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AN EMPIRICAL TEST OF THE DIMENSIONALITY OF SELF-CONTROL

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ABSTRACT

Tunze, Chloe Ann. Ph.D., Purdue University, August 2010. An Empirical Test of the Dimensionality of Self-Control. Major Professor: Kevin L. Rand, Ph.D.

Minimal attention has been devoted to examining the dimensionality of self-control. The present study tested a multidimensional model of self-control in which dimensions were based on the nature of the behavior required (i.e., persistence, initiation, cessation, or prevention). A total of 336 undergraduates completed measures of self-control and psychological well-being. Seventy-four of these participants completed behavioral self-control tasks representing the proposed subtypes. Participants' GPAs were obtained from the Registrar. Stop self-control was inversely related to previously-validated measures of persistence (β = -.61, p = .010) and prevention (β = -.56, p = .040) self-control and demonstrated differential predictive ability of persistence and prevention compared to the other proposed subtypes. Initiation self-control was inversely related to life satisfaction (β = -.35, p = .012) and demonstrated differential predictive ability of life satisfaction compared to stop self-control. These results were interpreted with caution due to inadequate power and questionable validity of several of the behavioral self-control tasks. Both handgrip persistence (r = -.25, p = .033) and blinking prevention (r = -.29, p = .023) were associated with depression. These pairwise correlations were not significantly different from each other, suggesting that no conceptual distinction should be made

between persistence and prevention self-control. Confirmatory factor analyses of self-report data revealed that items clustered based on domain rather than on type of behavior required for self-control exertion. Thus, the structure of self-control remains unclear. Limitations of the present study and implications for future research are discussed.

INTRODUCTION

Self-control is an essential feature of the human condition. If we lacked the ability to restrain ourselves from giving into our temptations, we would always eat the whole bag of potato chips. If we lacked the willpower to work hard on difficult or boring tasks, we would walk right past the treadmill at the gym. Although there are certainly times when we choose these indulgent behaviors, there are many other instances in which we are able to override our impulses. The ability to exert self-control is innate to all individuals in varying degrees, and it is by understanding the mechanisms through which self-control operates that we can gain insight into how we control our behavior. Why is it that under some circumstances we are able to exert self-control but in other circumstances our ability is compromised or altogether absent? Self-control is paramount in enabling us to make progress toward reaching our goals, and thus, it is a highly desirable quality that research should continue to explore.

One characteristic regarding the construct of self-control that is particularly important to investigate is its dimensionality. Some individuals may regularly resist the temptation of engaging in appetitive but goal-interfering tasks (e.g., not eating the entire bag of potato chips) but struggle to persist at aversive but goal-congruent tasks (e.g., running on the treadmill). For other individuals, the struggle may be in the opposite direction. Why do some self-control behaviors seem easier than others, and is there a

meaningful difference between the nature (i.e., whether inhibition or activation is required) of these behaviors? Increased knowledge regarding the dimensionality of self-control will improve the operational definition of self-control, improve our ability to predict behavior (e.g., likelihood of successful goal pursuits), and has many important clinical implications (e.g., helping to inform the design of interventions to improve self-regulatory capacity).

Overview of Self-Control

Self-control has been defined as the degree to which one is able to alter his or her own behavior to be consistent with his or her personal values and expectations (Baumeister, Vohs, & Tice, 2007). More specifically, self-control refers to the ability to override or inhibit behaviors that would prevent or delay successful goal attainment (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Shmueli & Prochaska, 2009). To date, the primary definitions of self-control focus on the ability to inhibit appetitive urges and override temptations. However, it is important to highlight that self-control is the exertion of any effortful, deliberate behavior that allows individuals to avoid short-term temptations in favor of long-term goals or rewards (Baumeister et al., 1998). This means that self-control is also crucial for the initiation and maintenance of aversive behaviors that lead to advantageous outcomes (e.g., overcoming procrastination), and this aspect of self-control should not be overlooked. Although the most common definitions of self-control do not explicitly recognize the initiation and maintenance in their wording, the behavioral tasks used to measure and deplete self-control sometimes require both the

initiation and maintenance of tasks. The ability to exert self-control is essential for myriad situations, including but not limited to: attentional control, dieting, decision making, persistence at work tasks, exercise behavior, and academic performance. Poor or depleted self-control is related to myriad problems as well, including, but not limited to: alcohol and substance abuse, overeating, violence or aggression, criminality, overspending, promiscuous sexual behavior, and procrastination.

Self-Control vs. Self-Regulation

Some researchers use the terms "self-control" and "self-regulation" interchangeably, each referring to one's ability to control his or her thoughts, emotions, and behavior across a variety of contexts (Baumeister & Vohs, 2004). However, others make a distinction between the two terms, viewing self-regulation as a broader construct than self-control. The exhaustive definition of self-regulation implies some form of governance by the self over homeostatic processes (e.g., body temperature), physiological processes (e.g., heart rate), and all goal-directed behavior whether conscious or automatic (Baumeister & Vohs, 2004). In contrast, self-control refers to the deliberate, conscious, and effortful subset of self-regulation (Baumeister, et al., 2007). Thus, the focus of this circumscribed definition is on the degree to which humans are able to control their behaviors consciously in order to bring themselves in line with their personal goals and society's preferred standards.

Although a distinction between self-regulation and self-control has been made for the purposes of this paper, they are not dissimilar. Self-regulation theory is important for

understanding self-control. From the perspective of classic self-regulation theory, an individual's behavior can be explained in terms of either moving toward or away from one's goals (Carver & Scheier, 1982; Rasmussen, Wrosch, Scheier, & Carver, 2006). From this perspective, individuals' behavior is generated as part of a feedback loop in which goals serve an important role (Carver & Scheier, 1982).

One final important aspect of the relationship between self-control and self-regulation is the ability of nonconscious self-regulation to take over in at least two specific situations. One instance in which nonconscious self-regulation can be the driving force behind an individual's behavior is in the case of extreme self-control depletion. This ability is important because it allows the individual to stay in line with preferred standards. A second situation in which nonconscious self-regulation may take over a task that at one time had required the exertion of conscious self-control is when the task has become overlearned. Driving is a good example; when one first learns how to drive, it requires much attention and effort to master the basic skills. However, once the individual drives on a regular basis for an extended period of time, he or she can multitask while driving and may even find him/herself at a location without remembering any details of the drive. Thus, driving – once an effortful task requiring the exertion of self-control – has become a task that requires very little self-control. Moreover, some evidence suggests that individuals can successfully achieve goals through entirely unconscious processes (Gailliot, Mead, & Baumeister, 2008). Exertion of nonconscious self-regulation is not associated with depletion effects, and research suggests that it works in tandem with conscious self-regulation, or self-control. Although it is beyond the scope

of this paper, an understanding of how and when nonconscious self-regulation is activated could have implications for future intervention research.

Self-Control as a Desirable Quality

Self-control is important for success across many areas of life. For this reason, the benefits of high self-control are widespread; it is an integral component of successful goal attainment, it is essential for coping successfully with daily struggles, and it facilitates successful adaptation to and successful acculturation within society. Self-control is what enables individuals to override impulses, avoid distractions, and stay on track in order to reach goals like getting good grades, staying out of trouble with the law, or fitting into a dress. Additionally, Baumeister and Vohs (2004) posit that self-control has been important in terms of human evolution; specifically, they suggest that natural selection shaped human nature for participation in culture, and the capacity for self-control may have evolved as part of this process.

Benefits of High Self-Control

Empirical evidence exists for both the long-term benefits of high self-control and the negative consequences of low self-control. For example, children with a greater ability to delay gratification at age four were later found to have higher SAT scores (Shoda, Mischel, & Peake, 1990). With regard to adjustment, Eisenberg and colleagues (1997) found that parent and teacher reported self-control is predictive of more adaptive social functioning through age 10. In the validation study of the Self-Control Scale

(SCS), Tangney, Baumeister, and Boone (2004) posited that high self-control would be related to a wide range of positive outcomes. In two separate samples totaling over 600 students, they found that people with higher self-control had better grades than those with lower self-control. Moreover, better self-control was associated with better overall psychological adjustment. Specifically, self-control was negatively related to depression, anxiety, and somatization symptoms. In addition, self-control was negatively related to poor impulse control problems and difficulty regulating eating patterns.

Negative Consequences of Low Self-Control

Further support for adverse outcomes related to low self-control exists as well. Many field studies have examined the role of self-control in relation to criminal behavior. Archer and Southall (2009) found that low self-control predicted bullying and aggression in a sample of male prisoners, although this relationship was partially mediated by scores from a workplace aggression costs-benefits scale that was modified for a prison setting. In addition, another study found that for a sample of drug users in court-mandated treatment, low self-control was associated with high criminal thinking (Packer, Best, Day, & Wood, 2009). Finally, in a sample of Hispanic adolescents, low self-control was found to be an independent predictor of deviant behavior (Miller, Jennings, Alvarez-Rivera, & Lanza-Kaduce, 2009). Taken together, these results demonstrate the important role of self-control in adaptive human behavior.

Dimensionality of Self-Control

Although research provides strong evidence for the importance of self-control, both for the individual and for society, its structure has received much less scrutiny. Current viewpoints and models of self-control make the implicit assumption of unidimensionality (e.g., Baumeister, Vohs, & Tice, 2007; Carver, Johnson, & Joorman, 2008; Hofmann, Friese, & Strack, 2009). However, this assumption has not yet been adequately empirically tested, leaving the question of dimensionality open for present research to address. Knowledge about the structure of self-control is important for a number of reasons: We do not know if the implicit assumptions about the dimensionality of self-control are misguided. If multiple dimensions exist, it may be beneficial to identify any discrepancies between the different types of self-control in terms of their unique properties (e.g., amount of energy required, resistance to depletion, etc.) and differential responses to intervention. Moreover, if multiple dimensions exist, it is possible that they have different antecedents and/or different outcomes. The conclusions addressing these issues may have implications for future self-control research and the design of future interventions to improve self-control.

Importance of Examining Dimensionality

Developing a more thorough understanding of self-control, especially in terms of the mechanisms by which it operates, is crucial to understanding human behavior. The present research will attempt to contribute to this goal by filling in gaps in the existing literature. The dimensionality of trait self-control (as defined in the present research) has

not yet been explicitly addressed in the literature. However, an understanding of whether self-control is unidimensional or multidimensional has the potential to lead to significant practical and clinical implications as well as significant improvements in scientific knowledge.

Many behaviors that can be characterized as deficits in self-control (e.g., violence, smoking, overeating, sedentary lifestyle, etc.) are prevalent in our society. Understanding why these behaviors occur, why they are exhibited by some individuals and not others, and how they are related will improve scientists' ability to study these behaviors in future research. Moreover, knowledge regarding the dimensionality of self-control will improve its operational definition by making it more precise and more consistent across researchers. A clearly delineated definition also has the potential to inform research decisions in future self-control studies. If self-control is composed of multiple subtypes, the populations and samples appropriate and/or important for study would need to be widespread in order to examine the properties of each individual dimension. For example, the results from studies investigating violence or aggression may only generalize to the nature of prevention self-control, since both violence and aggressive behaviors are consequences of the failure to refrain from specific behaviors. In contrast, examining factors that contribute to why some individuals lead sedentary lifestyles would lead solely to knowledge about initiation or persistence self-control due to the lack of action by these individuals. Methodological decisions may also have room for improvement depending on the nature of self-control; if self-control is unidimensional, smaller samples of

behavior should be sufficient for solid designs compared to the behavioral repertoire needed if it appears to be multidimensional.

Self-Control Models

Several models of self-control exist that posit that self-control behaviors are determined by one of two separate systems. In these models, one system, typically referred to as the *reflective system*, is thought to be responsible for higher-order and effortful functions, such as deliberate actions, strategic planning, and evaluation. The other system in two-mode models is generally referred to as the *impulsive* or *reflexive system*, because it contributes to automatic, immediate behavioral responses. It is thought to be responsible for producing unplanned, non-effortful behavior in response to urges or temptations. Ultimately, from the perspective of these models, for each unique situation, behavior is determined by the interaction between the reflective and impulsive systems. Which system determines the resulting behavior depends on which system was stronger for that given situation. Two specific dual-systems models will be discussed: 1) Reflective-Impulsive Model (Hofmann, Friese, & Strack, 2009; and 2) Effortful Control Dual Systems Model (Carver, Johnson, & Joorman, 2008). A third model, the Strength Model, which focuses on the finite nature of self-control, will also be discussed in more detail.

Reflective-Impulsive Model of Self-Control

This model, proposed by Hofmann, Friese, and Strack (2009), considers both reflective and impulsive precursors. The authors posit that two antagonistic forces are at work in situations requiring self-control: one force pulling the individual toward the reasonable, logical behavioral response (i.e., a reflective precursor) and the other force tempting the individual to act in a manner that forgoes logic in order to maximize pleasure and minimize pain (i.e., an impulsive precursor). Furthermore, similar to other dual-process models, this framework posits that reflective and impulsive precursors arise from two fundamentally different systems of behavior determination. In this model, the reflective system, while allowing for a higher degree of flexibility and control in responses, is thought to be relatively slow, and to rely on control resources. In contrast, the impulsive system is thought to operate faster than the reflective system, and as a result, may sometimes lead to behaviors that interfere with successful long-term goal attainment. Both systems may be activated at any given time, resulting in what Hofmann and colleagues (2009) refer to as self-control conflicts. Unique to Hofmann and colleagues' (2009) model, when a self-control conflict exists, which system will determine the end result (e.g., the behavioral response) also depends on both the situation (some situations may lead to a stronger activation of one system compared to the other) and the individual's disposition (i.e., personality characteristics and/or attitude). Importantly, this model implicitly views self-control as unidimensional in that it does not discriminate among the nature of the behaviors produced by the reflective system.

Effortful Control Dual-Systems Model of Self-Control

This model of self-regulation is similar to Hofmann and colleagues' (2009) model in that it has both a reactive control component (analogous to the impulsive system), which leads to reflexive and involuntary behavior, and a reflective, effortful control component (analogous to the reflective system), which leads to deliberate behavior. In virtually all variations of effortful control dual-process models (see: Eisenberg et al., 2004; Epstein, 1985; Kochanska & Knaack, 2003; Metcalfe & Mischel, 1999; Rothbart & Bates, 1998), effortful control is considered to be the superordinate system, because it can override impulsive behavior through executive functioning. This model further divides the impulsive component into two subunits based on whether the impulse has *approach incentives* or *avoidance threats*. An approach incentive exists when following through with the impulsive behavior results in immediate reward (e.g., eating a cookie is inherently pleasurable). In contrast, an avoidance threat exists when natural instincts urge the individual to avoid contact with the stimulus in order to avoid harm or punishment (e.g., getting to the car quickly in a dark, empty parking lot avoids harm). In their review of this model, Carver, Johnson, & Joorman (2008) highlight that the effortful control system can also be theoretically divided based on whether it is effortful action or effortful restraint that is required for a given situation. These two types of effort fit into self-control theory in that action and restraint are necessary for successful attainment of approach and avoidance goals, respectively. However, it remains unclear as to whether meaningful differences between these divisions exist because this conceptualization does not appear to have been thoroughly examined in the literature. In order to address this

question, empirical studies systematically investigating differences in self-control behaviors need to be conducted.

Strength Model of Self-Control

The strength model of self-control, formally proposed by Baumeister, Vohs, and Tice (2007), likens the exertion of self-control to the physical exertion of a muscle. In this model, self-control is viewed as a limited resource. Just as a muscle gets tired from repeated exertion, self-control appears to deteriorate after repeated execution as well. The findings from two studies conducted by Wegner, Schneider, Carter, and White (1987) are consistent with this model. They found that, compared to participants who were not instructed to avoid thinking about a white bear, participants who actively tried to suppress thoughts of a white bear during a five-minute suppression period later reported increased thoughts of a white bear. The authors concluded that active self-control exertion in the form of thought suppression leaves one susceptible to rebounding preoccupation with those thoughts. The strength model also implicitly defines self-control as a unidimensional construct because it makes no distinctions between the types of self-control behaviors that will lead to self-control depletion. Previous research has demonstrated that volition (i.e., making choices using self-control) requires effort, which can be taxing on one's ability to exert effort again in the immediate future; this idea is referred to as the *depleted-resource hypothesis*. It is well supported in the literature, and Baumeister and colleagues (1998) refer to this phenomenon as *ego depletion*. Moreover, it is thought that depleting self-control in one domain (i.e., area of focus) will deplete

self-control in all other domains. For example, in one study, participants who were asked to refrain from eating a tempting food (cookies) after they had skipped a meal and were instead asked to consume radishes, spent less time persisting at an unsolvable puzzle task compared to participants in two control groups who did not have to resist the tempting food (Baumeister et al., 1998). In another study, in which participants' self-control was depleted via a different domain (i.e., emotion regulation), participants who were asked to prevent themselves from making facial expressions displaying sadness while watching a sad video clip spent less time persisting at squeezing a handgrip compared to participants who were not asked to regulate their emotions (Muraven, Tice, & Baumeister, 1998). In a third study, participants who were asked to suppress thoughts about a white bear while recording their thoughts on a piece of paper later demonstrated impaired ability to refrain from expressing amusement (e.g., smiling, laughing, etc.) while watching a humorous video clip (Muraven et al., 1998). Thus, from the perspective of ego depletion, all effortful decisions rely on a single reserve of self-control.

