# SELF-CONTROL IN OVERWEIGHT AND OBESE INDIVIDUALS:

# THE RELATIONSHIP OF DISPOSITIONAL SELF-CONTROL

# AND BLOOD GLUCOSE

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Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

August 2016

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Edwards, Kate G. Self-control in overweight and obese individuals: The relationship of dispositional self-control and blood glucose. Doctor of Philosophy (Clinical Psychology), August 2016, 101 pp., 3 tables, 1 figure, references, 63 titles.

Currently, the etiology of obesity is conceptualized as a confluence of environmental, socioeconomic, behavioral, biological and genetic factors. With regard to behavioral factors, some have suggested that a failure of self-control may contribute to the difficulty of an overweight/obese individual because of their inability to resist food or maintain physical activity. Recent research proposed that self-control could be described as similar to a muscle that can be fatigued. Thus, if an individual engages in a self-control task they have lessened ability to utilize self-control on a subsequent task. Self-control may be fueled by a finite resource, identified as blood glucose. Blood glucose plays an important role, especially in overweight and obese populations, as they may be more likely to be insulin resistant. Therefore overweight individuals might react to self-control tasks differently than normal weight individuals. Participants who were considered normal weight, overweight, and obese were recruited from the UNT research pool. They answered questions about their trait self-control in daily life and engaged in either a task that required them to exert self-control or a control task. All participants then engaged in a subsequent self-control task to assess if engaging in the initial self-control task reduced performance on the subsequent self-control task compared to the control task. The current research findings were not in line with previous research, in that a depletion effect in self-control was not observed; in neither the normal weight individuals nor the overweight and obese groups. There were several limitations that may have contributed to these findings including; higher DSC than observed in the general population and a possible adaptation effect due to the duration of the self-control tasks, which is in keeping with subsequently published research.

SELF-CONTROL IN OVERWEIGHT AND OBESE INDIVIDUALS: THE RELATIONSHIP OF DISPOSITIONAL SELF-CONTROL AND BLOOD GLUCOSE

Being overweight is defined by the Centers for Disease Control and Prevention (2010) as "an adult who has a BMI [Body Mass Index] between 25 and 29.9," and obesity is defined as an adult with a BMI of 30 or more. The BMI is calculated using a height/weight proportion. While BMI can be influenced by differences in muscle weight and is not the most accurate assessment of being overweight or obese, it is largely used in medicine as criteria for being overweight or obese.

In research and public health data, it has become well known the rate of obesity has reached epidemic proportions in the United States. An estimated one third of the United States adult population has a BMI that falls within the category of obesity (Flegal, Carroll, Ogden & Curtin, 2010) and this rate is rising. The percentage increases to 68% when those with BMIs falling within the overweight range are also included.

The prevalence of obesity appears to be about equal among men (32.2%) and women (35.5%). However, there are indications of racial and ethnic differences. Non-Hispanic blacks have the highest prevalence of obesity (44.1%), followed by Mexican Americans (39.3%) and then non-Hispanic whites (32.6%). It is important to note that these racial ethnic and gender differences may be influenced by the difficulty of BMI to account for lean muscle tissue that might contribute to higher calculated BMIs in racial/ethnic groups. For example, women have higher levels of fat mass than men regardless of their BMI (Camhi, Bray, Bouchard, Greenway, Johnson, . . . & Katzmarzyk, 2011) and African American men and women have higher lean body mass while Asian individuals have higher body fat (Deurenberg, Yap & van Staveren, 1998).

The impact of the high and growing percentile/prevalence of the overweight/obese population can be exemplified by the financial strain it can place on society, especially costs related to health care. In 1995, the medical costs of obesity for government insurers (i.e. Medicare and Medicaid) were an estimated $78 billion dollars (Finkelstein, Fiebelkorn, & Wang, 2003). This number has increased by an estimated $40 billion in the past 10 years (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Furthermore, the costs of obesity and the health concerns related to obesity are not just limited to medical costs. Finkelstein, DiBonaventura, Burgess, and Hale (2010) estimated a $73.1 billion annual obesity-related cost for full-time employees. These costs include lost productivity and absenteeism. In 2008, the direct and indirect economic impact of obesity was estimated to be $147 billion dollars (Finkelstein et al., 2009).

BMIs within the overweight and obese range are associated with several increased health risks. These risks include, but are not limited to; hypertension (e.g. Havlik, Hubert, Fabsitz, & Feinleib, 1983; Matsuo, Sairenchi, Suzuki, Tanaka & Muto, 2005), sleep apnea (e.g. Khazaie, Najafi, Rezaie, Tahmasian, Sepehry & Herth, 2011) increased risk of coronary heart disease and greater mortality (Hensrud & Klein, 2006). In addition, a major concern with being overweight or obese, and a major topic of the current research, is the decreased ability to effectively metabolize blood glucose, i.e. insulin resistance, (Gniuli, Castagneto-Gissey, Iaconelli, Leccesi & Mingrone, 2010; Abbasi, Brown, Lamendola, McLaughlin, & Reaven, 2002). Insulin resistance increases risk of developing Type 2 Diabetes (Hensrud & Klein, 2006; West & Kalbfleisch, 1971), which if left untreated or poorly controlled can result in further major medical complications, including; kidney and cardiovascular disease, foot ulcers and possibly amputation, neuropathy (nerve damage that impairs sensation, movement, and function), to name a few.

Currently, the etiology of obesity is conceptualized as a confluence of environmental, socioeconomic, behavioral, and biological (e.g., genetic) factors (Bouchard, 2007; Faroqui & O'Rahilly, 2007; Heber, 2010; Manios, Panagiotakos, Pitsavos, Polychronopoulos & Stefanidis, 2005). Early theories of obesity approached the behavioral aspect as a failure of self-control or to self-regulate food consumption and physical activity (Herman & Polivy, 1980). In turn, researchers have implemented behavioral interventions to address this problem (e.g. Arags, Telch, Amow, Eldredge & Mamell, 1997).

Research has also described the development of obesity as "difficulty maintaining a nutritional balance (Herman & Polivy, 1980)." This model indicated that individuals who ate more calories than they burned through normal bodily functions and physical activity were likely to gain weight. Therefore, those who become overweight or obese were believed to have a failure of self-control to reduce calories or increase physical activity. The current research will focus primarily on possible behavioral (e.g., self-control) and biological (e.g., insulin resistance) mechanisms of obesity, to further explore factors that may contribute to obesity.

## An Overview of Self-Control

Engaging in self-control allows humans to function in their daily lives, by keeping us from behaving in ways that can be counterproductive to our health, safety, and interactions with society. For example, the ability to refrain from showing anger at bosses, stealing from neighbors, and driving recklessly in traffic relies on self-control. Self-regulation, self-control, and willpower are terms used to define individuals' ability to maintain control over their actions; however, for the purposes of this project, self-control will be used as a blanket term for this concept. In this section, I discuss research concerning dispositional self-control, the strength model of self-control, and finally, how these concepts relate to each other.

**Dispositional self-control.** Dispositional self-control (DSC) can be described as a trait characteristic of self-control, e.g., individuals vary in the degree to which they exert self-control in their daily lives. One of the most famous studies of DSC is the Stanford marshmallow experiment (Mischa, 1979). Children were presented with a marshmallow and were promised a second marshmallow if they could resist eating the first. Though the purpose of the original study was to understand the development of delayed gratification, a follow-up study of the same participants approximately 10 years later yielded some interesting results. They found a positive relationship between the amount of time the children were able to resist the marshmallow and their academic performance later in life. This was the first indication that children who had what could be conceptualized as higher DSC, fared better academically later in life.

Tagney, Baumeister, and Boone (2004) further investigated the notion of dispositional self-control (DSC) and its correlates. Their research indicated individuals who scored higher on the Self-Control Questionnaire (Tagney et al, 2004) were more likely to exhibit better performance in school, more conscientiousness, and better emotional stability. Individuals with high DSC were also less likely to score high on several subscales of the Eating Disorder Inventory, an indication of a possible relationship between self-control and eating behaviors.

**Strength model of self-control.** Recent research has begun to examine the possibility that self-control may be a resource that depletes with use. Muraven and Baumeister (2000) first postulated this theory when they suggested coping with stressors might be considered a form of self-control. They explain that coping (e.g. overriding thoughts, stopping emotions, blocking-sensations etc.) requires the individual to engage in self-control and regulate his or her attention away from the stressor.

One such stressor they first noticed was when individuals were exposed to an irritating noise they could or could not control. In this particular study, participants who are exposed to noise as a stressor – which they presumably had to cope with – demonstrated poorer performance on subsequent proof reading and frustration tolerance tasks (e.g., tasks that also required self-control) (Glass et al., 1969). However, once participants were given the ability to "control" the noise, the perceived stressor dissipated and subsequent self-control was not impaired. Thus, when individuals were provided freedom of choice to stop the noise; they eliminated the need to cope with the stress (by turning off the noise), and consequently eliminated the need to utilize self-control to cope with the stressor. Similar results were observed with various other stressors, such as bad odors (Rotton, 1983), overcrowding (Sherrod, 1974), and electric shock (Glass & Singer, 1972). In each of these studies, when a participant was exposed to the stressor they could not control and consequently had to cope with, they performed worse on subsequent tasks that required some form of self-control, e.g., frustration tolerance tasks, unsolvable puzzles, and the Stroop color naming task.

This association with active coping and difficulty on subsequent tasks led Muraven, Tice, and Baumeister (1998) to conceptualize self-control as a muscle that can be fatigued (Baumeister, Heatherton, & Tice, 1994). In essence, Muraven and Baumeister hypothesized that if an individual engages in a task requiring self-control (such as active coping), he/she will be less likely to effectively exert self-control on a subsequent task.

Several subsequent studies have examined the depletion of self-control when engaging in two consecutive self-control tasks (e.g. Baumeister, Bratslavsky, Muraven, & Tice, 1998; DeWall, Baumeister, Stillman, & Gailliot, 2007; Gailliot & Baumeister, 2007; Muraven et al, 1998). Findings indicated engaging in the initial self-control tasks depleted the participant's ability to effectively perform on subsequent self-control tasks, even if the two tasks were unrelated. For example, Baumeister et al. (1998) asked participants to suppress their emotions while watching an emotionally laden video and then perform a physical task (grip a handgrip dynamometer as long as possible). Participants in a control condition also watched the same video before performing the physical task, but did not receive the instruction to suppress their emotions. After viewing the video, the participants who were asked to suppress their emotions held the handgrip dynamometer for significantly less time than the participants who did not suppress their emotions. Though these two tasks required two different behaviors (physical and cognitive), suppressing the urge to express emotion during the video negatively impacted the period of time participants gripped the dynamometer.

To further reiterate the notion that the self-control tasks do not need to be related to deplete each other, in a meta-analysis of over 80 studies of the self-control research, Hagger, Wood, Stiff, and Chatzisarantis (2010) found no differences in effect sizes when the two self-control tasks were from the same domain (e.g., behavioral and behavioral) or from different domains (e.g., behavioral and cognitive). These findings give further credence to the notion that the depletion of self-control exists across various domains and that self-control "draws from a single, global resource . . . (pg. 517)."

Since the strength model of self-control implies self-control is like a muscle and can be fatigued, it also implies, that like a muscle, self-control can also be strengthened. Research has examined this component of the model and observed that self-control training can moderate the amount of self-control an individual may exhibit (Gailliot, Plant, Butz, & Baumeister, 2007; Hagger et al, 2010; Muraven, Baumeister, & Tice, 1999). In effect, self-control gets stronger, thus takes longer to be depleted. This was evidenced in research by Muraven et al. (1998), who demonstrated that participants who engaged in self-control tasks for two weeks exhibited a significant increase in the time they gripped a handgrip dynamometer, than participants who did not actively exercise their self-control. In effect, the participants increased their self-control strength.

In these studies, several alternative explanations for the decrease in self-control observed after the initial self-control task, were examined. One such explanation may be a change in mood and motivation. Muraven et al. (2000) indicated exposure to a stressor or situation that requires self-control can lead to a bad mood that reduces effectiveness on later tasks. Additionally, exposure to uncontrollable situations that require active coping can lead to learned helplessness (Seligman, 1975) thus the individual does not view further effort to be useful. However, research indicates these theories do not fully explain the entirety of situations in which self-control decreases after exposure to an initial task requiring self-control. For example, with regard to learned helplessness, even after a successful self-control experience, individuals still exhibited a decrease in self-control on subsequent tasks (Muraven et al., 2000).

