.73) | 2.08 (.49) | 1.90 (.59) | 1.92 (.63) |
| **Sleep Quality Wk3[b]** | 1.93 (.62) | 1.69 (.75) | 2.15 (.38) | 1.93 (.62) | 1.92 (.63) |
| **Sleep Satisfaction Wk1[c]** | 1.79 (.58) | 1.38 (.65) | 1.46 (.52) | 1.55 (.60) | 1.42 (.58) |

*Table 31 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| **Sleep Satisfaction Wk2[c]** | 1.79 (.58) | 1.69 (.75) | 2.15 (.38) | 1.88 (.61) | 1.92 (.63) |
| **Sleep Satisfaction Wk3[c]** | 1.79 (.58) | 1.69 (.75) | 2.08 (.28) | 1.85 (.58) | 1.88 (.59) |

*Note*. SR = Self-regulation training group. SC = Combined self-regulation and self-control training group. [a]In minutes. [b]Responses provided on a scale of 0 (*Very bad*) to 4 (*Very good*). [c]Responses provided on a scale of 0 (*Very unsatisfied*) to 4 (*Very satisfied*).

On a scale of 1 (*Not at all*) to 8 (*Extremely*), student participants reported being only slightly likely to have participated in the study if no research credit were provided ($M = 3.41$, *S.D.* = 1.58). However, there was one difference among groups such that the self-control training group was significantly more likely to have participated without compensation compared to the control group ($t$ (29) = 2.90, $p < .02$, $d = 1.05$). Interestingly, employees were significantly more likely to have participated without compensation compared to students ($M = 5.96$, *S.D.* = 2.01; $t$ (86) = 7.14, $p < .001$, $d = 1.52$). These findings suggest that, among students, participants in the combined student training group felt that they gained more from participation in the study than just the research credit, compared to the control group. In addition, employees reported that they would have been more likely than students to participate without the compensation provided, suggesting that they may have found something inherently interesting and/or useful about participating in the study beyond the monetary compensation they received.

***New self-regulation and self-control measures: Time 2.*** Control group participants also completed the self-regulation and self-control scales again for an indication of test-retest reliability of these measures. Scale characteristics for each sample are displayed in Table 32. Skewness and kurtosis for all samples fell within an acceptable range of what could be expected from a normal distribution. Internal consistency reliabilities ranged from .72 to .94 for the student sample, .63 to .92 for the employee sample, and .66 to .92 for the combined samples, all of which were given a rating of moderate or better (Ponterotto & Rockdeschel, 2007). All McDonald's ω values were above the threshold of $\geq$.50. Test-retest reliabilities ranged from .59 through .94

*Table 32*. Scale Characteristics of New Self-Regulation and Self-Control Measures in Experimental Study Control Groups at Time 2

| | Students (*n* = 15) | | | | | Employees (*n* = 14) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Scale** | *M* *(S.D.)* | α | ω | Range of Item-Total Correlations | Test-Retest Reliability with T1 | *M* *(S.D.)* | α | ω | Range of Item-Total Correlations | Test-Retest Reliability with T1 |
| **Decisional Self-Control (7 items)** | 29.92 (4.25) | .72[3] | .67 | .05-.70 | .68* | 30.86 (4.50) | .63[3] | .58 | -.38-.83 | .76* |
| **Protracted Self-Control (12 items)** | 45.00 (11.43) | .94[1] | .74 | .12-.92 | .91* | 46.79 (11.07) | .92[1] | .78 | .23-.91 | .93* |
| **Goal Establish-ment (9 items)** | 38.08 (5.25) | .79[1] | .75 | .03-.86 | .59* | 38.21 (5.16) | .77[2] | .74 | -.14-.84 | .84* |
| **Planning (13 items)** | 53.83 (6.00) | .74[3] | .64 | -.23-.76 | .72* | 56.92 (6.94) | .81[2] | .76 | .12-.61 | .94* |
| **Goal Striving (12 items)** | 52.50 (8.12) | .89[1] | .76 | .18-.83 | .88* | 54.71 (6.47) | .84[1] | .81 | .19-.87 | .82* |

*Table 32 (continued)*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Goal Revision (9 items)** | 36.92 (4.85) | .78[2] | .76 | .20-.59 | .67* | 40.64 (6.08) | .92[1] | .87 | .53-.83 | .78* |
| **IPIP Self-Regulation / Self-Control (11 items)** | 45.58 (5.00) | .46[5] | .34 | -.32-.46 | .87* | 43.50 (6.00) | .66[4] | .57 | -.06-.67 | .70* |

| | **Combined Samples (*n* = 29)** | | | | |
|---|---|---|---|---|---|
| **Scale** | *M (S.D.)* | α | ω | Range of Item-Total Correlations | Test-Retest Reliability with T1 |
| **Decisional Self-Control (7 items)** | 30.42 (4.33) | .66[3] | .60 | -.23-.66 | .72* |
| **Protracted Self-Control (12 items)** | 45.96 (11.05) | .92[1] | .79 | .13-.88 | .91* |
| **Goal Establishment (9 items)** | 38.15 (5.10) | .78[2] | .75 | .05-.83 | .73* |
| **Planning (13 items)** | 55.50 (6.59) | .79[2] | .76 | .15-.67 | .86* |

*Table 32 (continued)*

| | | | | | |
|---|---|---|---|---|---|
| **Goal Striving (12 items)** | 53.69 (7.22) | .86[1] | .82 | .18-.79 | .85* |
| **Goal Revision (9 items)** | 38.92 (5.76) | .87[1] | .83 | .46-.79 | .74* |
| **IPIP Self-Regulation / Self-Control (11 items)** | 44.46 (5.55) | .59[5] | .52 | -.03-.59 | .74* |

*Note*. *$p < .05$. Superscripts denote qualitative descriptions as provided by Ponterotto & Rockdeschel (2007) based on obtained alpha, *N*, and number of items as follows: [1] – Excellent, [2] – Good, [3] – Moderate, [4] – Fair, [5] – Poor.

and were all statistically significant. These scales all met or exceeded the thresholds I set for internal consistency and test-retest reliability.

In comparison, the IPIP self-regulation / self-control scale had alpha values of .46, .66, and .59 for the student, employee, and combined samples, respectively, with qualitative ratings of fair and poor. McDonald's ω values were .34, .57, and .52 for each sample respectively, indicating that in the student sample, the IPIP scale did not have adequate homogeneity across items. Test-retest values ranged from .70 through .87 and were all statistically significant. Compared to the reliability thresholds that I set, this scale from the combined sample had a lower internal consistency reliability than expected based on previous research ($\alpha = .75$), received a qualitative descriptor that did not meet my cutoff of moderate or better, and barely met the threshold for homogeneity of $\geq .50$. On average, the new measures of self-regulation and self-control had, greater internal consistency reliability values, better qualitative descriptors of their internal consistencies, and higher homogeneity estimates at Time 2 compared to the IPIP scale.

## Analyses

In what follows, I provide an overview of my predictions and several guidelines that I used to interpret my results. I then state each hypothesis and describe the analyses and results from the student, employee, and combined samples. A summary of hypotheses, analyses, and results may be found in Table 33. I finish this section with an overall summary of the results.

In general, I expected that because all participants had a desire to get more sleep during the week, the training sessions would help provide focus and direction in working towards those goals. Thus, I predicted that the training groups would get more sleep

*Table 33*. Summary of Hypotheses and Results for Student Sample, Employee Sample, and Combined Samples

| Hypothesis | Description | Statistical Analysis | Anticipated Results | Sample | Results | Conclusion |
|---|---|---|---|---|---|---|
| 1a | The self-regulation training group and the combined training group will show greater adherence to sleep duration goals during Week 2 compared to the control group. | Between-Within Repeated Measures ANOVA | *d*s = .50 - .80 | Student (*n* = 49) | *d*s = .44 and .71 | Partially supported |
| | | | | Employee (*n* = 41) | *d*s = .60 and .81 | Fully supported |
| | | | | Combined (*n* = 90) | *d*s = .49 and .75 | Partially supported |
| 1b | The combined training group will show greater adherence to sleep duration goals during Week 2 compared to the self-regulation training group. | Between-Within Repeated Measures ANOVA | *d* = .50 | Student (*n* = 49) | *d* = .31 | Partially supported |
| | | | | Employee (*n* = 41) | *d* = .18 | Partially supported |
| | | | | Combined (*n* = 90) | *d* = .27 | Partially supported |
| 2 | The combined self-regulation and self-control training group will show greater adherence to sleep duration goals during Week 3 compared to the self-regulation group. | Between-Within Repeated Measures ANOVA | *d* = .50 | Student (*n* = 49) | *d* = .03 | Not supported |
| | | | | Employee (*n* = 41) | *d* = .07 | Not supported |
| | | | | Combined (*n* = 90) | *d* = .02 | Not supported |
| 3a | Sleep duration will be negatively associated with subjective morning fatigue. | Pearson Product-Moment Correlation | *r* = -.60 | Student (*n* = 49) | *r* = -.29, *p* < .05 | Partially supported |
| | | | | Employee (*n* = 22) | *r* = -.23, *ns* | Partially supported |
| | | | | Combined (*n* = 71) | *r* = -.25, *p* < .05 | Partially supported |

*Table 33 (continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| 3b | Sleep duration will be negatively associated with negative affect. | Pearson Product-Moment Correlation | $r$ = -.40 | Student ($n$ = 49) | $r$ = -.29, $p$ < .05 | Partially supported |
| | | | | Employee ($n$ = 22) | $r$ = -.43, $p$ < .05 | Fully supported |
| | | | | Combined ($n$ = 71) | $r$ = -.25, $p$ < .05 | Partially supported |
| 3c | Sleep duration will be negatively associated with productivity impairment. | Pearson Product-Moment Correlation | $r$ = -.30 | Student ($n$ = 49) | $r$ = -.33, $p$ < .05 | Fully supported |
| | | | | Employee ($n$ = 22) | $r$ = -.14, *ns* | Partially supported |
| | | | | Combined ($n$ = 71) | $r$ = -.27, $p$ < .05 | Fully supported |
| 3d | Sleep duration will be positively associated with positive affect. | Pearson Product-Moment Correlation | $r$ = .40 | Student ($n$ = 49) | $r$ = -.02, *ns* | Not supported |
| | | | | Employee ($n$ = 22) | $r$ = .01, *ns* | Not supported |
| | | | | Combined ($n$ = 71) | $r$ = -.03, *ns* | Not supported |
| 4a-e | During Week 2, the combined training group will report higher positive affect, lower morning and evening fatigue, lower negative affect, and lower productivity impairment compared to the self-regulation group. | Between-Within Repeated Measures ANOVAs | $d$s = .25, .40, .30, .20, .25 | All samples | $F$ values ns, $d$ values < .15 | Not supported |

*Table 33 (continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| 5a | At the end of the study, participants in the training groups will report feeling less fatigued, more productive, better able to concentrate, in a better mood, and greater overall changes in mood compared to the control group. | Planned Comparisons | *d*s between .50 and .80 | Student (*n* = 49) | *d*s = .18, .15, .81, 1.09, and 1.27 | Partially supported |
| | | | | Employee (*n* = 40) | *d*s = 1.02, .21, 1.20, .45, and .28 | Partially supported |
| | | | | Combined (*n* = 90) | *d*s = 1.09, .08, .85, .72, and .72 | Partially supported |
| 5b | At the end of the study, participants in the combined training group will report greater subjective ability to apply self-regulation techniques to other areas of goal pursuit, such as academia (students only), personal, or work-related domains (employees only), compared to the self-regulation only training group. | Independent groups *t*-tests | *d*s = .20 | Student (*n* = 49) | *d*s = .05 and .07 | Not supported |
| | | | | Employee (*n* = 40) | *d*s = .13 and .01 | Not supported |
| | | | | Combined (*n* = 90) | *d* = .03 | Not supported |
| 6a | Stage 1 Decisional Self-Control items will load on a Stage 1 factor, and Stage 2 Protracted Self-Control items will load on a Stage 2 factor. The two stage factors will be correlated. This model will provide better fit than a one-factor model. | Confirmatory Factor Analysis | *CFI* > .95, *RMSEA* < .05, *r* = .35, significant $\Delta\chi^2$ | Combined Sample | *CFI* = .84, *RMSEA* = .09, *r* = .37, $\Delta\chi^2 = 78.48$, $\Delta d.f. = 2$, $p < .05$ | Partially Supported |