In addition to a more thorough understanding of self-control, the strength model of self-control may serve as a useful framework for designing interventions to improve self-control. More specifically, certain aspects of the analogy between self-control and a muscle suggest possible mechanisms by which individuals may build their self-control reserve. For example, it is not uncommon for an athlete to conserve necessary strength for the end of a game or the last repetition in a series of strength-training exercises. Therefore, if self-control is truly analogous to a muscle, it may be possible for one to conserve self-control for upcoming challenges; this is called the *conservation hypothesis*.

However, it is the expectancy of further demands on the muscle and the prediction of further challenges to self-control that are likely key factors in having the ability to conserve the resource consciously (Muraven, Shmueli, & Burkley, 2006). Interventions targeting planning and identification of situations when resources will be necessary may prove to be useful in building expectancies and ultimately allow for deliberate conservation of self-control resources. A final similarity between a muscle and self-control is the potential for increased strength through training (Baumeister et al., 2007; Muraven, Baumeister, & Tice, 1999). Studies have demonstrated that regular self-control efforts are associated with improvements on self-control tasks, thus suggesting an increase in total self-control resources. Muraven and colleagues (1999) conducted a study in which participants were asked to complete one of three exercises daily for two weeks (maintaining good posture, actively trying to regulate mood by targeting improvement, or keep a food diary). The degree of ego depletion evidenced by a single lab task (suppressing thoughts of a white bear) was measured before and after this two-week period, and it was discovered that participants had a smaller drop in handgrip persistence in response to depletion after the two-week period than they had before the two-week period. These findings suggest that regular self-control exertion can reduce participants' vulnerability to depletion effects (i.e., the reserve of self-control can become more resistant to depletion), and this is consistent with the strength model of self-control. Other studies have also found support for the strengthening effects of regular self-control exertion. Oaten and Cheng (2006a) found that participants who completed a self-control program in which they were required to exercise regularly were able to persist longer at a

visual tracing task after they had been depleted compared to their performance on the same sequence of tasks prior to beginning the program. These authors replicated these findings in support of the strength model of self-control using strength-training programs (i.e., regular self-control exertion) in academic and financial management domains (Oaten & Cheng, 2006b; Oaten & Cheng, 2007).

Model Synthesis and Current Research

Although the strength model and the dual-systems models have differences that are readily apparent, they also share considerable conceptual overlap. For example, all models conceptualize self-control as a trait-like construct whereby individual differences exist with regard to the initial amount. Additionally, all models posit that the initial reserve will be depleted over time (or the reflective system will be weakened) by repeated attempts at self-control or temptation avoidance. In the dual-systems models, impulsiveness is considered to be its own dimension or independent construct that is included in the model. While not explicitly stated in the framework, impulsiveness can be conceptualized as its own system in the strength model as well. This assumption can be made because the strength model defines self-control as the capacity to override or inhibit goal-impeding behaviors (i.e., override impulses), not taking into account automatic, reflexive behaviors. Because the goal of the present research is to gain a more thorough understanding of self-control, the present research will focus only on the nature of the deliberate, self-control system presented in these models.

Another commonality among the previously reviewed models is that self-control is activated when conflict is present. Although self-control is particularly important and useful in the pursuit of goals, it is not required for every deliberate behavior. Whether self-control is needed for any given instance depends on the salience of both short-term and long-term goals. Inner conflict will arise when one is faced with a lower-order goal offering immediate benefits that directly interferes with progress toward a higher-order goal offering delayed, but potentially greater benefits (Myrseth, Fishbach, & Trope, 2009). It should be noted that the temptation (which represents a short-term goal) does not have to be in conflict with a long-term goal; although that is the type of conflict that is usually described, it is possible for two short-term goals to be in conflict with one another, resulting in the need for self-control. In situations in which a goal-conflict exists, both systems (deliberative and impulsive) are active, and self-control must be exerted. No conflict exists when an individual's situation-specific, highly salient short-term goals do not impede the progress of any other goal. In these instances, self-control is not needed and impulsive behaviors will prevail.

The final important commonality among the models is the assumption made about the dimensionality of self-control. Both the strength model and the reflective-impulsive model appear to implicitly conceptualize self-control as a unidimensional construct. This assumption is premature, however, due to the lack of conclusive empirical evidence on this topic. As noted earlier, Carver and colleagues (2008) suggest that the control system in the effortful control dual-systems model may be divided depending on whether the effort is targeted at action behaviors or restraint behaviors. Additionally, impulsivity

research (one system of the dual-systems models) suggests that impulsivity is a multifaceted construct (Whiteside & Lynam, 2001). Therefore, it seems logical that the reflective, self-control system may be multidimensional as well. The present research will extend Carver and colleagues' (2008) idea of multiple dimensions by proposing an additional division in both effortful action and effortful restraint, resulting in four potential subtypes of self-control.

The Proposed Taxonomy

First, a single exertion of self-control can be classified into one of two main categories: inhibition or activation (analogous to effortful restraint and action, respectively). In certain situations, progressing toward successful goal attainment requires one to have the ability to override an impulse to act (i.e., inhibition) when that behavior would impede success. For example, if one is on a diet and sees a box of cookies, he or she must override the impulse to eat a cookie. In other situations, however, successful goal attainment requires one to have the ability to override the impulse *not* to act (i.e., activation). For example, if one is trying to improve his or her physical health, he or she must override the impulse to remain inactive and instead get started at the gym. Extending beyond Carver and colleagues' (2008) initial suggestion, these two categories can be bifurcated once more. With regard to inhibition self-control, the goal of one's behavior can be to prevent a goal-conflicting behavior from being initiated or to stop that behavior once it has already been initiated. One may have a goal of not beginning to eat cookies; however, if one has already started eating cookies, self-control can be exerted to

stop eating. Similarly, activation self-control is required not only to initiate an adaptive behavior, but is also required to sustain or persist at that behavior for a period of time that is long enough to bring one closer to his or her goal. For example, the act of running on a treadmill must be initiated, but for it to cause any noticeable or meaningful improvements in physical health, the behavior must also be sustained.

Ultimately, this taxonomy yields four subtypes of self-control behaviors: persistence, initiation, cessation, and prevention; if supported, the findings will suggest that self-control is multidimensional. One alternative option regarding the dimensionality of self-control is the possibility that no meaningful differences exist between these proposed dimensions and self-control is unidimensional. Another option that should be considered is that self-control is, in fact, a multidimensional construct, but the actual dimensions are different than those proposed in the present study. The dimensions that were proposed were chosen because the impulsive branch in the dual-systems models appears to have multiple dimensions based on the type of behavior required, suggesting that there may be a similar structure with regard to the deliberate branch of the model (Carver et al., 2009; Hofmann et al., 2009; Whiteside & Lynam, 2001). The question of the dimensionality of self-control is important because the differences in impulsivity dimensions have led to some important outcomes. As outlined earlier, the potential outcomes if evidence is found for multiple self-control dimensions would be important as well.

Existing Evidence

Existing research investigating the dimensionality of self-control is sparse. Three studies will be reviewed presently. The findings from a comprehensive review of the self-control literature suggest that currently, there is no strong evidence regarding the dimensionality of self-control (Tunze, 2012). In general, the current existing evidence is consistent with unidimensionality because medium to strong relationships appear to exist between all four proposed subtypes of self-control. Additionally, all four subtypes appear to be similarly affected by previous events and have similar influences on future outcomes. Across all studies reviewed by Tunze (2012), there were no salient patterns in the strength of relationships between self-control subtypes, and no differential relations of the proposed subtypes to future outcome variables were identified. All proposed subtypes were consistently related to one another (i.e., persistence, initiation, stop, and prevention tasks all had a depletion effect on subsequent tasks regardless of the nature of that task), and each of the four proposed subtypes had medium to strong effect sizes with regard to the outcome variables. The most evidence existed for: 1 – similar relations of prevention and persistence tasks to future outcome tasks; and 2 – similar effects of previous events on subsequent prevention and persistence tasks. Specifically, one study found that persistence (performance on a boring and tedious cognitive task) and prevention (refraining from eating a donut) tasks both had a medium effect on subsequent aggressive behavior (DeWall, Baumeister, Stillman, & Gailliot, 2007). Another study found that glucose depletion had a large effect on both persistence (a word fragment task) and prevention (the Stroop task) self-control (Gailliot et al., 2007). These findings are

consistent with unidimensionality; however, the conclusions made in the review were not able to definitively support unidimensionality because no direct tests of dimensionality have been conducted. No studies have attempted to identify dimensions consistent with the proposed taxonomy, and because of this, the methods needed to directly test the dimensionality of self-control have not yet been conducted. For this reason, multidimensionality cannot be ruled out.

A more recent meta-analysis of 102 studies also examined the existing literature regarding the dimensionality of self-control specifically seeking to determine whether there is evidence of a consistent distinction between what the authors termed *inhibitory* self-control and *initiatory* self-control (i.e., inhibition self-control and activation self-control as labeled in the present study; de Ridder, Van Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). The authors found medium effect sizes for the relationships between: 1 -self-report self-control and performance on desired behaviors; and 2 - self-report self-control and inhibition of undesired behaviors. Thus, the findings from this meta-analysis are consistent with Tunze's (2012) conclusions and support a unidimensional model of self-control.

Finally, de Ridder, de Boer, Lugtig, Bakker, and van Hooft (2011) examined the dimensionality of self-control by conducting a confirmatory factor analysis of the brief version of the Self-Control Scale (Tagney, Baumeister, & Boone, 2004). Ten of the scale's 13 items were included in the analyses; the remaining three items were removed from the analyses because they did not clearly fall into either of the predicted categories (i.e., inhibition or initiation). The authors determined that the two-factor model showed

adequate fit with the data in two independent samples and concluded that there is a meaningful difference between inhibition self-control and initiation self-control. Further, they found that the inhibitory self-control factor was a better predictor of self-report of behavior requiring inhibition or restraint (i.e., smoking: β = -.52, compared to β = .26 for initiatory self-control, and alcohol consumption: β = -.57, compared to β = .21 for initiatory self-control). Also consistent with a two-factor model of self-control, they found that the initiatory self-control factor was a better predictor of self-report of behavior requiring initiation of desired behavior (i.e., hours of exercise: β = .19, compared to β = -.07 for inhibitory self-control, and studying: β = .48, compared to β = -.18 for inhibitory self-control). These findings support a multidimensional model of self-control.

De Ridder and colleagues' (2011) findings are inconsistent with the comprehensive review and meta-analysis discussed above. It is important to note that their findings are based entirely on self-report of self-control and self-report of recent behavior, and this is the first study to provide evidence for a multidimensional model of self-control. It is possible that these findings represent the true structure of self-control. Alternatively, it is also possible that the self-report methodology created systematic error (e.g., biased recall of recent behavior or failure to accurately reflect on typical self-control abilities) that affected the findings. Either way, it can be concluded that there is currently a lack of clear evidence regarding the structure of self-control.

The inconsistent findings across studies highlight the need for future research to test the question of dimensionality appropriately and definitively. In order to do this, self-

control should be measured more objectively (i.e., behaviorally). Empirical evidence should be gathered by measuring all four subtypes in relation to future outcome variables. A sufficient test is a longitudinal design demonstrating the predictive power of each self-control task in relation to multiple future outcomes. If the subtypes show similar or identical relationships with the outcome, unidimensionality can be concluded (at least with regard to the proposed classification); if the subtypes have differential influences on the outcome, this can be interpreted as evidence of multidimensionality. Ideally, the tasks representing the subtypes of self-control should be within the same contextual domain (e.g., physical exertion, taste preferences, academic exercises, etc). Keeping the domain consistent will eliminate any confounds due to contextual information. The present study will empirically test the dimensionality of self-control, and will attempt to answer the following questions.

Research Questions

What does the evidence suggest regarding the dimensionality of self-control? Do the four proposed subtypes of self-control have differential relationships to academic performance or indices of well-being? If the self-control subtype tasks do differentially predict the outcome variables, it would suggest that self-control is multidimensional. If there is no evidence of differential predictive ability, I would expect to find similar relationships between the subtypes of self-control and the outcome variables. This outcome would suggest that self-control is unidimensional.

Hypotheses

The specific hypotheses for the present study are as follows: All four self-control tasks will be similarly related to performance on two previously validated measures of self-control (persistence on the handgrip task and prevention of blinking; H1). Persistence, initiation, stop, and prevention self-control tasks will be similarly related to academic performance (i.e., cumulative and semester GPA; H2). Persistence, initiation, stop, and prevention self-control tasks will be similarly related to self-report measures of depressive symptoms and life satisfaction (H3). It is important to note that all three hypotheses in the present study are consistent with the unidimensional model of self-control, and if supported, the findings would suggest that there no meaningful distinctions exist between the proposed subtypes of self-control. The hypotheses for the present study are consistent with the conclusions from the comprehensive review and meta-analysis outlined above. A unidimensional model is the most parsimonious, and in the absence of clear evidence suggesting otherwise, parsimony was valued.

METHOD

Participants

The sample consisted of college students (Time 1: $N = 336$; Time 2: $N = 73$) recruited from psychology courses in exchange for course credit. The mean age for the full sample was 21.00 years ($SD = 5.24$), and participants were from varied ethnic backgrounds (5.0% Asian/Pacific Islander; 10.6% African American; 2.1% Hispanic/Latino; 78.2% White/Caucasian; 2.4% Other). Participants were excluded from the study if they had any type of metabolic condition that would prevent them from consuming food or drink made with real sugar. It is unknown how many participants were excluded based on this criterion because the exclusion criteria were posted as part of the online survey, for which participants signed up independently. All participants scheduled for Time 2 (the laboratory session) stated that they were able to consume foods and/or drink made with real sugar. A convenience sample was appropriate for the present study because this was the first study to examine the dimensionality of self-control using behavioral measures of trait self-control, and GPA is an easily obtainable, standardized, and objective outcome variable that has been shown to be related to self-control (Tangney et al., 2004). Participants were randomly assigned to one of four groups (i.e., A, B, C, or D), with each group representing a subtype of self-control. Chi-squares and t-tests were conducted to compare the means for the demographic variables across self-

control subtype groups; no significant differences were found across groups for any of the variables (all p-values were greater than .15). See Table 1 for sample size and demographics across time points and groups.

Measures and Materials

Academic Goal Attainment

Participants' cumulative and semester GPAs were obtained from the Office of the Registrar at the end of the semester for those students who gave permission.

Depressive Symptoms

The CES-D (Radloff, 1977) is a 20-item index of depression developed by the National Institute of Mental Health and is intended for use with the general population. Participants are asked to rate each item with regard to how often they have felt that way during the past week on a 4-point scale ranging from "*Rarely or none of the time (less than one day)*" to "*Most or all of the time (5 to 7 days)*." Sample items include "I felt hopeful about the future," and "I could not get going." The CES-D has been shown to have high internal consistency in the general population (α = .85; Radloff, 1977). Evidence suggests that it is strongly correlated with other measures of depression (r = .83 with the Depression subscale of the Symptom Checklist-90) and moderately correlated with interviewer ratings of depression (r = .46; Radloff, 1977). For the present study, total scores were used, with higher scores indicating more depressive symptoms.

Life Satisfaction

The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) is a 5-item scale designed to measure people's satisfaction with their life as a whole. Respondents rate each item on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Sample items include "In most ways, my life is close to ideal," and "So far, I have gotten the important things I want in life." Diener and colleagues (1985) reported an internal consistency of $\alpha = .87$. Construct validity of the SWLS has been demonstrated in that psychiatric patients, students in poor countries, and abused women have been shown to have lower scores than persons without these characteristics or living conditions (Pavot & Diener, 1993). Additionally, it has been shown to be negatively correlated with a measure of negative affect ($r = -.31$; Diener et al., 1985). For the present study, total scores were calculated and higher scores indicated greater life satisfaction.

Neuroticism

The neuroticism subscale of the NEO-FFI (NEON; Costa & McCrae, 1989) is a 12-item abbreviated version of the neuroticism subscale of the NEO-Personality Inventory (Costa & McCrae, 1985). The 12 items were selected from the NEO-Personality Inventory because they loaded highly on the neuroticism factor in factor analyses (John, Naumann, & Soto, 2008). Respondents rate each item on a 0 (*strongly disagree*) to 4 (*strongly agree*) scale. Sample items include "I often feel tense and jittery," and "Sometimes I feel completely worthless." The NEON has been shown to have high internal consistency ($\alpha = .87$), and convergent validity has been demonstrated

by high correlations between the NEON and the neuroticism items on the Big Five Inventory (BFA) and the Trait Descriptive Adjectives (John et al., 2008). For the present study, total scores were calculated and higher scores indicated greater neuroticism.

Self-Report Self-Control

The Self-Control Scale (SCS; Tangney et al., 2004) is a trait-like measure of self-control. It consists of 36 items, and respondents rate each item on a 1 (*not at all*) to 5 (*very much*) scale. Sample items include "I am good at resisting temptation," and "People can count on me to keep on schedule." Internal consistency for the SCS ranges from α = .89 for a sample of college students (Tangney et al., 2004) to α = .92 for a sample of prisoners (Archer & Southall, 2009). Tangney and colleagues (2004) demonstrated predictive and concurrent validity for the SCS; specifically, the SCS was related to GPA (r = .39), depression (r = - .41), and anxiety (r = - .36 for SCS). For the present study, total scores were calculated and higher scores indicated greater self-control.