Hagger et al. (2010) also assessed whether the fatigue effect could be accounted for or moderated by other factors including; positive or negative affect, effort, self-efficacy, fatigue, and motivation. In their analyses, they found a medium to large overall effect of the strength model hypothesis, with no significant effect for self-efficacy or positive affect on depletion. However, negative affect, subjective fatigue, effort and motivation were associated with the depletion of self-control (Hagger et al., 2010; Tice, Braslavskly, Baumeister, 2001). Hagger and colleagues explain that the associations between negative affect, fatigue and effort were further evidence of the aversive nature of maintaining self-control. With regard to negative affect, it can be hypothesized that attempting to stay in a "good mood" could be a product of self-control.

Thus, an association between negative affect and the depletion of self-control might be contributed to the participant attempting to utilize self-control for the task instead of mood stabilization. Hagger and colleagues also hypothesized subjective fatigue could be conceptualized as an indicator of the effort given to self-control as opposed to the alternative explanation of fatigue being the contributing factor of decreased self-control. Furthermore, the increased fatigue may contribute to a decrease in motivation, which leads to a decrease in self-control. However, if the individual is sufficiently motivated to complete the self-control tasks, the depletion effect of fatigue may not be observed (Hagger et al., 2010).

Overall, the strength model of self-control has been observed in several studies investigating various "real life" behaviors that are perceived to require some level of self-control. These behaviors include; consumption of alcohol (Muraven, Collins & Neinhaus, 2002), expression of sexual behaviors (Gailliot & Baumeister, 2007) and violence (Finkel, DeWall, Slotter, Oaten, & Foshee, 2009). Although there may be other explanations of the observed depletion, such as fatigue and motivation, there appears to be an effect that continues to be explained by a decrease in self-control resources.

**Dispositional self-control (DSC) and the strength model of self-control.** To date, little research has been conducted that examines the possible relationship between DSC and the strength model of self-control. However, Dvorak and Simons (2009) examined the interaction of what they termed "good" subjective self-control – which could be conceptualized as DSC - and the depletion of self-control. Their findings indicated that good DSC was predictive of greater task persistence on unsolvable puzzles after a depletion task. However, they did not observe the same findings in poor DSC. Thus high DSC may play a protective role in the depletion effects of engaging in self-control tasks.

Further, Gailliot, Schmeichel, and Baumeister (2006) examined the relationship between DSC and the self-regulatory effects of mortality salience i.e. intrusive thoughts about death. Their findings indicated that individuals who scored lower on the Self-Control Scale, a subjective assessment of DSC were more likely to experience intrusive thoughts of death. Unfortunately, although they depleted the participants' self-control in additional studies included in the same article, interestingly, Galliot and colleagues did not examine the relationship between DSC and the depletion of self-control. Thus this was a missed opportunity to examine the moderating effects high dispositional self-control might have on the depletion of self-control.

## Blood Glucose (BG) and Self-Control

In this section, I discuss research that suggests BG (amount of glucose present in the blood stream) might be the "fuel" that is depleted when an individual engages in self-control tasks. Research has long studied the effect of BG levels on an individual's cognitive state. When an individual experiences a hypoglycemic state, (i.e. too little glucose in the blood) they become confused (Hale, Margen, & Rabak, 1982), experience feelings of anxiety (Herzer & Hood, 2009), and amnesia (McNay & Cotero, 2010). Similar symptoms as well as others, such as extreme lethargy, can be observed in individuals in a hyperglycemic state, (i.e. too much glucose in the blood) (National Institute of Health, 2010).

Recently, researchers have begun to examine the biological mechanisms of self-control as a function of the fluctuation of glucose levels in the blood (Galliot & Baumeister, 2007; Gailliot, Baumeister, DeWall, Maner, Plant, & Tice, 2007). Specifically, individuals who engage in a self-control task exhibit a drop in BG levels almost as if the glucose is "fueling" control behaviors and this fuel is depleted when self-control is exerted. Furthermore, when drinks containing glucose were consumed after the initial self-control task - increasing glucose present in the blood

– the individual's ability to exert self-control on the subsequent task was restored, as if fuel for control behavior was replenished (Gailliot, Peruche, Plant, Baumeister, 2009).

Research has also observed that individuals whose glucose levels were depleted during a self-restraint task were more likely to express prejudicial thoughts and stereotypes than individuals whose BG levels were not depleted (Gailliot et al. 2007). This was evidenced when Galliot et al. (2007) asked participants to complete the Stroop task as the initial self-control depletion task. After they were given the Stroop task, participants were given either a drink that contained sugar or a no calorie sweetener. Participants who consumed the sugar drink after they engaged in a self-control depletion task were less likely to use stereotypes in essays describing. Meanwhile, the participants who received a drink sweetened with an artificial no calorie sweetener used significantly more stereotypes in their essays. Galliot et al. demonstrated that individuals also regained self-control when they consumed a drink containing sugar and BG levels were restored.

Similar findings were observed in several studies (e.g., DeWall, Baumeister, Gailliot, & Maner, 2008; Dvorak & Simons, 2009; Masicampo & Baumeister, 2008). For example, DeWall et al. (2008) conducted three studies to examine the effects of the depletion of self-control on helpful behavior. Participants were asked to maintain their attention on a video of a woman talking while words flashed at the bottom of the screen. They were then asked about helping behaviors (i.e. donating money to charity). Participants who did not consume a drink containing glucose before watching the video were less willing to engage in hypothetical helping behaviors. However, the reverse was true for participants who did receive the glucose drink.

Finally, not only were these findings observable in humans, but in animals as well. Miller, Pattison, DeWall, Rayburn-Reeves, and Zantall (2010) suggested the possibility that BG plays a role in exerted self-control when they examined this relationship in dogs. The authors required the dogs to exert self-control by sitting and staying at the command of their owner for approximately 10 minutes. Dogs in a control group were held in a cage for the 10-minute period. Additionally, they gave half of the dogs in the experimental and control conditions a drink with a pre-determined glucose load. The other half of each group was given a drink with a no-calorie sugar replacement. As predicted the dogs in the self-control group that consumed the glucose drink exhibited greater persistence on the second self-control task than dogs in the self-control condition that consumed the drink with the no-calorie sweetener. In fact, the performance of the dogs in the self-control condition that consumed the glucose drink did not significantly differ from the performance of the control groups, as if they had not engaged in a self-control task at all.

The drop in BG after the initial self-control task may be attributable to a number of different body mechanisms. One such mechanism is theorized that a decrease in BG levels contributable to glucose consumption by the brain during these self-control tasks. Donohoe and Benton (1999) indicated that the brain begins to metabolize glucose 10 minutes after it has been absorbed into the blood stream. According to Siesjo (1978), the brain primarily uses glucose as a fuel source and it uses that about 20 – 30% of the body's BG. Thus, the brain could be consuming glucose when the frontal lobe (considered the primary cortex responsible for self-control) was activated during these tasks and in turn required more glucose to function. Consequently, when BG levels are not sufficient, it is more difficult to maintain self-control. Additionally, glucose may be utilized by periphery systems during difficult cognitive tasks. Scholey, Harper, and Kennedy (2001) observed that individuals who engaged in a 5-minute serial sevens task exhibited an increased heart rate and less BG levels compared to individuals who engaged in a 5-minute key pressing tasks. It is likely glucose utilization in both the periphery and the central nervous system contributes to the decrease in BG observed during these tasks.

However, there is argument that brain consumption of BG may not be the mechanism, or at least not the only mechanism responsible for the BG drops observed.. For example, Kennedy and Scholey, 2000 reported that participants who engaged in a serial 7's task where they were asked to subtract 7 from a number and continue subtracting for a period of 5 minutes exhibited the drop in BG, but also displayed an increase in heart rate. Greater heart rate may mean greater BG consumption in periphery organs, thus the decrease in BG. This, in addition to study designs measuring peripheral BG through finger sticks, gives rise to the expectation that brain consumption is not the sole contributor to the decreases in BG observed.

Furthermore, in a short review and re-analysis of Galliot et al's data, Kurzban (2010) discussed the findings of previous metabolic research that suggests brain consumption of BG may not be sufficient enough to consume an observable amount of BG during these tasks. First, Gibson and Green (2002) pointed out that, as BG is measured in the periphery and not in the brain, it couldn't be unequivocally assumed that changes in periphery BG directly influence BG changes in the brain. Second, Clark and Sokoloff (1998) and Raichle and Mintun (2006) indicated that there is no significant increase in regional blood flow – thus calorie, i.e., glucose consumption – when engaged in "even the most arousing perceptual and vigorous motor activity" (p. 467). Finally, when Kazaban (2010) re-analyzed the data from the Gailliot et al. (2007) studies, there was no replication of the findings reported in their original manuscripts.

**BG and DSC.** As stated earlier, Dvorak and Simons (2006) observed an interaction effect between high DSC and the depletion of self-control. In the same study, they examined the relationship between BG levels and DSC. They observed a significant drop in blood glucose immediately after individuals completed an emotional suppression task. This decrease in blood glucose was unrelated to subjective measures of high or low DSC. However, as stated in later sections, it would be beneficial to assess these relationships in individuals who might have impaired glucose metabolization.

## Obesity and Self-Control

As stated earlier, the etiology of obesity can be conceptualized as a confluence of environmental, biological, and behavioral factors. Also as previously mentioned, obesity is rising at alarming rates. Some argue the increased consumption in the past 40 years of foods higher in fat and sugar and caloric content is a main contributor of this surge (Wilborn, Beckham, Campbell, Galbreath, La Bounty, . . . Kreider, 2005). However, this cannot fully account for the increase in obesity for several reasons. 1) Though the rates of obesity are rising, there are still individuals who are not becoming obese. 2) There is substantial information about the types of foods that are considered to be unhealthy and thus most individuals have an understanding of what foods are healthy and what foods are not. 3) Genetics cannot fully account for the rapid increased prevalence of obesity. Although research does suggest genetics may play a role in the prevalence of obesity (Yang, Kelly, & He, 2007), the increase seen in recent years has far exceeded the rate at which genes contributing to obesity could account for (Yach, Stuckler & Brownwell, 2006).

Baumeister and Blatsky (1998) looked at several domains or "spheres" of self-control. These spheres include the ability to resist temptations, maintaining attention or focus, and persistence on difficult or impossible tasks. Additionally, they demonstrated that actively responding to a situation expends a greater amount of the resources needed for self-control than if an individual were to just passively respond to a situation. When self-control depleted individuals were required to actively opt out of watching the video, they would watch more than individuals who had been depleted and were able to passively opt out of the video. Individuals who had to do less work, i.e. stop pressing the button were more likely to quit sooner than individuals who had to actively decide to press the button to stop watching the video. This could be an example of why individuals who are obese have difficulty maintaining a healthy diet. It takes more resistance to *actively* seek out healthier foods than to passively continue to eat unhealthy foods, especially in settings where unhealthy foods are easily accessible i.e. restraint at parties, in the work break room etc.

Additionally, in their research, Balfour and Edwin (1975) examined the efficacy of behavior treatments in obesity. They included a "willpower" group that was asked to engage in the same skills as the behavioral group. However, unlike the behavioral group who had the benefit of attending meetings and therapy, the willpower group solely utilized self-control when engaging in these skills. They found that participants who were told to utilize solely their willpower lost significantly less weight than the behavioral group. Balfour and Edwin's research exemplifies the long-standing model that self-control is a contributing factor to being overweight and developing obesity as well as a critical component to successful weight-loss.

As stated earlier in this review, the exposure to stressors and the subsequent depletion of self-control has been observed in relation to the consumption of alcohol, expression of sexual behaviors, and violence. Kahan, Polivy, and Herman (2003) observed similar findings in restrained eaters, a.k.a. dieters. Fifty-nine undergraduates from the University of Toronto were assigned to either a "no-conflict" or a "conflict condition." Based on their scores on the Restraint Scale, a measure of concern for dieting and weight fluctuation (Herman & Polivy, 1980), participants were classified as either "restrained eaters" or "unrestrained eaters." The conflict condition was based on the Crutchfeild's (1955) version of the Asch experiments of conformity. Participants were asked to identify the size of shapes on a computer screen. The participant's responses were then compared to pre-written responses that were incorrect. This led the participants to struggle with either choosing what they felt was the best choice or conforming to the group. Participants in the no-conflict group completed the same task without the pre-written responses, thus eliminating the need to conform. After the computer task, all participants in the study were given access to food under the guise of a taste test. The results of this study indicated participants in the conflict group identified as restrained eaters consumed a significantly larger amount of food than restrained eaters in the no-conflict group. Interestingly, participants identified as non-restrained eaters showed no differences in food consumption between groups. Restrained eaters were more likely to experience the self-control depletion effects and thus more likely to consume a larger amount of food when depleted.

