TRAIT SELF-CONTROL AS A PREDICTOR OF WEIGHT LOSS AND TREATMENT ADHERENCE

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ABSTRACT

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Obesity is a major epidemic that affects nearly two-thirds of U.S. adults (National Center for Health Statistics, 2012). It is a serious public health concern because of its associated health risks, including cardiovascular disease, Type II diabetes, and premature mortality (Pi-Sunyer, 2009). As such, various interventions have been established to counteract the rising rate of obesity, such as behavioral interventions that focus on dietary recommendations, reduced caloric intake, increased physical activity, and behavioral modification. Researchers have focused on identifying specific factors, such as self-control, that may be associated with increased weight loss and health behavior change. The current study examined the relationship between trait self-control, weight loss and various health behaviors commonly associated with successful weight loss. Forty-three overweight and obese individuals participated in an 18 week behavioral weight loss program. Results showed a relationship between baseline trait self-control and baseline body fat percentage. In addition, results indicated that trait self-control increased throughout the intervention and this change in trait self-control was moderately associated with self-monitoring, calories expended through physical activity and percent weight loss from baseline to post treatment and baseline to six month follow-up. Future research should explore factors that contribute to change in trait self-control, such as motivation and creation of habits, and their relationship to weight loss.
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INTRODUCTION

Obesity

Obesity is a major epidemic in the United States with overweight (BMI between 25.0 to 29.9) adults making up 33.3% of the population and an additional 35.7% of adults labeled as obese (BMI of 30 or greater) in 2010 (National Center for Health Statistics, 2012; Ogden, Carroll, Kit, & Flegal, 2012). Health professionals are especially concerned about the rising risk of obesity because of the associated health risks, including cardiovascular disease, Type II diabetes, and cancer (Pi-Sunyer, 2009). In 2008, medical care costs associated with obesity totaled more than 147 billion dollars with obese patients paying an estimated 36 percent higher for annual average health care than healthy weight people (Finkelstein, Trogdon, Cohen, & Dietz, 2009; Hammond & Levine, 2010). The need to understand contributing factors and treatments of obesity has increased as obesity becomes a major public health concern.

Obesity is defined as an excessive amount of fat or adipose tissue (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK], 2012). A common and easy way to measure obesity is Body Mass Index (BMI), which is weight in kilograms divided by height in meters squared (Orzano & Scott, 2004). This index approximates body mass corrected for height (Orzano & Scott, 2004). A BMI of 30.0 or greater in adults is categorized as obese, while a BMI between 25.0 and 29.9 is categorized as overweight (U.S. Department of Agriculture and U.S. Department of Health and Human Services [HHS], 2010). BMI does not distinguish between fat and muscle and therefore is not an exact measure of body fat percentage (Centers for Disease Control and Prevention [CDC], 2010; NIDDK, 2012). However, it is found to be moderately correlated with body fat percentage and may be one of the best measures of obesity because it is an inexpensive and reliable measurement tool of the fat content of the body that can easily track
changes over time (Romero-Corral et al., 2008; Seidell, Kahn, Williamson, Lissner, & Valdez, 2001).

According to the Dietary Guidelines for Americans, in order to maintain a healthy weight, adults should consume foods high in nutrients and low in energy density, as well as engage in 150 minutes of moderate physical activity per week and muscle-strengthening activities two days a week (U.S. Department of Agriculture and U.S. Department of Health and Human Services [HHS], 2008; HHS, 2010). Weight gain occurs when there is an energy imbalance between the calories consumed (i.e. food) and the calories expended (i.e. exercise) (HHS, 2010; NIDDK, 2012). Overtime, this imbalance can lead to obesity. In order to lose weight, individuals must create a caloric deficit by consuming fewer calories than they expend (HHS, 2010). This can be achieved through decreasing calories consumed, increasing physical activity, or a combination of the two.

Most Americans are not living a healthy and active lifestyle. More than half of Americans do not meet the physical activity guidelines for aerobic activity and 33% do not engage in physical activity at all with men more likely than women to meet these physical activity recommendations (Schiller, Lucas, Ward, & Peregoy, 2012). Most American adults would benefit from increasing their consumption of whole grains, vegetables, and fruits, and decreasing their consumption of sugar-sweetened beverages, added sugar, and solid fats (HHS, 2010). Only one third of Americans eat at least some foods from the recommended food groups and only three percent of Americans eat the recommended number of servings from all food groups on a given day (Dixon, Cronin, & Krebs-Smith, 2001). In addition, only one fourth of Americans consume the recommended five serving of fruits and vegetables every day (Sampsel & May, 2007; HHS, 2010). These factors have contributed to an “obesogenic” environment in America
and led to an increased need for treatments to combat the growing overweight and obese population (CDC, 2010; HHS, 2010; Ogden, Carroll, Kit, & Flegal, 2012).

_Treatments_

While some individuals are able to lose weight on their own or through self-help resources, such as books, often times pharmacological, surgical, and behavioral weight loss interventions are utilized to help overweight and obese individuals lose weight. These three types of interventions are geared towards specific subsets of obesity and as such are recommended for different populations. Surgical interventions (i.e. bariatric surgery) are often prescribed to patients with BMIs exceeding 40 or patients with BMIs of 35 or more who have associated severe health complications (McTigue, 2005). Surgery can be costly and has high associated risks, including infection, and therefore is usually restricted to people who have not responded to other treatment methods (McTigue, 2005). Obese individuals with BMIs of 30 or more or people who have BMIs greater than 27 along with other health risk factors may be appropriate for pharmacological interventions (e.g. orlistat, sibutramine) to help aid in weight loss (McTigue, 2005). Due to safety concerns, side effects, and associated costs, drugs are not the preferred method of weight loss for overweight, and mild to moderate obese individuals unless they have severe risk factors that need more intensive and immediate intervention.

Behavioral weight loss programs (BWLP) have low cost and risk of complications in comparison to pharmacological and surgical interventions (Diabetes Prevention Program Research Group [DPPRG], 2002) and are the treatment of choice for mild to moderate obesity. BWLP have been shown to reduce the risk of diabetes and other diseases commonly associated with obesity (DPPRG, 2002; McTigue et al., 2003). BWLP typically consist of weekly meetings for three to six months (Foster, Makris, & Bailer, 2005). These interventions emphasize
behavioral modification, such as breaking bad habits, as well as address the psychological factors that impede weight loss, such as self-defeating thoughts, in order to teach long-term lifestyle changes (Shaw, O'rourke, Del Mar, & Kenardy, 2005). BWLP promote strategies for acquiring skills (e.g. self-monitoring), motivation, and support to change eating and exercise habits that promote weight loss (McTigue et al., 2003).

BWLP that incorporate both reduced caloric intake and increased physical activity along with behavioral modification have shown to be the most efficacious in producing weight loss (Smith & Wing, 2000). For example, the Diabetes Prevention Program (DPP) is a lifestyle intervention program that emphasizes a low-fat diet, moderate intensity exercise, and behavior modification. The DPP resulted in a 58 percent decrease in the incidence of diabetes in persons at high risk, and was significantly more effective than metformin (31%), a drug commonly used in pharmacological interventions (DPPRG, 2002). Of the 1,079 participants, 49 percent met the seven percent weight loss goal by the end of the program and 74 percent met the physical activity goal of 150 minutes per week of physical activity (The Diabetes Prevention Program Research Group [DPPRG], 2004).