An additional 19 self-control items were written for the purposes of the present study so that the proposed subtypes would be equally represented in the confirmatory factor analyses. A total of 11 items from the SCS measured prevention self-control, three measured persistence self-control, five measured initiation self-control, and three measured stop self-control. Therefore, additional items were written for persistence (e.g., "Once I start a task, I am able to work on it until it is finished."), initiation (e.g., "I wait until the last minute to get things done."), and stop (e.g., "If I start eating a tasty but unhealthy snack, it is difficult for me to stop.") self-control. No reliability or validity data

existed for these items, but they were modeled after items in the SCS, and respondents rated each item on the same 1 (*not at all*) to 5 (*very much*) scale. Total scores were not calculated because these items were only used in the confirmatory factor analyses. Of the 19 additional self-control items created, eight were written so that higher ratings indicated greater self-control and 11 were written so that higher ratings indicated lower self-control. See Appendix A for the categorization of SCS items and a complete list of the additional self-control items developed for the present study.

Behavioral Indices of Self-Control

Persistence Self-Control

Persistence self-control was assessed by the amount of a moderately aversive beverage that participants consumed. Persistence was operationalized as the volume of liquid in ounces that was consumed. Participants were given a nine-ounce cup of sugar-free iced tea made from concentrate using five cups of water and three cups of vinegar. The volume of the cup given to participants was carefully measured ahead of time. Once handed the cup, participants were told that they should begin drinking as soon as the experimenter closed the door and that they should drink as much as they could. The experimenter left the participant alone in the room and watched him or her through a two-way mirror. Participants rang a bell when they had consumed the entire cup or when they felt that they had consumed as much as they could. The experimenter then went back into the room, and if the cup was empty, he or she asked the participant if he or she could

drink more. If the answer was yes, the experimenter gave the participant another nine-ounce cup filled with the iced-tea mixture and the process was repeated. When the participant indicated that he or she was done, the experimenter measured the volume of liquid remaining in the cup and used it to calculate the volume of liquid that had been consumed. Participants were then instructed to fill out the rating sheet described in the Procedures section. This protocol that was used to measure persistence self-control is similar to that used by Vohs and colleagues (2008). For the present study higher scores indicated greater persistence self-control.

Initiation Self-Control

Initiation self-control was measured by the amount of time needed for participants to initiate a task in which they had to eat a small quantity of an aversive food combination. The experimenter placed a spoon with one-half teaspoon of horseradish mixed with tapioca pudding on it in front of the participant. They were told that, although it was considered aversive in our culture, it was a common dish in some cultures. Participants were then asked to smell the spoonful. They were given a small sample of this same combination and asked to taste it; this was done to allow the participants to gauge the extent to which it was aversive. Then the experimenter told participants that they would have 15 minutes during which they were free to browse the internet but that they must also eat the aversive food. Participants were instructed that they needed to eat the sample all at once rather than by several small bites. The experimenter then left the room and observed the participant through a two-way mirror; they recorded the length of

time in seconds that it took the participant to eat the aversive food. Upon completion of the task, participants were instructed to fill out the rating sheet described in the Procedures section. This protocol for measuring the amount of time that participants procrastinated before initiating an aversive behavior was modeled after a similar design used by Vohs and colleagues (2008). For the present study, participants' scores were reversed so that higher scores indicated greater initiation self-control.

Stop Self-Control

Stop self-control was assessed by measuring the amount of an appetitive food (in grams) that participants consumed after they had been explicitly asked to begin eating the food. The experimenter weighed a large glass bowl filled with M&Ms and then presented participants with the bowl and a scoop. Participants were told that they would be taking part in a taste test. They were asked to eat enough M&Ms to be able to fill out the rating sheet described in the Procedure section, but they were not told how many M&Ms they should consume. They were asked to ring the bell when they were done. The experimenter left the room and watched participants through a two-way mirror. After participants indicated they were done, the experimenter recorded the weight of the bowl and the remaining M&Ms and calculated the weight of M&Ms that the participant had eaten. This protocol was modeled after a study requiring participants to stop eating M&Ms once they had started as a mechanism for depleting self-control (Vohs & Heatherton, 2000). For the present study, participants' scores were reversed so that higher scores indicated greater stop self-control.

Prevention Self-Control

Prevention self-control was measured by the amount of time it took for participants to eat a bite of food from an array of tempting options. Participants were presented with several tempting foods (i.e., chocolate chip cookies, candy bars, fruity candy, and chips) and were asked to smell all of them. Participants were told that the experimenter was interested in taste perception when people are craving food. They were instructed to resist the food until it became uncomfortable and told that at that point, they should take a bite of the food that they found the most tempting. After reading the instructions, the experimenter left the room and began timing as soon as he or she closed the door. The experimenter watched participants through a two-way mirror and recorded the amount of time that passed until they took a bite of the food. There was a 15-minute time limit on the task, but participants were not informed of this. Once they had taken a bite of the food, they were asked to rate the taste on the rating sheet described in the Procedures section. For the present study higher scores indicated greater prevention self-control.

Handgrip Task

The handgrip task has been used as a measure of self-control in previous studies (Muraven, Baumeister, & Tice, 1999; Muraven & Schmeuli, 2006; Muraven, Tice, & Baumeister, 1998), and it has been shown to be predictive of semester GPA (Tunze, Rand, & Wallihan, 2012). Participants were given a hand dynamometer and told to use their dominant hand to squeeze it as hard as they could for as long as they could. The

length of time (in seconds) that they were able to squeeze the dynamometer with a grip strength greater than 10 kilograms was recorded as a measure of persistence self-control. For the present study higher scores indicated greater persistence self-control.

Blinking Task

The blinking task has also been used as a measure of self-control in a previous study (Schmeichel & Zell, 2007). Participants were asked to sit in a chair with their backs to the wall and their feet on the floor. They were asked not to blink until the experimenter told them to stop. They were told that if they did blink, to try not to blink again. The experimenter set a timer for two minutes, but participants were not informed of the time limit. The experimenter counted the number of times the participant blinked during the two-minute period and recorded that number as a measure of prevention self-control. Participants were asked ahead of time for permission to record them with a video camera while completing this task; for those who granted permission, both the number of blinks counted from watching the recording and the live count were recorded for the purpose of checking reliability. If participants did not consent to be recorded, they still completed the blinking task and only the live count of the number of blinks was recorded. For the present study, participants' scores were reversed so that higher scores indicated greater prevention self-control.

Procedure

At Time 1, participants ($N = 336$) completed the self-report measures and a demographics questionnaire online by clicking on a SurveyMonkey™ link. For Time 2, participants ($N = 73$) were randomly assigned to one of four groups: Group A, Group B, Group C, or Group D. An online random number generator was used to generate a random sequence of the numbers one through four, and participants were paired with the number in order of their participation. Participants paired with "one" were assigned to Group A, participants paired with "two" were assigned to Group B, and so on. They were asked to arrive at the laboratory having eaten within the past three hours but not within the past hour; a total of 65 out of 73 participants reported that they had abided by this request. Upon arrival to the laboratory, participants were told that they would be participating in a study investigating how taste perceptions and taste preferences are related to personality. The food-related self-control task was completed first. Participants assigned to Group A ($n = 17$) completed the persistence self-control task, participants assigned to Group B ($n = 16$) completed the initiation self-control task, participants assigned to Group C ($n = 20$) completed the stop self-control task, and participants assigned to Group D ($n = 19$) completed the prevention self-control task.

The experimenter left the room during the food-related self-control task so that participants were alone. Previous research on social facilitation has demonstrated that the presence of another person can have an impact on performance, and whether the impact is positive or negative depends on the task's difficulty and the participant's skill level (Zajonc, Heingartner, & Herman, 1969; Zajonc & Sales, 1966). By having all participants

complete the self-control task alone for all four conditions, the potential influence of social facilitation was minimized.

As participants completed the food-related self-control task, they were given a rating sheet to rate the food or drink that they consumed. The sheet required them to rate the food/drink on "the five basic components of taste." They rated the food/drink on the degree of sweetness, sourness, bitterness, saltiness, and spiciness, and they answered a few questions related to the amount of difficulty associated with completing the task and the degree of pleasure/unpleasantness they experienced while eating/drinking. Several participants expressed confusion about the items or rated the iced-tea task or the horseradish task as "extremely difficult" to disengage, so the validity of these data was compromised. Therefore, the information was used solely to sell the story that the focus of the study was on taste perception and was not used in the analyses.

Given the extensive empirical support for ego depletion (Baumeister et al., 1998), it is likely that completing the food-related self-control task depleted participants' self-control resources. In an attempt to replenish self-control, participants were then given a 10-minute recovery period during which they were asked to try to relax and to drink an eight-ounce glass of lemonade sweetened with real sugar. Research has shown that consuming drinks sweetened with sugar replenishes self-control by providing a resource (glucose) necessary for cerebral functioning and thus restoring energy (Gailliot & Baumeister, 2007). To standardize the effect across all participants, the experimenter asked participants to consume the entire glass. Magazines were available for participants to look through during this time in order to enhance relaxation.

After the recovery period, participants completed a second self-control task. The order of the handgrip and blinking tasks was counterbalanced, with half the participants completing the handgrip task second and the other half completing the blinking task second. After the second self-control task was administered, participants were given another 10-minute recovery period following the same procedure as the first. When the recovery period ended, participants completed whichever self-control task (the handgrip task or the blinking task) they had not yet completed.

Unlike for the food-related self-control subtype tasks, the experimenter was in the room with the participant for both the handgrip task and the blinking task. The experimenter's presence was necessary because he or she had to monitor dynamometer's digital output of grip strength during the handgrip task and count the number of eye blinks during the blinking task. Interaction with the participant was avoided during the handgrip and blinking tasks to minimize any effect of social facilitation.

After completing a food-related self-control task, the handgrip task, and the blinking task, participants were debriefed, informed of the real purposes of the tasks and the hypotheses of the study, and asked for permission to obtain both their cumulative and semester GPAs from the Registrar as a measure of real-world goal attainment.

RESULTS

Preliminary Analyses

Data were cleaned, all appropriate items from the self-report measures were reverse-scored, and mean imputation was used to replace missing data by substituting the mean of the participant's responses to other items on the scale. Total scores were calculated for each scale. The data were checked for normality and, with the exception of participant age and the tempting food prevention self-control variable, fit assumptions for parametric statistics (Kline, 1998). The prevention self-control variable (i.e., the amount of time in seconds that participants were able to refrain from eating tempting food items placed before them) was skewed (skewness = 4.18) and kurtotic (kurtosis = 17.91). Upon examination of the data, it was discovered that one participant in Group D had refrained from eating the tempting food for the entire 15-minute window. To adjust for skew and kurtosis, the variable was Winsorized (Hasings, Mosteller, Tukey, & Winsor, 1947). The mean prevention time without this participant's score was M = 48.71s (SD = 32.04). The participant's score was changed to be equal to three standard deviations above the mean (prevention time = 144.83s). After Winsorizing the prevention self-control variable, it was within normal limits for both skew (skew = .70) and kurtosis (kurtosis = .01). All of the self-control variables for which higher scores represented lower self-control (i.e., the blinking task, the horseradish initiation task, and the M&M prevention task) were reverse

scored so that higher scores indicated higher self-control for all self-control indices. Finally, it is important to note that a power analysis conducted before data collection indicated that, based on the predicted effect size of self-control indices, data should be collected from a total of 180 participants. However, it was not possible to recruit that many participants, and consequently, the analyses examining the predictive power of the food-related self-control variables are likely underpowered. See Appendix B for additional information regarding the a priori power analysis. A post-hoc power analysis demonstrated that based on an effect size of $R^2 = .30$ (as evidenced for several of the regressions), the power ranged from .31 to .43.

Correlations, means, standard deviations, and Cronbach's alphas were calculated for all measures and are presented in Table 2. Several correlations are worth noting. Three correlations were in the opposite direction than predicted. The correlation between handgrip persistence and M&M cessation was negative ($r = -.61$, $p = .004$), indicating that participants who ate more M&Ms persisted for longer on the subsequent handgrip task (i.e., lower self-control on stop self-control associated with higher self-control on persistence self-control). The correlations between the food-related prevention self-control task and depressive symptoms ($r = .50$, $p = .028$) and life satisfaction ($r = -.58$, $p = .009$) were also in the opposite direction than predicted, suggesting that lower prevention self-control is associated with fewer depressive symptoms and higher life satisfaction. Conversely, several correlations were in the predicted direction. The handgrip task and the blinking task were positively correlated ($r = .30$, $p = .015$), suggesting a positive association between persistence and prevention self-control.

Additionally, both tasks were negatively correlated with depressive symptoms, indicating that greater persistence self-control (r = -.25, p = .033) and greater prevention self-control (r = -.29, p = .023) are associated with fewer depressive symptoms.

Main Analyses

Correlations

In order to test Hypotheses 1-3, correlations between self-control subtypes and outcome variables were computed. The pairwise correlation coefficients were compared in order to determine if there were significant differences between each of the subtypes and each of the outcome variables. This resulted in the following four omnibus tests, which allowed for all four of the correlations between food-related self-control tasks and each outcome to be compared simultaneously: 1) comparison of the four correlations between self-control subtype tasks and semester GPA; 2) comparison of the four correlations between self-control subtype tasks and cumulative GPA; 3) comparison of the four correlations between the self-control subtype tasks and depressive symptoms; and 4) comparison of the four correlations between the self-control subtype tasks and life satisfaction. The same procedure (described below) was followed for each of these comparisons.

Correlations were transformed using Fisher's *z'* transformation (Cohen & Cohen, 1983). This was done to correct the skewed sampling distribution that results from non-

zero correlations and allowed for the comparison between pairwise correlations. The correlations were transformed using the following formula:

$$Z_f = ½ * \ln ((1 + R) / (1 - R)).$$

The independent correlation coefficients between each subtype of self-control and the outcome variables (i.e., semester and cumulative GPAs, depressive symptoms, and life satisfaction) were compared and tested for significant differences. As noted above, the first step for each set of comparisons was to compare all pairwise correlations using an omnibus test. This was done with a chi-square test, using the following formula:

$$\chi^2 = \Sigma (n_i - 3) z'^2_i - [\Sigma (n_i - 3) z'_i]^2 / \Sigma (n_i - 3)$$

The chi-square distribution for $k - 1$ degrees of freedom, where k = the number of independent sample coefficients being compared, allows for all correlations to be compared simultaneously. For the analyses comparing the food-related self-control tasks, $k = 4$.

Of the four omnibus tests conducted, the chi-square values for depressive symptoms and life satisfaction were significant, indicating that at least two of the four pairwise correlations compared in those analyses were significantly different from the other pairwise correlations. Z-difference scores were calculated for each of the possible comparison using the following formula:

$$z = (z'_1 - z'_2) / ((1 / n_1 - 3) + (1 / (n_2 - 3))^{½}$$

For the correlations between the self-control subtypes and depressive symptoms, the correlation between stop self-control and depressive symptoms (r = -.39, p = .093) was significantly different from the correlation between: 1) persistence self-control and

depressive symptoms (r = .41, p = .116); and 2) prevention self-control and depressive symptoms (r = .50, p = .028). These findings suggest that stop self-control may represent its own dimension or that this was the only dimension that was measured with a valid self-control task. It was negatively related to depressive symptoms, indicating that greater self-control (i.e., participants who ate fewer M&Ms) was associated with fewer depressive symptoms. Counter to previous research (Tangney et al., 2004), prevention self-control was *positively* associated with depressive symptoms, indicating that greater self-control was associated with more depressive symptoms.

For the correlations between the self-control subtypes and life satisfaction, the correlation between stop self-control and life satisfaction (r = .48, p = .034) was significantly different than the correlations between: 1) persistence self-control and life satisfaction (r = -.25, p = .352); 2) initiation self-control and life satisfaction (r = -.52, p = .038); and 3) prevention self-control and life satisfaction (r = -.58, p = .009). Stop self-control was positively related to life satisfaction, indicating that greater self-control (i.e., the fewer M&Ms that participants consumed) was associated with greater life satisfaction. Counter to previous research regarding the relationship between self-control and well-being (Tangney et al., 2004; Baumeister & Vohs, 2004), initiation and prevention self-control were inversely associated with life satisfaction, indicating that lower self-control was associated with greater life satisfaction.

These findings are partially consistent with the study hypotheses in that no distinction can be made between three of the four proposed subtypes of self-control. The significant correlations between stop-self-control and the indices of well-being are in the

predicted direction, whereas the correlations between well-being and the other three self-control subtype tasks are either non-significant or in the opposite direction than predicted. This outcome calls the validity of these tasks into question. However, it is unclear if the results are due to lack of validity or lack of multidimensionality.

The lack of statistical results suggests that there are no meaningful differences in the strength of the relationships among the proposed subtypes of self-control. See Table 3 for the chi-square values for each omnibus test. Because the omnibus tests were not significant for academic performance, handgrip persistence, or blinking prevention, *Z* difference scores for each of the pairwise correlations did not need to be calculated. The fact that none of the correlations significantly differed from each other is consistent with unidimensionality. It is important to note, however, that these analyses were underpowered. Hence, the proposed multidimensional model of self-control cannot be ruled out based on these findings. It is not a meaningful test of dimensionality to statistically compare nonsignificant pairwise correlations because the proposed multi-dimensional model was based on predicted significant relationships with the outcome variables. It is possible that the strength of the relationship among the variables of interest is small and was unable to be detected in the present study because the sample size was also small. It is possible that the self-control subtype tasks were not valid. If the former were true, it is also possible that had the analyses been adequately powered, the zero-order correlations between the self-control subtype tasks and the outcome variables would have been significant. Testing for significant differences between pairwise correlations would have been a better test of dimensionality because the validity of the

self-control subtype tasks would be less suspect. If there were no significant differences between adequately powered pairwise correlations, the evidence supporting unidimensionality would be stronger. However, it should be highlighted that if the differences between adequately powered pairwise correlations were non-significant, the validity of the self-control subtype tasks would still be questionable (based on well-supported findings from previous research) and would also prevent a sufficient test of multidimensionality.