Some research has looked at DSC in overweight and obese populations. For example, overweight individuals who exhibited high DSC were more likely to benefit from weight loss programs (Crescioni, Ehrlinger, Alquist, Conlon, Baumeister, . . . & Dutton, 2011). In this instance, higher DSC was not related to amount of calories consumed from fat outside of a weight loss program (Crescioni et al., 2011); but, that higher DSC appeared to be associated with greater weight loss when individuals engaged in a weight loss program, fewer calories consumed per meal during the weight loss program, and more weight loss meetings attended (Crescioni et al., 2011). Thus, individuals higher in DSC may be more likely to benefit from a weight loss program. It is noted that, if they are in an unstructured environment, they are not successful in dieting.

Additionally, although there was no interaction found by Dvorak and Simons (2009), research examining DSC and how it interacts with the BG hypothesis may help shed light on why obese/overweight individuals with high DSC are more successful at losing weight in a weight loss program. Greeno and Wing (1994) indicated that restrained eating appeared to be the best predictor of whether or not stress contributed to overeating. Thus, assessing DSC appears to be an important component of weight loss. However, there may be biological mechanisms that might inhibit overweight/obese individuals from being able to successfully utilize their DSC. These biological mechanisms are discussed in the section below.

**Insulin resistance and self-control in overweight and obese individuals.** As noted previously, the closest body of research that addresses the biological mechanisms of self-control in an obese/overweight population focused on individuals who were considered to be restrained eaters (i.e., dieters) (Kahan et al., 2003; Valentine, No Date; Vohs & Heatherton, 2000). None have specifically compared a normal weight population to an obese population. This is important to address these holes in the literature, as 1) overweight and obese individuals have been observed to metabolize glucose differently than normal weight individuals in times of stress (Wing, Blair, Epstein, & McDermott, 1990) and 2) many overweight and obese individuals develop insulin resistance as a function of their weight (Kahn & Flier, 2000).

Insulin resistance acts in a multitude of ways. The most well known mechanism is the decreased ability of muscle and fat cells to metabolize glucose. Insulin is a hormone that, in essence, is the key that "unlocks" the cell's ability to intake glucose and utilize it as fuel (metabolization). Thus, individuals whose cells can no longer unlock in the presence of insulin are considered insulin resistant. Because the cells are not opened, excess glucose then builds up in the blood stream, resulting in hyperglycemia.

Because insulin is what allows the body's cells to absorb glucose in the blood stream, the inability of cells to respond to insulin prevents them from using glucose for various functions (CDC, 2010). As glucose is the main fuel for brain cells, cognitive symptoms of insulin resistance include brain fogginess and inability to concentrate. This provides further evidence for the relationship between glucose and self-control, as concentration and focused attention could be considered a form of self-control. When taking into account that overweight/obese individuals metabolize glucose differently in times of stress (Wing, Blair, Epstein, & McDermott, 1990) and are prone to insulin resistance, it can be hypothesized these factors may account for 1) the increased failure of self-control seen in obese individuals, 2) the relationship between stress (i.e. coping with stress as a self-control task) and failures in restrained eating.

These factors might contribute to a difference in the ability of overweight/obese individuals to regulate themselves during times of stress and thus leads to overeating. This hypothesis is further strengthened by the notion that restrained eating behaviors have been considered by previous research to be considered a form of self-control (Kahan et al., 2003; Valentine, No Date; Vohs & Heatherton, 2000). Thus if an overweight or obese individual experiences the need to cope with stress, which, as stated earlier, Muraven et al (1998) considers a self-control task, they may have less self-control "resources" to resist tempting foods.

Furthermore, the ability to engage in self-control is an important component of weight loss. Understanding the role biological mechanisms play in the self-control of overweight/obese individuals may demystify the difficulties that overweight or obese individuals have when attempting to engage in self-control. Thus, it is important to examine how glucose levels, DSC, and exertion on self-control tasks are related in overweight and obese populations. By further exploring this possible biological mechanism of self-control, therapeutic and psychological treatments could be re-conceptualized to include a biological component in addition to behavioral and psychological interventions.

## Contradictory Findings

Although Kahan et al. (2003) observed a significant difference between the depleted restrained eaters and the non-restrained eaters; Valentine (n.d.) did not. Valentine recruited 105 participants identified as restrained eaters through the Restrained Eating Scale. These participants were then randomly assigned to a depletion group or a non-depletion group. Individuals in the depletion group were asked to list their thoughts but to try not to think about a white bear. The no-depletion group was asked to list any thought that came to mind. All participants were then given a drink containing either glucose or a no-calorie sugar replacement. Blood glucose was assessed before and after the initial thought suppression task, then participants were asked to complete a cookie taste test. Valentine (n.d.) found no significant difference in BG levels found between the restrained eaters in the depletion group and the non-depletion group. Additionally, no differences were found between groups in the amount of cookies eaten.

Though Valentine's (n.d.) findings contradict the depletion and glucose theories of self-control, several limitations are noted. For instance, BMI has been suggested to have a positive relationship with the Eating Restraint Scale (Mensink, Stroebe, Schut, & Aarts, 2003). Valentine (n.d.) did not take into account the possible effect BMI would have on the metabolization of glucose in overweight individuals. In fact, the mean BMI in this study was 26.28, 1.28 points above the CDC cutoff for the definition of being overweight.

Further examples of contradictory research include Kurzban's (2010) research that unsuccessfully attempted to reproduce the Galliot et al. studies. They argued that Galliot et al.

might have utilized data that only supported the glucose depletion hypothesis. However, other labs independent of Galliot et al. (i.e., Dvorak & Simons, 2009) have found an effect. Additionally, these researchers continue to not take into account the possibility of a weight by BG level interaction. Considering that individuals who are overweight or obese may metabolize glucose differently than others considered to be normal weight, it is important to understand how weight may play a factor in these findings.

When Hagger et al. (2010) examined the domains as moderating effects they found that a small majority of depletion and dependent tasks could account for some of the heterogeneity found in the research. For example, when an impulse control task (e.g., Stroop) was used as the depletion task and a cognitive task was used as the dependent variable, the effect size of depletion was much smaller. Additionally, Hagger et al. found that the complexity of the task might also play a role in the depletion of self-control. Thus the more complex the depletion task, the more evident the depletion of self-control becomes.

**Present Study and Significance**

Previous research has focused mainly on the depletion of self-control and its relationship to BG levels in a random sample of individuals or individuals who are considered to be dieting. To date, no research has been conducted that specifically examines these biological and psychological factors of self-control in overweight or obese individuals compared to normal weight individuals. Additionally, there is minimal research directly investigating the relationship between BG levels and DSC. The present study addressed three oversights in the current literature; 1) the magnitude of self-control depletion in overweight and obese individuals; 2) the relationship between BG and self-control depletion in overweight and obese individuals; and 3) the relationship between BG, self-control depletion, and DSC in overweight and obese individuals.

The present study addresses these holes by looking at the self-control depletion factors in a healthy weight sample compared to an overweight and obese sample. Research has indicated that those with a BMI falling within the overweight or obese range experience difficulty metabolizing glucose as a function of their weight alone, i.e., through the insulin resistance process. Because of the role that glucose plays in self-control and the increased difficulty of overweight and obese individuals to metabolize glucose, it can be hypothesized that overweight and obese individuals may not be able to as effectively "tap into" their BG to utilize it for self-control. Thus instead of a self-control depletion effect, overweight and obese individuals may not be able to metabolize the glucose needed for self-control in the first place.

Further, the depletion of self-control through multiple tasks also has not been examined specifically comparing overweight and obese populations compared to normal weight controls. As stated previously, overweight/obese individuals may be insulin resistant. However, there is also evidence they metabolize glucose differently than normal weight individuals in times of stress. Thus, insulin resistance and stress reactions, may be two possible ways BG may play a role in possible differences in self-control between normal weight and overweight/obese individuals. Accordingly, the relationship between BG levels before and after the self-control tasks in overweight and obese samples compared to the normal-weight controls will be examined.

Finally, little research has examined the role DSC may play in the strength theory of self-control. These relationships in BG and depletion of self-control will be examined between individuals who have high and low DSC.

Understanding the differences in self-control depletion between normal weight and overweight/obese groups may help explain why individuals who are overweight or obese experience self-control "failure" while dieting or attempting to maintain a physical activity regimen. Findings of this project can be utilized by future research to develop interventions for weight-loss based on psychological and biological factors of self-control.

## SPECIFIC AIMS AND HYPOTHESES

**SPECIFIC AIM #1: To examine the depletion of blood glucose levels in overweight and obese individuals compared to normal-weight individuals before and after self-control tasks.**

**Hypotheses 1.** 1a) First, it is expected that there will be no difference between BG levels before and after the self-control task in overweight and obese individuals. Because the literature suggests overweight and obese individuals metabolize glucose differently than normal weight individuals, no significant difference in blood glucose levels from the first to the second task is expected for overweight and obese individuals. 1b) The second sub-hypothesis is that there will be an interaction effect between weight and observed glucose levels before and after the self-control task. More specifically, individuals who meet criteria for being overweight and obese will not display the "drop" in blood glucose levels, but will be observed in the normal-weight individuals after a self-control task. 1c) Finally, it is expected that normal weight individuals who engage in a control task that does not require self-control will exhibit no change in BG.

**SPECIFIC AIM #2: To examine the depletion of exhibited self-control in overweight and obese individuals compared to that of normal-weight individuals on a self-control task subsequent to an initial self-control task.**

**Hypothesis 2.** Previous research indicates individuals who engage in a self-control task make more errors/display poorer performance on subsequent self-control tasks. Following an initial self-control task, obese and overweight individuals will display significantly poorer performance on a second self-control task than normal-weight individuals.

**SPECIFIC AIM #3: To examine the relationship between dispositional self-control, weight and the depletion of glucose after the initial self-control task.**

**Research Question.** DSC could be considered a trait variable and self-control depletion could be considered a state variable. To date, research examining the possible interaction of trait – DSC – and state – self-control depletion – self-control is absent from the literature. Further, although research has examined how overweight/obese individuals with high trait DSC fair in various weight loss programs as well as the concept of depleted glucose after a self-control task, there has been little research that compares overweight/obese individuals to normal weight individuals. Thus, research questions in the current study will examine a possible interaction between weight, measures of depletion of self-control (change in blood glucose after a self-control task) and DSC.

## METHOD

### Participant Eligibility and Recruitment

A convenience sample of **N =134 (female = 90) undergraduate students,** intentionally distributed among three BMI groups, with a mean age of 22.34 (SD = 4.95) years and a mean BMI of 26.25 (SD = 5.36), were recruited from the research pool at the University of North Texas (UNT). Using the effect sizes determined by Hagger et al. (2010) and G-power, in order to obtain an effect size of $d$ = 0.69, the smallest effect size reported by Hagger et al. for four groups, the total sample size needed was n = 60 with a power of .95. To obtain the largest effect size reported by Hagger et al., $d$ = 1.64 and with a power of 0.95, the total sample size needed was 17. This is in line with the literature that examined the effect sizes of the glucose depletion with smaller sample sizes (e.g. Galliot et al., 2007).