Factors of Successful Weight Loss

Researchers have identified various factors contributing to successful weight loss and maintenance. Many of these factors have been incorporated into BWLPs as a means to help increase positive health treatment outcomes. One of the greatest predictors of weight loss is self-monitoring (Burke, Wang, & Sevick, 2011). Individuals who consciously attend to their behaviors are better equipped to make healthier decisions, which can lead to prolonged weight-loss (Baker & Kirschenbaum, 1993). Self-monitoring dietary intake, physical activity, and weight have all been shown to help facilitate weight-loss (Burke et al., 2011; Butryn, Phelan,
Hill, & Wing, 2007; Boutelle, & Kirschenbaum, 1998; Carels, Darby, Rydin, Douglass, Cacciapaglia, & O’Brien, 2005). In terms of dietary intake, reduced caloric intake, reduced portion size, consumption of fewer dietary fats, and eating regular meals including breakfast are all factors associated with weight loss (Elfhag & Rössner, 2005; Harris, French, Jeffrey, McGovern, & Wing, 1994; Jeffrey, Bjornson-Benson, Rosenthal, Kurth, & Dunn, 1984; Katahn, Pleas, Thackery, & Wallston, 1982; Wing & Hill, 2001). Successful weight losers also regularly engage in moderately intense physical activity with walking being one of the most frequent forms of exercise (Schoeller, Shay, & Kushner, 1997; Wing & Hill, 2001).

The National Weight Control Registry (NWCR) is the largest online research database aimed at helping researchers understand components of successful weight loss and maintenance (Klem, Wing, McGuire, Seagle, & Hill, 1997). In order to be eligible for the NWCR, individuals must have lost at least 30 pounds and maintained that weight loss for one year with the average weight maintenance being 5.5 years (Klem et al., 1997; Wing & Hill, 2001). Subjects consistently reported three strategies for weight loss, including consuming a low-calorie, low-fat diet, doing high levels of physical activity, and weighing themselves frequently (Wing & Phelan, 2005). Out of over 3,000 subjects participating in the NWCR, 89 percent report modifying both diet and exercise in order to lose weight and 91 percent engage in some form of physical activity to maintain weight loss (Klem et al., 1997; Wing & Hill, 2001). Approximately 75 percent weigh themselves at least once a week and 35.5 percent count calories in order to lose weight (Klem et al., 1997; Wing & Hill, 2001; Wing & Phelan, 2005). The NWCR is a comprehensive resource for identifying factors contributing to successful weight loss.

While research shows that participants generally lose between 5-10% in 6-month behavioral weight loss interventions, most participants regain approximately one-third of their
initial weight loss within one year, and more than half regain the majority of the weight within five years (Gaesser, 2009; Perri & Corsica, 2002). While a number of putative contributors (e.g., self-monitoring, reduced caloric intake, exercise) to long-term weight loss and health behavior change have been suggested, one of the hypothesized driving forces is limited self-control in the face of temptations to eat unhealthy or to be sedentary (Crescioni et al. 2011; Junger & Van Kampen, 2010).

Self-Control

Self-control is the ability to override responses and alter its states or behaviors; it allows the self to exercise restraint over one’s own emotions, desires, or actions (Baumeister, Heatherton, & Tice, 1994; de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Tangney, Baumeister, & Boone, 2004). Self-control is unique to humans, and allows people to work towards more complex, long-term, future goals (Carver & Scheier, 1998). The ability to override immediate impulsive urges through regulating emotions, thoughts, and behaviors requires self-control. The dominant theory in self-control posits that self-control or self-regulation is a limited resource and that once used will result in a state of depleted resources and self-control failure (Muraven, Tice, & Baumeister, 1998; Muraven, & Baumeister, 2000). The theory suggests that all people experience states of self-control depletion, and self-control can be trained like a muscle to increase its capacity (de Ridder et al., 2012; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven, & Baumeister, 2000; Muraven et al., 1998). Furthermore, research has suggested that people have differing levels of trait self-control (de Ridder et al., 2012; Hagger, 2010; Hagger et al., 2010). Because of individual differences in trait self-control, high trait self-control serves as a buffer in situations requiring self-control (de Ridder et al., 2012; Hagger, 2010; Hagger et al., 2010). In short, trait self-control moderates self-control...
depletion (Dvorak & Simons, 2009; Hagger, 2010) As a result, individuals with higher trait self-control and therefore larger initial resources have the capacity to exert self-control in more situations (de Ridder et al., 2012; Hagger, 2010; Hagger et al., 2010). The convergence of state and trait self-control helps to explain why all people experience moments of decreased self-control, but some individuals experience these moments of low or depleted self-control less frequently and are able to utilize their self-control more efficiently to facilitate better outcomes. For example, high trait self-control has been shown to create many positive outcomes, such as enhancing academic performance, maintaining healthy interpersonal relationships, and reduced susceptibility to drug abuse and criminality (Duckworth & Segilman, 2005; Hagger et al., 2010; Tangney, Baumeister, & Boone, 2004).

Trait Self-Control and Health Behaviors

Self-control is associated with the maintenance of positive health behaviors including weight loss (Konttinen, Haukkala, Sarlio-Lahteenkorva, Silvertoinen, & Jousilahti, 2009; Schroder & Schwarzer, 2005). In a study conducted on adolescents, Junger and Van Kampen (2010) found that trait self-control was positively correlated with healthy behaviors, such as eating breakfast in the morning and increased physical activity, and negatively correlated with money spent on unhealthy foods and drinks. Studies on heart surgery patients (Schroder & Schwarzer, 2005) and high school students (Wills, Isasi, Mendoza, & Ainette, 2007) both found that people high in trait self-control reported that they exercised more frequently and consumed fewer calories than those low in trait self-control. Relative to those low in trait self-control, people high in trait self-control also report engaging in less emotional eating, which can lead to overconsumption of calories (Konttinen et al., 2009). Researchers have found that treatment seeking adults high in trait self-control demonstrate better eating and exercise behaviors as well.
as treatment outcomes than those low in self-control (Crescioni et al. 2011). A longitudinal study from the National Institute of Child Health and Human Development found that low trait self-control derived from an assessment of behavioral procedures at age three and follow-up assessments at age twelve predicted rapid and excessive weight gain through early adolescence (Francis & Susman, 2009). In addition, a naturalistic observational study conducted on a complete birth cohort of 1,037 children born in Dunedin, New Zealand in 1972-1973 found a relationship between low trait self-control and a five point physical health index, including cardiovascular, respiratory, dental, and sexual health, as well as inflammatory status that looked at metabolic abnormalities and whether an individual was overweight (Moffitt et al., 2011).