*Table 33 (continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| 6b | The stage factors of self-control will load on a higher-order self-control factor, and this hierarchical model will provide a better fit to the data than the two-factor model. | Confirmatory Factor Analysis | *CFI* > .95, *RMSEA* < .05, significant $\Delta\chi^2$ | Combined Sample | *CFI* = .86, *RMSEA* = .08, $\Delta\chi^2$ = 11.21, $\Delta d.f.$ = 4, $p < .05$ | Partially Supported |
| 6c | With regards to self-regulation, goal establishment items will load on a goal establishment factor; planning items will load on a planning factor; goal striving items will load on a goal striving factor; and goal revision items will load on a goal revision factor. The four stage factors will be correlated. This model will provide a better fit than a one-factor model. | Confirmatory Factor Analysis | *CFI* > .95, *RMSEA* < .05, *r*s between .25 and .40, significant $\Delta\chi^2$ | Combined Sample | *CFI* = .59, *RMSEA* = .09, *r*s = .21 and .40, $\Delta\chi^2$ = -13.69, $\Delta d.f.$ = 6 | Not Supported |
| 6d | The stage factors of self-regulation will load on a higher-order self-regulation factor, and the hierarchical model will provide a better fit to the data than the four-factor model. | Confirmatory Factor Analysis | *CFI* > .95, *RMSEA* < .05, significant $\Delta\chi^2$ | Combined Sample | *CFI* = .60, *RMSEA* = .09, *r*s = .47 and .64, $\Delta\chi^2$ = .12, $\Delta d.f.$ = 5 | Not Supported |
| 6e | Model 2 will provide a better fit to the data than Model 1. | Structural Equation Modeling and Chi-square difference test | significant $\Delta\chi^2$ | Combined Sample | -- | Not Tested |

*Note*. Fully supported indicates that results were in the same direction and were of a similar or greater magnitude than predicted. Partially supported indicates that results were smaller in magnitude but in the same direction as predicted. Not supported indicates that results were non-significant or in the opposite direction than predicted.

following the intervention, compared to the control group. I also expected these groups to report more positive outcomes related to fatigue, affect, and productivity compared to the control group. Additionally, because the process of working towards a goal often involves altering typical behavioral patterns, I reasoned that self-control skills would be helpful to maintain goal-directed behavior in the event of a temptation or desire that might thwart efforts towards goal attainment. Therefore, based on the additional self-control module covering two methods of self-control offered to participants in the combined self-regulation / self-control training group, I anticipated that the participants in this group would be able to call on their self-control methods and would have more favorable outcomes compared to the self-regulation only training group.

To evaluate the efficacy of the two training sessions administered in the experimental studies, five hypotheses were tested within each sample. These hypotheses fall under three general topics: goal adherence, outcomes related to sleep duration, and post-intervention reports. With regards to goal adherence, I expected that the training groups would demonstrate better goal adherence during Weeks 2 and 3 of the study, compared to the control group. Further, I predicted that the combined self-regulation and self-control training group would have incrementally better goal adherence during Weeks 2 and 3 than the self-regulation only training group. These predictions were included in Hypotheses 1 and 2, respectively.

Based on the research presented in the introduction section demonstrating the association between sleep duration and health, cognition, mood, and concentration, I anticipated that sleep duration in the current studies would be negatively associated with subjective morning fatigue, negative affect, and productivity impairment, and positively

associated with positive affect. This prediction was stated in Hypothesis 3. Additionally, I predicted in Hypothesis 4 that the combined training group would report lower morning fatigue, negative affect, and productivity impairment, and higher positive affect during Week 2, compared to the self-regulation training group, due to their predicted greater goal adherence from Hypothesis 1.

With regards to post-intervention reports, I hypothesized that the combined training group would report more positive changes in fatigue, affect, and concentration, compared to the beginning of the study. I also expected the combined training group to rate the transferability of the training skills that they learned as more applicable to other life domains (e.g., academia, work, and personal), compared to the self-regulation training group. Hypotheses 5a and 5b describe these predictions.

In addition to evaluating the efficacy of the training interventions, I also evaluated the new measures of self-regulation and self-control that I developed in the preliminary study. Similar to the analysis plan for that study, I tested whether self-regulation and self-control were higher-order constructs, with the stages of each as lower-order factors in Hypotheses 6a-d. In Hypothesis 6e, I planned to evaluate the relationship between the two constructs by testing several possible structural models. Note that this set of hypotheses was only tested on the combined sample due to the small size of each sample individually for CFA and SEM analyses.

Hypotheses are described below as fully supported when results were in the same direction and of similar or greater magnitude as predicted, and as partially supported when results were in the same direction but of lesser magnitude than predicted. Hypotheses that were not supported had associated results that were either not significant

or are in the opposite direction than predicted. A *p*-value of .05 was chosen for all analyses except when multiple comparisons were conducted across groups, in which case the *p*-value was divided by the number of comparisons to avoid making Type I errors. Due to the small sample sizes and low power of the student and employee groups separately, some of the statistical analyses presented did not reach statistical significance at the.05-level but showed trends in the expected direction with *p*-values between .05 and .10. These results are presented along with associated effect sizes, though it is understood that these findings are not statistically significant.

**Sleep Duration Goal Adherence (Hypotheses 1a and 1b)**

*Hypothesis 1: There will be group differences on adherence to sleep duration goals during Week 2, such that a) The self-regulation training group and the combined training group will show greater adherence to sleep duration goals than the control group (anticipated ds between .50 and .80); and b) The combined self-regulation and self-control training group will report greater adherence to sleep duration goals than the self-regulation training group (anticipated d = .50).*

Adherence to sleep duration goals was calculated by subtracting the number of minutes of sleep actually obtained each night from that designated by the sleep duration goal.[6] Positive values indicated getting less sleep than the sleep duration goal, a value of zero indicates meeting the sleep duration goal exactly, and negative values indicated more sleep than the goal. If revisions were made to the sleep duration goal, the revised

[6] Calculation of adherence values in this way produced a difference score, an index that has low reliability when the correlation between the two measures used to create the difference score is high and/or when the reliability of each measure is low. The correlation between measures was moderate in magnitude and the reliability of the sleep duration goal was higher than that of the daily actigraph reports, yielding difference score reliabilities that were lower than traditionally acceptable values (e.g., Nunnally,1978). Reliabilities for Weeks 2 and 3 ranged from .14 through .54 across samples, all but one of which met the criteria of moderate size and statistical significance. One method for decreasing the impact of low reliabilities in difference scores is to assign ordinal values to ranges of the obtained difference scores (Kuyken et al., 2008). To determine the impact of difference scores versus assigned ordinal values on statistical results, several simulations were conducted with $N = 100$ and $N = 1000$. ANOVA analyses were simulated because those were the analyses in which difference scores were included in the present research. The ANOVA analyses yielded similar results when difference scores and assigned ordinal values were used. Therefore, for ANOVA analyses involving difference scores, the difference scores were used.

value was used for that night and any future night until another revision was made. The sleep duration goal used for the control group was the value reported in the initial trait questionnaire regarding the amount of sleep needed to feel refreshed the next day. Reports of the amount of sleep needed to feel refreshed were positively correlated with sleep duration goals for the training groups ($r$s > .65, $p$ < .05) for the student, employee, and combined samples. There were no significant differences across groups within any sample on sleep duration goals.

***Students.*** A 3 (group) x 5 (daily adherence scores in Week 2) between-within repeated measures ANOVA was conducted to determine whether there were any differences between groups and/or whether there were different patterns of adherence over time during Week 2. Results showed a trend towards overall group differences ($F$ (2, 46) = 2.43, $p$ = .10), with both the self-regulation the combined training groups showing trends towards greater goal adherence compared to the control group ($d$s = .44 and .71, respectively). The combined training group also demonstrated a trend towards greater goal adherence than the self-regulation only training group ($d$ = .31). There were no significant interaction effects. A regression analysis indicated that group membership explained 9% of the variance in Week 2 adherence values ($\beta$ = -.29, $p$ < .05, $R^2$ = .09) for all three groups. Though the $F$-test was not statistically significant, the magnitudes of the effect sizes suggest meaningful differences between groups in the expected directions; therefore, Hypotheses 1a and 1b were partially supported.

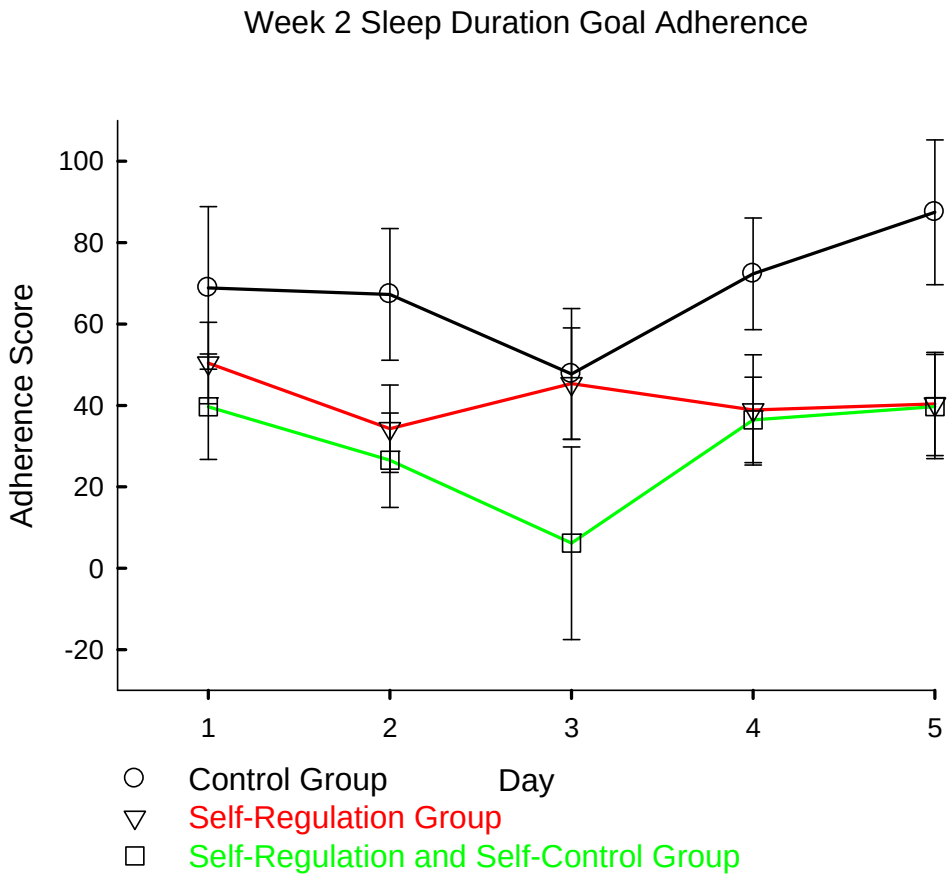
***Employees.*** Similar to the student sample, results from a 3 x 5 ANOVA also showed a trend towards overall group differences ($F$ (2, 38) = 2.51, $p$ = .09), with both the self-regulation training group and the combined training group showing trends of

greater goal adherence compared to the control group (*d*s = .60 and .81, respectively). The combined training group also demonstrated a trend towards greater goal adherence than the self-regulation only training group (*d* = .18). There were no significant interaction effects. A regression analysis indicated that group membership explained 11% of the variance in Week 2 adherence values ($\beta$ = -.33, $p < .05$, $R^2$ = .11) for all three groups. Though the *F*-test was not significant, the differences between groups show trends in the expected direction and with similar magnitudes of effect sizes. Therefore, Hypotheses 1a and 1b were partially supported.