The participant sample was assessed for outliers with one individual from the NWC, two individuals from the NWE, and one individual from the OWE group with high blood glucose (BG) (175, 143, 140, 139) removed, three individuals from the OBE group were removed for their BMI (65.78, 50.48, 46.51) (one individual from this group was also removed for high BG) resulting in a total six individuals removed from the dataset.[1]

Three experimental groups meeting BMI criteria for normal weight ($n$ = 33, $M_{BMI}$ = 22.63, $SD$ = 1.74), overweight (OWE) ($n$ = 34, $M_{BMI}$ = 27.45, $SD$ = 1.46) and obesity (OBE) ($n$ = 30, $M_{BMI}$=36.28, $SD$ = 8.11]) were recruited from participants who completed an initial online screening questionnaire. An additional group of 32 normal weight participants ($M_{BMI}$ = 22.25, $SD$ = 1.12) served as a control group. Participants in the control group were normal weight in order to make sure weight and possible insulin resistance of overweight and obese individuals were not

[1] Analyses were conducted both with and without these outlying cases removed. Analyses did not change significantly when outliers were removed.

included in the control group so these factors did not confound the results. The control group also served as a manipulation check to ensure any significant findings in the NWE were due to the experimental manipulation and not to chance.

The participants in the NWC group ranged in age from 19 to 27 (*M* = 21.13, *SD* = 1.98); 75.8% female (*n* = 25). Participants in the NWE group ranged in age from 19 to 28 (*M* = 21.13, *SD* = 1.98); 69.7% female (*n* = 23). The OWE group ranged in age from 19 to 55 (*M* = 23.38, *SD* = 6.94); 55.9% female (*n* = 19). The OBE group ranged in age from 19 to 43 (*M* = 24.19, *SD* 6.61); 66.7% female (*n* = 20). Regarding racial/ethnic background 54.5% of NWC (*n* = 18), 54.5% of NWE (*n* = 23), 55.9% of overweight (*n* = 19), and 50% of obese (*n* = 15) participants identified as Caucasian. See Table E.1 in Appendix E for a complete list of frequencies for racial/ethnic groups for the overall sample, and the experimental and control groups.

## Materials

**Demographic questionnaire/screener.** Prior to participation in the in the experimental portion of the study, potential participants were asked to complete a demographic/screening questionnaire that asked for demographic variables (e.g., birthdate, gender, race/ethnicity), as well as variables to calculate self-report BMI (i.e., height and weight) and diabetes status (e.g., diagnosed with diabetes mellitus vs. no diagnosis) (Appendix A). These latter questions served as a screener to assess if a potential participant met the exclusion criteria further explained in the procedure section.

**Self-Control Scale.** Tangney, Baumeister, and Boone (2004) developed this scale to be utilized in research as a self-report to measure individual differences of dispositional self-control (DCS). Each participant was given this 36-item questionnaire to assess his or her DCS. Questions were answered with how well each item typically represents them, with item responses ranging from 1 (*not at all*) to 5 (*very much*). After reversing negatively scored items, possible total scores range from 36 to 180 with higher scores indicating higher DSC. The range for the Self-Control Scale obtained in the current study was 82 to 178, with a mean of 122.5 (*SD* = 16.51).

The overall mean and range in the current study was greater than the reported in the general population reported by Tangey et al. (2004) (*M* = 114.7, *SD* = 18.81, range = 44 – 168, Study 1; *M* = 102.66, *SD* = 18.19, range = 50 – 154, Study 2). A one sample t-test as shown below in Table 1 indicates a significant difference between the overall sample mean and the mean of the two studies reported by Tagney et al (Study 1, $t = 5.26$, $p < .01$ & Study 2 $t = 13.43$, $p < .01$). Similar results were seen in the NWC (Study 1, $t = 3.05$, $p < .01$; study 2, $t = 6.72$, $p < .01$), NWE (Study 1, $t = 3.05$, $p < .01$; study 2, $t = 6.59$, $p < .01$), and OWE (Study 1, $t = 3.28$, $p < .01$; study 2, $t = 7.72$, $p < .01$) groups. As for the OBE group, there was a significant difference between obtained scores and the second study ($t = 4.90$, $p < .01$); however, the difference between the OBE mean and the mean of the first study were not significant ($t = .72$, $p = .48$).

Table 1

*One-Sample t-Test Comparisons of Self-Control Scale in Current and Validation Studies of Tangney, Baumeister, and Boone (2004)*

| | Study 1 | | | | Study 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean Diff[1] | *t* | df | Sig. | Mean Diff | *t* | df | Sig. |
| Overall Sample | 7.80 | 13.43 | 123 | .00** | 19.84 | 5.26 | 123 | .00** |
| NWC | 9.84 | 3.05 | 31 | .00** | 21.71 | 6.72 | 31 | .00** |
| NWE | 9.38 | 2.91 | 31 | .00** | 21.24 | 6.59 | 31 | .00** |
| OWE | 8.76 | 3.28 | 30 | .00** | 20.63 | 7.72 | 30 | .00** |
| OBE | 2.95 | .72 | 24 | .48 | 13.97 | 4.90 | 24 | .00** |

** *Correlation is significant at the 0.01 level.*

1. *The mean difference is reported in lieu of the means of both variables to manage table size*

To test whether a dimensional conceptualization would be more effective, the Self-Control Scale was utilized in the analyses as a continuous variable and a categorical variable of DSC. To categorize the variable, a cut score was made to indicate high/low DSC. In their development of the Self-Control Scale, Tangney et al reported the measure has high internal consistency ($\alpha$ = .89), with a sample of 351 undergraduates. In the current study, the scale had high internal consistency that was consistent with the previous literature ($\alpha$ = .88). Further, the Self-Control scale was highly consistent within each experimental and control groups; NWC ($\alpha$ = .88), NWE ($\alpha$ = .91), OWE ($\alpha$ = .88), and OBE ($\alpha$ = .86).

**Vanilla baseline.** The vanilla baseline consisted of a series of pictures of 20 innocuous landscapes presented to the participant in pairs. Participants rated their preference of landscape for each pair. These pictures are intended to be non-stimulating to allow time for the participant's BG levels and heart rate to stabilize (see Appendix C). This procedure is utilized in research that involves cardiovascular variance (Fishel, Muth, & Hoover, 2007).

**Crossing-out-letters (COL) task.** Consistent with the procedures utilized by DeWall, Baumeister, Mead and Vohs (n.d.), participants in the experimental group were presented a piece of paper with text unrelated to the experiment (COLe). They were given oral and written instructions to cross out every instance of the letter "e" in an initial one-minute habituation task. After the habituation task, participants in the experimental weight conditions were provided a second task and asked to cross out every "e" that was preceded by a vowel either two letters before it or immediately before it. For example, "Given the circumstances, people were not allowed to participate. The view of the . . ." A total of 375 "e"s were provided in the text. To ensure the participants understood the task, they were provided with a small practice section

(Appendix D). Participants were allowed 10 minutes to cross out as many “e”s as they could in this second more cognitively complex task.

Participants in the NWC condition participated in an alternative COL task (COLc) similar to the initial habituation COLe task with instructions to cross out every letter “e” instead of crossing out the letter “e” that is preceded by a vowel either two letters before it or immediately before it. This task also consisted of 375 instances of the letter “e.” Participants in the NWC condition were also given a one-minute habituation task to ensure procedures for the NWC group and experimental weight groups were similar. Though it is unlikely due to the amount of items, if a participant finished the task before the 10-minute time limit, they were asked to carefully go through the text to make sure they did not miss any “e”s until the time allotment is completed.

**Stroop Color and Word Test (Stroop).** The Stroop is designed to assess for brain dysfunction, cognitive flexibility, maintenance of attention and resistance to interference. This task consists of three parts; 1) reading the name of a color printed in black ink; 2) name the color ink in which four X’s are printed (ex. XXXX), 3) name the colors that are printed in non-corresponding ink colors (ex. Red). All four groups, three experimental and one control, were given the same version of the Stroop. The first two tasks were to help the participant become familiar with the task and ensure they understand the instructions. Because of the need to exert self-control to name the color and not read the word, the final Stroop task served as the outcome self-control task. The number of items correctly completed in the allotted time on part 3 was utilized as a dependent measure. The Stroop has been successfully utilized in previous research as a task to examine and deplete a participant’s self-control (Bray, Ginis, & Woodgate, 2011) and as a dependent measure (Baumeister et al., 2007).

**Other questions questionnaire.** After completion of both self-control tasks, participants were asked questions to assess levels of subjective fatigue, level of hunger and level of effort on the tasks (Appendix A) (Hagger et al., 2010). These assessments were used as covariates in the analyses to rule out these as confounders of the current research, because this might moderate the effects of the self-control depletion due to a "recovery" effect (Baumeister & Heatherton, 1996).

**Assessment of blood glucose (BG) levels.** Glucometers are utilized in medical populations to measure the BG levels, most commonly of individuals diagnosed with Diabetes Mellitus or as a diagnostic screening for diabetes. The side of a participant's finger was wiped clean with an alcohol pad then pricked using a lancet in an automatic lancing device. A small amount of blood was then collected with a BG test strip attached to a glucometer. The glucometer provided an instantaneous measure of the participant's BG level. If participants wished to view their BG measures, they were provided with that information at the end of their participation. If a participant had BG levels higher than normal for a person who is fasting (> 140 milligrams per deciliter, 3 or more hours after eating), they were then referred to the UNT Health and Wellness Center or encouraged to see their physician for further assessment, with four individuals advised to seek further assessment.

**Assessment of pulse rate and blood oxygen.** As mentioned earlier in the literature, Scholey et al. (2001) discussed that increased heart rate may contribute to some of the glucose metabolized during a difficult mental task. To assess heart rate, each participant was asked to place a fingertip pulse oximeter on the middle finger of his or her non-dominant hand. This was used to measure the participant's pulse and blood oxygen level at various times throughout the assessment (see Appendix B).

## Procedure

After receiving UNT-IRB approval, individuals were recruited through the UNT SONA system, a web based recruitment channel, where UNT students can sign-up to participate in research for extra credit. On SONA, this project was presented as a two-part study of the relationship of performance on two different verbal tasks while monitoring physiological measures. First, potential participants were asked to fill out the Demographics/Screening questionnaire online. As stated earlier, they were asked questions about medical history to assess for the exclusion criteria through this website. Participants were excluded from possible participation in the second part of the study if they were diagnosed with diabetes mellitus, taking medications to facilitate glucose metabolism, or color blind (for effective administration of the Stroop task).

One thousand six hundred seventy students participated in the online questionnaire. Students who did not meet the exclusion criteria were asked to sign-up for the second experimental portion of the study, which lasted approximately 90 minutes. Participants in the experimental portion were asked to fast from all foods and liquids, except for water, for at least three hours prior to appearing for their scheduled session. This ensured they were not continuing to digest any foods or caloric liquids, thus metabolizing glucose, during their participation in the study. To ensure fasting, participants were informed their BG would be assessed during the study.

Although there are similar questions asked during the SONA screening, prior to participation, each participant were asked brief focused questions about their medical history to ensure they did not incorrectly answer on the SONA questions. Specifically, they were asked if they have diabetes or a doctor or other health professional has told them they have diabetes or problems with their blood sugar. Participants were also asked if they are currently taking any oral medications or injections to control their blood sugar. No individuals were excluded from participation for misreporting glucose related metabolic impairment (e.g. diabetes, metabolic syndrome, hypoglycemia etc.) in the screening questionnaire.

After participants provided informed consent, the participant's height and weight were measured on a scale similar to those found in a doctor's office. These measurements were utilized to calculate the BMI for each participant. Additionally, participants' waist and hip circumference were measured with a measuring tape. To measure the waist, the participant was asked to point to their belly button. The experimenter then measured the circumference approximately two inches (i.e. two fingertip widths) above the belly button. To measure the hip, the participant was asked to point to the top of their hipbone. The examiner then measured the circumference at the top of the participant's hipbone. These measurements were utilized to calculate each participant's waist/hip ratio. Waist/hip ratio is positively associated with metabolic syndrome and heart disease (Larsson et al., 1984). This measure is quickly becoming an integral part of obesity research because of its ability to distinguish between individuals with high BMIs and a large amount of muscle (e.g. athletes) and individuals with a high BMI and a large amount of abdominal adipose tissue.

After height, weight, and body circumference measurements were completed, participants were asked to first wash their hands with soap and warm water and then allow the side of their finger to be further cleaned with an alcohol swap. The finger was pricked with an auto lancing finger stick device and a blood drop sample was pulled into a test strip on a glucometer by means of the capillary action of the test strip. Figure 1 can be used to help follow the below description of procedure.

After height, weight, circumference and BG measurements are taken the participant was asked to place the fingertip oximeter comfortably on the middle finger of their non-dominant hand. They were provided the pairs of non-stimulating landscapes described earlier. Participants were asked to rate each picture pair in terms of preference. They were allowed 10 minutes for this task, after which time their pulse and percent blood oxygen were recorded immediately prior to the COL task.