**Hypotheses**

While researchers have begun to examine the relationship between trait self-control and weight, rarely has this relationship been examined in weight loss treatment seeking adults. Determining whether greater weight loss is associated with higher self-control in treatment seeking adults is an important area of inquiry. To test the relationship between self-control and weight loss in treatment seeking adults, I attempted to replicate and extend the results found by Crescioni et al. (2011) that tested whether high trait self-control predicted positive health behaviors and weight loss success in an overweight and obese college student sample, however, using an older, non college student sample. Consistent with Crescioni et al. (2011), I examined whether participants higher in trait self-control attended more weight loss classes, lost more weight, and had lower baseline BMIs than individuals lower in trait self-control. In addition, I tested whether higher trait self-control predicted high self-monitoring behaviors, which is one of the best predictors of weight loss success (Burke et al., 2011).

Overweight and obese individuals with higher trait self-control may be better equipped to
practice self-control prior to the start of a weight loss program due to high self-control resources. While high trait self-control participants may not have established healthy patterns of behavior that would lead to weight loss, it is expected that they would be able to resist more temptations and less likely to consistently engage in impulsive behaviors, such as binge eating, which can lead to rapid weight gain. Therefore, participants with higher trait self-control coming into the program may not have gained as much weight throughout their life as participants with lower trait self-control. I hypothesized that participants who have higher trait self-control would enter the program with lower baseline BMIs than participants with lower trait self-control due to their ability to utilize self-control effectively despite unhealthy habits.

Attending meetings requires participants to take time from their schedules to devote to the weight loss intervention classes. This may require participants to regulate self-defeating thoughts as well as override feelings of fatigue in order to decide to come to class. Also, submitting self-monitoring data online requires participants to record what they eat, to estimate how many calories their meals consist of each day, and report physical activity habits. Individuals with higher self-control may be better equipped to manage impulsive thoughts, emotions, and behaviors in order to meet the demands of the program. I predicted that participants who reported higher trait self-control would attend more weekly meetings and submit more self-monitoring forms online than participants lower in trait self-control.

Habits involved in weight loss require participants to engage in new behaviors that may contradict previously established patterns of mindless or impulsive eating, and sedentary behavior. Participants who are able to utilize self-control to override impulses to consume more calories and less healthy foods are more likely to create a greater caloric deficit and intake more nutrient dense meals than participants who give in to impulsive eating behaviors. In addition,
participants who can establish and maintain regular physical activity will use more energy in a
day in comparison to more sedentary participants, which will result in a greater caloric deficit.
Therefore, I hypothesized that participants high in trait self-control would consume fewer
calories, exercise for more minutes per week, and expend more energy overall than participants
low in trait self-control.

The deficit resulting from reduced caloric intake and increase physical activity would
likely result in a greater percentage of pounds lost over the course of the intervention (HHS,
2010). Therefore, I hypothesized that participants who report higher trait self-control would lose
more weight at the end of the weight loss intervention than participants who endorsed lower trait
self-control regardless of intervention.
METHODS

Participants

Participants were weight loss treatment seeking adults (N=43; 81.4% Female; mean age 52.54, SD=13.05, range: 24-71; 93% Caucasian) in a behavioral weight loss intervention. All participants were recruited through local and online newspaper advertisements, university emails, and public flyers. The participants were subjects in an 18 week weight loss intervention. The data for this study were collected at in-person baseline assessments with participants before any experimental manipulation was applied and again at post intervention assessments. Eligible participants met the inclusion criteria of BMI ≥ 27, age ≥ 18, nonsmoking, and no existence of major medical problems (e.g. uncontrolled diabetes, uncontrolled blood pressure, severe physical disability, dementia, renal dysfunction) or mental illness (e.g. Schizophrenia, Bipolar Disorder, Depression). All participants were asked to provide a $100 deposit to be returned upon completion of the weight loss program. In addition, all participants provided their informed consent and the procedures were approved by the university’s Human Subjects Review Board.

Study Design

Data for the current investigation were collected at an initial weight loss treatment orientation session, which was part of a larger experiment testing the effectiveness of two weight loss intervention types. Participants completed all questionnaires on computers. Additional measures of height, weight, and body fat percentage were taken after completion of the self-report measures. Participants completed the self-control measure at post-treatment. Post intervention data were also collected on measures of weight and body fat percentage.

All participants were randomly assigned into one of two weight loss interventions; a modified Diabetes Prevention Program (DPP) or Transforming Your Life (TYL) program. Both
programs met weekly for one hour over the course of 16 weeks with one practice week at the
time. The current DPP is an abbreviated version of the University of Pittsburgh’s Group
Lifestyle Balance program. The Group Lifestyle Balance program was modified from the DPP’s
Lifestyle Change Program that was designed to be delivered in individual sessions between
participants and counselors (Venditti, & Kramer, 2012). This program promoted a reduced
calorie low-fat diet, 150 minutes of moderate intensity exercise, and life-style changes. The TYL
program focused on a reduced calorie diet emphasizing lean protein, whole grain, and reduced
added sugars. Additional components of the TYL program emphasized disrupting unhealthy
habits and creating new healthy ones, transforming the environment through developing healthy
eating and exercise promoting cues (Carels et al, 2011). Participants in both interventions
received a manual with weekly lessons, and were taught how to self-monitor calories and
exercise, and create a 500 calorie/day deficit through diet and physical activity. A licensed
clinical health psychologist and/or graduate students specializing in clinical health psychology
led small groups consisting of 8-16 people through weekly 90 minute lessons over the course of
16 weeks.

Measures

Demographic Information. Basic demographic information, such as age, gender, race, income, and education, was collected.

Height and Body Weight. Participants’ body weight was measured in 0.1 pound
increments using a Tanita BF-350e electronic scale. Height was measured in 0.5 increments
using a standard measuring tape. Participants’ BMIs were calculated using height and weight
data obtained from these instruments where BMI equals weight in kilograms divided by height in meters squared (Orzano & Scott, 2004).

**Caloric Intake.** Participants were instructed how to self-monitor the daily calories they consumed in order to create a caloric deficit. They were provided demonstrations of common food measurement procedures, as well as instructions for estimating food portion sizes. Participants used a food and beverage calorie guide provided by internet dietary programs, such as Calorie King (http://www.calorieking.com) or My Fitness Pal (http://www.myfitnesspal.com), to estimate energy intake from food and beverages. Participants were further instructed on how to electronically submit (or submit by paper and pencil) daily records of total caloric (i.e. energy) intake.

**Energy Expenditure.** Caltrac Accelerometers were provided to participants to assess total energy expenditure and energy expended during movement. The Caltrac accelerometer measured vertical acceleration and converted the measurement into an energy expenditure value while active for a consecutive 24 hour period (i.e. CALS USED/ACTM; Swan, Brynes, & Haymes, 1997; Westerterp, 1999). It also used information on age, gender, height, and weight to calculate how much energy they expended at rest, which was added to the active energy expenditure value to come up with a total energy expenditure value for a consecutive 24 hour period (i.e. CALS USED). Participants were instructed on how to record these values and electronically submit (or submit by paper and pencil) daily records of the calories they used while active (i.e. CALS USED/ACTM) and the total calories they expended (i.e. CALS USED). Participants also recorded and submitted online how many minutes per day they engaged in physical activity.