***Combined samples.*** Results from a 3 x 5 ANOVA showed overall group differences ($F$ (2, 87) = 4.54, $p < .05$), with both the self-regulation training group and the combined training group showing greater goal adherence compared to the control group (*d*s = .49 and .75, respectively). The combined training group also demonstrated greater goal adherence than the self-regulation only training group (*d* = .27). There were no significant interaction effects. A regression analysis indicated that group membership explained 9% of the variance in Week 2 adherence values ($\beta$ = -.30, $p < .05$, $R^2$ = .09).

The adherence scores for the combined sample during Week 2 are plotted in Figure 7. As shown in this figure, the self-regulation group missed their sleep duration goals throughout Week 2, with adherence values of approximately 40 minutes. The combined training group had several days in which their adherence values were lower than the self-regulation group, and one day for which the average adherence value was near zero. In comparison, the control group demonstrated adherence values between 47 and 80 during Week 2. Due to the significant *F* test but slightly lower effect sizes than expected, Hypotheses 1a and 1b were partially supported.

*Figure 7*. Week 2 Sleep Duration Goal Adherence across Groups from Combined Experimental Studies




*Note*. Error bars represent standard error of the mean. Adherence scores are in minutes. Negative values indicate more sleep than sleep goal. Positive values indicate less sleep than sleep goal. A value of zero indicates sleeping the same amount as sleep goal.

***Summary.*** The findings across samples all demonstrated the same pattern. There were group differences in adherence to sleep duration goals during Week 2, such that the training groups demonstrated greater adherence compared to the control group, and the combined self-regulation and self-control training group demonstrated greater adherence than the self-regulation training group. Due to low power of the samples individually, the *F* tests did not reach significance. The effect sizes ranged from $d = .18$ through $d = .81$ for comparisons within samples, some of which were smaller than hypothesized but were large enough to suggest trends in the expected directions. When combining the samples, statistical power was high enough for the *F* test to become statistically significant. The magnitudes of the effect sizes remained smaller than anticipated, but were all over the threshold of .20 for a "small" effect (Cohen, 1992). Therefore, it appeared that Hypotheses 1a and 1b were partially supported, with trends in the expected directions within the individual samples, and statistically significant findings but smaller-than-expected effect sizes in the combined samples.

**Post-Intervention Effects on Sleep Duration Goal Adherence (Hypothesis 2)**

*Hypothesis 2: The combined self-regulation and self-control training group will show greater adherence to sleep duration goals during Week 3, compared to the self-regulation training group (anticipated d = .50).*

***Students.*** To evaluate post-intervention sleep duration adherence, a 3 (group) x 5 (adherence scores during Week 3) between-within repeated measures ANOVA was conducted comparing Week 3 adherence scores across groups. Results revealed overall group differences ($F(2, 46) = 3.22$, $p < .05$); however, this difference was mainly driven by the difference between training groups and the control group. The self-regulation group and combined training group showed greater goal adherence during Week 3

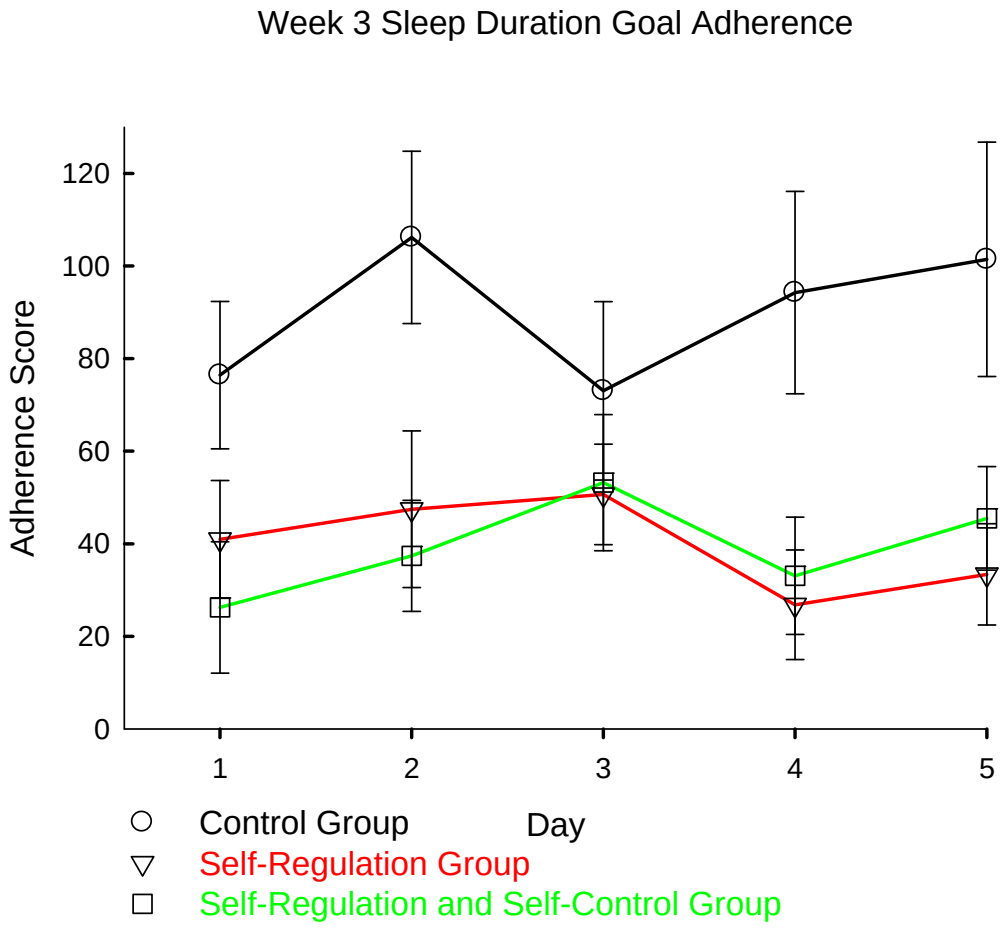
compared to the control group (*d*s = .71 and .69, respectively), but there was no significant difference between training groups (*d* = .03). Therefore, Hypothesis 2 was not supported.

***Employees.*** Results revealed overall group differences ($F$ (2, 38) = 4.50, $p < .05$); however, this difference was also mainly driven by the difference between training groups and the control group. The self-regulation group and combined training group showed greater goal adherence during Week 3 compared to the control group (*d*s = .88 and .97, respectively), but there was no significant difference between training groups (*d* = .07). There were no significant interaction effects. Therefore, Hypothesis 2 was not supported.

***Combined samples.*** As shown in Figure 8, results revealed overall group differences ($F$ (2, 87) = 8.12, $p < .05$); however, this difference was mainly driven by the difference between training groups and the control group. The self-regulation group and combined training group showed greater goal adherence during Week 3 compared to the control group (*d*s = .81 and .85, respectively), but there was no significant difference between training groups (*d* = .02). Figure 8 shows that the training groups were approximately 30 minutes away from their sleep goal on average, whereas control group participants averaged around 80 minutes less sleep than their sleep goals. Hypothesis 2 was not supported.

***Summary.*** This finding across samples indicates that both training groups continued to get more sleep during Week 3, but that there were not significant differences between training groups in adherence to sleep duration goals during Week 3. I hypothesized that the combined training group would have better adherence during Week

*Figure 8*. Week 3 Sleep Duration Goal Adherence across Groups from Combined Experimental Studies




*Note*. Error bars represent standard error of the mean. Adherence scores are in minutes. Negative values indicate more sleep than sleep goal. Positive values indicate less sleep than sleep goal. A value of zero indicates sleeping the same amount as sleep goal.

3 compared to Week 2 due to exposure to additional tools of self-control to assist with meeting goals. It may have been that this post-intervention evaluation was too close to the intervention to see any noticeable differences that might exist over time. Alternatively, it may be that although the self-control training helped boost adherence during Week 2, this effect did not last over time.

**Association between Sleep Duration and Subjective Reports (Hypotheses 3a-d)**

*Hypothesis 3a-d: Sleep duration will be negatively associated with subjective fatigue (anticipated r = -.60), negative affect (anticipated r = -.40), and productivity impairment (r = -.30), and will be positively associated with positive affect (anticipated r = .40).*

***Students.*** To evaluate the relationship between daily sleep duration and daily subjective reports of fatigue, positive and negative affect, and productivity, Pearson product-moment correlations were conducted on the average of measures collected during Week 1. Individuals from all groups and sessions were included[7]. Average sleep time as recorded by the Fitbit was negatively associated with subjective morning fatigue ($r$ = -.29, $p < .05$), negative affect ($r$ = -.29, $p < .05$), and school-related productivity impairment ($r$ = -.33, $p < .05$), providing partial support for Hypotheses 3a and 3b and full support for 3c. Hypothesis 3d was not supported, as average sleep time was not significantly associated with positive affect ($r$ = -.02, *ns*); however, adherence to sleep duration goals was positively associated with positive affect during Weeks 2 and 3 ($r$s = .34 and .28, $p < .05$, respectively). These findings indicate that greater sleep duration was associated with less morning fatigue, less negative affect in the morning, and less impairment of schoolwork productivity throughout the day, but that positive affect was more associated with how close sleep time came to the sleep duration goal.

[7] I conducted this analysis for Sessions 1-3 separately from Session 4 due to the baseline difference in NA described above. Session 4 had a similar pattern of results as the other three sessions combined; therefore, all sessions were combined.

***Employees.*** Among employees, analyses on Session 3 were conducted separately due to the baseline differences in NA between this session and the other three sessions. For Sessions 1, 2, and 4 combined ($n$ = 22), sleep duration was negatively associated with subjective morning fatigue ($r$ = -.23, *ns*), NA ($r$ = -.43, $p < .05$), and work-related productivity ($r$ = -.14, *ns*), and was not associated with PA ($r$ = .01, *ns*); however, due to the low $N$, only the association with NA reached significance. This pattern of results was different for Session 3 participants, with sleep duration not associated with morning fatigue ($r$ = .06, *ns*), negatively associated with PA ($r$ = -.50, $p < .05$), and positively associated with NA ($r$ = .20, *ns*), work-related productivity impairment ($r$ = .17, *ns*), and evening subjective fatigue ($r$ = .22, *ns*). Given the different pattern of results in Session 3 compared to the other three sessions combined, this session was not included with the other sessions to boost statistical power. As a result, the findings from Sessions 1, 2, and 4 provide full support for Hypothesis 3b, partial support for Hypotheses 3a and 3c, and no support for Hypothesis 3d.

***Combined samples.*** Because of the differences observed in the employee sample between Session 3 and the other three sessions, this group was not included in the overall sample. Sleep duration was negatively associated with morning fatigue, negative affect, and productivity impairment ($r$s = -.25, -.25, and -.27, $p < .05$, respectively), but was not significantly associated with positive affect ($r$ = -.03, *ns*). However, positive affect was significantly correlated with adherence to sleep duration goals during Weeks 2 and 3 ($r$s = .22 and .24, respectively). Hypotheses 3a and 3b were partially supported, Hypothesis 3c was fully supported, and Hypothesis 3d was not supported.