In order to compare the correlations between the previously validated indices of self-control (i.e., handgrip task and blinking task) and the outcome variables, *Z* difference scores were calculated using the formula listed above. The *Z* difference scores for all comparisons were less than 1.96, indicating that semester and cumulative GPA, CES-D scores, and SWLS scores are not differentially related to handgrip persistence ($R_{AH} = R_{BH} = R_{CH} = R_{DH}$) and blinking prevention ($R_{AK} = R_{BK} = R_{CK} = R_{DK}$). See Table 4 for the *Z* difference scores. These findings support the study hypotheses and are consistent with the unidimensional model of self-control.

Regressions

A series of hierarchical multiple regressions were conducted to test the dimensionality of self-control across several outcome variables (i.e., handgrip persistence, blinking prevention, semester GPA, cumulative GPA, depressive symptoms, and life satisfaction). Gender, age, minority status, and neuroticism were entered into the first step of each regression. For the regressions predicting academic performance,

previous academic performance (i.e., high school GPA) was also entered into the first step. This was done so that general academic performance would not represent a confounding variable (i.e., so that it could not be argued that the participants who are used to succeeding in school were the participants who performed best on the tasks because they are used to putting forth more effort). For all regressions, a food-related self-control task was entered into the second step. Because the design of the present study is a between-groups design, participants only completed one of the four food-related self-control tasks, and therefore, the relative predictive power of these tasks could not be tested by entering the variables into the same regression. In order to test for significant differences in the predictive power of each of self-control subtypes, four separate regressions were conducted for each outcome variable, and the unstandardized B coefficients were tested for significant differences by calculating the Z-difference scores. The fact that the coefficients are unstandardized made the self-control subtypes difficult to compare because they were not measured in the same metric (i.e., persistence self-control was measured by volume of liquid consumed; initiation self-control was measured by time in seconds until the horseradish combination was eaten; stop self-control was measured by weight of M&Ms consumed; and prevention self-control was measured by time in seconds until food was eaten). In order to adjust for this complication, the self-control subtype variables were converted to *Z*-scores before being entered into the regressions. This standardization of the variables before they were entered into the regressions allowed for the unstandardized *B* coefficients associated with each subtype of self-control to be compared across independent regressions. The

following formula was used to compare the unstandardized *B* coefficients (Cohen & Cohen, 1983):

$$Z = (B_{i1} - B_{i2}) / (SE^2_{Bi1} + SE^2_{Bi2})^{1/2}$$

In cases for which $Z \geq 1.96$, the *B* values were considered to be significantly different from one another, which could be interpreted as evidence of multidimensionality.

Regressions Predicting Previously Validated Self-Control Tasks

A two-step hierarchical regression predicting handgrip persistence was conducted for each proposed subtype of self-control, resulting in a total of four regressions (see Table 5). Persistence self-control ($B = 2.02$, $\beta = .06$, $p = .850$), initiation self-control ($B = -5.11$, $\beta = -.18$, $p = .280$), and prevention self-control ($B = -9.10$, $\beta = -.20$, $p = .263$) did not significantly predict handgrip persistence time. However, stop self-control ($B = -23.82$, $\beta = -.61$, $p = .010$) was a significant predictor. It should be noted that the stop self-control task (which required participants to stop eating M&Ms once they had already started) predicted self-control in the *opposite direction* than predicted, such that people who exhibited lower self-control on the food-related task (i.e., ate more M&Ms) persisted for longer on the handgrip task.

A comparison of unstandardized *B* coefficients across the four regressions predicting handgrip persistence revealed significant differences between the regression coefficients for: 1 – stop self-control and persistence self-control ($Z = 1.97$, $p < .05$); and 2 – stop self-control and initiation self-control ($Z = 2.033$, $p < .05$). See Table 6 for the *Z*-difference scores between all four regressions. These differences imply that stop self-

control differentially predicts handgrip persistence compared to persistence and initiation self-control. Additionally, the results suggest that no distinction can be made between the relationships among the persistence, initiation, and prevention self-control on the one hand and handgrip persistence on the other hand. These results support a two-dimensional model of self-control and are partially consistent with the study hypotheses.

A two-step hierarchical regression predicting performance on the blinking task (i.e., number of blinks within a two-minute period) was also conducted for each subtype of self-control, resulting in an additional four regressions predicting a previously validated index of self-control (see Table 7). A similar pattern to the regressions predicting handgrip persistence was found. Again, persistence self-control (B = 3.43, β = .33, p = .393), initiation self-control (B = -4.17, β = -.22, p = .631), and prevention self-control (B = 4.51, β = .22, p = .374) did not significantly predict blinking task prevention. Stop self-control was found to be a significant predictor of blinking task performance such that participants who consumed more M&Ms blinked fewer times than those who consumed fewer M&Ms (B = -7.74, β = -.56, p = .040). This finding is in the *opposite direction* than predicted. A comparison of unstandardized B coefficients across the four regressions predicting performance on the blinking task revealed significant differences between the regression coefficients for: 1 – stop self-control and persistence self-control (Z = 2.18, $p < .05$); and 2 – stop self-control and prevention self-control (Z = 2.07, $p < .05$). These findings support a multidimensional model of self-control in which stop the self-control task has differential predictive ability compared to persistence self-control and prevention self-control but no distinction can be made among the other proposed

subtypes. These findings are partially consistent with the study hypotheses of unidimensionality. See Table 8 for the *Z*-difference scores between all four regressions coefficients. The stop self-control task significantly predicted both the handgrip task (conceptualized as a persistence task) and the blinking task (conceptualized as a prevention task) such that lower stop self-control was associated with higher persistence and prevention. Also of note, the tasks representing the other three subtypes of self-control failed to predict both persistence and prevention.

Regressions Predicting GPA

Eight two-step hierarchical regressions predicting GPA were conducted (four with semester GPA as the dependent variable and four with cumulative GPA as the dependent variable; see Tables 9 and 11). For the regressions predicting semester GPA, persistence self-control (B = .25, β = .30, p = .317), initiation self-control (B = -.12, β = -.30, p = .488), stop self-control (B = -.21, β = -.32, p = .361), and prevention self-control (B = -.04, β = -.06, p = .710) were not significant predictors. A comparison of unstandardized B coefficients between regressions revealed no significant differences between self-control subtype tasks, indicating that the tasks do not have differential predictive power for semester GPA. It is important to note that the lack of significant findings regarding the predictive power of the self-control subtype tasks and the lack of significant differences between regression coefficients may be because the analyses are underpowered rather than evidence of unidimensionality. See Table 10 for the *Z*-difference scores between all four regressions.

Similar to the findings regarding Fall 2010 GPA, persistence self-control (B = .27, β = .41, p = .299), initiation self-control (B = .03, β = .05, p = .919), stop self-control (B = -.27, β = -.42, p = .267), and prevention self-control (B = -.03, β = -.04, p = .742) did not significantly predict cumulative GPA. Again, a comparison of unstandardized B coefficients between regressions revealed no significant differences between self-control subtype tasks, indicating that the tasks do not have differential predictive power for cumulative GPA. Although they are inconsistent with the multidimensional model of self-control, these null results may be the result of inadequate power. Further, it is important to note that high school GPA (a potential confound that was entered into the regression as a control variable) sometimes significantly predicted GPA and sometimes did not, depending on the group (i.e., A, B, C, or D). This suggests that the groups may have been meaningfully different from each other in some way. See Table 12 for the Z-difference scores between all four regressions.

Regressions Predicting Depressive Symptoms

In order to explore the effects of the proposed subtypes of self-control on depressive symptoms, four two-step hierarchical regressions predicting CES-D scores were conducted (see Table 13). None of the self-control regression coefficients were significant; persistence self-control (B = 3.00, β = .37, p = .107), initiation self-control (B = .34, β = .04, p = .852), stop self-control (B = -1.81, β = -.18, p = .418), and prevention self-control (B = 1.05, β = .09, p = .517) all failed to predict depressive symptoms. A comparison of unstandardized B coefficients between regressions revealed no significant

differences between self-control subtype tasks, indicating that the tasks do not have differential predictive power for depressive symptoms. Again, the results do not suggest a unidimensional model of self-control due to the low power to adequately test for significant differences between self-control subtypes. See Table 14 for the *Z*-difference scores between all four regressions.

Regressions Predicting Satisfaction with Life

In order to explore the effects of the proposed subtypes on life satisfaction, four two-step hierarchical regressions predicting SWL scores were conducted (see Table 15). Persistence self-control ($B = .68$, $\beta = .09$, $p = .762$), stop self-control ($B = 2.13$, $\beta = .26$, $p = .234$), and prevention self-control ($B = -1.79$, $\beta = -.25$, $p = .156$) all failed to predict satisfaction with life. However, initiation self-control ($B = -2.51$, $\beta = -.35$, $p = .012$) significantly predicted life satisfaction such that higher self-control (i.e., initiating the horseradish task quickly) was associated with lower satisfaction with life. This finding is in the *opposite direction* than predicted. A comparison of unstandardized *B* coefficients across the four regressions predicting life satisfaction revealed significant differences between the regression coefficients for initiation self-control and stop self-control ($Z = 2.46$, $p = .05$). These findings are consistent with a multidimensional model of self-control in which only initiation and stop self-control may represent different dimensions and in which no distinction can be made between persistence and prevention self-control. These findings are partially consistent with the study hypotheses. See Table 16 for the *Z*-difference scores between all four regressions.

Predictive Power of Handgrip Persistence and Blinking Prevention on Outcomes

All participants who participated in Time 2 completed both the handgrip task and the blinking task. As a result, the analyses investigating the predictive power of persistence self-control and prevention self-control on: 1 – academic performance (semester and cumulative GPA); 2 – depressive symptoms (CES-D); and 3 – life satisfaction (SWL) should have adequate power (based on the estimated *R* of .26 used in the *a priori* power analysis) to detect meaningful relationships. However, all of the analyses were non-significant (see Tables 17 and 18). Neither the handgrip task ($B = .13$, $\beta = .19$, $p = .176$) nor the blinking task ($B = .09$, $\beta = .12$, $p = .359$) predicted semester GPA. Both tasks also failed to predict cumulative GPA (handgrip: $B = .05$, $\beta = .07$, $p = .631$; blinking: $B = .05$, $\beta = .07$, $p = .604$). Additionally, the handgrip task and the blinking task did not predict depressive symptoms (handgrip: $B = -1.33$, $\beta = -.14$, $p = .171$; blinking: $B = -.85$, $\beta = -.09$, $p = .363$) or life satisfaction (handgrip: $B = .01$, $\beta = .00$, $p = .995$; blinking: $B = -.53$, $\beta = -.07$, $p = .505$). As a result, the comparisons of unstandardized *B* coefficients for persistence and prevention self-control tasks in relation to the outcome variables revealed no significant differences between regression coefficients (see Table 19). These findings suggest that, counter to previous research (Schmeichel & Zell, 2007; Tunze et al., 2012), persistence and prevention self-control are unrelated to the outcome variables. These non-significant findings are surprising given that the analyses were not underpowered.

Confirmatory Factor Analyses

A total of $N = 336$ participants completed the Self-Control Scale (SCS) and the extra self-control items (EXSC) that were written so that the four proposed subtypes would be equally represented in terms of number of items. A confirmatory factor analysis (CFA) was conducted in order to test the goodness of fit of the data to multidimensional models. The Chi Square statistic, the Standardized Root Mean Squared Residual (SRMR), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) were the indices used to assess model fit. Hu and Bentler's (1999) recommended cutoffs were used: nonsignificant Chi Square; RMSEA < .06; SRMR < .08; and CFI > .95.

A total of 41 items were initially used to conduct the CFA. Twenty-two of these items (11 prevention items, three stop items, three persistence items, and five initiation items) were from the SCS (Tangney et al., 2004). These items are the 22 items out of the full 36 items on the SCS that clearly represented one of the proposed self-control subtypes. The remaining 14 items measured impulsivity (e.g., "People would describe me as impulsive.") or could not be categorized into a single subtype (e.g., "I am self-indulgent at times" could represent prevention or stop self-control; "I wish I had more self-discipline" could represent any or all of the proposed subtypes). The remaining 19 items used in the initial CFA (seven stop items, seven persistence items, and five initiation items) were created by the author so that there would be at least 10 items measuring each subtype. See Table 44 for a list of the items and factors used in the CFA.

Initially, all 41 items were entered as one factor. The one-factor model did not show good fit with the data: $\chi^2 = 2890.39$, $df = 779$, $p < 0.001$, RMSEA = .090, SRMR = .081, and CFI = .83. A two-factor model was then tested. The prevention and stop items were combined into a single factor representing inhibition self-control and the persistence and initiation items were combined into a second factor representing activation self-control. The two-factor model did not show good fit with the data: $\chi^2 = 2474.69$, $df = 778$, $p < 0.001$, RMSEA = .081, SRMR = .075, and CFI = .86. Next, a four-factor model examining the fit of the data to the four proposed subtypes (prevention, stop, persist, and initiate) was tested. The four-factor model showed poor fit with the data: $\chi^2 = 2517.75$, $df = 774$, $p < 0.001$, RMSEA = .082, SRMR = .011, and CFI = .85.

These initial analyses revealed poor fit to the data and factors that appeared to be based on the content or the domain of the items. For example, several items with factor loadings greater than .5 for the "prevent" factor inquired about ability to refrain from speaking (e.g., "I say inappropriate things;" and "I often interrupt people."), and several items with factor loadings greater than .5 for the "stop" factor were about drinking and drug use. Therefore, it was decided that items should be eliminated and the models should be retested for fit to the data. Items that had standardized factor loadings lower than .5 across all three models were removed. Previous studies have used .4 as the cutoff for factor loadings (Bernard, 1998), and the present study used a slightly more conservative cutoff due to the concerns regarding domain-specific items mentioned above. Then items were re-examined for theoretical fit to the self-control subtype, and several items were removed. Remaining items were removed if they did not clearly fit the

subtype (e.g., “I am not easily discouraged;” and “I eat healthy foods.”). Additionally, any remaining domain-specific items (e.g., “When exercising, I often quit earlier than I mean to;” and “It is easy for me to stick to a diet once I start.”) were eliminated. This was done because the goal of the present study was to investigate the plausibility of a multidimensional of self-control based on the nature of the behavior required for exertion (i.e., persistence, initiation, cessation, or prevention) rather than a multidimensional model based on specific domains of behavior (e.g., gambling, health-behaviors, etc.). Therefore, by removing all items associated with a specific domain, a potential confound for testing the fit of the proposed model was eliminated.

Once items were removed through the process explained above, the four-factor model was tested again with three persist items, four initiate items, six stop items, and seven prevention items (see Table 45). This four-factor model did not show good fit with the data: $\chi^2 = 707.57$, $df = 164$, $p < 0.001$, RMSEA = .099, SRMR = .075, and CFI = .89. A three-factor model was also tested and did not show good fit with the data: $\chi^2 = 379.20$, $df = 144$, $p < 0.01$, RMSEA = .070, SRMR = .059, and CFI = .94. The three factors appeared to align with persistence, initiate, and inhibit (a combination of stop and prevention). Adequate fit for this model would support a multidimensional model of self-control that is only partially consistent with the proposed taxonomy. In this model, persistence and initiate self-control represent different dimensions, but stop and prevention self-control are combined into a single factor and cannot be distinguished from one another. However, none of the models tested provided adequate fit with the

data, and therefore, conclusions regarding the dimensionality of self-control are unable to be drawn from the confirmatory factor analyses.

DISCUSSION

In general, the present study yielded null results with regard to the relationship between behavioral self-control tasks, on the one hand, and academic performance, depressive symptoms, and life satisfaction on the other hand. Unfortunately, these results preclude arriving at a meaningful and compelling conclusion regarding the dimensionality of self-control. The pattern of findings in the present study could be explained by several alternative possibilities, which will be discussed below.

Food-Related Self-Control Tasks: Null Results

First, the failure of the food-related self-control subtype tasks to predict academic performance, depressive symptoms, and life satisfaction could be explained by the fact that the analyses are underpowered. The null findings regarding the ability of self-control to predict academic performance are not consistent with previous research, which supports a positive association between self-control and GPA (Duckworth & Seligman, 2005; Duckworth & Seligman, 2006; Tangney et al., 2004; Tunze et al., 2012). The null findings resulting from tests of the ability of self-control to predict depressive symptoms and life satisfaction are also inconsistent with previous research, which have shown a negative relationship between self-control and depressive symptoms (Tangney et al., 2004) and a positive relationship between self-control and life satisfaction (Lightsey,

Maxwell, Nash, Rarey, & McKinney, 2011). The present study replicated the negative association between self-control and depressive symptoms, with the previously validated self-control tasks (r = -.25, p = .033 for the correlation between handgrip persistence and the CES-D; r = -.29, p = .023 for the correlation between blinking prevention and the CES-D). However, these predicted relationships were only replicated by the correlations and not by the regressions. It is possible that if the study had been adequately powered, significant relationships between the self-control subtype tasks and academic performance, depressive symptoms, and life satisfaction would have been detected. This may be especially true for the iced-tea persistence task because nonsignificant trends in the expected direction were observed for the correlations with handgrip persistence, blinking prevention, and academic performance. The correlations between the other self-control subtype tasks were more questionable, and some correlations (e.g., between the initiation task and outcome variables) were in the opposite direction than predicted, thus calling into question the validity of the self-control tasks.