Consistent with previous research, participants were asked to engage in two consecutive tasks requiring self-control. For the first self-control task, the NWE, OWE and OBE participants were asked to complete the COLe task. In a meta-analysis, Hagger et al (2010) reported an effect size of $d = .70$ on the performance on the subsequent self-control task, when the COLe task was utilized as the initial self-control task. Participants in these three experimental weight groups (NWE, OWE, OBE) were asked to complete both the habituation and then the self-control COLe tasks. Participants in the NWC group engaged in two habituation COLc tasks. Specifically, on the second presentation of the COLc task, this NWC group continued to cross out every instance of the letter "e" and was not asked to distinguish if the "e" follows a vowel as described above. All participants had their pulse and percent blood oxygen recorded twice, before and immediately following the administration of the COLc task. After participants complete the two trials of this task all participants' BG were measured.

For the second self-control task, all participants, those in the three experimental weight groups and the NWC group engaged in the Stroop Color and Word Test (Stroop, 1935). The participants in all four groups were asked to complete the Stroop task similarly (Baumeister, 1998; Burkely, 2008). This provided a manipulation check to ensure that the self-control depletion task was effective. The BG levels of each participant were measured a third time. Pulse and percent blood oxygen were again recorded twice, immediately before and immediately following the STROOP task.

After completing the STROOP task, participants were asked to complete the Other Questions questionnaire and then asked sit quietly for a total elapsed time of 10 minutes. Pulse and percent blood oxygen were again recorded immediately prior and immediately following the rest period. BG was measured a fourth and final time at the end of the 10-minute period.

This procedure allowed the assessment of pulse/heart rate, percent blood oxygen and blood glucose throughout the assessment. A total of seven pulse/heart rate and percent blood oxygen recordings and four BG measures were recorded. The analysis of this particular data was primarily exploratory in nature.

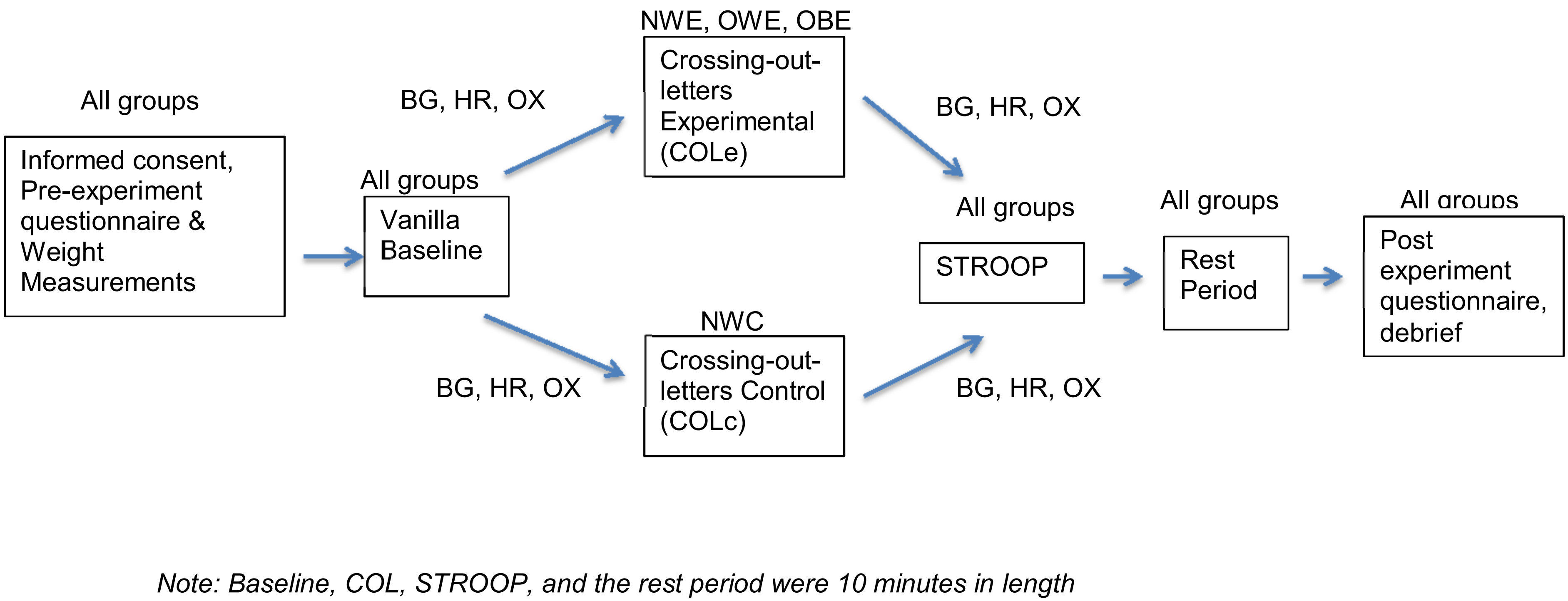


*Figure 1.* Flow-chart showing experimental progression of participants.

# RESULTS

In this Results section, first an overview of descriptive analyses not directly related to the hypotheses is discussed, followed by a summary of preliminary correlational analyses. Finally, the hypotheses, research questions, and exploratory analyses are discussed.[2]

## Descriptive Statistics

The normal weight control (NWC) and normal weight experimental (NWE) groups were compared on age, race/ethnicity, gender, BMI, waist/hip ratio, DSC to assess if random assignment was successful. No significant differences were found in four independent samples t-tests conducted to compare the continuous variables for the NWC and NWE groups (Table 2) and chi-square for categorical variables (Table 3).

Table 2
*T-test Comparisons of Demographic Variables between NWC and NWE groups*

| Variable | Mean Diff | *t* | Sig. |
|---|---|---|---|
| Age | .00 | .00 | 1.00 |
| Body Mass Index (BMI, weight (lb) X 703/ height$^2$ (in$^2$)) | -.30 | -.83 | .41 |
| Waist/Hip ratio | -.02 | -.87 | .39 |
| Dispositional Self-Control | .47 | .10 | .92 |

Table 3
*Comparison of Race/Ethnicity and Gender between NWC and NWE groups*

| Variable | Chi-square | DF | Sig. |
|---|---|---|---|
| Gender | .08 | 1 | .78 |
| Race/Ethnicity | 1.76 | 4 | .78 |

**Preliminary analyses.** A preliminary analysis of the relationships for each continuous variable was conducted for the overall sample (Table E.9, Appendix E), and then individually for

[2] As there were categorical and continuous variables, frequency and descriptive statistics tables can be found in Appendix E, Tables E.2-E.6. However, some descriptive statistics of note are also reported in text. First, min and max scores for the seven blood oxygen percent measurements for all groups were 97 to 100 with a range of 3, thus this score was considered a constant and not included in analyses as was stated in the original proposal.

the NWC group (Table E.8, Appendix E), NWE (Table E.9, Appendix E), the overweight experimental (OWE; Table E.10, Appendix E), and the obese (OBE; Table E.11, Appendix E) experimental groups, using Pearson r correlations.[3]

In preliminary analyses of the hypotheses, several significant relationships between the weight variables and the self-control tasks were observed in the overall sample. Most notable was the relationship between the increase in correct responses on the COL task with lower weight ($r = -.37$, $p < .01$), BMI ($r = -.38$, $p < .01$), waist circumference ($r = -.40$, $p < .01$), hip circumference ($r = -.33$, $p < .01$), and waist/hip ratio ($r = -.30$, $p < .01$), in the overall sample (Table E.7). However, when the control and experimental weight groups are examined individually, most of these relationships were not apparent. A contributor to this may be the NWC received the control COL task, which resulted in a significantly higher number of correct responses on the COL tasks than the experimental groups (Table E.12, Appendix E). Thus, when the groups were examined separately, the relationship between the weight variables was no longer significant. In order to account for the possibility restriction of weight range may account for these non-significant findings, the three experimental groups were combined into one. Again, the relationship between weight variables and performance on the COL tasks was not significant.

There were three observed relationships between weight variables and performance on the self-control tasks, including a strong relationship between greater BMI and decrease in correct Stroop responses in the NWE ($r = -.46$; Table E.9) and OBE ($r = .47$, $p < .05$; Table E.11) groups, and a moderate relationship between greater hip circumference and an increase commission/omission errors on the COLe task in the OWE ($r = .35$, $p < .05$; Table E.10) group.

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[3] It must be noted that the overall sample includes the control sample and the experimental sample, thus these relationships should be interpreted with caution. All participants received the same Stroop task, thus those relationships may be better for interpretation for the self-control task in the overall group.

None of the four BG measurements taken after baseline, before and after the self-control tasks, or after the rest period, were related to the self-control variables. However, in the overall sample, a decrease in the BG taken between baseline and after the rest period was related to an increase in correct STROOP responses ($r$ = -.26, $p$ < .01). Furthermore, in the overall sample, errors on the COL task – particularly omission errors – increased if BG measurements increased between the completion of the COL task and after the rest period ($r$ = .23, $p$ < .05).[4]

Finally, DSC was not related to variables in the overall group and the experimental groups, with few exceptions. First, as DSC increased, errors made on the STROOP were observed to decrease ($r$ = .23, $p$ < .05) for the overall group. The same relationship was observed in the NWE group ($r$ = -.37, $p$ < .05), however, the strength of these relationships as weak to moderate.

**Tests of Hypotheses**

**Hypothesis #1.** First, it was expected that there will be no difference between BG levels before and after the COL task in the overweight and obese experimental groups (H1a), however, there will be differences observed in the normal weight experimental group (H1b). Since the NWC group did not engage in this depletion task, their BG levels pre and post the COL task are expected to stay the same (H1c). Four paired-samples t-tests (one-tailed) were conducted to evaluate these four related sub-hypotheses in hypothesis #1 (Table E.13, Appendix E).[5]

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[4] As there were significant relationships between the BG measurements and hunger, hunger was used as a covariate in ANCOVA analyses and hierarchical regressions, when applicable. No new additional findings were observed.

[5] A large number of t-test values are shown in Tables E.13. Most of these are simply meant as exploratory in nature. Only one's predicted by hypotheses are commented on here. Because of this large number of comparisons, it was decided to save space by showing mean differences and not individual means.

As expected in the stated hypothesis (H1a), there was not a statistically significant difference between the BG measurements at baseline and after the COLc task for the NWC group, and between BG at baseline and after the COLe task for the OWE and OBE groups (H1c). However, contrary to the stated hypothesis (H1b), BG levels would drop after a self-control task, there was no significant change between these two measurements for the NWE experimental group as well.

To further explore the data, paired sample t-tests were repeated between each BG measurement within experimental/control group (Table E.13). These results were variable in that an increase in BG before and after completion of the STROOP task was significant in the overall group ($t$ = 2.67, $p$ < .01) and approached significance in the NWC group ($t$ = 1.61, $p$ = .06), but was not observed in any of the experimental weight groups. A significant increase in BG between the COL task and the rest period was observed for the overall ($t$ = 2.58, $p$ < .05) and OWE groups ($t$ = 2.48, $p$ < .05), and approached significance in the OBE group ($t$ = 1.47, $p$ = .07). However, the effect sizes for these relationships were small to moderate with Cohen's $d$ ranging from .16 to .30.

Finally, the NWE, OWE, and OBE groups were combined into one experimental group. The paired-samples $t$-tests were then compared for each BG measurement (Table E.14, Appendix E). Findings indicated a significant increase in BG before and after the STROOP task ($t$ = 2.12, $p$ < .05), approached significance in the NWC ($t$ = 1.61, $p$ = .06). A significant increase in BG between the COLe task and the rest period ($t$ = 2,63, $p$ < .05) was also observed in the combined experimental group. However, again the effect sizes were weak at best, Cohen's $d$ ranged from 1.7 to .19.

**Hypothesis #2**. The second primary hypothesis is that, following the COL task; OBE and OWE individuals will display significantly poorer performance on the STROOP task than the

NWE group. The participants' performance on the STROOP task was determined by the number of items completed and number of errors made in the 10-minute time period.

A one-way between groups ANOVA was conducted to explore the impact of weight group on correct STROOP responses after completing an initial self-control task. Contrary to the stated hypothesis, there were no observed differences between correct or incorrect STROOP responses between the experimental and NWC groups (Table E.12). After adjusting for performance on the COL task, a one-way between-groups ANCOVA indicated there was still no difference between weight groups in correct STROOP responses; $F\ (3, 124) = 1.35$, $p = .26$.