***Summary.*** These findings suggest that greater sleep duration is associated with less morning fatigue, less negative affect in the morning, and less impairment of schoolwork productivity throughout the day, but is not significantly associated with positive affect. A closer look at positive affect revealed that, among students, positive affect was positively associated with adherence to the sleep duration goal. This result suggests that positive affect was more associated goal attainment rather than sleep duration. This association was not found among the employee sample, indicating that the significant relationship found in the combined samples was driven by the student sample. Overall, support was found for Hypotheses 3a through 3c, with some effect sizes smaller than expected and some of the expected magnitude. Hypothesis 3d was not supported.

**Effect of Training on Daily Subjective Reports (Hypothesis 4a-e)**

*Hypothesis 4a-e: During Week 2, the combined training group will report higher positive affect (anticipated d = .25), lower morning fatigue (anticipated d = .40), lower evening fatigue (anticipated d = .30), lower negative affect (anticipated d = .25), and higher productivity (anticipated d = .20), compared to the self-regulation only group.*

This hypothesis was posed due to a combination of findings from Hypotheses 1 and 3 above. Because the combined training group had greater goal adherence during week two compared to the self-regulation training group, and because sleep duration was found to be negatively associated with fatigue, negative affect, and productivity impairment, I predicted that the combined training group would have lower fatigue, negative affect, and productivity impairment in Week 2 than the self-regulation training group. However, results did not support this prediction. Five 2 (group) x 5 (day) repeated measures ANOVAs were performed to evaluate group differences during Week 2 on morning fatigue, evening fatigue, NA, PA, and productivity impairment for each

sample.[8] Alpha was set to < .01 to account for the number of comparisons. There were no significant differences between training groups on these variables during Week 2 for the student, employee, or combined samples. As a result, Hypotheses 4a-e were not supported. Further examination of the data revealed notable within-group differences, which are presented below for the combined sample only due to their exploratory nature.

***Combined samples.*** Paired *t*-tests were conducted within-groups to determine whether there were changes in average sleep duration in Week 2 compared to Week 1.[9] Results indicated that the self-regulation training group slept more on average during Week 2 compared to Week 1 (dependent $t$ (30) = 3.31, $p < .05$, $d = .60$), as did the combined training group (dependent $t$ (28) = 2.46, $p < .05$, $d = .46$). Next, to evaluate within-group changes in subjective reports from Week 1 to Week 2, paired *t*-tests were computed on morning and fatigue, positive and negative affect, and productivity impairment for all three groups. The combined training group reported lower average evening fatigue (dependent $t$ (28) = 3.07, $p < .05$, $d = .60$), morning fatigue (dependent $t$ (28) = 3.23, $p < .05$, $d = .66$), and negative affect (dependent $t$ (28) = 3.17, $p < .05$, $d = .60$), but no significant difference in positive affect(dependent $t$ (28) = 1.96, $p = .06$, $d = .38$) or productivity impairment (dependent $t$ (28) = 1.59, $p = .09$, $d = .30$) during Week 2 compared to Week 1. The self-regulation only group only showed a trend towards lower negative affect (dependent $t$ (30) = 1.85, $p = .07$, $d = .38$). These results suggest that there were within-group differences in sleep duration for both training groups from Week

[8] A 2 (group) x 5 (daily subjective reports during Week 2) between-within repeated measures MANOVA was originally proposed, using group as the independent variable, and the daily subjective reports as the dependent variables. However, initial assessments indicated potential multicollinearity between two or more of the dependent variables, with variance inflation factors (VIF) greater than 5, as Box's test of Equality of Covariance Matrices could not be computed. This was also the case with the employee and combined samples.

[9] All sessions were included from each sample based on preliminary analyses within the student and employee samples that revealed similar patterns across sessions within each sample.

1 to Week 2, but that only the combined training group reported differences in related outcomes of lower morning fatigue, evening fatigue, and negative affect.

***Summary.*** Taken together, these findings indicate that while there were within-group changes in sleep duration for both training groups, and that average fatigue and negative affect decreased for the combined training group in Week 2 compared to Week 1, there were no significant differences in these subjective reports for the combined training group when compared to the self-regulation only group. Despite that the combined training group showed better goal adherence during Week 2 compared to the self-regulation training group, the difference may not have been large enough to drive differences in these outcome variables. Overall, it is likely that a number of factors contribute to daily subjective reports of fatigue, affect, and productivity, and that the between-group difference was not large enough to lead to differential reports of these outcomes between groups.

**Post-Intervention Effects on Subjective Outcomes and Cross-Domain Applicability (Hypotheses 5a and 5b)**

*Hypothesis 5a: At the end of the study, participants in the training groups will report feeling less fatigued, more productive, better able to concentrate, in a better mood, and greater overall changes in mood compared to the control group (anticipated ds between .50 and .80).*

*Hypothesis 5b: At the end of the study, participants in the combined training group will report greater subjective ability to apply self-regulation techniques to other areas of goal pursuit, such as academia (student sample only), personal, or work-related domains (employee sample only), compared to the self-regulation only training group (anticipated d = .20).*

***Students.*** Part of the final questionnaire included comparisons of feelings from the beginning to the end of the study. Participants reported comparisons of fatigue, productivity, concentration, engagement in endeavors, levels of distress, and mood from

the beginning to the end of the study. Table 34 displays the results from this part of the final questionnaire. The portions involved in this hypothesis are displayed in the top half of the table; the other portion is included to explore whether there were any other differences across groups.

To test Hypothesis 5a, one-way ANOVAs were first performed to assess whether there were group differences, followed by planned comparisons to see whether there were differences between the two training groups together compared to the control group. One-way ANOVA results indicated significant differences across groups on 4 of the 5 hypothesized items, all of which were significant when using a more stringent *p*-value of $< .01$ to account for the number of comparisons. These differences included lower fatigue, better concentration, better mood, and overall changes in mood. All planned comparisons for these items were also significant, suggesting that the overall group differences were driven by differences between the training groups and the control group.

As shown in Table 34, the effect sizes between the self-control and control groups were the largest (*d*s range from 1.02 – 1.56), followed by the differences between the self-regulation and control groups (*d*s range from .62 – .98), and the differences between the two training groups (*d*s range from .18 – .53). In general, the two training groups reported feeling less fatigued, having more energy, better concentration, and in a better mood at the end of the study compared to the control group. The largest effect size between training groups was on reported ability to concentrate better at the end of the study ($d = .53$), with the combined training group reporting better concentration. Because the effect sizes between training groups and the control group were over .50 for four of the five hypothesized effects, Hypothesis 6a was partially supported.

ed Comparisons of Feelings from Beginning to End of the Study for the Student Experimental Study

| | Group | | | One-Way ANOVA | | Contrasts | | Effect Sizes | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **f the study, I…"** | Control *M* (*S.D.*) | SR *M* (*S.D.*) | SC *M* (*S.D.*) | *F* | *d.f.* | \|*t*\| | *d.f.* | \|*d*\|[b] | \|*d*\|[c] | \|*d*\|[d] |
| | 3.00 (0.76) | 3.94 (1.11) | 4.13 (0.89) | 6.39** | 2, 46 | 3.55** | 46 | .99 | .19 | 1.37 |
| **.** | 2.07 (0.96) | 1.94 (1.35) | 1.88 (1.09) | 0.11 | 2, 46 | .44 | 46 | .11 | .05 | .18 |
| **better now.** | 3.00 (1.07) | 3.72 (1.23) | 4.25 (0.69) | 5.76** | 2, 46 | 3.09** | 46 | .62 | .53 | 1.39 |
| **r mood now.** | 2.60 (0.83) | 3.56 (1.20) | 3.75 (0.93) | 5.74** | 2, 46 | 3.36** | 46 | .93 | .18 | 1.24 |
| **anges in my overall** | 4.60 (1.06) | 3.33 (1.50) | 2.87 (1.15) | 7.23** | 2, 46 | 3.82** | 46 | .98 | .34 | 1.56 |
| | 3.27 (0.88) | 3.83 (0.99) | 4.13 (0.81) | 3.37* | 2, 46 | 2.56* | 46 | .60 | .33 | 1.02 |
| **anges in my sleepiness.** | 4.07 (1.44) | 2.94 (1.16) | 3.00 (1.37) | 3.61* | 2, 46 | 2.68* | 46 | .86 | .05 | .78 |
| **w.** | 2.20 (1.08) | 2.17 (1.47) | 2.19 (1.17) | 0.03 | 2, 46 | .06 | 46 | .02 | .02 | .01 |
| **ged in my endeavors now.** | 3.40 (1.06) | 3.94 (1.16) | 3.88 (0.96) | 1.22 | 2, 46 | 1.54 | 46 | .49 | .06 | .48 |
| **deavors less now.** | 1.93 (1.16) | 1.83 (0.79) | 1.56 (0.73) | 0.71 | 2, 46 | .84 | 46 | .10 | .35 | .38 |

. **$p < .01$. SR = Self-regulation only training group. SC = Combined self-regulation and self-control training
vided on a scale of 1 (*Strongly disagree*) to 6 (*Strongly agree*). [b]Effect size between control and SR groups.

Hypothesis 5b was posited because past researchers have found that individuals who have undergone self-regulation training reported applying the learned self-regulation techniques to behaviors other than those targeted in the intervention (Frayne & Latham, 1987). To evaluate whether these results were replicated in the present studies, independent groups *t*-tests were conducted to evaluate reported transferability composites of training techniques to other domains between training groups. While participants reported agreeing that the training skills would be transferable, no significant differences were found between groups on transferability to the academic domain ($t$ (32) = .19, *ns*, $d$ = .05) or the personal domain ($t$ (32) = .19, *ns*, $d$ = .07). Thus, Hypothesis 5b was not supported.

***Employees.*** Table 35 displays the results from the employee comparisons of feelings from the beginning to the end of the study. One-way ANOVA results indicated significant differences across groups on 2 of the hypothesized items, including lower fatigue and better concentration ($p < .01$). For the significant items, the effect sizes between the self-control and control groups were the largest ($d$s = 1.16 and 1.30), followed by the differences between self-regulation and control groups ($d$s = .88 and .91). Significant planned comparisons indicated that the two training groups reported feeling less fatigued and being better able to concentrate compared to the control group. Responses to the other three items were not significantly different across groups; therefore, Hypothesis 5a was partially supported.

To evaluate Hypothesis 5b, the training groups were compared on their ratings of transferability of training skills to work and personal domains. While participants reported generally agreeing that the training skills would be transferable, results from

independent *t*-tests indicated no significant difference between groups on average transferability to the work domain ($t$ (24) = .31, *ns*, $d$ = .13) or the personal domain ($t$ (24) = .05, *ns*, $d$ = .01). Thus, Hypothesis 5b was not supported.

***Combined samples.*** Table 36 displays the results from the combined samples on comparisons of feelings from the beginning to the end of the study. One-way ANOVA results revealed significant differences across groups on 4 of the 5 hypothesized items ($p$ < .01), and on three additional items on the questionnaire. Groups differed on reports of lower fatigue, more energy, better concentration, greater engagement in endeavors, overall changes in sleepiness, better mood, and greater overall changes in mood. The contrasts for each of these items were all significant, suggesting that the differences between training groups and the control group were driving the overall group differences. Of the significant effects, differences between the combined self-control training group and the control group (*d*s between .67 and 1.36) were larger on average than the differences between the self-regulation training group and the control group (*d*s between .42 and .92). Differences between training groups ranged from $d$ = .05 through $d$ = .45, with the greatest difference on better concentration for the combined training group. With average effect sizes all over $d$ = .72 for improvements in fatigue, concentration, mood, and overall changes in mood, but no difference across groups on reports of more productivity, Hypothesis 5a was partially supported.