A second potential explanation for the null findings is that the food-related self-control subtype tasks are not valid measures of self-control. To explore this option, each food-related subtype task is individually examined below and evaluated for reasons as to why its validity as a self-control task can be called into question. The iced tea consumption task, conceptualized as a persistence self-control task, may have been hampered by a restriction of range resulting from the specific procedure used to collect data. Participants were given a cup of the iced tea made from concentrate, water, and vinegar, and were asked to begin drinking as soon as the experimenter closed the door.

The task was designed to be moderately aversive so that initiation of the task was not overly difficult. For this reason, the first few sips of the beverage were not extremely aversive, and several participants chose to drink the entire cup quickly. Upon finishing the cup, only three participants asked for and/or accepted another cup. It is possible that several participants would have consumed more liquid than could be contained in a nine ounce cup but that actually requesting a second cup was too much effort. The persistence task should be modified in future research in order to increase variability in performance. Specifically, a bigger cup could be provided or several nine ounce cups could be filled ahead of time and placed in a row in front of participants prior to beginning the task. Vohs and colleagues (2008) found that participants whose self-control had previously been depleted drank less of an aversive beverage made with vinegar compared to participants whose self-control resources had not previously been depleted. The methodology used by Vohs and colleagues differed from the present study; they placed 20 small paper cups each filled with one-ounce of the aversive beverage in front of participants and told them that they would be paid a nickel for each cup that they drank. The procedure was changed for the present study because having several small cups would have required participants to initiate drinking the aversive beverage several times, and therefore could be conceptualized as an activation (i.e., persistence and initiation) task. The present study also differed from Vohs and colleagues' methodology in that participants were not offered a monetary incentive to consume as much of the aversive beverage as possible. This would have potentially motivated participants to accept a second cup offered to them after they had finished the first cup.

The horseradish task, conceptualized as an initiation self-control task, may have been affected by individual differences with regard to aversion to horseradish, thus introducing variability in the amount of self-control exertion required to initiate the task. Some participants did not appear to be repelled by the taste test; whereas, others gagged or verbally expressed their aversion. In fact, only seven of the 16 participants in Group B rating the horseradish task as "extremely unpleasant," and 12 participants rated the task as "not at all difficult" or "slightly difficult" to initiate. Several participants ate the horseradish immediately; this could reflect extreme aversion that people wanted to quickly get past (thus requiring self-control to initiate) or it could reflect people casually but quickly eating a bite of food that they did not find terribly aversive (thus not requiring much self-control). The most likely outcome was that the initiation self-control scores reflect a combination of these reactions, and therefore, some participants that were not repelled by the task likely ate the food more quickly than other participants who were quite repelled. If individual differences in aversion to horseradish explained the variability in scores, the time to consumption was not a valid indicator of degree of self-control. The initiation task is also noteworthy for its significant predictive power of life satisfaction, such that participants who ate the horseradish more quickly (i.e., greater self-control) expressed less life satisfaction; this relationship is in the opposite direction than predicted. One explanation for this finding is that the initiation task is not a valid marker of self-control (for the reasons described above) and the significant relationship is spurious. With the large number of regressions conducted to test the study questions and hypotheses, there was a strong probability that spurious relationships would emerge (i.e.,

Type I error). An alternative explanation for the significant finding is that self-control is multidimensional, and people who force themselves to quickly complete productive but extremely aversive tasks (i.e., have high initiation self-control) are less satisfied with the quality of their lives compared to people who do not quickly initiate those types of tasks. A second alternative explanation is that the horseradish task could measure a different construct from self-control that is inversely related to life satisfaction.

The M&M consumption task, conceptualized as a stop self-control task, also has questionable validity. The finding that the M&M task predicted the handgrip and blinking task performance such that eating more M&Ms (i.e., lower self-control) resulted in greater self-control exertion was also in the opposite direction than predicted. The resulting significant differences between regression coefficients may support a two-dimensional model of self-control in which self-control required to stop an appetitive but maladaptive behavior is qualitatively different from all other self-control behaviors. Alternatively, these results may be better explained by the fact that participants who completed the stop self-control task (i.e., eating M&Ms ostensibly as part of a taste test) had consumed sugar before completing the handgrip task and therefore may have experienced a temporary boost in self-control due to increased glucose in their body. This explanation is consistent with the glucose hypothesis (Gailliot et al., 2007). Another potential reason to question the validity of the M&M task is that in order for participants to be exerting self-control to stop eating the M&Ms, they must have weight loss, weight maintenance, or maintaining a healthy diet as a goal. In other words, if they stopped eating because the impulse to continue eating was absent, their behavior did not require

self-control exertion. It is unlikely that 100% of college students have the abovementioned health-related goals, and therefore, some participants' scores on the M&M task may not have reflected their stop self-control abilities.

The validity of the tempting food task, conceptualized as a prevention self-control task, may also be questionable. Previous research has demonstrated a decline in participants' self-control resources resulting from resisting tempting foods (Baumeister et al., 1998; DeWall, Baumeister, Stillman, & Gailliot, 2007). However, the task was unrelated to all other behavioral measures of self-control, self-report self-control, and both indices of academic performance (i.e., no evidence of convergent or predictive validity). Additionally, it was significantly correlated with both depressive symptoms and life satisfaction in the opposite direction than predicted. Greater resistance time was associated with *more* depressive symptoms and *lower* life satisfaction. The questionable validity may be due to the fact that participants may not have been tempted by the food options. One third of participants (n = 6; 31.6%) rated the task as "slightly pleasant" or below, and only one participant rated the task as one from which it was "extremely difficult" to disengage. According to the dual-systems models of self-control, if participants were not tempted by the foods, self-control exertion was not necessary. Thus, a number of factors other than self-control could have accounted for individual differences (e.g., participants' hunger, hurry to complete the study, etc.). Future research could reduce the likelihood of this explanation by recruiting participants who report an affinity for a particular food (e.g., chocolate) and using that food in the tempting food prevention task.

A third explanation for the null results from the present study is that behaviorally-measured self-control is largely unrelated to academic performance, depressive symptoms, and life satisfaction. Most of the research examining the relationship between self-control and these outcome variables has measured self-control via self-report assessments (Duckworth & Seligman, 2005; Duckwork & Seligman, 2006; Tangney et al., 2004). It is possible that behaviorally-measured self-control is capturing something different from self-report self-control; in other words, the lack of significant relationships may be due to measurement problems. Cyders and Coskunpinar (2011) noted that within clinical psychology research, it is not uncommon for implicit and explicit measures of the same construct to be only moderately related or to be unrelated. In their meta-analysis examining the relationship between self-report and behaviorally-measured impulsivity, they found very little overlap; thus, the present findings regarding the relationship (or lack thereof) between self-report and behaviorally-measured self-control might not be surprising. The non-significant association may be explained in multiple ways. It may be that behavioral self-control tasks, measured at a single time-point, have lower reliability than multi-item, retrospective self-report measures of self-control, which are designed to capture behavior over a period of time. Another potential explanation for the lack of association between self-report self-control and behaviorally-measured self-control is that self-report self-control measures are face valid and are therefore susceptible to participants trying to present themselves in a more or less favorable light, depending on their motivations. Research suggests that social desirability response biases are most likely to occur when participants are motivated to engage in impression management or

when self-deceptive enhancement is likely (Bobbio & Manganelli, 2011). The latter may be particularly likely due to the fact that self-control is a highly desirable quality that is necessary for success across multiple domains (Baumeister & Vohs, 2004). Additionally, answering questions about one's typical behaviors and self-control successes requires a certain degree of insight and self-awareness. Participants may have been pulled to think of recent or particularly salient examples when answering items and therefore have chosen responses that are not representative of their behaviors overall.

The limitations associated with self-report self-control may have artificially increased the relationships self-control and the outcome variables reported in previous research. For example, people with greater depressive symptoms are more likely to view themselves in a judgmental and negative light (Beck & Perkins, 2001). These participants may have been more likely to answer self-control items consistent with low self-control despite the fact that they regularly exerted self-control (e.g., attended school and work, participated in research studies for course credit, etc.). Therefore, it is not surprising if their scores on behavioral self-control tasks reflected a performance that, although consistent with their behavior, was less strongly (if at all) associated with their scores on self-report depressive symptoms. It is possible, then, that the nonsignificant findings regarding behavioral self-control tasks and depressive symptoms could reflect a true lack of relationship between these constructs, and previous research supporting the association between self-control and depression is the result of measurement error associated with cognitive biases.

The above explanation is unlikely given the bulk of studies suggesting otherwise (Duckworth & Seligman, 2005; Duckworth & Seligman, 2006; Lightsey et al., 2007; Tangney et al., 2004). Moreover, research has demonstrated a link between behaviorally-measured self-control and self-report self-control. This can be interpreted as convergent validity for both types of self-control assessment and argues against measurement error associated with self-report self-control. One study found that the blinking task was positively associated with the SCS (Schmeichel & Zell, 2007). Additionally, the present study found a positive relationship between the blinking task and the self-control items developed by the author ($r = .28$, $p = .024$) and negative relationships between depressive symptoms and the previously-validated behavioral self-control tasks.

Handgrip Persistence and Blinking Prevention Findings

The analyses with the handgrip and blinking tasks are likely not underpowered, so the null results suggest a lack of relationships between the self-control tasks and the outcome variables. It is difficult to argue that these tasks are not valid because both the handgrip task (Muraven et al., 1999; Tunze et al., 2012) and the blinking task (Schmeichel & Zell, 2007) have evidence of construct and criterion-related validity from previous studies. Moreover, the findings from the present study demonstrate evidence of convergent validity through the positive correlation between the handgrip task and the blinking task ($r = .30$, $p = .015$) and the negative correlations between the CES-D and both the handgrip task ($r = -.25$, $p = .033$) and the blinking task ($r = -.29$, $p = .023$). However, as noted above, previous research consistently supports an association between

self-control and the outcome variables. Potential explanations for the non-significant findings regarding the predictive power of the handgrip task and the blinking task on academic performance, depressive symptoms, and life satisfaction are discussed below.

The null results may be better explained by systematic and random error introduced by the study design. Specifically, the fact that all participants completed three self-control tasks within a single laboratory session is problematic from the perspective of the limited-resource model of self-control (Baumeister et al., 1998). According to this theory, each self-control task should have reduced remaining self-control resources and caused impaired performance on subsequent self-control tasks.

In order to avoid this problem, recovery periods were implemented to help participants replenish their reserve of self-control. During this time, participants were provided with magazines and instructed to try to relax, but it is unknown how they actually used their time. Some participants read articles in the magazines, whereas others did not. It is impossible to know what covert behaviors these participants were engaging in. If they were indeed relaxing, it is reasonable to expect that some self-control resources were replenished during the recovery period because current self-control theories link self-control depletion to energy (Baumeister et al., 1998; Baumeister et al., 2007), and presumably, relaxation would allow for energy to be regained. However, some participants may have been experiencing boredom, thinking about tasks they had to complete following their participation in the study, or ruminating about current life stressors. It is unlikely that these covert activities would have a replenishing effect on self-control resources and may, in fact, have further depleted the reserve.

The effectiveness of the recovery period is particularly relevant because the order of the handgrip task and the blinking task was counterbalanced across participants. If the recovery periods did not work as designed, participants were differentially depleted (i.e., had completed either one or two previous self-control tasks) when they completed these tasks. Importantly, differential depletion could explain why the handgrip and blinking tasks were not associated with the outcomes as predicted.

A second complicating factor is that participants were given lemonade made with real sugar in order to replenish self-control resources. As noted in the methods section, this decision was based on previous empirical support for the glucose hypothesis (Gailliot & Baumeister, 2007). However, the glucose hypothesis is somewhat controversial in that some researchers argue against its plausibility from a neurophysiological standpoint (Kurzban, 2010). Therefore, glucose may not replenish self-control resources, and participants could have experienced a steady decline in self-control resources throughout the laboratory session. Alternatively, extra glucose consumption may only temporarily increase self-control. This hypothesis was supported in the present study by the finding that for participants in Group C, greater M&M consumption predicted greater subsequent self-control. The fact that some participants had extra glucose compared to other participants could be problematic in that those who had the extra sugar have a larger self-control boost compared to those who did not. If this is true, the differential self-control boost and/or depletion across study participants could have prevented the handgrip task and the blinking task from significantly predicting long-term goal attainment (i.e.,

academic performance) and more stable, trait-like constructs (i.e., depressive symptoms and life satisfaction).

Although most of the analyses with the handgrip task and the blinking task are non-significant, as noted above, the correlations between these variables and the CES-D are significant. Therefore, the question of multidimensionality can be assessed in this instance. A statistical comparison of the correlations revealed that the correlation between handgrip persistence and depression is not significantly different from the correlation between blinking prevention and depression (i.e., $R_{\text{handgrip-depression}} = R_{\text{blinking-depression}}$). This finding is consistent with the unidimensional model of self-control. Unfortunately, this was the only case in which dimensionality of self-control could be directly tested and for which the analyses would have adequate power to detect significant differences.

Dimensionality of Self-Report Self-Control

In general, the confirmatory factor analyses revealed that items seemed to cluster based on content (e.g., health-related behaviors, drug use, etc.) rather than on the type of self-control behavior required. Because the dimensions of the proposed taxonomy in the present study were based on the latter rather than the former, the items analyzed in the CFAs did not lend themselves well to a test of the proposed taxonomy. In order to provide a better test of the dimensionality of self-control, items with no reference to domain should be created (e.g., prevent: “I am good at resisting temptation;” stop: “I have a hard time quitting bad habits;” persist: “I am good at staying on task;” initiate: “I

wait until the last minute to get things done."), and the factor analysis should be conducted again testing one-, two-, three-, and four-factor models.

Limitations

The primary limitation of the present study is that the analyses were underpowered (power ranged from .22 to .36 based on post-hoc analyses). As a result, firm conclusions were unable to be made. The present analyses cannot be interpreted as evidence of the lack of a meaningful relationship between self-control and the outcome variables. Instead, there is simply a lack of evidence due to insufficient power. Additionally, although there are several reasons to question the validity of the food-related self-control tasks (as mentioned above), the underpowered analyses prevent this interpretation from being definitively made. It was important to collect data from all participants in the same semester so that the main dependent variable of interest (i.e., semester GPA) was the same across all participants. This is particularly true given that almost half of the sample (47.5%) consisted of first-semester college freshmen. Many study participants were adjusting to college life and increased autonomy compared to high school (e.g., courses that do not take attendance, more time devoted to studying for success), and it is possible that this adjustment may require more self-control than subsequent semesters.

In addition to underpowered analyses, the questionable validity of several of the self-control subtype tasks, and the potential error introduced into the study design due to ambiguous effects of the recovery periods, the present study had several limitations worth

noting. First and foremost, the present study utilized a between-subjects design in which each participant completed only one self-control subtype task. This design was chosen due to concerns of high attrition if participants were asked to attend four separate lab sessions in order to complete all four self-control subtype tasks. Ultimately, this concern was valid as evidenced by only 73 out of the 336 participants in Time 1 (the online survey administration) choosing to participate in Time 2 (i.e., the laboratory session) of the study. However, the between-subjects design prevented direct comparisons of performance across all four proposed subtypes. In the present study, it is unknown how a participant who performed well on the persistence task (i.e., drank a large amount of moderately aversive liquid) would have performed on the other three self-control subtype tasks. In order to provide stronger evidence for a multidimensional model of self-control, there needs to be evidence of differential performance across tasks assessing different subtypes of self-control within an individual.

A second limitation of the present study is the fact that participants completed three self-control tasks within a single laboratory session. Ideally, participants would complete a single self-control task per session at several different time points. Although this may result in participants arriving at the laboratory session with differentially depleted self-control resources, these effects would balance out across conditions.

A third limitation of the present study was that the self-control subtype tasks were all food related. This was done intentionally; the fact that all four proposed subtypes are measured in the same domain (i.e., food) rules out the potential confound of domain as an explanation for the pattern of findings. For example, one cannot argue that participants

may have arrived at the study hungry and so therefore performed worse on the prevention task but were not affected by the stop task because both tasks require food-related exertion of self-control. This domain turned out to be problematic because of the potential for large individual differences associated with food preferences, which almost certainly affected task performance. Some participants were not as tempted as others by the appetitive tasks, and some participants were not as repelled by the aversive tasks as others. Food-related tasks may also have been problematic for assessing the relationships between the appetitive but goal-interfering tasks (i.e., stop and prevention self-control tasks) and the indices of well-being. The correlations between the prevention task and the indices of well-being were in the opposite direction than predicted, and this could have been the result of anhedonia and decreased appetite associated with depression. It is likely that there would be fewer individual differences (and other problems associated with temptation) with other domains (e.g., cognitive tasks) within a college sample and that any differences that do exist could be controlled for statistically (e.g., intelligence as a control variable).