**Treatment Adherence.** Adherence was measured as the percentage of self-monitoring diaries completed throughout the program and percentage of group meetings attended. In cases
where participants started the program during the first or second week of the program, the total
group meetings were adjusted.

Total Self-Control Scale (Total SCS). Tangney, Baumeister, and Boone (2004) developed
the Total SCS as a 36 item instrument to measure trait self-control. The creators of the Total SCS
operationally defined self-control as the ability of the self to override responses and alter its
states or behaviors whether through breaking habits, demonstrating strong self-discipline, or
resisting temptation.

The items of the Total SCS were derived from an extensive review of published studies
on self-control processes and failures (Baumeister et al., 1994). The developers of the Total SCS
used this review to generate 93 items encompassing spheres of self-control failure, which was
then reduced to the final 36 items (Tangney et al., 2004). Items were designed to be rated via
self-report on a five point Likert scale that reflected how the participants’ typically are. Answer
choices range from not at all like me to very much like me (Tangney et al., 2004).

Tangney et al. (2004) reported that initial validation of the Total SCS was conducted
through two studies with a total sample of 351 (72% female, 28% male) and 255 (81% female,
19% male) in Study 1 and Study 2, respectively. All of the participants were undergraduate
students attending a large East Coast state university who received credit toward an
undergraduate psychology course in exchange for participating. In Study 1, participants ranged
in age from 18 to 55 ($M = 20.07, SD = 4.99$); Regarding ethnic/racial background, 49% were
White, 20% Asian, 11% African American, and 20% Other. In Study 2, participants ranged in
age from 18 to 49 ($M = 20.10, SD = 4.23$); Regarding ethnic/racial background, 58% were
White, 13% Asian, 11% African American, and 22% Other.
The final 36 items chosen for the scale had good internal consistency (Cronbach’s Alpha = 0.89) for both studies (Tangney et al., 2004). Participants in Study 2 completed the scale a second time three weeks later in order to establish test-retest reliability. Test-retest reliability was .89 for the Total SCS (Tangney et al., 2004).

Social perception can often influence self-control and thus people can at times override behaviors, thoughts, or emotions in order to be viewed in a socially desirable manner. As a result, the Marlowe-Crowne Social Desirability Scale (MC-SDS) was administered and found to be moderately correlated with the Total SCS in both Study 1 ($r = .56, p < .001$) and Study 2 ($r = .60, p < .001$) (Tangney et al., 2004). All analyses were rerun controlling for social desirability.

Self-control as a construct was hypothesized to be related to measures of impulse control because self-control involves the ability to override impulses (Tangney et al., 2004). One indicator of impulse control involves the ability to regulate eating habits and not engage in binging behavior. Thus, Tangney et al. (2004) measured the convergent validity of impulse control by administering the Eating Disorder Inventory (EDI) to Study 1 participants (Garner, Olmstead, & Polivy, 1983). Scores on the Total SCS negatively correlated to those on subscales of the EDI including, Drive for Thinness ($r = -.31, p < .001$) and Body Dissatisfaction ($r = -.33, p < .001$), when controlling for social desirability suggesting that the more self-control a person has the less problems regulating eating behaviors they exhibit (Tangney et al, 2004).

The results of the Tangney et al. (2004) study suggest that the Total SCS has good psychometric properties and is a good instrument to measure a person’s self-control. The current study aimed to build on the Total SCS as a valid measure of trait self-control by extending the test-retest reliability to 18 weeks. See Appendix A.
The Marlowe-Crowne Social Desirability Scale (MC-SDS). The MC-SDS is a widely used, well-validated measure of social desirability response bias. Participants rate 33 items as True or False (Crowne & Marlowe, 1960). This measure was included because of the degree to which it correlated with the Total SCS ($r = .56$ to $.60$, $p < .001$) during the initial validation of the Total SCS (Tangney et al., 2004). Due to this correlation between self-control and social desirability it is possible that participants’ responses to the self-control scale may be influenced by self-presentation and therefore social desirability must be controlled for in any analyses. See Appendix B.

Data Analyses

Preliminary tests were conducted on the treatment sample data to determine if associations between demographic characteristics (e.g. age, gender, income) and trait self-control exist. Also, since social desirability has been shown to be moderately correlated with self-control (Tangney et al., 2004), social desirability along with other found relationships were controlled for in subsequent analyses.

Hypothesis 1, that participants with higher trait self-control would have lower BMIs at baseline compared to participants with lower trait self-control, was examined using regression analyses while controlling for variables social desirability and age.

Hypothesis 2, that participants with higher trait self-control would attend more classes and self-monitor more frequently, was examined at post-treatment using regression analysis while controlling for variables social desirability and age.

Hypothesis 3, that participants with higher trait self-control would consume fewer calories, engage in more minutes of physical activity per week, and expend more total and active energy daily, was examined using regression analyses while controlling for variables such as social
desirability, age, and baseline BMI where necessary. Self-monitoring data regarding daily calorie consumption and minutes exercised, as well as Caltrac Accelerometer data were used to test this hypothesis.

Hypothesis 4, that higher trait self-control would predict greater weight loss, was examined using regression analyses while controlling for variables social desirability and age.
RESULTS

Demographics and Preliminary Analyses

*Trait Self-Control.* Participants’ scores on the Total Self-Control Scale at baseline and post assessment were normally distributed with a mean of 115.4 and 124.8, and a standard deviation of 14.1 and 16.4 (range = 77-144 and 94-162), respectively. The baseline Total Self-Control scores were consistent with the original validation of the scale (Tangney et al., 2004). However, in this investigation, Trait Self-Control scores significantly increased from baseline to post scores. Cronbach’s Alpha for the current study at baseline and post assessment was .81 and .72, respectively, suggesting good to acceptable internal consistency.

*Social Desirability.* Participants’ scores on the Marlowe-Crown Social Desirability Scale at baseline and post assessment were normally distributed with a mean of 19.3 and 18.5, and a standard deviation of 4.6 and 5.8 (range = 9-29 and 7-30), respectively. The baseline and post assessment Marlowe-Crown Social Desirability Scale scores were approximately one standard deviation above the mean compared with previous validation research conducted with college students (Crowne & Marlowe, 1960). These findings suggest that social desirability was higher in the current sample than in previous research using a younger sample. Consistent with these findings, previous research has found a relationship between social desirability and age, with older adults demonstrating greater social desirability (Fastame & Penna, 2012; Soubelet & Salthouse, 2011). Considering the relationships between age, social desirability, and self-control it is reasonable that an older sample would report higher overall social desirability. Cronbach’s Alpha for the current study at baseline and post assessment was .82 and .81, respectively, suggesting good internal consistency.
Preliminary Analyses. Preliminary analyses between demographic variables (i.e. BMI, age, gender, race, income, education, weight loss condition, and weight loss class) and personality traits (i.e. trait self-control and social desirability) indicated significant positive correlations between baseline trait self-control and age ($r = .30, p = .027$) and between baseline social desirability and age ($r = .33, p = .017$). In addition, Pearson correlation analyses revealed that baseline trait self-control and baseline social desirability were positively related ($r = .44, p = .002$). Social desirability scores did not change from baseline ($M = 19.5, SD = 4.7$) to post assessment ($M = 18.5, SD = 5.8$); $t(38) = 1.73, p = .092$ and were averaged for use in future analyses. The variables age and average social desirability were controlled for in subsequent analyses. In addition, paired samples t-test revealed a significant increase in trait self-control scores from baseline ($M = 116.6, SD = 11.8$) to post assessment ($M = 124.8, SD = 16.4$); $t(38) = -4.18, p < .001$). Subsequent analyses were run looking at both baseline trait self-control as well as the change in trait self-control (i.e. post trait self-control minus baseline trait self-control).