An independent groups *t*-tests was conducted on composite of transferability to the personal domain, as this was the only domain common to both the employee and student samples. While participants reported generally agreeing that the training skills would be transferable, results indicated no significant difference between groups on

*Table 35*. Self-Reported Comparisons of Feelings from Beginning to End of the Study for the Employee Experimental Study

| **Item**[a] | **Group** | | | **One-Way ANOVA** | | **Contrasts** | | **Effect Sizes** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **"Compared to the start of the study, I…"** | Control *M* (*S.D.*) | SR *M* (*S.D.*) | SC *M* (*S.D.*) | *F* | *d.f.* | \|*t*\| | *d.f.* | \|*d*\|[b] | \|*d*\|[c] | \|*d*\|[d] |
| **…feel less fatigued now.** | 3.07 (1.27) | 4.23 (1.36) | 4.38 (0.96) | 4.79** | 2, 37 | 3.08** | 37 | .88 | .13 | 1.16 |
| **…am less productive now.** | 1.71 (0.91) | 2.08 (1.19) | 1.77 (0.93) | .49 | 2, 37 | .62 | 37 | .35 | .29 | .07 |
| **…am able to concentrate better now.** | 2.93 (1.14) | 3.92 (1.04) | 4.23 (0.83) | 6.12** | 2, 37 | 3.41** | 37 | .91 | .33 | 1.30 |
| **…am generally in a better mood now.** | 3.43 (1.09) | 4.00 (1.08) | 3.85 (1.21) | .93 | 2, 37 | 1.32 | 37 | .53 | .13 | .36 |
| **…have not noticed any changes in my overall mood.** | 3.79 (1.72) | 3.62 (1.61) | 3.08 (1.32) | .75 | 2, 37 | .85 | 37 | .10 | .37 | .46 |
| **…have more energy now.** | 3.14 (1.29) | 4.08 (1.12) | 4.31 (1.03) | 3.88* | 2, 37 | 2.74** | 37 | .78 | .21 | 1.00 |
| **…have not noticed any changes in my sleepiness.** | 3.79 (1.53) | 3.85 (1.68) | 2.62 (1.50) | 2.57 | 2, 37 | 1.07 | 37 | .04 | .73 | .69 |
| **…am more distressed now.** | 1.93 (1.21) | 2.69 (1.44) | 1.54 (.88) | 3.14 | 2, 37 | .47 | 37 | .57 | .96 | .37 |
| **…find myself more engaged in my endeavors now.** | 3.43 (1.51) | 4.08 (1.26) | 4.54 (0.88) | 2.70 | 2, 37 | 2.13* | 37 | .47 | .42 | .90 |
| **…find that I enjoy my endeavors less now.** | 2.00 (1.11) | 1.69 (0.86) | 1.46 (0.88) | 1.08 | 2, 37 | 1.33 | 37 | .31 | .26 | .54 |

*Note*. $N = 40$. *$p < .05$. **$p < .01$. SR = Self-regulation only training group. SC = Combined self-regulation and self-control training group. [a]Responses provided on a scale of 1 (*Strongly disagree*) to 6 (*Strongly agree*). [b]Effect size between control and SR groups. [c]Effect size between SR and SC groups. [d]Effect size between the control and SC groups.

*Table 36*. Self-Reported Comparisons of Feelings from Beginning to End of the Study for the Combined Experimental Studies

| **Item**[a] | **Group** | | | **One-Way ANOVA** | | **Contrasts** | | **Effect Sizes** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **"Compared to the start of the study, I…"** | Control *M* (*S.D.*) | SR *M* (*S.D.*) | SC *M* (*S.D.*) | *F* | *d.f.* | \|*t*\| | *d.f.* | \|*d*\|[b] | \|*d*\|[c] | \|*d*\|[d] |
| **…feel less fatigued now.** | 3.03 (1.02) | 4.06 (1.21) | 4.24 (.91) | 11.09** | 2, 86 | 4.68** | 86 | .92 | .17 | 1.25 |
| **…am less productive now.** | 1.90 (.94) | 2.00 (1.27) | 1.83 (1.00) | .19 | 2, 86 | .07 | 86 | .09 | .15 | .07 |
| **…am able to concentrate better now.** | 2.97 (1.09) | 3.81 (1.14) | 4.24 (.74) | 12.06** | 2, 86 | 4.65** | 86 | .75 | .45 | 1.36 |
| **…am generally in a better mood now.** | 3.00 (1.04) | 3.74 (1.15) | 3.79 (1.05) | 4.92** | 2, 86 | 3.14** | 86 | .67 | .05 | .76 |
| **…have not noticed any changes in my overall mood.** | 4.21 (1.45) | 3.45 (1.52) | 2.97 (1.21) | 5.77** | 2, 86 | 3.15** | 86 | .51 | .35 | .93 |
| **…have more energy now.** | 3.21 (1.08) | 3.94 (1.03) | 4.21 (.90) | 7.65** | 2, 86 | 3.79** | 86 | .69 | .28 | 1.01 |
| **…have not noticed any changes in my sleepiness.** | 3.93 (1.46) | 3.32 (1.45) | 2.83 (1.42) | 4.26* | 2, 86 | 2.65** | 86 | .42 | .34 | .76 |
| **…am more distressed now.** | 2.07 (1.13) | 2.39 (1.45) | 1.90 (1.08) | 1.22 | 2, 86 | .26 | 86 | .25 | .38 | .15 |
| **…find myself more engaged in my endeavors now.** | 3.41 (1.27) | 4.00 (1.18) | 4.17 (.97) | 3.50* | 2, 86 | 2.59** | 86 | .48 | .16 | .67 |
| **…find that I enjoy my endeavors less now.** | 1.97 (1.12) | 1.77 (.81) | 1.52 (.79) | 1.76 | 2, 86 | 1.54 | 86 | .20 | .31 | .46 |

*Note*. $N = 89$. $*p < .05$. $**p < .01$. SR = Self-regulation only training group. SC = Combined self-regulation and self-control training group. [a]Responses provided on a scale of 1 (*Strongly disagree*) to 6 (*Strongly agree*). [b]Effect size between control and SR groups. [c]Effect size between SR and SC groups. [d]Effect size between the control and SC groups.

average transferability to the personal domain ($t$ (58) = .13, *ns*, $d$ = .03). Thus, Hypothesis 5b was not supported.

***Summary.*** Results from these analyses indicate that, compared to the control group, participants in the training groups felt less fatigued, better able to concentrate, in a better mood, and greater overall changes in mood at the end of the study compared to the beginning. Though the differences were mainly driven by differences between each training group and the control group, the effect sizes between the combined training group and the control group were larger, on average, than those between the self-regulation training group and the control group. Several additional differences also emerged with respect to greater energy, changes in sleepiness, and more engagement in endeavors. Additionally, participants in the training groups generally reported that the skills they learned were applicable to other domains, such as academia, work, and personal domains; however, there were no significant differences between groups on these ratings. Taken together, these findings suggest that the training groups noticed positive changes at the end of the study compared to how they felt at the beginning, and felt that the training skills would be applicable to other important domains; however, there were no significant differences between groups on ratings of transferability of training skills.

**Latent Constructs of Self-Regulation and Self-Control (Hypotheses 6a-e)**

To evaluate the measurement and structural models of self-regulation and self-control that were developed in the preliminary study, a series of CFA and SEM models were evaluated.

*Hypothesis 6a: Stage 1 decisional self-control items will load on a Stage 1 factor and Stage 2 protracted self-control items will load on a Stage 2 factor*

*(anticipated CFI > .95, anticipated RMSEA < .05). The two stage factors will be correlated (anticipated r = .35) and this two-factor model will provide a better fit to the data than a one-factor model (anticipated $\chi^2$ difference test significant at the .05 level).*

A two-factor model of self-control provided a better fit to the data (CFI = .84, RMSEA = .09, 90% CI = .06 - .10) compared to a one-factor model (CFI = .72, RMSEA = .12, 90% CI = .10 - .13), though the CFI value did not reach the desired threshold of .95 or higher. The chi-square test of the difference was significant ($\Delta\chi^2 = 78.48$, $\Delta d.f. = 1$, $\Delta CFI = .12$, $p < .05$). The correlation between decisional and proctracted self-control factors was .37, $p < .05$. Though neither the one-factor nor the two-factor model provided a good fit to the data, the trend was towards the two-factor model fitting better. Based on this trend and the inter-factor correlation, Hypothesis 6a was partially supported.

*Hypothesis 6b: The stages of self-control will represent lower-order factors, which will load on a higher-order self-control factor (anticipated CFI > .95, anticipated RMSEA < .05). This hierarchical model will provide a better fit to the data than the two-factor model (anticipated $\chi^2$ difference test significant at the .05 level).*

The higher-order model of self-control provided a slightly better fit to the data (CFI = .86, RMSEA = .08, 90% CFI = .06 - .11) compared to the two-factor model ($\Delta\chi^2 = 11.21$, $\Delta d.f. = 5$, $\Delta CFI = .02$, $p < .05$), though the CFI value still did not reach .95. The factor loadings were .59, $p < .05$ and .34, $p < .05$ for decisional and protracted self-control, respectively, on the higher-order factor. Because the higher-order model provided a slightly better fit than the two-factor model, and there was a significant difference in the chi-square value, Hypothesis 6b was partially supported; however, this model still did not meet criteria for a good fit to the data.

*Hypothesis 6c: With regards to self-regulation, goal establishment items will load on a goal establishment factor; planning items will load on a planning factor; goal striving items will load on a goal striving factor; and goal revision items will load on a goal*

*revision factor (anticipated CFI > .95, anticipated RMSEA < .05). The four stage factors will be correlated (anticipated rs between .25 and .40), and this four-factor model will provide a better fit to the data than a one-factor model (anticipated $\chi^2$ difference test significant at the .05 level).*

The tests of the self-regulation model indicated that the one-factor model provided a similarly poor fit (CFI = .58, RMSEA = .09, 90% CI = .08 - .10) as the four-factor model (CFI = .59, RMSEA = .09, 90% CI = .08 - .10) with an increase in chi-square ($\Delta\chi^2 = 13.69$, $\Delta d.f. = 5$, $p < .05$) rather than the expected decrease in the chi-square value. The factor loadings in the four-factor model were between .21 and .40, all $p < .05$. Because neither the one-factor nor the four-factor model provided a good fit to the data, Hypothesis 6c was not supported.

*Hypothesis 6d: The stages of self-regulation will represent lower-order factors, which will load on a higher-order self-regulation factor (anticipated CFI > .95, anticipated RMSEA < .05). This hierarchical model will provide a better fit to the data than the four-factor model (anticipated $\chi^2$ difference test significant at the .05 level).*

The higher-order model of self-regulation also provided a poor fit to the data (CFI = .60, RMSEA = .09, 90% CI = .08 - .10) and a slight increase in the chi-square value ($\Delta\chi^2 = .12$, $\Delta d.f. = 2$, *ns*), rather than the expected decrease. The factor loadings ranged from .47 through .64, with all $p < .05$. However, based on the extremely low CFI value and change in chi-square in the opposite direction as predicted, Hypothesis 6d was not supported.

*Hypothesis 6e: Using the results from the preliminary study, a model in which self-control loads on the goal striving stage of self-regulation will provide a better fit to the data than a model with self-control as an intercorrelated factor with the four self-regulation factors (anticipated $\chi^2$ difference test significant at the .05 level).*

Based on the poor fit of the self-regulation measurement and structural models, the relationship between two models of self-regulation and self-control could not be evaluated. Model fit would be expected to be poor based on the poor fit of the self-

regulation model alone, and the structural relationship between self-control and self-regulation could not be properly assessed. Therefore, this hypothesis was not tested.