A final noteworthy limitation of the present study is the potential restriction of range and compromised external validity associated with studying college students as a result of biased sampling. This population may represent a convenient option for getting large samples and may be particularly appealing for studying self-control as related to goal attainment, given that GPA is an objective and standardized outcome variable. However, it can be argued that college students have greater self-control compared to the overall population. College students have to attend classes and study for tests, and they

have a history of more successful academic performance compared to their same age peers. By utilizing a college student sample, the findings may not generalize to persons outside of the college student population. Persons with severe self-control deficits were excluded from the study because these people would likely not be functioning at a high enough level to be admitted to the university. Moreover, it is likely that the students who signed up to participate in the present study had higher self-control than the typical college sample because research participation was worth only 3% of students' final course grades. It is possible that self-control is unidimensional for populations without significant behavioral, cognitive, or executive functioning deficits, but that it is multidimensional for specific clinical populations. This is an empirical question that remains unanswered.

Conclusions and Future Directions

Given that most of the self-control tasks in the present study failed to significantly predict academic performance, depressive symptoms, and life satisfaction, the results from the present study do not provide conclusive support for either a unidimensional or a multidimensional model of self-control. The null results could be evidence of a unidimensional model in which none of the proposed subtypes of self-control predict academic performance or psychological well-being. This explanation is unlikely given consistent support for the importance of self-control across multiple domains. Alternatively, if the self-control tasks were not valid measures of self-control (for a variety of reasons detailed above), the dimensionality of self-control cannot be assessed

via the correlations and regressions conducted in the present study. The one comparison between pairwise correlations that was able to be tested for significant differences revealed that the correlations between: 1 – handgrip persistence and depression; and 2 – blinking prevention and depression were not significantly different from one another. These findings partially support Hypothesis 3 (H3) and are consistent with unidimensionality. In contrast, recent research (De Boer, Van Hooft, & Bakker, 2011) provides preliminary support for a multidimensional model of self-control in which a meaningful difference exists between start (i.e., persistence and initiation) and stop (i.e., prevention and stop) self-control. Due to the limited conclusions able to be drawn from the present study and the fact that research investigating the dimensionality of self-control is a new area of study with few studies and limited replication, the question of dimensionality should continue to be pursued through future research.

Future studies should investigate the question of dimensionality by measuring self-control via behavioral assessments and via self-report. In order to address the question through behavioral tasks, the limitations listed above should be addressed and the present study should be replicated. Most notably, the self-control subtype tasks should be piloted and validated before data collection for the study begins, the study should use a within-subjects design in which all participants complete tasks measuring all four proposed subtypes of self-control, and enough participants should be recruited to ensure that the analyses have adequate power. Improvements can be made to the study design for investigating dimensionality of self-report self-control as well. The fact that the confirmatory factor analysis factor loadings appeared to be based on the content of the

item (e.g., eating behaviors, gambling, etc.) in the present study is something that can be corrected in future studies. New items for each proposed subtype should be written with the goal of avoiding items that are related to a particular content. The items should be factor analyzed to find a model that fits the data. Additionally, if a multidimensional model of self-control is supported through factor analysis, convergent and discriminant validity of the subtypes can be demonstrated by finding evidence of differential predictive validity through regressions predicting outcomes of interest (e.g., tasks in which persistence is important vs. tasks in which prevention is important, etc.).

Finally, it is important to note that the dimensionality of self-control has several significant implications that should not be overlooked and should continue to be pursued. The key role that self-control failures or deficits play with regard to the occurrence of many problematic behaviors (e.g., violent or aggressive behavior, excessive drinking and/or drug use, overeating, sedentary lifestyle) has been well demonstrated in the literature (Archer & Southall, 2009; Miller et al., 2009; Packer et al., 2009). Additionally, it can be argued that self-control deficits may be linked to symptoms in a variety of clinical disorders (e.g., difficulty initiating productive behavior for persons experiencing a major depressive episode; failure to prevent oneself from engaging in compulsions for persons with obsessive compulsive disorder; failure to initiate or persist at exposure exercises for persons with anxiety disorders). Given that research supports the idea that self-control can be improved (Baumeister et al., 2007; Oaten & Cheng, 2006), targeting self-control may be a useful intervention strategy to reduce symptoms and/or increase

quality of life. In sum, knowledge regarding the dimensionality of self-control has the potential for important basic and clinical implications and should continue to be pursued.

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TABLES

Table 1

Sample Demographics

Variable	Time 1: Survey	Time 2: Lab	Group A	Group B	Group C	Group D
			Persist	Initiate	Stop	Prevent
	(N = 336)	(N = 73)	(n = 17)	(n = 16)	(n = 20)	(n = 19)
Age, years	21.00 (5.24)	21.64 (6.90)	21.25 (3.82)	22.00 (5.62)	19.95 (2.21)	22.89 (11.54)
Sex						
Female	256 (75.5%)	46 (63.0%)	11 (64.7%)	11 (68.8%)	10 (50.0%)	13 (68.4%)
Male	80 (23.6%)	26 (35.6%)	5 (29.4%)	5 (31.3%)	10 (50.0%)	6 (31.6%)
Race						
Asian/Pacific Islander	17 (5.0%)	5 (6.8%)	1 (5.9%)	1 (6.3%)	1 (5.0%)	2 (10.5%)
African American	36 (10.6%)	6 (8.2%)	1 (5.9%)	2 (12.5%)	1 (5.0%)	2 (10.5%)
Hispanic/Latino	7 (2.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
White/Caucasian	265 (78.2%)	60 (82.2%)	14 (82.4%)	12 (75.0%)	18 (90.0%)	15 (78.9%)
Other	8 (2.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Year in College						
Freshman	161 (47.4%)	36 (49.3%)	9 (52.9%)	7 (43.8%)	8 (40.0%)	12 (63.2%)
Sophomore	95 (28.0%)	16 (21.9%)	2 (11.8%)	4 (25.0%)	6 (30.0%)	4 (21.1%)
Junior	54 (15.9%)	13 (17.8%)	4 (23.5%)	3 (18.8%)	4 (20.0%)	2 (10.5%)
Senior	16 (4.7%)	5 (6.8%)	1 (5.9%)	1 (6.3%)	2 (10.0%)	1 (5.3%)
Fifth year	9 (2.7%)	1 (1.4%)	0 (0.0%)	1 (6.3%)	0 (0.0%)	0 (0.0%)
High School GPA	3.43 (.49)	3.40 (.56)	3.29 (.49)	3.18 (.74)	3.47 (.46)	3.59 (.54)
College GPA (self-report)	3.07 (.60)	3.10 (.58)	3.06 (.60)	2.88 (.75)	3.16 (.42)	3.20 (.62)
Fall 2010 GPA	---	3.28 (.73)	3.28 (.73)	3.33 (.72)	3.20 (.67)	3.26 (.82)
Cumulative GPA	---	3.15 (.71)	3.09 (.58)	3.13 (.83)	3.12 (.67)	3.20 (.79)

Table 2

Correlations, Means, and Standard Deviations

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Persistence	--												
2. Initiation	--	--											
3. Stop	--	--	--										
4. Prevention	--	--	--	--									
5. Handgrip	0.26	-0.25	-0.61*	-0.37	--								
6. Blinking	0.26	-0.34	-0.41	-0.15	0.30*	--							
7. SCS	-0.20	-0.43	0.20	-0.38	0.14	0.16	--						
8. Self-Control Items	-0.14	-0.48	0.16	-0.35	0.19	0.25*	0.94**	--					
9. Fall 2010 GPA	0.29	-0.11	-0.06	0.20	0.18	0.12	-0.06	-0.04	--				
10. Cumulative GPA	0.33	0.14	-0.14	0.16	0.09	0.05	-0.07	-0.10	0.84**	--			
11. Depressive Symptoms	0.41	0.11	-0.39	0.50*	-0.25*	-0.29*	-0.44**	-0.45**	-0.12	-0.06	--		
12. Satisfaction With Life	-0.25	-0.52*	0.48*	-0.58*	0.06	0.10	0.38**	0.40**	0.03	0.05	-0.58**	--	
13. Neuroticism	0.16	0.07	-0.33	0.39	-0.19	-0.28*	-0.51**	-0.53**	-0.01	0.05	0.69**	-0.57**	--
M	154.36	172.46	33.60	53.77	43.62	60.15	118.74	136.32	3.28	3.15	16.89	23.86	33.75
SD	103.77	77.80	9.08	38.15	36.43	16.24	18.61	20.81	0.73	0.71	10.00	6.74	7.74
Cronbach's alpha	--	--	--	--	--	--	.89	.89	--	--	.89	.88	.82

* $p < .05$; ** $p < .01$

Table 3

Comparison of Correlation Coefficients Between Outcome Variables and Food-Related Self-Control Subtype Tasks

Outcome	χ^2	*P*	r_1	r_2	Z-difference score
Fall 2010 GPA	1.55	.671			
Cumulative GPA	1.67	.644			
CES-D	8.96†	.030			
1, 2					
Persist-Initiate			.41	.11	0.78
Persist-Stop			.41	-.39	2.16*
Persist-Prevent			.41	.50	0.25
Initiate-Stop			.11	-.39	1.33
Initiate-Prevent			.11	.50	1.07
Stop-Prevent			-.39	.50	2.55*
SWL	14.10†	.003			
1, 2					
Persist-Initiate			-.25	-.52	0.70
Persist-Stop			-.25	.48	1.97*
Persist-Prevent			-.25	-.58	0.89
Initiate-Stop			-.52	.48	2.71*
Initiate-Prevent			-.52	-.58	0.16
Stop-Prevent			.48	-.58	3.03*
Handgrip task	7.51	.057			
Blinking task	4.11	.250			

† χ^2 > Critical value (7.815)
* $p < .05$

CES-D: Center for Epidemiologic Studies Depression Scale
SWL: Satisfaction with Life Scale

Table 4

Comparison of Correlation Coefficients of Correlations Between Handgrip Persistence and Outcome Variables and Blinking Prevention and Outcome Variables

	$R_{handgrip}$	$R_{blinking}$	Z-difference score
Fall 2010 GPA	.18	.12	0.30
Cumulative GPA	.09	.05	0.17
CES-D	-.25*	-.29*	.19
SWLS	.06	.10	.24

CES-D: Center for Epidemiologic Studies Depression Scale
SWLS: Satisfaction with Life Scale

Table 5

Handgrip Persistence Task Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*P*
Persistence Task (n = 15)								
Step 1				.33	.33	4,11	1.36	.308
Gender*	-34.36	21.20	-.50				-1.62	.136
Age	-61.50	128.09	-.14				-.48	.641
Minority status**	-2.74	26.28	-.03				-.10	.919
NEON total score	.67	1.28	.14				.52	.612
Step 2				.33	.00	5,10	1.00	.464
Iced tea consumed	2.02	10.38	.06				.19	.850
Initiation Task (n = 14)								
Step 1				.77	.77	4,10	8.41	.003
Gender	-23.78	9.18	-.41				-2.59	.029
Age	81.80	45.33	.29				1.80	.105
Minority status	-4.75	11.76	-.07				-.40	.696
NEON total score	-1.63	.60	-.49				-2.73	.023
Step 2				.80	.03	5,9	7.21	.006
Horseradish time	-5.11	4.45	-.18				-1.15	.280
Stop Task (n = 19)								
Step 1				.24	.24	4,15	1.20	.351
Gender	-20.42	16.55	-.27				-1.23	.238
Age	108.22	172.62	.12				.63	.541
Minority status	4.10	25.51	.03				.16	.875
NEON total score	-1.03	1.05	-.20				-.98	.345
Step 2				.53	.29	5,14	3.20	.039
M&Ms consumed	-23.82	8.06	-.61				-2.96	.010
Prevention Task (n = 18)								
Step 1				.68	.68	4,14	7.26	.002
Gender	-80.61	16.98	-.87				-4.75	.000
Age	112.38	81.42	.37				1.38	.191
Minority status	-61.23	26.88	-.58				-2.28	.040
NEON total score	-.16	.87	-.03				-.18	.858
Step 2				.71	.03	5,13	6.23	.004
Time refrained	-9.07	7.76	-.20				-1.17	.263

* Gender: 1 = male; 2 = female;
** Minority status: 0 = white; 1 = minority

Table 6

Comparison of B Coefficients on Regressions Predicting Handgrip Persistence

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	2.02	-5.11	0.63
Persist-Stop	2.02	-23.82	1.97*
Persist-Prevent	2.02	-9.07	0.86
Initiate-Stop	-5.11	-23.82	2.03*
Initiate-Prevent	-5.11	-9.07	0.44
Stop-Prevent	-23.82	-9.07	1.32

*$p < .05$

Table 7

Blinking Prevention Task Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*P*
Persistence Task (n = 15)								
Step 1				.09	.09	4,11	.26	.901
Gender*	-.22	7.85	-.01				-.03	.978
Age	-23.49	47.42	-.16				-.50	.631
Minority status**	-4.12	9.73	-.13				-.42	.681
Neuroticism	.19	.47	.12			5,10	.40	.696
Step 2				.15	.07		.36	.865
Iced tea consumed	3.43	3.84	.33				.89	.393
Initiation Task (n = 10)								
Step 1				.22	.22	4,6	.411	.796
Gender	1.89	31.99	.04				.17	.872
Age	-10.74	79.85	-.05				-.14	.898
Minority status	-20.46	34.79	-.44				-.59	.582
Neuroticism	.44	2.61	.15				.17	.872
Step 2				.25	.04	5,5	.34	.869
Horseradish time	-4.17	8.16	-.22				-.51	.631
Stop Task (n = 18)								
Step 1				.10	.10	4,14	.40	.805
Gender	3.45	7.45	.13				.46	.651
Age	5.10	73.03	-.56				.07	.945
Minority status	5.36	10.77	.12				.50	.627
Neuroticism	-.92	.52	-.50				-1.76	.103
Step 2				.36	.26	5,13	1.46	.269
M&Ms consumed	-7.74	3.39	-.56				-2.28	.040
Prevention Task (n = 15)								
Step 1				.52	.52	4,11	3.01	.067
Gender	-23.60	10.90	-.57				-2.17	.056
Age	117.52	48.67	.94				2.42	.036
Minority status	-32.91	15.75	-.74				-2.09	.063
Neuroticism	-.66	.51	-.32				-1.30	.224
Step 2				.56	.04	5,10	2.55	.098
Time refrained	4.51	4.85	.22				.93	.374

* Gender: 1 = male; 2 = female;
** Minority status: 0 = white; 1 = minority

Table 8

Comparisons of B Coefficients for Regressions Predicting Blinking Prevention

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	3.43	-4.17	0.84
Persist-Stop	3.43	-7.74	2.18*
Persist-Prevent	3.43	4.85	0.18
Initiate-Stop	-4.17	-7.74	0.40
Initiate-Prevent	-4.17	4.85	0.91
Stop-Prevent	-7.74	4.85	2.07*

*$p < .05$

Table 9
Fall 2010 GPA Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Persistence Task (n = 14)								
Step 1				.68	.68	5,9	3.89	.037
Gender*	-.08	.49	-.05				-.16	.275
Age	3.89	3.08	.36				1.26	.242
Minority status**	-1.21	.47	-.56				-2.58	.032
Neuroticism	.00	.03	-.01				-.02	.983
High School GPA	1.40	.47	.85				2.97	.018
Step 2				.72	.04	6,8	3.48	.054
Iced tea consumed	.25	.23	.30				1.07	.317
Initiation Task (n = 12)								
Step 1				.36	.36	5,7	.78	.596
Gender	.28	.36	.31				.78	.464
Age	-.32	1.88	-.08				-.17	.869
Minority status	-.10	.49	-.09				-.20	.846
Neuroticism	.00	.02	.08				.18	.867
High School GPA	.15	.35	.25				.42	.691
Step 2				.41	.05	6,6	.70	.664
Horseradish time	-.12	.16	-.30				-.73	.488
Stop Task (n = 17)								
Step 1				.22	.22	5,12	.67	.657
Gender	.71	.46	.54				1.56	.148
Age	1.92	4.53	.13				.42	.680
Minority status	-.66	.59	-.32				-1.12	.289
Neuroticism	-.04	.02	-.43				-1.50	.161
High School GPA	-.08	.50	-.06				-.16	.880
Step 2				.28	.06	6,11	.70	.655
M&Ms consumed	-.21	.22	-.32				-.95	.361
Prevention Task (n = 17)								
Step 1				.87	.87	5,12	16.33	.000
Gender	.11	.22	.06				.50	.631
Age	-3.20	1.47	-.59				-2.18	.052
Minority status	.94	.55	.44				1.73	.112
Neuroticism	-.03	.01	-.33				-2.44	.033
High School GPA	1.35	.17	.91				8.15	.000
Step 2				.87	.00	6,11	12.66	.000
Time refrained	-.04	.12	-.06				-.38	.710

* Gender: 1 = male; 2 = female;
** Minority status: 0 = white; 1 = minority

Table 10
Comparisons of B Coefficients for Regressions Predicting Fall 2010 GPA

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	.25	-.12	1.30
Persist-Stop	.25	-.22	1.43
Persist-Prevent	.25	-.04	1.12
Initiate-Stop	-.12	-.22	.31
Initiate-Prevent	-.12	-.04	.38
Stop-Prevent	-.22	-.04	.66