Main Analyses

Hypothesis 1. The hypothesis that participants with higher trait self-control would have lower BMI at baseline compared to lower trait self-control participants was not supported. Results using multiple regression analyses are included in Table 1. However, baseline trait self-control was negatively associated with baseline body fat percentage ($F (3,35) = 4.55, p = .009$; $B = -.43, t(38) = -2.58, p = .014$) with baseline trait self-control accounting for 13.7% of the variance in baseline body fat percentage.

Hypothesis 2. The hypothesis that participants with higher trait self-control would self-monitor more frequently and attend more classes compared to participants with lower trait self-control was not supported using baseline trait self-control. Out of the 39 post-treatment
participants, only 31 (79.5%) submitted self-monitoring data (range: 7-121 entries). There was a significant relationship between change in trait self-control and self-monitoring, however, the overall model was not significant \( F(3,35) = 2.07, p = .122; B = .40, t(38) = 2.47, p = .019 \).\(^1\) Change in trait self-control accounted for 14.8% of the variance in self-monitoring entries.

Further exploration using logistic regression and self-monitoring as a dichotomous variable (0 = no entries, 1 = at least one entry) revealed that higher trait self-control \( p = 0.05 \) increased the likelihood of self-monitoring by 1.11 times. Again, the overall model was not significant \( p = .10 \). Results using multiple regression analyses are included in Table 2.

**Hypothesis 3.** The hypothesis that participants with higher trait self-control would consume fewer calories, engage in more minutes of physical activity per week, and expend more overall energy daily compared to participants with lower trait self-control was not supported using either baseline trait self-control or change in trait self-control. Since Caltrac accelerometer data can be inflated by BMI, energy expenditure data were reexamined controlling for baseline BMI. While there was a moderately significant relationship between change in trait self-control and average total calories expended through movement per day, the overall model was not significant \( F(4,26) = 1.29, p = .30; B = .42, t(30) = 2.03, p = .052 \).\(^2\) Change in trait self-control accounted for 13.2% of the variance in average daily calories expended through movement. Results using multiple regression analyses are included in Table 3.

\(^1\) The analysis was rerun after removing control variables age and social desirability due to their lack of relationship with self-monitoring. A significant relationship and overall model was found between self-monitoring and change in trait self-control \( F(1,37) = 5.46, p = .025 \). Change in trait self-control accounted for 12.9% of the variance in self-monitoring entries.

\(^2\) The analysis was rerun after removing control variables age, social desirability, and baseline BMI due to their lack of relationship with calories expended through movement. A significant relationship and overall model was found between average calories expended through movement and change in trait self-control \( F(1,29) = 4.19, p = .05 \). Change in trait self-control accounted for 12.6% of the variance in average daily calories expended through movement.
Hypothesis 4. The hypothesis that there would be a positive relationship between trait self-control and weight loss at the post assessment, was not supported using baseline trait self-control. There was a significant positive relationship between change in trait self-control and percent weight loss, however the overall model was not significant \((F (3,35) = 2.60, p = .068; B= .324, t(38) = 2.04, p = .049)\).\(^3\) Change in trait self-control accounted for 9.7% of the variance in percent weight loss. Results using multiple regression analyses are included in Table 4.

Post-Hoc Analyses

Additional post hoc exploratory analyses were conducted using data from the six-month follow-up assessment. There was a marginally \((p = .06)\) significant positive relationship between change in trait self-control and percent weight loss from baseline to six-month follow-up \((F (3,33) = 3.70, p = .021; B= .306, t(36) = 1.95, p = .059)\).\(^4\) Change in trait self-control accounted for 8.7% of the variance in percent weight loss. Baseline trait self-control did not predict weight status at follow-up, nor did baseline, post treatment, or change in trait self-control predict change in weight status from post-treatment to follow-up.

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\(^3\) The analysis was rerun after removing control variables age and social desirability due to their lack of relationship with percent weight loss. A significant relationship and overall model was found between change in trait self-control and percent weight loss was significant \((F (1,37) = 6.00, p = .019)\). Change in trait self-control accounted for 14% of the variance in percent weight loss.

\(^4\) The analysis was rerun after removing social desirability from the equation due to the lack of relationship to percent weight loss, which increased the significance of the relationship between change in trait self-control and percent weight loss from baseline to six-month follow-up \((F (2,34) = 5.682, p = .007; B= .310, t(36) = 2.01, p = .052)\). Change in trait self-control accounted for 8.9% of the variance in percent weight loss.
DISCUSSION

While past research indicates a positive relationship between trait self-control and multiple health behaviors (e.g. increased exercise, reduced caloric intake), few studies have examined trait self-control as a predictor of weight loss following treatment (Crescioni et al., 2011; Schroder & Schwarzer, 2005). As such, the present study sought to examine whether trait self-control predicted weight loss in a treatment-seeking sample of overweight and obese adults. This study also examined trait self-control’s influence on behaviors commonly associated with weight loss outcomes, such as self-monitoring, exercise, calories consumed, and attendance.

In this investigation, trait self-control increased from pre to post treatment. The theory of self-control posits that self-control functions like a muscle and can be strengthened through practice by continuously overriding impulsive urges and exercising restraint (de Ridder et al., 2012; Muraven & Baumeister, 2000). Therefore, it is possible that behaviors such as adherence to self-monitoring, regular exercise, and dietary changes, served to strengthen self-control (Muraven & Baumeister, 2000). Alternatively, as participants lost weight their perception of their own self-control capacity may have been enhanced. Research in self-control has also shown that a positive manipulation of people’s perception of their self-control capacity can lead to short term increases in performance compared to participants who did not have their perceptions manipulated (Job, Dweck, & Walton, 2010). Therefore, being part of a weight loss group may have enhanced perceptions of self-control capacity. Similarly, it is possible that reinforcement from researchers about the controllability of participants’ health behaviors led to their short term increases in performance that overtime enhanced participants’ perception of their own abilities to exercise restraint and override impulsive responses.
It was hypothesized that there would be a relationship between trait self-control and BMI at baseline. This hypothesis was based on the assumption that being overweight is aversive to most people and that many people have the goal of being thin. For example, approximately 24% of women and 8% of men are dieting at any given time with a lifetime prevalence of 55% of women and 29% of men reporting dieting at some point in their lives (Hill, 2002). Therefore, it is plausible that individuals with greater self-control would have had greater resources to engage in behaviors that would maintain their weight status, such as exercise and greater restraint in eating situations. While trait self-control was not associated with BMI, it was negatively associated with body fat percentage. Though BMI is one of the most widely used measures to assess body fat and obesity because of its low cost and accessibility, it is not a precise measure of body fat (CDC, 2010; NIDDK, 2012). BMI does not distinguish between muscle and fat and as a result is prone to estimation errors (CDC, 2010; NIDDK, 2012). Therefore, body fat percentage is likely to better represent a participant’s weight status (NIDDK, 2012).