***Summary.*** Taken together, the self-control model developed from the preliminary study provided a better fit to the data than the self-regulation model. The self-control models did not quite reach the desired standards for model fit, but the best-fitting model was the higher-order model. The self-regulation model that was supported in the preliminary study with four intercorrelated factors did not fit the data from the experimental study participants well.

**Summary of Results**

The analyses presented here provide an evaluation of the efficacy of the training interventions and also the new measures of self-regulation and self-control, all with the goal of providing empirical evidence regarding the relationship of self-regulation and self-control. The combined training group had better goal adherence during Week 2 compared to the self-regulation only training group, which supports the argument that self-control plays a useful role in the self-regulatory process. However, these group differences did not extend into Week 3. I also found that sleep duration was negatively associated with morning fatigue, negative affect, and productivity impairment, but there were no significant differences in these outcome variables across training groups in Week 2. Post-intervention reports indicated that the combined training group reported greater positive changes in fatigue, concentration, and mood from the beginning to the end of the study, compared to the self-regulation and the control group. Additionally, both training groups reported that the skills they learned in the training session would be applicable to other life domains, including academia, work, and personal domains; however, there

were no significant differences in reported transferability between training groups. Finally, I evaluated the new measures of self-regulation and self-control that I developed in the preliminary study. While their psychometric properties were adequate and better in some cases than the extant IPIP measure, the measurement and structural models developed in the preliminary study did not fit the data well. Further explanations and implications are discussed in the following chapter.

# CHAPTER 4

# DISCUSSION

Through the program of research and results from the three studies described here, I submit that I accomplished the three aims of this dissertation, with the overarching goal of empirically demonstrating that self-regulation and self-control are separate but related constructs. First, I developed new measures of self-regulation and self-control based on theoretical models of each construct. I also demonstrated that, among a broad student sample, self-control fits best in the self-regulation model when associated with goal striving, placing self-control within the context of self-regulation as predicted by the theoretical models. Second, I evaluated the distinct nature of the two constructs through the implementation of two training sessions targeted towards improving sleep habits. By administering self-regulation training and a combined self-regulation and self-control training, the added value of the self-control component was empirically assessed. Several sets of results indicate that the combined training group fared better in terms of goal adherence during the study, and sleep-related, affective, and productivity improvements following the training intervention. Third and finally, I demonstrated the efficacy of these interventions within a working population. This was the first study to implement a combined self-regulatory and self-control intervention within an employee sample. Similar to evidence that the techniques learned in self-regulatory interventions have been transferable to other domains (e.g., Frayne & Latham, 1987; Latham & Frayne, 1989), the training administered in these experiments was reported to be applicable not only to the targeted behavior of increasing sleep duration, but also to school, work, and personal domains.

In what follows, I provide a discussion of the results found and also not found in the current program of research. Using current research on the subject of behavior modification in various domains, I place the current studies in the context of the current literature. I also compare this research to past studies to demonstrate similarities and/or areas of growth and improvement. A section of limitations addresses the potential limitations of the current research, and future research directions are provided to help guide future work in this area.

**Self-Regulation and Self-Control as Related, Multi-faceted Constructs**

The main theoretical contribution of this program of research was the empirical demonstration that self-regulation and self-control are separate yet related constructs. The historical development of both constructs suggests that they are distinct motivational processes. With self-control growing out of the fields of ethics and philosophy, and self-regulation stemming from goal-setting and goal-striving work, these two constructs should have clear boundaries that define their construct space. However, they have been used interchangeably in both theory and empirical research in recent years (e.g., Hanif et al., 2012; Muraven & Baumeister, 2000; Muraven et al., 1999; Sauer, Burris, & Carlson, 2010; Tice, Baumeister, Shmueli, & Muraven, 2007; K. Vohs & Baumeister, 2004; K. D. Vohs et al., 2008), leading to theoretical confusion and research findings that appear to be incongruent.

Trait self-regulation and self-control have been assessed frequently in research studies through self-report questionnaires (Baumeister, 2002; Baumeister & Vohs, 2004; Muraven et al., 1999; Muraven et al., 1998; Tangney et al., 2004). However, the use of over 18 measures with approximately 25% of overlap in item content calls into question the construct validity of the measures. The present efforts to more accurately measure

self-regulation and self-control based on theoretical formulations of each provide a first step in the direction of improving these self-report measures. Through several methods of item selection, a demonstration of convergent and discriminant validity, and model fitting using CFA, E/CFA, and SEM, new measures were developed that had acceptable psychometric properties and the expected relationships with other constructs. Data from the preliminary study also offered a first step towards empirically demonstrating that self-control is associated with the goal striving stage of self-regulation, providing support for the theoretical statements regarding self-control as an aspect of self-regulation (Hagger et al., 2010; F. Kanfer & Karoly, 1972; McCullough & Willoughby, 2009). Furthermore, in many cases, the new scales had better psychometric properties than the extant IPIP self-regulation / self-control scale.

The preliminary study provided a broad sample with which to develop measures of self-regulation and self-control and their constituent stages. However, these models did not meet the criteria for good fit within the experimental samples. The hierarchical model of self-control provided the best fit to the data, but the *CFI* value was too low and the *RMSEA* value was too high to support model fit (*CFI* = .86, *RMSEA* = .09). The extremely high intercorrelations among self-regulation factors presented issues when trying to confirm model fit from the self-regulation model established in the preliminary study. Consequently, the relationship between self-regulation and self-control factors could not be tested in the experimental studies.

There are at least three explanations for why the models developed in the preliminary study did not fit the data well in the experimental studies. First, the selection criteria for enrolling participants in the experimental studies were more stringent than

those for the preliminary study. Specifically, participants in the experimental studies were selected based on a desire to get more sleep during the week. These individuals were willing to seek outside assistance and engage in a research study to help work towards their sleep goals. Perhaps these participants could not distinguish between the four stages of self-regulation as well as those from a broader population. Similarly, it may be that self-control has a broader meaning for individuals who seek assistance with behavior modification and goal-directed behavior. A hierarchical model with two factors of decisional and protracted self-control may not fully cover the construct space for self-control among these individuals.

Second, it may be that the decisions and model specifications made in the preliminary study under the E/CFA framework over-modified the models to fit the sample. Perhaps if a different sample of undergraduate students had been evaluated, different model specifications would have been made. This explanation is one of the primary drawbacks to using a bottom-up approach to develop and tweak a model, and one of the major reasons to validate exploratory models using replication studies.

Third, there is a possibility that the four stages of self-regulation and two stages of self-control tested here are not distinct dimensions along which all individuals view themselves. The method of using self-report scales to measure each stage relies on the assumption that each is a trait with distinct construct space. It may be that individuals do not or are not able to distinguish among four self-regulatory stages and/or two-self-control stages when reporting about their traits and general behavioral tendencies. As traits, self-regulation and self-control may be more general constructs that occupy a broader construct space without clear-cut stages. It could be that only in an intervention

setting is it possible for individuals to differentiate between the stages of each construct and understand how to implement them during goal-directed behavior.

A combination of these reasons could also account for the lack of model fit for the tested models of self-regulation and self-control found in the present studies, or there may be additional explanations. Future researchers should continue to determine the applicability and validity of the measures of trait self-regulation and self-control developed here.

**Goal Adherence**

Another way of establishing self-regulation and self-control as distinct constructs was through the implementation of training techniques. As expected, I found that both training groups showed better goal adherence during Week 2 of the study compared to the control group, with medium to strong effect sizes across samples (*d*s between .44 and .81). I also found that the combined self-regulatory and self-control training group had greater adherence to self-set goals during Week 2, above and beyond that demonstrated by the group receiving self-regulatory training, with a small effect size across samples (*d*s between .18 and .31). One major source of the increase in goal achievement could have been the implementation of self-control techniques in addition to self-regulatory techniques, which would contribute to the argument that they occupy different roles in the overall process of goal achievement.

While the effect sizes associated with differences in goal adherence between the training and control groups were roughly of the expected magnitudes of medium to large, the associated effect sizes for difference between training groups were smaller than I expected. As previous researchers have described, self-control is implemented in order to "act counter to immediate contingencies" (F. Kanfer & Karoly, 1972, p. 406) or to "alter

the probability of a problematic act" (F. Kanfer, 1975, p. 317); that is, problematic in the context of overall goal-directed behavior. As participants in the present studies reported that they would need to alter their typical evening and/or morning routines (e.g., going to bed earlier, waking up later), I expected that participants may have needed to exercise self-control frequently during Week 2. For example, if plans to go to bed earlier than the typical bed time required skipping a favorite television show, self-control may be required to keep from turning on the television or to turn it off before the show starts. Those who learned self-control skills would be able to implement them and may have a better chance of maintaining their plans to get more sleep. However, as participants reported, they only encountered things that they believed required self-control 60% of the time during Week 2, offering less opportunities for the skills learned in the additional self-control module to assist those participants in better adhering to their goals. Therefore, a smaller effect size of the difference in adherence between groups seems warranted.

The evaluation of whether differences in adherence scores across groups persisted during the Week 3 follow-up period revealed no significant differences (*d*s < .07). I predicted that both training groups would continue to put the training skills that they learned to use during Week 3, and that the difference between training groups would remain significant. I found that the training groups adhered better to their goals during the final week compared to the control group, with effect sizes in each sample of medium-to-large in magnitude (*d*s between .69 and .97), suggesting that these groups continued to work towards their goals of getting more sleep during the week. However, the combined training group did not adhere to their sleep duration goals any more than

the self-regulation training group. As the analyses on individual samples had a low associated power, no conclusions can be made as to whether these findings are due to the lack of a significant difference in the population or the lack of power to detect an effect. However, these effects demonstrated the same pattern across the student, employee, and combined samples, and the combined sample had higher associated power. Therefore, it appears that there is some support for the conclusion that there was not a significant difference between training groups.

There may be at least four possible explanations for this finding. First, it may not have been feasible for the combined training group to maintain their goal adherence from Week 2, as some research has found that exercising self-control can be fatiguing and may be difficult to maintain over time (e.g., Muraven et al., 1999). Second, self-control may not have been required during Week 3 as often as it was during Week 2 for participants in the combined training group to reach their sleep goals. Reports indicated that self-control was necessary approximately 60% of the time during Week 2. If that percentage decreased during Week 3, the combined training group would not need to implement the self-control training as often and would have the same tools to apply towards goal-directed behavior as the self-regulation training group. Third, Siztmann and Ely (2010) found that an intervention that included continuous self-regulatory prompts was the strongest intervention with the greatest improvement in learning outcomes, compared to pre-training prompts and prompts only in the beginning of the study period. These investigators might argue that more prompts were needed during Week 3 to help the training groups keep self-regulation and/or self-control in the forefront of their minds. Although participants were asked if they wanted to revise their sleep goal each evening,

this question may not have served as a strong enough prompt to ensure that the other stages of self-regulation and, when applicable, self-control were engaged in. Finally, evaluating post-intervention differences across groups may require a longer time period than just one week following the intervention. Stadler, Oettingen, and Gollwitzer (2010) conducted a two-year intervention study and found the greatest differences between the training and control groups at 24 months. Nonetheless, in all experimental samples, both training groups continued to get more sleep during Week 3 and demonstrated greater adherence compared to the control group, which supports the utility of both training interventions over a short period of time.