**Research Question.** As stated in the specific aims, the relationship between DSC and the changes in BG was assessed. There were no significant differences in DSC between the control group and the three experimental groups, $F\ (3, 124) = .88$, $p = .46$. Additionally, DSC did not account for a significant amount of variance seen in the change in BG before and after each self-control task (Table E.15, Appendix E).[6]

**Exploratory analyses.** Previous research indicates there will be a significant change in BG after engaging in an initial self-control task. As observed in the preliminary analyses for each group, some relationships were observed between the changes in BG measurements and the self-control measures (See Tables E.2-E.6). Further, a significant relationship between the increase in BMI and a decrease in BG before and after the COLe task ($r = -.44$, $p < .05$), and the decrease in BG between the baseline measurement and after the rest period ($r = .52$, $p < .01$) was observed in the NWE group.

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[6] These regression analyses were repeated again to explore the differences between each BG measurement (e.g., BG at baseline – BG after rest; BG after the COL task – BG after the STROOP) to assess this relationship over time. There was no significant amount of variance in these BG changes explained by DSC.

Although BMI was not significantly related to any other BG variable, in accordance with stated exploratory analyses, DSC was assessed as a possible suppressor variable for the observed changes in BG before and after tasks and BMI. A regression was conducted with interaction terms for BMI and dispositional self-control and a change term for the blood glucose measurement as the dependent measure. Multiple regression was used to assess the interaction between BMI and dispositional self-control (as measure by the self-control questionnaire). As expected from previous analyses, there was no significant interaction of dispositional self-control and BMI on the change score between the blood glucose measurements at baseline and after the initial self-control task $F$ (3, 125) = .28, $p$ = .84 for the overall group.[7]

To further explore DSC, an ordinal variable was created for high/low self-control. Two-tailed independent sample t-tests [8] were conducted for the overall sample and between each weight group to assess the differences in continuous variables with high/low DSC as the independent variable (Table E.16, Appendix E). While there were no significant differences between high/low DSC in the self-control tasks, there were some notable significant differences in other variables. First, individuals in the OBE group with lower DSC have significantly lower waist/hip ratio than individuals with higher DSC ($t$ = 2.45, $p$ < .05, Cohen's $d$ = 1.19). Second, each of the four BG measurements were significantly higher for individuals with high DSC in the NWC group ($t$ = -.2.27, $p$ < .05; $t$ = -2.15, $p$ < .05; $t$ = -2.15, $p$ < .05; $t$ = -2.48, $p$ <.01; $t$ = -3.29, $p$ < .01). Cohen's $d$ for these findings ranged from .76 to .96, considered medium to large effect sizes.

[7] These regression analyses were again repeated for each experimental group and the control group. Again, dispositional self-control and BMI did not account for a significant amount of the variance in the BG change before and after the COL task.

[8] Two tailed t-tests were used instead of one-tailed t-tests because these analyses are exploratory in nature, thus the direction of the analysis was not predicted.

Further, individuals with higher reported DSC in the NWC group reported the self-control tasks (COLc and Stroop) as less effortful than individuals with lower reported DSC ($t$ = 2.39, $p < .05$, Cohen's $d$ = .86). Finally, in paired-samples t-tests conducted in the overall sample, individuals with high DSC appeared to experience a significant increase in BG (Table E.17, Appendix E). The largest of these increases was between the BG measurement taken before and after the COL task ($t$ = 2.14, $p < .05$, Cohen's $d$ = .25) and the BG measurement taken after the baseline task and after the 10-minute rest period ($t$ = 3.01, $p < .01$, Cohen's $d$ = .23).

To further explore that data, a mixed between-within subjects ANOVA was conducted to assess the BG measurements across the four time periods (baseline, COL, STROOP, and rest) for each weight group (Table E.18, Appendix E). There was no significant interaction between weight group and time. However, there was a trend toward an interaction between high/low DSC and BG measurements over time which approached significance $F$ (3, 115) = 2.19, $p$ = .09 as well as the main effect for time, Wilk's Lambda = .95, $F$ (3, 124) = 2.36, $p$ = .08, partial eta squared .08.[9]

Finally, a similar multiple regression analysis to the one described in the research question was conducted with the waist/hip ratio included in place of the BMI measure. This allows for an examination of the relationship and interaction of abdominal obesity on the blood glucose levels after a self-control task. The ability of waist/hip ratio and DSC to predict the change in BG before and after the COLe task was not statistically significant, $F$ (2, 91) = .43, $p$ = .65. These analyses were repeated for each weight group and the BG change after the Stroop task

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[9] These analyses were to be repeated on an exploratory level for the eight pulse rate and blood oxygen repeated measures. Although, there were statistically significant differences between groups (See Appendix E for full statistics), the tool to measure these components did not appear to reliably measure them. Thus these results were not interpreted.

and the 10-minute rest. Again, the ability of waist/hip ratio and DSC to predict the changes in BG after the Stroop and rest period was not significant for any of the weight groups.

# DISCUSSION

The present study aimed to examine factors that may help explain the strength model of self-control in an experimental design. These specific factors include BMI, dispositional self-control (DSC), the theory of glucose depletion, and engagement in self-control tasks. First, the hypothesis in the current study assumes that glucose depletes after an initial self-control task. The second hypothesis assumes that participants who engage in the self-control task will show poorer performance on a subsequent self-control task compared to a control group. These hypotheses were examined between weight groups (i.e., normal weight control [NWC], normal weight experimental [NWE], overweight experimental [OWE], and an obese experimental group [OE]).

## Hypothesis #1

In the strength model of self-control, previous research has indicated blood glucose (BG) decreases after an individual engages in a self-control task. Accordingly, it is hypothesized BG is the fuel supplying self-control. In the current research, preliminary statistics indicated there might be some credence to this hypothesis. First, in the overall sample, when the participant's BG decreased between the baseline task and the rest period, correct responses on the Stroop increased. The opposite relationship was observed in the OWE, with an increase in errors made on the COL task, particularly omission errors, when BG measurements increased between the COL task and the rest period. However, this is where the support of this hypothesis ended.

Three sub-hypotheses were directly tested in the current research including: 1a) due to possible biological mechanisms (e.g., insulin resistance) that would prevent them from utilizing glucose for self-control, there would be no difference in BG levels before and after the COLe task in the OWE and OBE groups, 1b) due to the less likely change their ability to metabolize glucose, the NWE group would exhibit a significant drop in BG after the self-control task, and

1c) differences in BG would not be observed in the NWC group because they did not engage in the initial self-control task. Although significant decreases in BG were not observed in the OWE, OBE, and NWC groups, supporting hypothesis 1a & 1c, a significant drop was not observed in the NWE group either (hypothesis 1b). Thus, the initial self-control task did not appear to deplete BG as hypothesized.

The BG hypotheses were further explored with the assessment for significant changes between each BG measurement (e.g., change in BG between baseline and the COL task, change in BG between the COL task and the Stroop, etc.). These results were mixed. For instance, there was a significant increase in BG before and after the Stroop task for the overall group. This was contrary to the theory that BG would decrease after the self-control task. Significant increases in BG were also observed between measurements taken after the COL task and after the rest period for the overall and OWE groups and approached significance in the OBE group. Again, this increase was contrary to what was stated in hypothesis 1 and its related sub-hypotheses.

A final test of this hypothesis, the NWE, OWE, and OBE groups were combined into one single experimental group. Findings continued to be contrary to what was expected. Significant increases in BG were observed between measurements taken before and then after the Stroop task and between the measurements taken after the COLe and after the rest period. These significant findings when the experimental groups were combined may indicate a larger sample size for each experimental group was needed to observe an effect on BG for the experimental groups.

An additional explanation for the observed increase in BG as opposed to the hypothesized decrease may also be an effect of two interacting factors. First, research published after the completion of data collection for the current study indicates there may be an adaptation effect in terms of length of the self-control task (Dang, Dewitte, Mao, Xiao, & Shi, 2013).

Second, the body reacts to stressors in a myriad of ways, including releasing glucose into the bloodstream (e.g., Sim, Park, Kang, Kim, Lee, Jung, & Suh, 2010). Since participants in the current study engaged in the self-control tasks for 10 minutes each, this may have been adequate time for them to adapt to the task. It could be hypothesized the lack of change in the NWE and significant increase in BG in the OWE and the combined experimental group was a biological adaptation response to the self-control tasks. In essence, the window to observe a decrease in BG in the NWE group was missed and due to insulin resistance, BG in the OWE and OBE groups may have actually increased in response to the stressor.

In terms of daily living, these mechanisms of adaptation and glucose release would make sense. Individuals do not engage in one or two self-control tasks and then "call it quits" only to lose total control throughout the rest of the day. Daily living is riddled with difficult decisions, which, in essence, could be considered self-control tasks. Thus, it is almost essential for the body to adapt to these stressors e.g., varying the amounts of BG released in response to the presence and absence of stressors, so that it may continue to function. The strength of these relationships, as observed by the calculation of Cohen's *d*, may give credence to this hypothesis.

**Hypothesis #2**

The previous literature indicated individuals who engage in a self-control task, and were thus depleted, would perform worse on a subsequent self-control task. The present study aimed to examine if individuals' performance on the subsequent self-control task would be influenced by BMI. There were relationships present between weight variables and participant performance on the first self-control task. Specifically, as the weight variables (i.e., weight, BMI, waist and hip circumference, and waist/hip ratio) increased, correct responses on the crossing-out-letters task (COL) task decreased. Although, at first glance, this relationship may support the hypothesis that individuals with higher weight variables (e.g., BMI, weight, etc.) would perform poorer on the self-control tasks, this might not be the case. For instance, the COL variable for the overall population includes both the COL control (COLc) and COL experimental (COLe) tasks. Because the COLc task was easier than that COLe task, normal weight control (NWC) participants made a higher number of correct responses. Consequently, when the control and experimental groups were combined, this control group artificially raised the number of correct responses. This is evidenced by the disappearance of this relationship when the single NWC control and the three combined experimental groups were examined separately.

However, there was an observed relationship between the second self-control task (Stroop) and BMI in the normal weight experimental (NWE) and the obese experimental groups (OBE). In this instance, a higher BMI in both groups was associated with a poorer performance on the Stroop task in terms of decreased correct responses. A similar relationship was observed in the overweight experimental (OWE) group with larger hip circumference associated with increased errors on the COLe task. Unlike the previously mentioned relationships with the overall group, these relationships observed in the experimental groups do lend some support to the hypothesis that weight plays a role in performance on self-control tasks. However, further exploration of these relationships indicates they may be spurious.

This possibility these findings were misleading was most evident in the direct testing of hypothesis 2. In accordance with the strength model of self-control, it was hypothesized participants who engaged in a self-control task would demonstrate poorer performance on a subsequent self-control task. For the current research, it was hypothesized that the NWE group would demonstrate poorer performance on the second self-control task compared to the NWC group and the overweight and obese individuals would were demonstrate markedly poorer performance than both the NWE and NWC - presumably due to poorer glucose metabolism.

Contrary to the stated hypothesis, there were no differences in Stroop performance between each group.

As stated above, one explanation for these findings is that the non-significant results observed are an adaptation effect due to the time duration of the self-control tasks. As a result of the time duration and adaptation responses, any observed effect may have been washed out.

**Research Questions and Exploratory Analyses**

At the time of this study, previous literature had not assessed the role dispositional self-control (DSC) would play in the theory of self-control depletion. Analyses of research questions and exploratory analyses were conducted to examine possible relationships between DSC - a trait variable - and the dependent variables (i.e., BG, weight variables, performance on the self-control tasks). The three experimental weight groups did not differ on reported DSC, Further, DSC did not account for a significant amount of variance observed in the changes in BG before and after the self-control tasks or variance in BMI.

However, when a categorical variable was created to capture individuals with high and low DSC, there were some notable differences. These differences include; significantly lower BMI in OBE individuals with higher DSC and significantly higher BG levels at all four time measurements in NWC participants with higher DSC. Further, in correlational analyses, higher DSC was related to a decrease in errors on the Stroop.