The hypothesis that participants with higher trait self-control would attend more classes compared to participants with lower trait self-control was not supported. A number of reasons may account for the null findings. First, it may be that the discrepancy between the results of this study and previous research were due to the modest sample size in this investigation (e.g. 43 participants [39 at post-treatment] compared to 260, 86, and 5,145 in previously cited studies, respectively; Chao et al., 2000; Crescioni et al., 2011; Wadden et al., 2009). Also, 8 participants (20.5%) attended all of the classes, while another 14 (35.8%) only missed one to two classes. With a range of absences from zero to six classes and over half of the participants missing no more than two classes it is possible that this study did not have enough variability in attendance to detect changes relative to self-control. It was similarly hypothesized that there would be a
significant positive relationship between change in trait self-control and self-monitoring frequency. While the findings were modest, this hypothesis was generally supported, particularly when analyses were rerun without covariates. In addition, when a dichotomous self-monitoring variable was created to indicate any self-monitoring versus no self-monitoring there was a significant relationship between self-monitoring and self-control, although again the overall model was not significant. Nevertheless, this may suggest that not only is trait self-control related to frequency of self-monitoring data entry, but also to participants’ ability to comply with instructions to self-monitor. Given that regular self-monitoring is one of the strongest predictors of weight loss, (Burke et al., 2011), higher self-control may help explain the differences in compliance to weight loss intervention guidelines among various participants.

It was additionally hypothesized that self-control would be related to various health behaviors associated with weight loss, including consuming fewer calories, exercising for more minutes per week, and expending more energy overall. This hypothesis was not supported and is inconsistent with previous research that has shown people with higher trait self-control consume fewer calories and exercise more frequently (Crescioni et al., 2011; Schroder & Schwarzer, 2005; Wills et al., 2007). A number of reasons may account for these null findings. Again, the discrepancy between the results of this study and previous research may be due to the modest sample size in this investigation (e.g. 43 participants compared to 86, 381, and 539 in previously cited studies, respectively). In addition to a modest sample size, only 31 (79.5%) out of the 39 post-treatment participants submitted any self-monitoring data about calories consumed and exercise expenditure reducing the sample size further. Also, the self-monitoring data that was submitted ranged from 7 to 121 entries. For those individuals who only submitted self-monitoring data for a couple of days, their data may not be representative of their normal daily
behavior, and their exercise and eating habits, thereby reducing the likelihood of observing relationships between self-monitoring and self-control. Nevertheless, there was a significant relationship between change in trait self-control and average daily calories expended through movement, although the overall model was not significant. Without covariates (i.e. age, social desirability, and baseline BMI) the overall model was significant suggesting that trait self-control may be a factor in increasing participants’ exercise behaviors. This relationship may be important since past research has shown that increased exercise leads to greater treatment outcomes (Schoeller et al., 1997; Wing & Hill, 2001).

The final hypothesis in this study examined trait self-control as a predictor of weight loss. This hypothesis was not supported with baseline trait self-control, however, it was supported with change in trait self-control. Again, the overall model was not significant until covariates were removed. Therefore, participants who increased trait self-control by the end of the intervention lost more weight than participants with lower trait self-control at the end of the intervention. As has previously been suggested, self-control may function like a muscle with the ability to increase strength through practice (e.g. engaging in desired behaviors and overriding impulsive urges; de Ridder et al., 2012; Muraven, & Baumeister, 2000). By regularly engaging in self-control, initially effortful behaviors may become automatic. As automaticity increases and the behaviors become habitual, fewer self-control resources are required (Baumeister & Alquist, 2009; de Ridder et al., 2012; Lally, Chipperfield & Wardle, 2008). Consistent with this theory, research has shown that self-control is helpful in the transformation of conscious, effortful behaviors into automatic behaviors, such as exercise. It is likely that self-control helps individuals consciously override impulsive urges (i.e. watching television) and perform behaviors (e.g. going for a walk) that favor more long-term, but less immediately gratifying
goals that require effort (Baumeister & Alquist, 2009; de Ridder et al., 2012). This may help explain why increasing trait self-control predicts weight loss. Individuals who are motivated to lose weight may direct their self-control resources towards engaging in desirable behaviors, such as self-monitoring or physical activity. Practicing self-control leads to increased self-control capacity, while repeatedly using self-control to engage in effortful health behaviors leads to positive health habits that in turn lead to weight loss. An individual’s motivation to change, creation of positive health behaviors, and weight loss may contribute to an actual or perceived increase in self-control at the end of the weight loss intervention. In addition, as participants lose weight and receive reinforcement from researchers about the controllability of health behaviors their perception of their self-control capacity may be enhanced.

In contrast to the current investigation, a previous study examining trait self-control as a predictor of weight loss found that baseline trait self-control predicted weight change, however, trait self-control did not increase from pre to post treatment (Crescioni et al., 2011). Methodological differences between the studies may account for the inconsistent findings. In the study conducted by Crescioni et al., participants completed the trait self-control measure every two weeks for a total of six times, while the current study only took baseline and post treatment measurements. Additionally, Crescioni et al. examined trait self-control data using an unconditional growth model to test for linear change in self-control scores over time, but did not run analyses examining change from baseline to post assessment. This type of analysis allowed the researchers to bypass the potential unreliability of longer period test-retest of the measure. Nevertheless, both studies suggest an association between self-control and weight loss.

Further post-hoc analyses were conducted on data collected at a six-month follow-up to the weight loss intervention. Similar to post-treatment results, baseline trait self-control did not
predict treatment outcome and there was not a significant relationship between change in trait self-control and decrease in body fat percentage from baseline to follow-up. Similarly, post treatment trait self-control did not predict weight change following treatment (i.e. post treatment to follow-up). However, there was a significant relationship between change in trait self-control and percent weight loss from baseline to follow-up. These results suggest that participants who increased trait self-control throughout the intervention showed greater percent weight loss through a six-month follow-up than those participants with lower trait self-control. If these findings are replicated in future research, trait self-control may be identified as a significant factor in weight loss treatment (HHS, December 2010; NIDDK, 2012; Orzano & Scott, 2004).