*$p < .05$

Table 11

Cumulative GPA Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Persistence Task (n = 14)								
Step 1				.45	.45	5,9	1.46	.292
Gender*	.00	.50	.00				.01	.995
Age	.65	3.17	.08				.20	.843
Minority status**	-.33	.48	-.20				-.69	.513
Neuroticism	.00	.03	-.02				-.05	.959
High School GPA	.88	.48	.69				1.82	.106
Step 2				.52	.07	6,8	1.46	.304
Iced tea consumed	.27	.24	.41				1.11	.299
Initiation Task (n = 11)								
Step 1				.39	.39	5,6	.761	.609
Gender	.41	.62	.30				.67	.534
Age	-3.58	3.22	-.56				-1.11	.317
Minority status	-.59	.83	-.35				-.71	.507
Neuroticism	.00	.04	.03				.06	.957
High School GPA	-.08	.59	-.09				-.13	.901
Step 2				.39	.39	6,5	.532	.768
Horseradish time	.03	.38	.05				.11	.919
Stop Task (n = 16)								
Step 1				.11	.11	5,11	.281	.914
Gender	.70	.48	.53				1.45	.179
Age	1.02	4.81	.07				.21	.836
Minority status	-.10	.85	-.04				-.12	.908
Neuroticism	-.02	.03	-.19				-.60	.561
High School GPA	-.55	.54	-.40				-1.02	.330
Step 2				.22	.11	6,10	.472	.814
M&Ms consumed	-.27	.23	-.42				-1.17	.267
Prevention Task (n = 18)								
Step 1				.86	.86	5,13	15.86	.000
Gender	.03	.22	.02				.12	.904
Age	-2.60	1.03	-.49				-2.53	.027
Minority status	.46	.34	.24				1.34	.205
Neuroticism	-.02	.01	-.25				-1.92	.080
High School GPA	1.29	.16	.89				7.88	.000
Step 2				.86	.00	6,12	12.34	.000
Time refrained	-.03	.10	-.04				-.34	.742

* Gender: 1 = male; 2 = female;

** Minority status: 0 = white; 1 = minority

Table 12
Comparisons of B Coefficients for Regressions Predicting Cumulative GPA

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	.27	.03	.64
Persist-Stop	.27	-.27	1.62
Persist-Prevent	.27	-.03	1.16
Initiate-Stop	.03	-.27	.83
Initiate-Prevent	.03	-.03	.22
Stop-Prevent	-.27	-.03	.94

*$p < .05$

Table 13

Depression (CES-D Scores) Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Persistence Task (n = 15)								
Step 1				.64	.64	4,11	4.95	.016
Gender *	1.79	3.46	.10				.52	.616
Age	10.10	20.89	.09				.48	.639
Minority status**	5.85	4.29	.24				1.37	.202
Neuroticism	.81	.21	.65				3.85	.003
Step 2				.73	.09	5,10	5.36	.012
Iced tea consumed	3.00	1.69	.37				1.77	.107
Initiation Task (n = 14)								
Step 1				.65	.65	4,10	4.73	.021
Gender	-1.41	3.66	-.08				-.39	.709
Age	-35.57	18.06	-.41				-1.97	.080
Minority status	.34	4.69	.02				.07	.944
Neuroticism	.60	.24	.60				2.54	.032
Step 2				.66	.00	5,9	3.43	.052
Horseradish time	.34	1.77	.04				.192	.852
Stop Task (n = 19)								
Step 1				.43	.43	4,15	2.83	.062
Gender	-.02	4.45	.00				.00	.997
Age	23.22	46.44	.10				.50	.625
Minority status	1.94	6.86	.06				.28	.781
Neuroticism	.75	.28	.59				2.65	.019
Step 2				.46	.03	5,14	2.36	.094
M&Ms consumed	-1.81	2.17	-.18				-.83	.418
Prevention Task (n = 18)								
Step 1				.81	.81	4,14	14.79	.000
Gender	9.17	3.46	.38				2.65	.020
Age	-35.04	16.60	-.45				-2.11	.055
Minority status	15.51	5.48	.57				2.83	.014
Neuroticism	.79	.18	.64				4.46	.001
Step 2				.82	.01	5,13	11.45	.000
Time refrained	1.05	1.58	.09				.67	.517

* Gender: 1 = male; 2 = female

** Minority status: 0 = white; 1 = minority

Table 14

Comparisons of B Coefficients for Regressions Predicting CES-D Scores

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	3.00	.34	1.09
Persist-Stop	3.00	-1.81	1.75
Persist-Prevent	3.00	1.58	.84
Initiate-Stop	.34	-1.81	.77
Initiate-Prevent	.34	1.58	.30
Stop-Prevent	-1.81	1.58	1.07

*$p < .05$

Table 15

Life Satisfaction (SWL scores) Regressed on Food-Related Self-Control Tasks (Z-Scores)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Persistence Task (n = 15)								
Step 1				.52	.52	4,11	2.93	.071
Gender*	6.87	4.42	.41				1.55	.151
Age	-16.40	26.69	-.15				-.61	.553
Minority status**	.75	5.48	.03				.14	.894
Neuroticism	-.70	.27	-.59				-2.64	.025
Step 2				.52	.01	5,10	2.17	.139
Iced tea consumed	.68	2.16	.09				.31	.762
Initiation Task (n = 14)								
Step 1				.79	.79	4,10	9.62	.002
Gender	2.17	1.64	.15				1.32	.219
Age	-11.17	8.11	-.15				-1.38	.201
Minority status	-6.41	2.10	-.37				-3.05	.014
Neuroticism	-.57	.11	-.67				-5.34	.000
Step 2				.90	.11	5,9	16.54	.000
Horseradish time	-2.51	.795	-.35				-3.15	.012
Stop Task (n = 19)								
Step 1				.47	.47	4,15	3.37	.037
Gender	2.81	3.52	.17				.80	.437
Age	2.09	36.69	.01				.06	.955
Minority status	-6.17	5.42	-.23				-1.14	.274
Neuroticism	-.64	.22	-.60				-2.87	.012
Step 2				.53	.05	5,14	3.10	.043
M&Ms consumed	2.13	1.71	.26				1.24	.234
Prevention Task (n = 18)								
Step 1				.68	.68	4,14	7.36	.002
Gender	-2.47	2.60	-.17				-.95	.360
Age	12.09	12.45	.25				.97	.350
Minority status	-11.63	4.12	-.69				-2.83	.014
Neuroticism	-.34	.13	-.45				-2.58	.023
Step 2				.73	.05	5,13	6.87	.002
Time refrained	-1.79	1.19	-.25				-1.51	.156

* Gender: 1 = male; 2 = female

** Minority status: 0 = white; 1 = minority

Table 16
Comparisons of B Coefficients for Regressions Predicting SWL Scores

1, 2	B_1	B_2	Z-difference score
Persist-Initiate	.68	-2.51	1.38
Persist-Stop	.68	2.13	0.53
Persist-Prevent	.68	-1.79	1.00
Initiate-Stop	-2.51	2.13	2.46*
Initiate-Prevent	-2.51	-1.79	0.50
Stop-Prevent	2.13	-1.79	1.88

*$p < .05$

Table 17

Outcome Variables Regressed on Handgrip Persistence (Z-score)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Fall 2010 GPA (n = 64)								
Step 1				.25	.25	5, 59	3.94	.004
Gender*	.16	.20	.11				.76	.449
Age	.50	.92	.07				.54	.591
Minority status**	-.35	.25	-.18				-1.40	.166
Neuroticism	-.01	.01	-.06				-.48	.630
High School GPA	.56	.16	.46				3.57	.001
Step 2				.27	.02	6, 58	3.64	.004
Handgrip time	.13	.09	.19				1.37	.176
Cumulative GPA (n = 62)								
Step 1				.19	.19	5, 58	2.72	.028
Gender	.03	.21	.02				.16	.874
Age	-.59	.94	-.09				-.63	.533
Minority status	-.17	.25	-.09				-.65	.516
Neuroticism	.00	.01	-.04				-.28	.784
High School GPA	.45	.16	.38				2.79	.007
Step 2				.19	.00	6, 57	2.27	.049
Handgrip time	.05	.10	.07				.48	.631
CES-D Score (n = 70)								
Step 1				.55	.55	4, 66	19.98	.000
Gender	-1.24	1.98	-.06				-.62	.536
Age	1.40	8.91	.01				.16	.876
Minority status	2.48	2.39	.09				1.04	.303
Neuroticism	.87	.11	.71				8.31	.000
Step 2				.56	.01	5, 65	16.59	.000
Handgrip time	-1.33	.96	-.14				-1.38	.171
SWL Score (n = 70)								
Step 1				.48	.48	4, 66	15.39	.000
Gender	3.04	1.70	.19				1.79	.078
Age	-10.82	7.62	-.14				-1.42	.160
Minority status	-4.63	2.05	-.22				-2.26	.027
Neuroticism	-.63	.09	-.66				-7.02	.000
Step 2				.48	.00	5, 65	12.12	.000
Handgrip time	.01	.82	.00				.01	.995

* Gender: 1 = male; 2 = female

** Minority status: 0 = white; 1 = minority

CES-D: Center for Epidemiologic Studies Depression Scale

SWL: Satisfaction with Life Scale

Table 18

Outcome Variables Regressed on Blinking Task Prevention (Z-Score)

	B	S.E.	*β*	R^2	ΔR^2	*df*	*F/t*	*p*
Fall 2010 GPA (n = 55)								
Step 1				.31	.31	5, 51	4.49	.002
Gender*	-.08	.18	-.06				-.44	.662
Age	1.02	.87	.17				1.18	.243
Minority status**	-.45	.24	-.25				-1.91	.063
Neuroticism	.01	.01	.07				.49	.624
High School GPA	.61	.15	.54				4.05	.000
Step 2				.32	.01	6, 50	3.87	.003
Blinking score	.07	.09	.12				.93	.359
Cumulative GPA (n = 56)								
Step 1				.20	.20	5, 51	2.47	.044
Gender	-.03	.20	-.02				-.14	.891
Age	-.31	.96	-.05				-.33	.744
Minority status	-.19	.25	-.10				-.73	.469
Neuroticism	.00	.01	.04				.30	.769
High School GPA	.47	.17	.40				2.77	.008
Step 2				.20	.00	6, 50	2.08	.073
Blinking score	.05	.10	.07				.52	.604
CES-D Score (n = 62)								
Step 1				.50	.50	4, 58	14.27	.000
Gender	.81	1.91	.04				.42	.674
Age	.65	9.44	.01				.07	.945
Minority status	3.14	2.50	.13				1.25	.215
Neuroticism	.79	.12	.65				6.44	.000
Step 2				.50	.01	5, 57	11.55	.000
Blinking score	-.85	.93	-.09				-.92	.363
SWL Score (n = 62)								
Step 1				.45	.45	4, 58	11.76	.000
Gender	3.11	1.63	.19				1.91	.061
Age	-9.09	8.04	-.12				-1.13	.263
Minority status	-4.75	2.13	-.24				-2.23	.030
Neuroticism	-.63	.11	-.64				-6.06	.000
Step 2				.45	.00	5, 57	9.41	.000
Blinking score	-.53	.79	-.07				-.67	.505

* Gender: 1 = male; 2 = female

** Minority status: 0 = white; 1 = minority

CES-D: Center for Epidemiologic Studies Depression Scale

SWL: Satisfaction with Life Scale

Table 19

Comparison of B Coefficients for Outcome Variables Regressed on Handgrip Persistence and Blinking Prevention

	$B_{handgrip}$	$B_{blinking}$	Z-difference score
Fall 2010 GPA	.13	.07	0.31
Cumulative GPA	.05	.05	0.05
CES-D	-1.33	-.85	0.36
SWL	.01	-.53	0.47

*$p < .05$

CES-D: Center for Epidemiologic Studies Depression Scale

SWL: Satisfaction with Life Scale

APPENDICES

Appendix A: Self-Control Scale (SCS) and Additional Self-Control (EXSC) Items as Categorized for the Confirmatory Factor Analyses

Persistence

SCS 15. I keep everything neat.
SCS 24. I am not easily discouraged.
SCS 29. I have trouble concentrating.
EXSC 1. Once I start a task, I am able to work on it until it is finished.
EXSC 2. I finish most projects that I start.
EXSC 3. When working on an unpleasant or difficult task, I would rather get it over quickly rather than taking lots of breaks.
EXSC 4. When exercising, I often quit earlier than I meant to
EXSC 5. It is easy for me to stick to a diet once I start.
EXSC 6. I am not easily distracted.
EXSC 7. I follow through on promises I make to friends and family.

Initiation

SCS 8. Getting up in the morning is hard for me.
SCS 23. I have worked or studied all night at the last minute.
SCS 26. I engage in healthy practices.
SCS 27. I eat healthy foods.
SCS 36. I am always on time.
EXSC 8. It is hard for me to get started when I need to study for a test.
EXSC 9. Getting started exercising is hard for me.
EXSC 10. I always get up early enough to leave myself time to get ready.
EXSC 11. I wait until the last minute to get things done.
EXSC 12. I do homework/study most nights of the week (M-F) when I have a big project or test coming up.

Stop

SCS 14. I spend too much money.
SCS 28. Pleasure and fun sometimes keep me from getting work done.
SCS 35. I sometimes drink or use drugs to excess.
EXSC 13. If I start eating a tasty but unhealthy snack, it is difficult for me to stop.
EXSC 14. I have a hard time disengaging from an argument if someone has made me mad.
EXSC 15. It is hard for me to have just one drink.
EXSC 16. I have a hard time stopping once I've started gambling, no matter if I am winning or losing money.
EXSC 17. I have a hard time going to bed early enough to get enough sleep if I am having fun.
EXSC 18. Once I've started talking, it is hard for me to stop even if I know that it's in my best interest.
EXSC 19. I have a hard time quitting bad habits that I have already acquired.

Prevention

SCS 1. I am good at resisting temptation.
SCS 4. I say inappropriate things.
SCS 5. I never allow myself to lose control.
SCS 6. I do certain things that are bad for me, if they are fun.
SCS 9. I have trouble saying no.
SCS 11. I blurt out whatever is on my mind.
SCS 13. I refuse things that are bad for me.
SCS 21. I don't keep secrets very well.
SCS 31. Sometimes I can't stop myself from doing something, even if I know it is wrong.
SCS 33. I lose my temper too easily.
SCS 34. I often interrupt people.

Items not included in the confirmatory factor analyses because they did not fit into any of the proposed subtypes:

Impulsivity

SCS 10. I change my mind fairly often.
SCS 12. People would describe me as impulsive.
SCS 18. I am reliable.
SCS 20. I do many things on the spur of the moment.
SCS 25. I'd be better off if I stopped to think before acting.
SCS 32. I often act without thinking through all the alternatives.

Inhibit (Prevent and Stop)

SCS 2. I have a hard time breaking bad habits.
SCS 16. I am self-indulgent at times.
SCS 19. I get carried away by my feelings.

Activate (Initiation and Persist)

SCS 3. I am lazy.
SCS 7. People can count on me to keep on schedule.

All subtypes

SCS 17. I wish I had more self-discipline.
SCS 22. People would say that I have iron self-discipline.
SCS 30. I am able to work effectively toward long-term goals.

Appendix B: A Priori Power Analysis

A power analysis for regression was conducted before data collection began in order to determine the necessary sample size for the current study. The following equations and a power table from Cohen and Cohen (1983) were used:

$$f^2 = R^2 / (1 - R^2) \text{ and } n = (L / f^2) + k + 1$$

Tunze and Rand's previous research with behavioral self-control tasks has yielded R^2 values of .21-.37 (Tunze, Rand, & Wallihan, 2012), so $R^2 = .26$ was used as an estimate of expected effect size. For Power to be equal to .80, when $p = .05$, $R^2 = .26$, and there are six predictor variables (k), the sample size must be $n = 45$. For Power to be equal to .80, when $p = .05$, $R^2 = .26$, and there are five predictor variables (k), the sample size must be $n = 42$. Therefore, the initial goal was to collect data from $N = 180$ participants.

VITA

VITA

Chloe Ann Tunze

Education

August 2012	Doctor of Philosophy in Clinical Psychology Indiana University – Purdue University Indianapolis Indianapolis, IN Dissertation Title: An Empirical Test of the Dimensionality of Self-Control
August 2011 - July 2012	Predoctoral Clinical Psychology Internship Salem Veterans Affairs Medical Center Salem, VA
May 2010	Preliminary Examination Indiana University – Purdue University Indianapolis Indianapolis, IN Preliminary Examination Title: Is there evidence that self-control is unidimensional or multidimensional?
May 2009	Master of Science in Clinical Psychology Indiana University – Purdue University Indianapolis Indianapolis, IN Thesis Title: The Role of Family Functioning in Children with Comorbid Epilepsy and ADHD
December 2006	Bachelor of Science Colorado State University Fort Collins, Colorado Psychology Major Biomedical Sciences Minor

Research Experience

11/2011 – Present	Research Minor Intern Project: The Roles of PTSD, Depression, and Shame in Suicidal Behaviors in a Treatment-Seeking Veteran Population Mentor: Dana Holohan, Ph.D.
2010 – Present	Dissertation Follow-Up Studies: Empirical Tests of the Dimensionality of Self-Control Role: Co-investigator Principal Investigator: Kevin Rand, Ph.D.
2010 – Present	Doctoral Dissertation: An Empirical Test of the Dimensionality of Self-Control Committee: Kevin Rand, Ph.D., Jesse Stewart, Ph.D., Melissa Cyders, Ph.D., Leslie Ashburn-Nardo, Ph.D., Daniel Rexroth, Psy.D.
11/2011 – 01/2012	Computer-Based Attention Retraining for the Treatment of PTSD in a Veteran Population; grant application will be submitted to the Psychological Health/Traumatic Brain Injury Program for the Basic/Applied Psychological Health Award in January 2012. Role: Research Assistant Principal Investigator: Dana Holohan, Ph.D.
2010 – 2011	The Relationship Between Subtypes of Perceived Stigma and Depression Over Time in an SMI Population Role: Research Assistant Principal Investigator: Paul Lysaker, Ph.D.
2010- 2011	Illness Management and Recovery (IMR) Clinical Research Studies Role: Research Assistant Principal Investigator: Alan McGuire, Ph.D.
2008 – 2011	Neuropsychology and Self-Control Research Studies Role: Co-Investigator Principal Investigator: Kevin Rand, Ph.D.
2009 – 2010	Clinical Psychology Preliminary Examination: Is there evidence that self-control is unidimensional or multidimensional? Committee: Kevin Rand, Ph.D., Jesse Stewart, Ph.D., Melissa Cyders, Ph.D.