The use of adherence scores as a critical outcome variable of the differential effects of the training sessions could be one potential weakness of the experimental studies. The use of adherence scores requires the creation and evaluation of difference scores, which have low reliability when the correlation between the two measures used to create the difference score is high and/or when the reliability of each measure is low. All but one of the reliabilities of difference scores in the experimental studies met the reliability criteria that I set of moderate magnitude and above the threshold for statistical significance. Furthermore, the use of adherence scores in similar behavior modification studies has been common, as it is often necessary to evaluate behavior change in the context of the original behavioral patterns. Recently, difference scores have been used to evaluate improved handgrip time (Hanif et al., 2012), weight loss (Ciampolini et al., 2010), decrease in number of daily cigarettes smoked (Kelly et al., 2010), derivations from current diet and weight loss (Hennecke & Freund, 2010), and pain management and

reduction (Sauer et al., 2010). However, there has been no mention of the potential issues that arise with the use of difference scores, nor have the reliabilities been reported.

**Daily Outcomes associated with Increased Sleep Duration**

Based on the research presented in the introduction that lack of sleep has been associated with outcomes such as greater fatigue, lower concentration, worse mood, and poor health, I predicted that similar findings would result in the present research. As predicted, I found that sleep duration was negatively associated with subjective morning fatigue (*r*s between -.23 and -.29), negative affect (*r*s between -.25 and -.43), and productivity impairment (*r*s between -.14 and -.33) across all samples. However, the effect sizes were smaller than anticipated. I chose the expected effect sizes based on results reported in previous research, so it was surprising that the results from the present studies were smaller than those in other studies. One possible reason for this is that much of the extant research relies on self-reported rather than objectively measured sleep duration. Reporting feelings of fatigue, affect, and productivity impairment may be conflated with reports of sleep duration when implementing self-report methods. Additionally, I did not find that sleep duration was positively associated with positive affect, suggesting that sleep duration has an impact on traits with an overall negative valence (e.g., negative affect) but not on traits with a positive valence. Alternatively, this lack of significance may be due to the low power of the individual studies; however, the magnitudes of correlation values were all smaller than $|r| = .05$ and this was replicated across studies, providing support for the conjecture that it is possible that sleep duration and positive affect were not significantly associated.

In this same vein, I expected that there would be differences between training groups on the daily affective and productivity outcome variables during Week 2, such that the combined training group would have lower negative affect, higher positive affect, greater productivity, and less fatigue (*d*s < .15). Despite the baseline associations between sleep duration and these outcome variables, and the within-group changes from Week 1 to Week 2 in sleep duration, fatigue, and negative affect, there were no significant differences between groups on these affective outcomes. The lack of difference between groups on these variables could be a result of the smaller-than-expected difference between training groups found in Hypothesis 1. That is, the small effects associated with the differences in goal adherence were too small to drive differences in daily affective outcomes. Additionally, a number of other factors likely contribute to daily fatigue, affect, and productivity, such as activities during the day or the corresponding traits (Ackerman, Kanfer, & Wolman, 2008). Overall, while these findings do indicate that both interventions were associated with positive changes in daily fatigue, negative affect, and productivity impairment during the intervention period, they do not support the argument that the combined training group was associated with incrementally more positive changes in these variables than the self-regulation group.

**Post-Intervention Improvements**

Across all experimental study samples, participants in the training groups retrospectively reported feeling positive changes at the end of the study period compared to the beginning, with effect sizes ranging from small to large. Effect sizes of these differences were expected to be medium to large in size, and these expectations were generally supported (*d*s between .72 and 1.09 for four of five effects from the combined

sample). Training group participants reported feeling less fatigue (average *d* = 1.09), better able to concentrate (average *d* = .85), and in a better general mood (average *d* = .72), compared to the control group. For many of the significant group differences, the differences between the combined training group and the control group were larger (*d*s between .76 and 1.36) than those between the self-regulation only training group and the control group (*d*s between .51 to .92). Additionally, participants in the combined training group reported greater changes in their ability to concentrate at the end of the study compared to the self-regulation only training group (*d* = .45).

There are several possible explanations for these findings. These ratings could be viewed as a manipulation check, to evaluate whether participants understood that they were in a study regarding behavior change and that they were supposed to feel differently following the training intervention. However, the changes reported did not just pertain to sleepiness and fatigue, but also included concentration, mood, and engagement in endeavors. Consequently, these ratings may not just reflect a manipulation check, but could be an accurate portrayal of the changes in feelings from beginning to end of the study. Given that training group participants gave favorable evaluations of the training they received, and knowledge tests results indicated that participants learned the necessary information during the intervention session, it seems more likely that training group participants noticed affective changes related to altering their sleep-related behavior over the course of the study. Furthermore, participants in both groups reported that the training skills would be applicable to other life domains, suggesting that perhaps they might apply these skills to academia, work, and/or personal endeavors going forward. Taken together, these post-intervention reports indicate that participants

experienced changes not only in the targeted behavior of sleep duration, but also in related feelings, and that application of training skills to other domains might allow for improvements in the targeted behavior and other feelings related to that behavior.

**Practical Implications**

While these training interventions can be applied to a wide variety of targeted behaviors, they may be particularly useful in the field of sleep and fatigue. Extant interventions in this field have yet to demonstrate significant improvement in sleep habits (e.g., Philbrick & Sherry, 2003), or those that do fall mainly under the clinical domain in which intensive, individual therapy sessions are required (e.g., Coates & Thoresen, 1979; Thoresen et al., 1981). Based on evidence provided here that an intervention combining self-regulation and self-control had positive effects on goal adherence, and that increased sleep duration was associated with lower negative affect, fatigue, and productivity impairment, this intervention provides a useful option for cases in which individuals need to get more sleep. Furthermore, the intervention was administered in a group setting, decreasing the burden of time and resources required to conduct one-on-one sessions. Overall, the implementation of the interventions administered here among individuals without sleep-related disorders provides a new intervention that could be used in this field.

**Limitations**

The three studies described here have four primary limitations. First, the samples used in these studies may have unique qualities. For example, two of the three studies included student samples, and two of the three studies selected participants based on potential issues with their self-regulatory and/or self-control skills. Results indicated that

self-regulation may not have the same latent structure among groups who were selected to learn about and improve upon self-regulatory techniques. While the process of self-regulation and self-control are likely similar across populations, this research suggests that there are some differences. Future research should be focused on determining among which populations self-regulation and self-control have a similar structure and meaning, and among which populations these processes might be structured differently. In samples where the models that were tested here appear not to fit, it would be useful to develop alternative models based on other models of self-regulation and self-control.

Second, these studies had low statistical power for the student and employee samples on their own. Cohen (1988) recommends a level of at least .80; however, low power seems to be common in this field of research. For example, Sitzmann and Ely (2010) recently reported a power level of .28 in a footnote of their publication in the *Journal of Applied Psychology*. In longitudinal field studies, there is often a tradeoff between power and feasibility, in terms of how many participants who fit the inclusion criteria can be recruited in a given amount of time. The present studies had power levels that were on par with some other behavior modification studies, and the power of the combined samples fell within a more traditionally accepted range.

Third, the two experimental studies were conducted over a three-week period. While this length of time is a good start to examining self-regulation and self-control processes over time, it would be useful to investigate these constructs over a longer period of time. It might be the case that they operate differently over different periods of time, or that they take some individuals longer than three weeks to implement. Three-week interventions have been common in behavior modification research of late (Kelly et

al., 2010; Wanberg, Zhu, & Van Hooft, 2010), though some studies have been conducted over a longer time frame. For example, as mentioned previously, Stadler, Oettingen, and Gollwitzer (2010) conducted a two-year intervention study and found the greatest differences between the training and control groups at 24 months. However, with longer study periods comes a tradeoff of fewer daily assessments. Stadler et al. (2010) only assessed behavior five times during the study period. Similarly, Hennecke and Freund (2010) conducted a 6-week intervention study and assessed behaviors with one questionnaire per week. Given that it is not yet known how self-regulatory processes unfold over time, studies of lesser and greater length would likely be useful in understanding self-regulation in short- and long-term time frames.

Finally, the control groups employed in the experimental studies had access to their sleep-wake information as recorded by the actigraph device during the study. These participants may have monitored this information and used the feedback to alter their sleep-wake behaviors during the study period, despite instructions to follow their normal sleeping and waking patterns. Other researchers have also used a self-monitoring group as their control group (Kelly et al., 2010). In the future, the inclusion of a control group that does not have the option to monitor their behaviors might provide a closer approximation to a control group; however, an argument could be made that even wearing an actigraph on a daily basis may incite a greater awareness of sleep-wake patterns, making a "true" control group difficult to implement in a field study setting.

**Future Directions**

There are at least four ways in which future research could continue to develop and extend the current understanding of self-regulation and self-control. First, researchers should investigate whether the timing of this type of intervention has an

impact on outcomes. For example, Siztman and Ely (2010) found that continuous self-regulatory prompts during the study period were the strongest type of intervention, compared to prompting in the early and late stages of the study. In the present research, the online questionnaires for the training groups included questions regarding each stage of the self-regulatory (and self-control, when applicable) process during Week 2. However, these questions were not asked during Week 3. It may be that adding questions to prompt self-regulatory processes throughout the study period could lead to greater goal adherence and/or additional positive affective outcomes. In addition, posing preliminary questions regarding self-regulatory processes before an intervention could help participants begin to think about their goals and goal striving behaviors prior to the intervention, which may help them to develop goals, plans, and strategies that are more realistic and more likely to lead to sustained goal adherence over time. Alternatively, other investigators have administered the intervention in the very beginning of the study period, giving participants several weeks to practice the skills learned (Denson, Capper, Oaten, Friese, & Schofield, 2011). Because self-regulation and self-control interventions focus on the alteration of behavior, which is an effortful process, individuals may benefit from a greater period of time in which to practice and develop these skills before sustained behavior change can be observed.

Second, the interventions administered in the present research should be further developed and refined in future research, with particular attention paid to the group versus the individual setting. For example, Van Genogten (2010) administered a personalized intervention for weight loss with positive outcomes. Although there are benefits to having an intervention that can be administered in groups and personalized to

some degree, some participants may benefit more from an intervention that tailors the content specifically to each individual. The processes of self-regulation and self-control remain the same, but it would be useful to explore whether certain individuals benefit more from individualized interventions, and/or whether there are certain domains in which goals are more often attained with personalized interventions.

Third, investigators could work to apply this intervention among different age groups than were included in the present program of research, particularly among younger age groups. Perels, Dignath, and Schmitz (2009) applied a self-regulatory among elementary school children; however the only assessments were administered pre- and post-intervention. Duckworth et al. (2010) applied parts of the self-regulatory model among adolescents with favorable outcomes in an academic setting. Recently, researchers have called for better field measures of self-regulation for children and adolescents, in addition to improved interventions (McClelland & Cameron, 2011). The measures and interventions developed and tested in the program of research presented here could be used as a starting point for assessment and training of self-regulation and self-control among individuals of younger ages.

Fourth, various self-regulatory interventions and the assessment of self-regulatory processes have been widely used to track and change behaviors in a variety of domains, such as attention regulation (Chen et al., 2011), learning (Duckworth et al., 2010; Duckworth & Seligman, 2005), weight loss (Ciampolini et al., 2010), and work (Stobbeleir, Ashford, & Buyens, 2011). Each of these interventions has been met with some success in each domain. It would be useful to determine how these other interventions compare to the trainings applied here, and whether a combined self-

regulation and self-control training is more or less beneficial than extant interventions in different domains.

**Conclusions**

The study of self-regulation and self-control reflects an area of research with both theoretical and practical implications. Theoretical work on both constructs has described the two as distinct, yet related motivational constructs; however, the present research is one of the first research programs centered around the collection of empirical evidence to test these theoretical formulations. Through this research, I provided two types of empirical evidence to suggest that self-regulation and self-control are distinct, yet related constructs. Specifically, self-control appears to be the most applicable during the goal striving phase of self-regulation from a measurement perspective. Moreover, learning self-control techniques in addition to self-regulation skills led to greater goal adherence and positive post-training changes compared to learning self-regulation skills alone and to a control group. This research may serve to both support and advance current theoretical formulations, and offers some progress towards the joining of theory and application of self-regulatory interventions going forward.