DSC self-control also appeared to play a role in the perceived effort the participant's felt was needed to complete the self-control tasks. First, participants with higher DSC in the NWC reported the control and self-control tasks as less effortful than participants with lower DSC. This finding may indicate higher DSC self-control plays a role in the perceived effort individuals experience during self-control tasks.

BG measures further indicated participants in the overall sample with high DSC displayed a significant increase in BG between the measurements taken before and after the COL task and the measurement taken at baseline and after the rest period. Additionally, the interaction between high/low self-control and time in terms of the four repeated measures of BG approached significance. This may indicate changes in BG may be in some way related to an individual's DSC. In terms of the previous suppositions, it could be hypothesized that individuals with high DSC exhibit a greater adaptation effect, displaying a greater rise in BG in order to counteract the depletion effects.

## Overall Discussion

Support for the current study's hypotheses was negative to mixed. First, there was some mixed support for changes in BG before and after the self-control tasks as observed. In direct analyses, the changes expected in BG were not observed. Specifically no change in BG in the NWE group was observed, along with either a trend or significant increase in the OWE and OBE groups. Further, it was hypothesized that weight may be related to performance on the self-control tasks. This too was mixed, for example, higher BMI was associated with poorer performance on these tasks in some groups. However, these findings were not supported when directly assessed.

As mentioned above, the current study's method was conceptualized in that if self-control is a depletable resource, the longer a stressor is introduced, the greater the depletion effect would be observed. However, research, published in the year after data was collected, suggests there may be an adaptation effect that occurs the longer an individual engages in the self-control task, regardless of motivation (Dang et al., 2013). Though there appears to be an initial self-control depletion response, the longer the individual engages in the task, the less likely they are to make mistakes, a kind of practice effect if you will. Additionally, the adaptation effect appears to carry over to subsequent cognitive tasks that are similar to the initial task. The way the current research as conceptualized may have inadvertently assessed this adaptation effect with the length and type of cognitive tasks chosen.

Another possible explanation of the results may be any significant findings are due to chance, and that a different opposing theory may more adequately explain losses in self-control. Previous research has indicated there may be multiple factors that contribute to the decline in performance seen in depletion tasks, including; increased task motivation (Hagger et al, 2010; Tice, Braslavskly, Baumeister, 2001), beliefs in unlimited self-control (Job, Dweck, & Walton, 2010), as well as behaviors such as smoking (Heckman, Ditre, & Brandon, 2012), confirming a core values (Schmeichel & Vohs, 2009), and even praying (Friese & Wanke, 2013). This led Inzelicht and colleagues (Inzlicht, Schmeichel, & Macrae, 2013) to posit that self-control is a more dynamic resource than put forth by the strength model. Inzelicht et al's theory suggests that self-control operates in context of one of two opposing domains; a proximal domain (e.g., cognitive processes such as "I want to do X") versus a meso-level domain (e.g., "I have to do X"). More specifically, organisms are evolutionarily adapted to seek a balance between the proximal factors (I want) – that help lead to exploration for new resources – and meso-level factors (I have to) – that allow the organism to feel obligated to exploit, or adequately utilize, the resources available to them. Meso-level factors are the closest representation in this theory to what could be considered self-control (e.g., persisting in task engagement). Thus they hypothesized results seen in previous research that suggest "depletion," may be the participant's switching from an meso-level "have to" or work motivation (e.g., doing well on the self-control task) versus a proximally rewarding "want to" or leisure motivation (e.g., disengaging from the self-control task to day dream).

In terms of the current research, participants in this study endorsed a higher DSC than seen in previous studies. This may indicate they utilized their DSC to consistently engaged in the meso-level factors during the self-control tasks (e.g., I have to complete this task adequately to receive SONA credit). Consequently, they did not engage in the "I don't wanna do this cause it's boring" (proximal factor) and thus did not display what could possibly look like a depletion effect observed in previous research.

## Limitations

Several limitations were observed in the current study. First and most obvious of limitations was the duration of the self-control task. Due to the absence of a shorter depletion task to compare it to, strong conclusions about the self-control adaptation hypothesis cannot be made. However, the failure to observe depletion effects in the BG measurements before and after the self-control tasks may indicate that not only do individuals cognitively adept to the self-control task, but may physiologically adapt as well. As stated previously, when stressed, the body decreases insulin and increases glucose released from the liver (Sim, Park, Kang, Kim, Lee, . . . & Suh, 2010). The absence of differences observed in BG between the NWC compared to NWE groups, and NWE compared to the OWE and OBE groups may be due to the NWE release of glucose in response to adapting to the stressor, i.e., the self-control tasks. Specifically, the NWE's glucose response may have depleted and adapted or remained the same and the OWE and OBE group glucose response may have increased in response to the duration and stress of the self-control task.

Another limitation would be the range of participant's dispositional self-control (DSC), which was significantly higher than seen in the general population. While this is common among college students (the population sampled here), it may account for some of the mixed results seen in the literature as well as the results seen in the current study. Specifically, although it has been linked to favorable outcomes in individuals with high DSC, to date, it has not been assessed in studies of self-control depletion theory. Thus, in keeping with the self-control depletion theory, individuals with higher DSC may be less susceptible to the self-control depletion effects of these particular self-control tasks. However, the results could also be in line with the dynamic theory of Inzelicht and colleagues, in that college students have a higher DSC, and thus are more likely to be motivated to persist in the "have to" aspect of self-control tasks.

Finally, a major limitation of the current research was the overlooked opportunity to further examine the role restrained eating might play in the strength theory of self-control. The results for the strength theory of self-control and restrained eating are also mixed in the literature (Kahan, et al., 2003; Valentine, No Date). This, in conjunction with research that suggests restrained eating is associated with higher BMI, insinuates the current sample would likely score high on restrained eating questionnaires. More specifically, the relationship between restrained eating and self-control could have been explored further. Could restrained eaters with differences high/low DSC account for the null findings in the current study? Future research is needed to explore this question.

## Future Research

Future research would likely focus on the limitations described above. Specifically, efforts could be made to recruit from a more general population in contrast to the college undergraduate population assessed here. A more general population would more likely have a broader range in DSC observed in participants. A broader range of DSC would allow a clearer assessment of the role DSC may play in self-control depletion.

Additionally, future research may also focus on the adaptation responses observed in previous research in relation to self-control depletion, not only with regard to cognitive responses (e.g., errors on self-control tasks), but physiological responses as well (e.g., hormonal responses, metabolic responses, etc.). Specifically, future research would assess the effect of a shorter self-control on the cognitive and physiological responses to stressors in contrast to a longer, and theoretically more adaptive stressor.

Future research may also be expanded to include individuals with diabetes/pre diabetes given that individuals with diabetes also experience cognitive difficulties during stress. Individuals with known diabetes/pre diabetes were purposefully excluded from the current study to examine the role weight alone may play in the depletion effects of self-control. However, there is previous research that indicates individuals with diabetes may experience cognitive difficulties such as mental slowing and reduced mental flexibility (Brands, Biessels, de Haan, Kappelle, & Kessels, 2005). Additionally, better cognitive functioning was associated with improved metabolic control in individuals with type 2 diabetes (Ryan, Freed, Rood, Cobitz, Waterhouse, & Strachan, 2006). Thus, examining the strength model of self-control and the theory of glucose depletion in individuals diagnosed with type 2 diabetes would further add to the literature.

Overall, the current and future research would further examine the factors that relate to self-control and the reasons behind why some individuals may or may not disengage in activities that require self-control. Further understanding the failure and success of maintaining self-control would assist in developing interventions and therapies that can assist practitioners in treating patients.

# APPENDIX A
# DEMOGRAPHICS AND OTHER QUESTIONS

Demographics Questionnaire

First we'd like to ask a few questions about you.

1) What is your birth date? ____/_____/_______ (mm / dd / yyyy)
2) What is your gender? Male Female
3) What is your relationship status? (e.g., single never married, married, divorced, etc.) _________________
4) What is your race/ethnicity? _______________________________________
5) Are you Hispanic? Yes No
6) Are you color blind? Yes No
7) Do you have any concern about you having a blood borne or bleeding disease that would make use of a sterile lancet to draw a drop of blood dangerous? Yes No
8) Has a doctor ever said you have diabetes or sugar disease? Yes No
9) Has a doctor ever said you have low blood sugar or hypoglycemia? Yes No
10) Have you ever or are you currently taking any of the following medications, which are typically used to manage diabetes? (Please check all that apply).
    i. Actos (pioglitazone) ______
    ii. Amaryl (glimepiride) ______
    iii. Avandia (rosiglitazone) _______
    iv. Byetta (exenatide) _______
    v. DiaBeta (glyburide) _______
    vi. Glucophage (metformin) _______
    vii. Glucovance (glyburide and metformin) _______
    viii. Glynase (glyburide) ______
    ix. Glyset (miglitol) ________
    x. Humalog (insulin lispro) _______
    xi. Insulin Isophane ______
    xii. Januvia (sitagliptin) ________
    xiii. Lantus (insulin glargine) ________
    xiv. NovoLog (insulin aspart) ________
    xv. Onglyza (saxagliptin) ________
    xvi. Prandin (repaglinide) ________
    xvii. Precose (acarbose) ________
    xviii. Starlix (nateglinide) ________
    xix. Victoza (liraglutide) ________

Other Questions

Please Rate your current level of fatigue:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Not Fatigued at all | | | | Moderately fatigued | | | | | Extremely fatigued |

How effortful were the self-control tasks?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Not at all effortful | | | | Moderately effortful | | | | | Extremely effortful |

What was the time of your last meal? ___:___ AM/PM

How hungry are you currently?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Not hungry at all | | | | Moderately hungry | | | | | Extremely hungry |

APPENDIX B

BLOOD GLUCOSE MEASURE, PULSE, AND PERCENT OXYGEN

Experimenter: Please record bio-measures below.

| | | | |
|---|---|---|---|
| Baseline * | | | |
| | Pulse/Blood $O_2$ % | | Glucose |
| Crossing-out-letters 2 | | | |
| | Pulse/Blood $O_2$ % (Pre) | Pulse/Blood $O_2$% (Post) | Glucose |
| Stroop 2 | | | |
| | Pulse/Blood $O_2$ % (Pre) | Pulse/Blood $O_2$% (Post) | Glucose |
| 10 minute period | | | |
| | Pulse/Blood $O_2$ % (Pre) | Pulse/Blood $O_2$% (Post) | Glucose |

*(Taken immediately before Crossing-out letters task 1)

# APPENDIX C
# VANILLA BASELINE

**Baseline Picture Rating Task**

**- Examiner Script**

You are being presented a notebook series of pictures. Please look at these pictures and mark which of the pair you prefer. Please do not open the book or turn the pages until you are instructed to do so. You will be given approximately 1 minute to make your selection.

Are you ready? Please turn to the 1st picture set.

(Time participant for 1 minute)

If you have not made a selection please do so now and then turn to the 2nd picture set.

(1 minute)

If you have not made a selection please do so now and then the 3rd picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 4th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 5th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 6th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 7th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 8th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 9th picture set.

(1 minute)

If you have not made a selection please do so now and then turn to the 10th picture set.

(1 minute)

**Baseline Picture Rating Task**

When instructed, open the Book and examine the first set up pictures. When you are instructed rate which picture you prefer by circling your choice below. You will be instructed as to when to continue to the next set of ratings. You will have approximately 1 minute for each set of pictures.

**Preference**

| | Picture | Picture |
|---|---|---|
| Set 1 | A | B |
| Set 2 | A | B |
| Set 3 | A | B |
| Set 4 | A | B |
| Set 5 | A | B |
| Set 6 | A | B |
| Set 7 | A | B |
| Set 8 | A | B |
| Set 9 | A | B |
| Set 10 | A | B |

APPENDIX D

CROSSING-OUT-LETTERS TASK

Sample Crossing-Out-Letters Task 1 (All Participants)

Instructions: Cross out each instance of the letter "e." For example, "The penguin is a flightless bird." You will have five minutes. Make sure to cross out each possible instance, working as fast as you can without making mistakes. If you make a mistake, do not erase the mistake and continue with the task. If you finish before the five minutes is up, start again from the beginning and make sure you have crossed out every letter "e." If you do not finish before the five minutes, please place a mark at the last spot you looked.