Limitations

This study had several limitations that should be considered when interpreting the results. First, the sample was small and also experienced modest attrition from baseline to post (4 participants) and post to follow-up (2 participants) that further decreased the sample size. In addition, the sample was relatively homogenous, as it was predominately Caucasian and female, and there were restrictions placed on inclusion into the study (e.g., individuals could not have Type I diabetes, severe mental health issues, cardiovascular problems, injuries that prevented mobility, etc.) that likely limits the generalizability of the findings to more diverse populations. Likewise, these individuals were treatment-seeking overweight and obese adults who may have had greater motivation to make healthy lifestyle changes and lose weight and therefore limits the generalizability to a community or normal weight population. This study gathered data primarily through self-report questionnaires, which are known to be subject to bias. Studies have show that participants tend to underestimate dietary energy intake and either under or overestimate energy expenditure (Prince et al., 2008; Schoeller, 1995). Similarly, while this study used a validated
and widely used measure of trait self-control (i.e. Total Self-Control Scale), previous studies have only demonstrated test retest reliability up to three weeks and as such the long-term stability of this measure is unknown (Tangney et al., 2004). In addition, despite significant relationships, several overall models did not become significant until covariates were removed. Therefore, the results may be more susceptible to disconfirmation upon replication. However, while the covariates were associated with trait self-control (i.e. main independent variables), they were not associated with the dependent variables of interest, which possibly contributed to the overall regression model failing to reach conventional levels of statistical significance.

**Future Directions**

Given that research on trait self-control and health behaviors, particularly weight loss, has only recently emerged, future research should continue to identify associational and causal links between trait self-control and various health behaviors. The dominant theory in self-control suggests that self-control has the capacity to, like a muscle, strengthen through practice. If research continues to show that trait self-control predicts weight loss and other health behaviors, developing effective methods for increasing self-control may be a vital element to incorporate into behavioral weight loss interventions.

Because of the associational nature of this research, this study could not rule out the possibility that weight loss contributed to higher self-control rather than the opposite. Replicating this study and examining relationships between trait self-control and factors know to influence weight loss, such as self-efficacy, motivation, eating and exercise behaviors, self-monitoring, and coping strategies, may help illuminate the direction of causality between trait self-control and weight loss (Burke et al., 2011; Elfhag & Rössner, 2005; West et al., 2011; Wing & Hill, 2001). In addition, gaining additional details about participants’ frequency of practicing self-control
while in a weight loss intervention may shed light on the observed change in trait self-control from baseline to post-treatment. This can be accomplished through methodologies such as ecological momentary assessment that capture real time moments of enacting self-control and then examining its relationship to exacting certain behaviors and subsequent changes in self-control (Shiffman, Stone, & Hufford, 2008).

Obesity has emerged as a global epidemic. While behavioral weight loss interventions are recommended for individuals who are overweight or have mild to moderate obesity, there is considerable variability in treatment outcomes and successful maintenance. This variability is due in part to the complex nature of obesity and the multitude of contributing factors. Nevertheless, trait self-control may be an important factor that influences an individual’s success in losing weight and other positive health behaviors changes. Greater research in this area is needed to isolate important factors that predict weight loss and determine the best way to distribute this information to the general public that will result in necessary behavior change and improved health.
REFERENCES


### Table 1

*Multiple Regression Analyses Predicting Baseline BMI and Body Fat Percentage*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Predictor</th>
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<th>SE B</th>
<th>B</th>
<th>T</th>
<th>P</th>
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</thead>
<tbody>
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</table>

*Note.* Social Desirability = Marlowe-Crowne Social Desirability Scale baseline and post averaged scores (higher scores indicate higher social desirability); Self-Control.BL = Total Self-Control score at baseline (high scores indicate higher self-control); BMI.BL = Body Mass Index (higher scores indicate greater BMI at baseline); Body Fat Percentage BL = Percentage of body fat at baseline (higher scores indicate greater body fat percentage)

* = p ≤ .05.
Table 2

Multiple Regression Analyses Predicting Self-Monitoring Frequency and Class Attendance

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<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>B</th>
<th>T</th>
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Note. Social Desirability = Marlowe-Crowne Social Desirability Scale baseline and post-averaged scores (higher scores indicate higher social desirability); Self-Control_BL = Total Self-Control score at baseline (high scores indicate higher self-control); Self-Control_Change = Change in Total Self-Control score from baseline to post treatment (higher scores indicate greater increase in self-control); Class Attendance = Percentage of classes attended (higher percentage indicates more classes attended); Self-Monitoring Frequency = Self-monitoring diary entries (higher scores indicate more self-monitoring diary entries submitted).

* = p \leq .05.
### Table 3

Multiple Regression Analyses Predicting Caloric Intake, Physical Activity, and Daily and Active Energy Expenditure

<table>
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<tr>
<th>Variable</th>
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<th>Predictor</th>
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<td>.136</td>
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<tr>
<td></td>
<td></td>
<td>Social Desirability</td>
<td>-40.424</td>
<td>17.663</td>
<td>-.377</td>
<td>-2.289</td>
<td>.030*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Control_Change</td>
<td>-6.633</td>
<td>7.208</td>
<td>-.920</td>
<td>.365</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>29</td>
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<td>.347</td>
<td>.277</td>
<td>1.255</td>
<td>.221</td>
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<td>Activity</td>
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<td>.895</td>
<td>-.064</td>
<td>-.316</td>
<td>.755</td>
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<td></td>
<td></td>
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<td>.385</td>
<td>-.068</td>
<td>-.318</td>
<td>.753</td>
</tr>
<tr>
<td>Daily Energy</td>
<td>32</td>
<td>Age</td>
<td>-7.229</td>
<td>8.005</td>
<td>-.190</td>
<td>-.903</td>
<td>.374</td>
</tr>
<tr>
<td>Expenditure</td>
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<td>Social Desirability</td>
<td>2.180</td>
<td>18.486</td>
<td>.021</td>
<td>.118</td>
<td>.907</td>
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<td></td>
<td></td>
<td>BMI.BL</td>
<td>36.972</td>
<td>16.031</td>
<td>.450</td>
<td>2.306</td>
<td>.029*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Control_Change</td>
<td>.882</td>
<td>7.926</td>
<td>.020</td>
<td>.111</td>
<td>.912</td>
</tr>
<tr>
<td>Caloric Intake</td>
<td>32</td>
<td>Age</td>
<td>-1.668</td>
<td>5.655</td>
<td>-.068</td>
<td>-.295</td>
<td>.770</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Desirability</td>
<td>-12.475</td>
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<td>-.018</td>
<td>-.955</td>
<td>.348</td>
</tr>
<tr>
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<td></td>
<td>BMI.BL</td>
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<td>.566</td>
</tr>
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<td></td>
<td></td>
<td>Self-Control_Change</td>
<td>11.495</td>
<td>5.656</td>
<td>.416</td>
<td>2.032</td>
<td>.052</td>
</tr>
</tbody>
</table>

Note. Social Desirability = Marlowe-Crowne Social Desirability Scale baseline and post averaged scores (higher scores indicate higher social desirability); Self-Control_BL = Total Self-Control score at baseline (high scores indicate higher self-control); Self-Control_Change =
Change in Total Self-Control score from baseline to post treatment (higher scores indicate greater increase in self-control); Caloric Intake = Total calories consumed (higher scores indicate more calories consumed per day); Physical Activity = Total minutes exercised (higher scores indicate more minutes engaged in exercise per day); Daily Energy Expenditure = Total calories burned (higher scores indicate more calories burned per day); Active Energy Expenditure = Calories burned through movement (higher scores indicate more calories burned through physical activity); BMI_BL = baseline Body Mass Index (higher scores indicate greater BMI at baseline)