## APPENDIX A

## NEW SELF-REGULATION AND SELF-CONTROL SCALES

Decisional Self-Control

1. I frequently find that when certain things happen, I cannot restrain my reaction. (R)
2. Sometimes I impulsively do things that at other times I definitely would not let myself do. (R)
3. I often act without thinking through all the alternatives. (R)
4. I frequently break basic rules. (R)
5. I can always control my immediate wishes and not let those wishes determine my total behavior.
6. I make rash decisions. (R)
7. I often act on the spur of the moment without stopping to think. (R)

Protracted Self-Control

1. I cannot keep my mind on one thing. (R)
2. I have trouble concentrating. (R)
3. I usually have a whole bunch of thoughts and feelings that interfere with my ability to work in a focused way. (R)
4. I have more trouble concentrating than others seem to have. (R)
5. I can control my thoughts from distracting me from the task at hand.
6. I am careful not to leave some of my tasks unfinished in favor of more attractive activities.
7. It is difficult for me to suppress thoughts that interfere with what I need to do. (R)
8. Pleasure and fun can sometimes keep me from getting my work done. (R)
9. I find it hard to keep my mind on a task or job. (R)
10. I often do whatever makes me feel cheerful here and now, even at the cost of some distant goal. (R)
11. I find that I am able to stick to one task at a time, rather than jumping from one task to another.
12. I can concentrate on one activity for a long period of time if necessary.

Goal Establishment

1. I think carefully and choose goals that are important to me.
2. When preparing for a task, I identify goals to be achieved.
3. I make an effort to seek out ideas about how to reach my goals.
4. When I work on a task, I set short-term goals for myself in order to direct my efforts.
5. I discuss the appropriateness of my goals with anyone who may be involved.
6. I have a hard time setting goals for myself. (R)
7. When working on a task, I make up questions to help me focus on the task.
8. If a task is difficult for me, I try to change the way I approach it.
9. I try to think through a task and what I am supposed to learn from it rather than than just diving in.

Planning

1. When preparing to do a task, I take into account the available resources.
2. If I find it difficult to concentrate on a certain job, I divide the job into smaller segments.
3. When I plan to work, I remove all the things that are not relevant to my work.
4. I do my tasks only just before they need to be done. (R)
5. I usually plan my work when faced with a number of things to do.
6. When preparing to do a task that involves others, I take their characteristics (e.g., prior knowledge) into account.
7. I do not devote much thought or effort to preparing for the future. (R)
8. When preparing to do a task, I decide on the appropriate strategy.
9. I work out practical ways or strategies to achieve the goals I set for myself.
10. I plan ahead what to do before I act.
11. When thinking about how to reach a goal, I try to identify the tasks that I may not be very good at.
12. I try to apply ideas about effective task accomplishment when working towards my goals

13. When I find it difficult to settle down to a certain task, I look for ways to help me settle down.

Goal Striving

1. When I decide to do something, I am able to follow through.
2. I make careless mistakes because I rush through my work. (R)
3. I work hard to do well, even if I do not like what I am doing.
4. I persist with plans, even in the face of difficulties.
5. Even when a task is dull and uninteresting, I manage to keep working until finished.
6. I stick to what I am doing, even if the task is lengthy and unpleasant.
7. When I become confused over something I am working on, I go back and try to figure it out.
8. I work towards my goals enthusiastically.
9. People can count on me to keep a schedule.
10. I am always on time.
11. I actually put my plans or intentions to action.
12. I direct myself to use time effectively.

Goal Revision

1. I learn from my mistakes.
2. When evaluating whether or not I have attained a goal, I compare my current performance to previous performance.
3. I ask myself questions to make sure I am working effectively towards my goal.
4. I use feedback from others to determine my goal progress.
5. At the end of a task, I try to determine whether I have met my goals or not.
6. I try to change the way I approach certain tasks in order to fit the requirements of the task.
7. If the strategies I use do not help me attain my goal, I use alternative strategies.
8. I use feedback to improve my performance.
9. I give others feedback on ways in which they can help me achieve my goals.

## APPENDIX B

## MISSING DATA ANALYSES AND IMPUTATION PROCEDURES

Missing data were analyzed for each sample to determine whether there was a pattern to missingness. As distinguished by Little and Rubin (1989), missing data may be missing completely at random (MCAR), missing at random (MAR), or not missing at random (NMAR). Data that are MCAR are missing in a truly random fashion that is unrelated to observed or missing variables in the data set. If data are missing, MCAR is the preferred pattern of missingness. MAR occurs when missing values depend on the value of an observed variable, but are MCAR within any level of that observed variable. NMAR is the most difficult type of missing data, as data that are NMAR are missing in a way that is directly related to relevant study variables. Included within the output of the missing values analysis is an assessment of whether the missing values are MCAR or not. Significance below the .05-level indicates that it is plausible that the data are not MCAR.

Two missing data analyses were conducted for each sample. First, daily Fitbit reports were evaluated. Over the study period, 4% of the student reports were missing, and a missing values analysis indicated that the missing data were MCAR ($\chi^2$= 671.98, *df* = 1128, *ns*). A total of 7% of employee Fitbit reports were missing, and were also MCAR ($\chi^2$= 639.99, *df* = 1233, *ns*). Some researchers argue that if less than 5% of a data set is missing, biases from listwise deletion are likely to be inconsequential (J. W. Graham, 2009). However, deleting cases could have a deleterious effect on statistical power (Roth, 1994). Therefore, missing student and employee Fitbit data were imputed. In comparing the original and imputed data sets, there were no significant differences

(i.e., more than one standard error) between data sets on any of the weekly means for all measures obtained through the actigraph.

Second, daily online questionnaires were evaluated. Three percent of the student data were missing, and Little's MCAR test indicated that the data were MCAR ($\chi^2$ = 479.47, *df* = 558, *ns*). For employees, 6.5% were missing and were also MCAR $\chi^2$= 607.38, *df* = 643, *ns*). There were some associations between missingness and trait- and state-level variables in both samples, described below.

In the student sample, the total number of missing morning questionnaires was negatively associated with trait fatigue ($r$ = -.30, $p$ < .05). All other associations between late and missing questionnaires and trait-level variables were not significant (all |*r*s| < .28). At the state level, the number of late evening questionnaires was positively associated with reports of evening fatigue for Weeks 1 and 2 (*r*s = .29 and .39, $p$ < .05, respectively) and with morning fatigue in Week 2 ($r$ = .31, $p$<.05). The number of late morning questionnaires was positively associated with average reported time missed from academic obligations during Week 2 ($r$ = .37, $p$<.05). The number of missing morning questionnaires was positively associated with sleep quality in Week 1 ($r$ = .32, $p$<.05) and the number of missing evening questionnaires was positively associated with Week 1 sleep quality ($r$ = .31, $p$<.05). All other associations between late and missing questionnaires and state-level variables were not significant (all |*r*s| < .28). These relationships were all similar when looking at the imputed data set, except that the association between the number of missing morning questionnaires and sleep quality during Week 1 became non-significant ($r$ = .24, *ns*).

In the employee sample, at the trait level, late evening questionnaires were associated with higher neuroticism ($r = .37$, $p < .05$) and missing evening questionnaires were associated with greater sleep difficulty ($r = .53$, $p < .05$). At the state level, late morning and missing evening questionnaires were positively associated with state positive affect during all three weeks ($r$s = .41, .40, and .43, and $r$s = .42, .37, .36, respectively). Additionally, total missing morning questionnaires was associated with greater caffeine intake during Weeks 2 and 3 ($r$s = .41 and .36, respectively).

In the imputed data set, some of these relationships were similar. The number of missing morning questionnaires was associated with state PA during Week 1 ($r = .40$) and caffeine intake during Week 2 ($r = -.39$). However, other relationships became significant. The total number of missing morning questionnaires was also associated with morning fatigue during Week 1 ($r = -.41$) and evening fatigue during Weeks 2 and 3 ($r$s = -.32 and -.38). Total missing evening questionnaires was associated with morning fatigue during Week 1 ($r = -.34$), greater impairment of academic productivity due to loss of sleep during Week 2 ($r = -.31$), and evening fatigue during Week 3.

Taken together with the evidence of MCAR for both samples, these relationships suggest that although the number of late and missing questionnaires may be related to these trait- and state-level variables, the patterns of missing data were not contingent on participants' scores on these variables. Therefore, daily student and employee data were imputed.

All data were imputed using the EM algorithm, which involves two steps: the expectation step followed by the maximization step. First, the expected value of the missing data point is estimated using current parameter estimates from observed data.

Next, the maximization step occurs, during which new parameters are estimated using both the original observed data and the estimated expected values of missing data. The process iterates until the parameter estimates converge and predicted values are provided for missing data points (Moon, 1996).

**Imputation Procedures**

Several considerations were made when imputing missing values, including whether to split the data sets by Week when imputing data, how to treat values from late questionnaires, and whether the imputed data set differed significantly from the original data set. Each of these considerations is described in turn below.

**Splitting the data sets by weeks.** Because this study involved slightly different instructions for each week and an intervention prior to Week 2 for two of the three groups, I expected that the daily data would differ across weeks. Because the EM algorithm estimates missing values using parameter estimates from observed data, and observed data could have changed each week due to experimental manipulations, data were imputed separately for each week. This way, the within-week parameters were used to estimate missing data for each week.

**Treating values from late questionnaires**. Because participants were able to complete questionnaires outside the designated time frames, it was important to consider whether values from on-time questionnaires differed from those in questionnaires completed late. To explore these potential differences, the means of state-level variables in each week from on time and late questionnaires were compared.

Among the students, for all state-level variables, the on-time and late means were within 1 standard error except for the fatigue scores from the late evening questionnaires,

which were more than three standard errors higher than those from on time questionnaires (*d*s = 1.25, .95, .94 for Weeks 1 through 3, respectively). Because of the associations between fatigue and the timing of the daily questionnaires, higher evening fatigue values from late questionnaires may have been influenced by trait fatigue. As a result, late evening fatigue scores from all three weeks were considered missing and were imputed with the rest of the missing data.

For the employee sample, the on-time and late means were within 1 standard error of the mean except for the following variables: subjective positive affect during Week 3, subjective morning fatigue during Weeks 2 and 3, and subjective evening fatigue during Weeks 1 and 3. During Week 3, positive affect was significantly higher on the late morning questionnaires compared to the on-time questionnaires ($d = 3.15$). During Weeks 2 and 3, morning ratings of fatigue were significantly lower on the late questionnaires compared to the on-time questionnaires (*d*s = 1.47 and 1.51, respectively). Lastly, during Week 1, the evening fatigue from the late questionnaires was significantly higher than that from the on-time questionnaires ($d = 1.99$), but the relationship switched during Week 3, with the fatigue scores from on-time evening questionnaires being higher ($d = 1.36$). As a result, late scores for these variables during these weeks were considered missing and were imputed with the rest of the missing data.

Imputing all data from late questionnaires in addition to the missing data would have required imputation of over 20% of the data. Past research has demonstrated that estimation of this much missing data introduces biases into the data (J. W. Graham, 2009). Consequently, because there were no significant mean differences on other trait

variables and to avoid introducing possible biases when imputing data, all other data from late questionnaires were kept.

**Comparing original and imputed data sets.** Comparisons were made between the original and imputed data sets to assess whether there were differences between them on variables that were imputed. There were no significant mean differences (i.e., more than one standard error difference) on any imputed variables for any week. The imputed data sets were used for all analyses.

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