2007 – 2008	Test of Goal Attitudes: Development of a Measure Principal Investigator: Kevin Rand, Ph.D.
2007- 2009	Masters Thesis: The Role of Family Functioning in Children with Comorbid Epilepsy and ADHD Committee: Philip Fastenau, Ph.D. (co-chair), Kevin Rand, Ph.D. (co-chair), John McGrew, Ph.D., David Dunn, M.D., Jesse Stewart, Ph.D.
01/2006 - 07/2007	Clinical Research Assistant, EEG Test Retest Study and Sensory Gating Study, Occupational Therapy Department CSU Principal Investigators: Patricia L. Davies, OTR, Ph.D. & William J. Gavin, Ph.D.
2006	499 Senior Thesis CSU: Examining the Ability of the Wechsler Abbreviate Scale of Intelligence to Detect Learning Disabilities and Evaluating Memory as a Construct Affecting Adults' Ability to Learn Mentors: Patricia L. Davies, OTR, Ph.D. & Karla Gingerich, Ph.D.
2006	496 Research Assistant CSU: Situational and Dispositional Uncertainty as Moderators of Justice to Outcome Relationships: Testing Uncertainty Management Theory in Virtual Teams Principal Investigator: Kurt Kraiger, Ph.D. Co-Investigator: Tasha Eurich, M.S.

Publications

Lysaker, P. H., Erikson, M., Macaphagal, K., & Tunze, C. A. (in press). Development of personal narratives as a mediator of the impact of deficits in social cognition and social withdrawal on negative symptoms in schizophrenia. *Journal of Nervous and Mental Disease.*

McGuire, A. B., Stull, L. G., Mueser, K. T., Mook, A., Nicksic, C., Rose, N., White, L. (in press). Development and Reliability of an Illness Management and Recovery Clinical Competence Measure. *Psychiatric Services*.

Lysaker, P. H., Tunze, C. A., Yanos, P. T., Roe, D., Ringer, J., & Rand, K. L. (2011). Relationships between stereotyped beliefs about mental illness, discrimination experiences, and distressed mood over one year among persons with schizophrenia enrolled in rehabilitation. *Social Psychiatry and Psychiatric Epidemiology*, *31,* 172-195.

Manuscripts in Preparation

Tunze, C. A., & Holohan, D. R. *The role of shame in predicting previous suicidal behavior for veterans with comorbid PTSD and depression.*

Tunze, C. A., Rand, K. L., & Wallihan, J. *Hope and self-control predict subsequent academic performance.*

Presentations

Tunze, C. A. (2012, March) *Dissecting self-control: Measurement issues and dimensionality*. Research presented to the psychology staff and trainees of the Salem Veterans Affairs Medical Center.

Tunze, C. A., & Rand, K. L. (2012, January). *Well-being has different predictors depending on its valence.* Poster accepted for presentation at the annual meeting of the Society of Personality and Social Psychology, San Diego, CA.

Tunze, C. A. (2011, November) *Cognitive-behavioral Therapy with a Patient with Generalized Anxiety Disorder*. Case presented to the psychology staff and trainees of the Salem Veterans Affairs Medical Center.

Tunze, C. A., & Rand, K. L. (2011, January). *Predictive validity of self-reported versus behaviorally-measured self-control.* Poster presented at the annual meeting of the Society of Personality and Social Psychology, San Antonio, TX.

Tunze, C. A., Rand, K. L., & Johnson, C. B. (2010, November). *Academic goal attainment: The roles of hope, optimism, and self-control.* Poster presented at the annual meeting of the Indiana Psychological Association, Indianapolis, IN.

Nicksic, C. A., Rand, K. L., & Johnson, C. B. (2010, January). *Academic goal attainment: The roles of hope, optimism, and self-control.* Poster presented at the annual meeting of the Society of Personality and Social Psychology, Las Vegas, NV.

Nolan, M. R., Nicksic, C. A., & Tassi, M. (2005, April). *The relationship between nicotine and neurophysiology in schizophrenia.* Poster presented at the Undergraduate Research and Creativity Showcase, CSU.

Clinical Experience

04/2012 – Present	Predoctoral Psychology Intern, Center for Traumatic Stress Major Rotation, Salem, VA Medical Center Supervisor: Theodore Wright, Ph.D.

08/2011 – Present	Predoctoral Psychology Intern, Long-term individual psychotherapy, Salem VA Medical Center Supervisor: Gilbert T. Vance, Ph.D.
02/2012 – 04/2012	Predoctoral Psychology Intern, Neuropsychology Major Rotation, Salem VA Medical Center Supervisor: Brian V. Shenal, Ph.D.
08/2011 – 02/2012	Predoctoral Psychology Intern, Outpatient Psychological Services Major Rotation, Salem VA Medical Center Supervisor: Sarah Voss Horrell, Ph.D.
08/2011 – 12/2011	Predoctoral Psychology Intern, Military Sexual Trauma Minor Rotation, Salem VA Medical Center Supervisor: Dana Holohan, Ph.D.
05/2010 – 12/2010	Practicum Student, Richard L. Roudebush Veterans Affairs Medical Center, Psychosocial Rehabilitation and Recovery Center and Intensive Outpatient Recovery Program Supervisor: Paul Lysaker, Ph.D.
01/2010 – 07/2010	Practicum Student, Psychiatry Clinic at Indiana University School of Medicine Supervisor: Jeff Lightfoot, Ph.D.
09/2009 – 12/2009	Practicum Student, Larue D. Carter Memorial Hospital (State Psychiatric Hospital), Indianapolis, IN Supervisors: Tim Lines, Ph.D. & Ginger Burge, Ph.D.
08/2008 – 07/2009	Practicum Student, Neuropsychology Clinic, Indiana University School of Medicine Supervisor: Dan Rexroth, Psy.D.
05/2006 – 12/2006	Clinical Volunteer, Center for Neurorehabilitation Services Supervisors: Marlis J. Lane, OTR, CDRS; Christy Dittmar, M.S., OTR, CDRS; & Kelly Walker-Haley

Workshops and Special Training

09/2011- present	Cognitive Processing Therapy Three-Day Training and Consultation Claire Collie, Ph.D., Staff Psychologist, PTSD Clinic at the Durham VA Medical Center and Local Evidence Based Psychotherapy Coordinator; and Janea Swander, LCSW, Clinical Social Worker, Center for Traumatic Stress at the Salem Veterans Affairs Medical Center. Salem, VA
06/2012	Issues in Supervision Didactic Training Dana Holohan, Ph.D., Director of Training for Psychology and Director of the Center for Traumatic Stress; Brian V. Shenal, Ph.D., Director of Center for Neurocognitive Services, Salem VA Medical Center. Salem, VA
06/2012	Transitioning from Student to Professional Didactic Training Dana Holohan, Ph.D., Director of Training for Psychology and Director of the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA
06/2012	Testifying in Court Didactic Training Rob Lanahan, Ph.D., Psychologist, Salem, VA
05/2012	Assessment of Children Didactic Training Rob Lanahan, Ph.D., Psychologist, Salem, VA
05/2012	Geropsychology Issues Didactic Training Sarah Rowe, Ph.D., Geropsychology Postdoctoral Fellow at the Salem VA Medical Center. Salem, VA
04/2012	Media Psychology Didactic Training Lou Perrot, Ph.D., Psychologist. Salem, VA
04/2012	Marketing Issues in Independent Practice Didactic Training Lou Perrot, Ph.D., Psychologist. Salem, VA
04/2012	Business Psychology Didactic Training Lou Perrot, Ph.D., Psychologist. Salem, VA
04/2012	Private Pay Independent Practice Didactic Training Lou Perrot, Ph.D., Psychologist. Salem, VA
04/2012	Managed Care Practices Didactic Training Lou Perrot, Ph.D., Psychologist. Salem, VA

03/2012	Traumatic Brain Injury Didactic Training Jeff Barth, Ph.D., Neuropsychologist. Salem, VA
02/2012	Electroconvulsive Therapy Didactic Training Brian Wood, D. O., Director of Psychiatric Education, Salem VA Medical Center. Salem, VA
01/2012	Reminiscence Therapy Didactic Training Katherine Luci, Psy.D., Neuropsychology Postdoctoral Fellow at the Salem VA Medical Center. Salem, VA
12/2011	Couples Therapy Didactic Training Ted Wright, Ph.D., Staff Psychologist at the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA
12/2011	Appalachian Culture and Views on Mental Health Didactic Training Lisa Bradford, LCSW, Clinical Social Worker, Center for Neurocognitive Services at the Salem VA Medical Center. Salem, VA
12/2011	Personality Disorders Didactic Training Dana Holohan, Ph.D., Director of Training for Psychology and Director of the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA
12/2011	Setting Boundaries in Therapy Didactic Training Mary K. Burton, Ph.D., Staff Psychologist at the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA
11/2011	Diversity Day Workshop Todd Vance, Ph.D., Staff Psychologist at the Center for Traumatic Stress, Salem VA Medical Center; Reliford Sanders, Ph.D., Psychologist at Cook Counseling Center, Virginia Tech. Salem, VA
11/2011	Sport and Performance Psychology Didactic Training John Heil, DA, LCP, Psychological Health, Roanoke Provider. Salem, VA
11/2011	Global Assessment of Functioning Scores Didactic Training Mary K. Burton, Ph.D., Staff Psychologist at the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA

10/2011	Legal and Ethical Issues in the Practice of Psychology Didactic Training Jerry Gilmore, Ph.D., Associate Chief of Clinical Services, Salem VA Medical Center. Salem, VA
10/2011	Assessment of Combat Exposure and PTSD Didactic Training Major Glenn Sullivan, Ph.D., Assistant Professor of Psychology, Virginia Military Institute. Salem, VA
10/2011	PTSD and Suicide Risk Didactic Training Major Glenn Sullivan, Ph.D., Assistant Professor of Psychology, Virginia Military Institute. Salem, VA
10/2011	Neuropsychological Assessment Didactic Training Brian Shenal, Ph.D., Psychologist, Center for Neurocognitive Services at the Salem VA Medical Center. Salem, VA
09/2011	Neuropsychological Theories Didactic Training Stacy Belkonen, Ph.D., Psychologist, Center for Neurocognitive Services at the Salem VA Medical Center. Salem, VA
09/2011	Substance Abuse Assessment and Treatment Two-Day Didactic Training Josie Demarce, Ph.D., Coordinator of the Substance Abuse Liaison Team; Steve Lash, Ph.D., Psychologist for the Substance Abuse Treatment Program; and Phil Lehman, Ph.D., PTSD/Substance Use Disorders Psychologist, all presenters at the Salem VA Medical Center. Salem, VA
09/2011	Developing Suicide Safety Plans Laura Clevinger, LCSW, Suicide Prevention Coordinator, Salem VA Medical Center. Salem, VA
09/2011	Acceptance and Commitment Therapy Two-Day Training Facilitator: Kevan McCutcheon, Ph.D., Clinical Psychologist, Louis Stokes Cleveland VA Medical Center. Salem, VA.
08/2011	Managing High-Risk Patients Didactic Training Sarah Voss Horrell, Ph.D., and Susan Duma, Psy.D., Staff Psychologists, Center for Traumatic Stress at the Salem VA Medical Center. Salem, VA

08/2011	Case Conceptualization Didactic Training Dana Holohan, Ph.D., Director of Training for Psychology and Director of the Center for Traumatic Stress, Salem VA Medical Center. Salem, VA
08/2011	Conducting Intake Evaluations and Assessing Mental Status Didactic Training Ted Wright, Ph.D., Staff Psychologist, Center for Traumatic Stress at the Salem VA Medical Center. Salem, VA
2009 – 2011	ProSeminar in Clinical Psychology Department of Psychology, IUPUI Professional development course covering advanced clinical topics such as case conference/case conceptualization, clinical practice issues, and advanced clinical topics. Relevant topics included: supervision, consulting, diversity, ethics, professionalism, teaching, research methods, licensure, and grant writing.
03/2011	Schema Therapy Workshop Joan Farrell, Ph.D., Indiana University School of Medicine, Department of Psychiatry and Training Director of the Center for Borderline Personality Disorder Treatment & Research. Indianapolis, IN
01/2011	Society for Personality and Social Psychology Annual Conference Preconference: Emotions San Antonio, TX
03/2010	Clinical Workshop in Evidence-Based Practice Barbara Walker, Ph.D. Indiana University - Bloomington Professor. Indianapolis, IN
Summer 2009	Seminar in Teaching Psychology Kathy Johnson, Ph.D., Indiana University-Purdue University Indianapolis, Instructor. Indianapolis, IN. Grade: A
04/2009	Clinical Workshop in Acceptance and Commitment Therapy Rhonda M. Merwin, Duke University Assistant Professor. Indianapolis, IN
04/2008	Clinical Workshop in Motivational Interviewing Indianapolis, IN

Teaching Experience

Summer 2011 PSY-B 370 Social Psychology
Role: Instructor; created course material

Spring 2011 PSY-B 307 Tests and Measurement
Role: Instructor; created course material

Spring 2011 PSY-B 370 Social Psychology
Role: Instructor; created course material

Fall 2010 PSY-B 307 Tests and Measurement Instructor
Role: Instructor; created course material

Fall 2010 PSY-B 104 Psychology as a Social Science
Role: Instructor for two sections; created weekly activities

Spring 2010 PSY-B 307 Tests and Measurement
Role: Instructor; created course material

Spring 2010 PSY-B 104 Psychology as a Social Science
Role: Instructor; created course material

Fall 2009 PSY-B 307 Tests and Measurement Instructor
Role: Instructor; created course material

Fall 2009 PSY-B 104 Psychology as a Social Science
Role: Instructor; created weekly activities

Spring 2009 PSY-B 311 Introductory Lab in Psychology
Role: Teaching Assistant, taught lab section including research design, data collection, and writing components of a formal research proposal
Instructor: Rob Stewart, Ph.D.

Spring 2009 PSY-B 105 Psychology as a Biological Science
Role: Teaching Assistant
Instructor: Deborah Harold, Ph.D.

Fall 2008 PSY-B 311 Introductory Lab in Psychology
Role: Teaching Assistant, taught lab section including research design, data collection, and writing components of a formal research proposal
Instructor: Leslie Ashburn-Nardo, Ph.D.

Spring 2008	PSY-B 105 Psychology as a Biological Science Role: Teaching Assistant Instructor: Deborah Harold, Ph.D.
Fall 2007	PSY-B 340 Cognitive Psychology Role: Teaching Assistant Instructor: Kathy Johnson, Ph.D.
Fall 2007	PSY-B 461 Capstone Seminar in Psychology Role: Teaching Assistant Instructor: Kathy Johnson, Ph.D.
Fall 2006	384 Teaching Assistant CSU Instructor: Will Szlemko, M.S. *PY100 Introduction to Psychology*
Spring 2006	384 Teaching Assistant CSU Professor: Nazanin Mohajeri-Nelson, Ph.D. *PY315 Social Psychology*

Awards

2011	Clinical Psychology Graduate Student Teaching Award
2010	Clinical Psychology Award for Citizenship

Service

04/2012	Coordinated the Clothesline Project for Sexual Assault Awareness Month at the Salem VAMC
2011	Coordinated psychology booth for National Depression Screening Day at the Salem VAMC
2009 – 2011	Graduate Student Representative for Clinical Psychology Faculty Meetings
2009 – 2011	Upper-level graduate student mentor to first-year graduate student
2009 – 2010	Graduate Student Undergraduate Honors Thesis Mentor
2006	Member of student interview committee to assess potential undergraduate psychology advisors at Colorado State University
2006	Volunteer worker for National Depression Screening Day at Colorado State University

2006	Represented CSU Biomedical Sciences and Psychology Departments as a demonstrator at Brain Awareness Week
2005	Psi Chi Tutor for a Cognitive Psychology student

Professional Organizations

2010 – Present	Psychology Graduate Student Organization Indiana University – Purdue University Indianapolis
2008 – Present	Society of Personality and Social Psychology Student Member
2010 – 2011	Indiana Psychological Association Student Member
2005-2006	Psi Chi (National Honor Society in Psychology) Colorado State University