* = p \leq .05.
Table 4  

*Multiple Regression Analyses Predicting Weight Loss*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>B</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Loss</td>
<td>39</td>
<td>Age</td>
<td>.001</td>
<td>.001</td>
<td>.284</td>
<td>1.578</td>
<td>.124</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Desirability</td>
<td>.000</td>
<td>.002</td>
<td>.014</td>
<td>0.072</td>
<td>.943</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Control_BL</td>
<td>.000</td>
<td>.001</td>
<td>.004</td>
<td>0.022</td>
<td>.983</td>
</tr>
<tr>
<td>Weight Loss</td>
<td>39</td>
<td>Age</td>
<td>.001</td>
<td>.001</td>
<td>.190</td>
<td>1.105</td>
<td>.277</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Desirability</td>
<td>.001</td>
<td>.002</td>
<td>.047</td>
<td>0.281</td>
<td>.780</td>
</tr>
<tr>
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<td>Self-Control_Change</td>
<td>.002</td>
<td>.001</td>
<td>.324</td>
<td>2.040</td>
<td>.049*</td>
</tr>
</tbody>
</table>

*Note.* Social Desirability = Marlowe-Crowne Social Desirability Scale baseline and post averaged scores (higher scores indicate higher social desirability); Self-Control_BL = Total Self-Control score at baseline (high scores indicate higher self-control); Self-Control_Change = Change in Total Self-Control score from baseline to post treatment (higher scores indicate greater increase in self-control); Weight Loss = Percentage of weight loss (higher scores indicate greater percent weight loss at post treatment)  
* = p ≤ .05.
APPENDIX A. TOTAL SELF-CONTROL SCALE (TSC)

Self-Control Scale

Using the scale provided, please indicate how much each of the following statements reflects how you typically are.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am good at resisting temptation.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>2. I have a hard time breaking bad habits.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>3. I am lazy.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>4. I say inappropriate things.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>5. I never allow myself to lose control.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>6. I do certain things that are bad for me, if they are fun.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>7. People can count on me to keep on schedule.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>8. Getting up in the morning is hard for me.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>9. I have trouble saying no.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>10. I change my mind fairly often.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>11. I blurt out whatever is on my mind.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>12. People would describe me as impulsive.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>13. I refuse things that are bad for me.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>14. I spend too much money.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>15. I keep everything neat.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>16. I am self-indulgent at times.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>17. I wish I had more self-discipline.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>18. I am reliable.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>19. I get carried away by my feelings.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>20. I do many things on the spur of the moment.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>21. I don’t keep secrets very well.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>22. People would say that I have iron self-discipline.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>23. I have worked or studied all night at the last minute.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>24. I’m not easily discouraged.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>25. I’d be better off if I stopped to think before acting.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>26. I engage in healthy practices.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>27. I eat healthy foods.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>28. Pleasure and fun sometimes keep me from getting work done.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>29. I have trouble concentrating.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>30. I am able to work effectively toward long-term goals.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>31. Sometimes I can’t stop myself from doing something, even if I know it is wrong.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>32. I often act without thinking through all the alternatives.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>33. I lose my temper too easily.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>34. I often interrupt people.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>35. I sometimes drink or use drugs to excess.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
<tr>
<td>36. I am always on time.</td>
<td>1</td>
<td>2 3 4 5</td>
</tr>
</tbody>
</table>

* Items included in the Brief Self Control measure  
(R) Reversed Items
APPENDIX B. THE MARLOWE-CROWN SOCIAL DESIRABILITY SCALE (MC-SDS)

Personal Reaction Inventory

Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is *true* or *false* as it pertains to you personally.

1. Before voting I thoroughly investigate the qualifications of all the candidates. (T)
2. I never hesitate to go out of my way to help someone in trouble. (T)
3. It is sometimes hard for me to go on with my work if I am not encouraged. (F)
4. I have never intensely disliked anyone. (T)
5. On occasion I have had doubts about my ability to succeed in life. (F)
6. I sometimes feel resentful when I don't get my way. (F)
7. I am always careful about my manner of dress. (T)
8. My table manners at home are as good as when I eat out in a restaurant. (T)
9. If I could get into a movie without paying and be sure I was not seen I would probably do it. (F)
10. On a few occasions, I have given up doing something because I thought too little of my ability. (F)
11. I like to gossip at times. (F)
12. There have been times when I felt like rebelling against people in authority even though I knew they were right. (F)
13. No matter who I'm talking to, I'm always a good listener. (T)
14. I can remember "playing sick" to get out of something. (F)
15. There have been occasions when I took advantage of someone. (F)
16. I'm always willing to admit it when I make a mistake. (T)
17. I always try to practice what I preach. (T)
18. I don't find it particularly difficult to get along with loud mouthed, obnoxious people. (T)
19. I sometimes try to get even rather than forgive and forget. (F)
20. When I don't know something I don't at all mind admitting it. (T)
21. I am always courteous, even to people who are disagreeable. (T)
22. At times I have really insisted on having things my own way. (F)
23. There have been occasions when I felt like smashing things. (F)
24. I would never think of letting someone else be punished for my wrong-doings. (T)
25. I never resent being asked to return a favor. (T)
26. I have never been irked when people expressed ideas very different from my own. (T)
27. I never make a long trip without checking the safety of my car. (T)
28. There have been times when I was quite jealous of the good fortune of others. (F)
29. I have almost never felt the urge to tell someone off. (T)
30. I am sometimes irritated by people who ask favors of me. (F)
31. I have never felt that I was punished without cause. (T)
32. I sometimes think when people have a misfortune they only got what they deserved. (F)
33. I have never deliberately said something that hurt someone's feelings. (T)
APPENDIX C. HSRB APPROVAL LETTER

DATE: September 5, 2013
TO: Robert Carels
FROM: Bowling Green State University Human Subjects Review Board
PROJECT TITLE: [300066-7] Weight Loss Program
SUBMISSION TYPE: Continuing Review/Progress Report
ACTION: APPROVED
APPROVAL DATE: October 1, 2013
EXPIRATION DATE: September 30, 2014
REVIEW TYPE: Full Committee Review
REVIEW CATEGORY: Full Committee review category

Thank you for your submission of Continuing Review/Progress Report materials for this project. The Bowling Green State University Human Subjects Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The final approved version of the consent document(s) is available as a published Board Document in the Review Details page. You must use the approved version of the consent document when obtaining consent from participants. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that you are responsible to conduct the study as approved by the HSRB. If you seek to make any changes in your project activities or procedures, those modifications must be approved by this committee prior to initiation. Please use the modification request form for this procedure.

You have been approved to enroll 750 participants. If you wish to enroll additional participants you must seek approval from the HSRB.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must also be reported promptly to this office.

This approval expires on September 30, 2014. You will receive a continuing review notice before your project expires. If you wish to continue your work after the expiration date, your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date.

Good luck with your work. If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsr@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.
This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Bowling Green State University Human Subjects Review Board's records.