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*Gadsby: A Story of Over 50,000 Words Without Using the Letter "E"* is a 1939 novel by Ernest Vincent Wright. The plot revolves around the dying fictional city of Branton Hills, which is revitalized thanks to the efforts of protagonist John Gadsby and a youth group he organizes.

The novel is written as a lipogram and does not include words that contain the letter "e". Though self-published and little-noticed in its time, the book is a favorite of fans of constrained writing and is a sought-after rarity among some book collectors. Later editions of the book have sometimes carried the alternative subtitle: *50,000 Word Novel Without the Letter "E"*.

The novel's 50,110 words do not contain a single *e*. In *Gadsby*'s introduction Wright says his primary difficulty was avoiding the "-ed" suffix for past tense verbs. He focused on using verbs that do not take the -ed suffix and constructions with "do" (for instance "did walk" instead of "walked"). Scarcity of word options also drastically limited discussion involving quantity, pronouns, and many common words. Wright was unable to talk about any quantity between six and thirty. An article in the linguistic periodical *Word Ways* said that 250 of the 500 most commonly used words in English were still available to Wright despite the omission of words with *e*. Wright uses abbreviations on occasion, but only if the full form is similarly lipogrammatic, such as with "Dr.", and "P.S.".

Wright also turns famous sayings into lipogrammatic form. Music can "calm a wild bosom", and Keats' "a thing of beauty is a joy forever" becomes "a charming thing is a joy always."

Sample Crossing-Out-Letters Task 2 (Control Group)*

Instructions: For this task, please cross out each instance of the letter “e.” For example, “**The penguin lives in the Artic circle. ~~E~~very winter . . .**” Please practice on the example below.

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An Aftershave is a lotion, gel, balm, powder, or liquid used mainly by men after they have finished shaving. It may contain an antiseptic agent such as denatured alcohol or stearate citrate to prevent infection of cuts. Menthol is used in some varieties as well to numb damaged skin, and it is an ingredient that shaving cream manufacturers have started including in their formulations, too. Aftershave with alcohol also usually causes an immediate burning sensation in men who apply it post-shave—with effects sometimes lasting several minutes.

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Now complete the following passage in the same way. You will have five minutes. Make sure to cross out each possible instance, working as fast as you can without making mistakes. If you make a mistake, do not erase the mistake and continue with the task. If you finish before the five minutes is up, start again from the beginning and make sure you have crossed out every letter “e.” If you do not finish before the five minutes, please place a mark at the last spot you looked.

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Clay animation or claymation is one of many forms of stop motion animation. Each animated piece, either character or background, is "deformable"—made of a malleable substance, usually Plasticine clay.

All traditional animation is produced in a similar fashion, whether done through cel animation or stop motion. Each frame, or still picture, is recorded on film or digital media and then played back in rapid succession. When played back at a frame rate greater than 10–12 frames per second, a fairly convincing illusion of continuous motion is achieved. While the playback feature creating an illusion is true of all moving images (from zoetrope to films to videogames), the techniques involved in creating CGI are generally removed from a frame-by-frame process.

In clay animation, each object is sculpted in clay or a similarly pliable material such as Plasticine, usually around a wire skeleton called an

*Excerpt of the COL control task, which consists of 5 pages.

Sample Crossing-Out-Letters Task 2 (Experimental Group)*

Instructions: For this task, please cross out each instance of the letter "e" ONLY if it is preceded by a vowel immediately before its occurrence or if a vowel comes two letters. For example, "**The penguin lives in the Artic circle. ~~E~~very winter . . .**" In this example, you cross out the "e" in penguin and lives, but not the "e" in circle. In the word "Every" you would cross out each "e" because they are both preceded by a vowel. Please practice on the example below.

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An Aftershave is a lotion, gel, balm, powder, or liquid used mainly by men after they have finished shaving. It may contain an antiseptic agent such as denatured alcohol or stearate citrate to prevent infection of cuts. Menthol is used in some varieties as well to numb damaged skin, and it is an ingredient that shaving cream manufacturers have started including in their formulations, too. Aftershave with alcohol also usually causes an immediate burning sensation in men who apply it post-shave—with effects sometimes lasting several minutes.

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Now complete the following passage in the same way. You will have five minutes. Make sure to cross out each possible instance, working as fast as you can without making mistakes. If you make a mistake, do not erase the mistake and continue with the task. If you finish before the five minutes is up, start again from the beginning and make sure you have crossed out every letter "e." If you do not finish before the five minutes, please place a mark at the last spot you looked.

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Clay animation or claymation is one of many forms of stop motion animation. Each animated piece, either character or background, is "deformable"—made of a malleable substance, usually Plasticine clay.

All traditional animation is produced in a similar fashion, whether done through cel animation or stop motion. Each frame, or still picture, is recorded on film or digital media and then played back in rapid succession. When played back at a frame rate greater than 10–12 frames per second, a fairly convincing illusion of continuous motion is achieved. While the playback feature creating an illusion is true of all moving images (from zoetrope to films to videogames), the techniques involved in creating CGI are generally removed from a frame-by-frame process.

*Excerpt of the COL experimental task, which consists of 5 pages.

# APPENDIX E
# STATISTICAL TABLES

Table E.1

*Demographic Frequencies for Overall Sample and Weight Groups*

| | Gender | | Race/Ethnicity | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Male (%) | Female (%) | Caucasian (%) | Black or African American (%) | Hispanic/ Latino (%) | Asian (%) | Native American (%) | Other (%) | Total *n* (%) |
| Overall Sample | 44 (32.8) | 90 (67.2) | 73 (54.5) | 20 (14.9) | 18 (13.4) | 10 (7.5) | 3 (2.2) | 10 (7.5) | 130 (100) |
| Normal Weight Control | 8 (24.2) | 25 (75.8) | 18 (54.5) | 6 (18.2) | 5 (15.2) | 2 (6.1) | 0 (0) | 2 (6.1) | 33 (24.6) |
| Normal Weight Experimental | 10 (30.3) | 23 (69.7) | 18 (54.5) | 3 (9.1) | 6 (18.2) | 2 (6.1) | 2 (6.1) | 4 (12.1) | 33 (24.6) |
| Overweight Experimental | 15 (44.1) | 19 (55.9) | 19 (55.9) | 4 (11.8) | 2 (5.9) | 4 (11.8) | 2 (5.9) | 3 (8.8) | 34 (25.4) |
| Obese Experimental | 10 (33.3) | 20 (66.7) | 15 (50) | 7 (23.3) | 4 (13.3) | 2 (6.7) | 1 (3.3) | 1 (3.3) | 30 (22.4) |

Table E.2

*Descriptive Statistics of the Overall Sample*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 126.00 | 19.00 | 55.00 | 22.34 | 4.95 | 3.85 | .22 | 18.59 | .43 |
| Height (inches) | 122.00 | 55.00 | 75.00 | 65.41 | 3.68 | .06 | .22 | -.14 | .44 |
| Weight (lbs) | 122.00 | 101.00 | 331.00 | 160.42 | 38.56 | 1.37 | .22 | 3.04 | .44 |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | 122.00 | 18.30 | 47.77 | 26.25 | 5.36 | 1.57 | .22 | 3.36 | .44 |
| Waist Circumference (inches) | 122.00 | 30.00 | 56.50 | 40.52 | 4.75 | .90 | .22 | 1.70 | .44 |
| Hip Circumference (inches) | 122.00 | 25.00 | 53.50 | 33.02 | 5.51 | 1.25 | .22 | 2.15 | .44 |
| Waist/Hip Ratio | 122.00 | .66 | 1.01 | .81 | .08 | .41 | .22 | -.57 | .44 |
| Blood Glucose (BG) at Baseline (mg/dL) | 122.00 | 71.00 | 130.00 | 96.12 | 10.24 | .72 | .22 | 1.22 | .44 |
| BG Crossing-out-letters (COL)[a] (mg/dL) | 121.00 | 75.00 | 138.00 | 96.65 | 11.52 | .93 | .22 | 1.57 | .44 |
| BG STROOP[b] (mg/dL) | 121.00 | 71.00 | 121.00 | 94.93 | 9.76 | .11 | .22 | -.25 | .44 |
| BG Rest (mg/dL) | 120.00 | 65.00 | 123.00 | 95.18 | 10.14 | .14 | .22 | .41 | .44 |
| BG at Baseline – BG COL task[a] | 121.00 | -22.00 | 24.00 | .61 | 7.98 | .33 | .22 | .27 | .44 |
| BG COL task[a] – BG STROOP[b] | 120.00 | -31.00 | 12.00 | -1.88 | 7.69 | -.72 | .22 | 1.30 | .44 |
| BG STROOP[b] – BG 10-minute Rest | 120.00 | -13.00 | 26.00 | .18 | 5.84 | .96 | .22 | 3.27 | .44 |
| BG Baseline – BG STROOP[b] | 121.00 | -18.00 | 28.00 | 1.12 | 7.60 | .59 | .22 | 1.55 | .44 |
| BG Baseline – BG 10-minute Rest | 120.00 | -15.00 | 21.00 | .93 | 7.12 | .26 | .22 | .60 | .44 |
| BG COL task[a] – BG 10-minute Rest | 119.00 | -12.00 | 31.00 | 1.76 | 7.46 | .97 | .22 | 2.44 | .44 |
| COL Correct Responses[a] | 122.00 | 1.00 | 542.00 | 199.09 | 133.77 | 1.15 | .22 | .02 | .44 |
| COL Omission Errors[a] | 122.00 | 1.00 | 178.00 | 33.43 | 29.43 | 1.73 | .22 | 4.23 | .44 |
| COL Commission Errors[a] | 122.00 | .00 | 114.00 | 5.25 | 14.47 | 5.54 | .22 | 34.35 | .44 |
| COL Errors (Om & Com)[a] | 122.00 | 3.00 | 261.00 | 38.68 | 37.39 | 2.88 | .22 | 12.77 | .44 |
| Correct STROOP Responses[b] | 122.00 | 276.00 | 882.00 | 521.25 | 113.27 | .81 | .22 | .74 | .44 |
| Incorrect Stroop Responses[b] | 122.00 | 3.00 | 60.00 | 20.84 | 11.41 | .91 | .22 | .91 | .44 |
| Heart Rate at Baseline Pre (beats/min) | 112.00 | 44.00 | 150.00 | 81.32 | 16.78 | .67 | .23 | 1.78 | .45 |
| Heart Rate at Baseline Post (beats/min) | 113.00 | 46.00 | 118.00 | 79.83 | 13.68 | .13 | .23 | .16 | .45 |
| Heart Rate at COL[a] Pre (beats/min) | 110.00 | 50.00 | 120.00 | 80.05 | 13.47 | .42 | .23 | -.02 | .46 |
| Heart Rate at COL[a] Post (beats/min) | 113.00 | 45.00 | 135.00 | 83.00 | 14.95 | .77 | .23 | 1.55 | .45 |
| Heart Rate at STROOP[b] Pre (beats/min) | 111.00 | 46.00 | 123.00 | 78.78 | 12.93 | .64 | .23 | 1.06 | .46 |
| Heart Rate at STROOP[b] Post (beats/min) | 112.00 | 53.00 | 130.00 | 83.67 | 12.82 | .56 | .23 | 1.11 | .45 |
| Heart Rate at Rest Pre (beats/min) | 111.00 | 43.00 | 116.00 | 75.09 | 13.02 | .24 | .23 | .40 | .46 |
| Heart Rate at Rest Post (beats/min) | 111.00 | 39.00 | 110.00 | 73.71 | 12.52 | .22 | .23 | .59 | .46 |
| Blood Oxygen at Baseline Pre (beats/min) | 112.00 | 82.00 | 100.00 | 97.76 | 1.86 | -6.18 | .23 | 48.25 | .45 |
| Blood Oxygen at Baseline Post (beats/min) | 113.00 | 82.00 | 99.00 | 97.95 | 1.68 | -7.89 | .23 | 73.97 | .45 |
| Blood Oxygen at COL[a] Pre (beats/min) | 110.00 | 97.00 | 100.00 | 98.29 | .60 | .07 | .23 | -.18 | .46 |
| Blood Oxygen at COL[a] Post (beats/min) | 113.00 | 96.00 | 99.00 | 98.23 | .52 | -.14 | .23 | 2.17 | .45 |

[a.] *Denotes the combined responses for both COL control task completed by the Normal Weight control group and the COL experimental task for the experimental groups.*

[b.] *All participants were given the STROOP task.*

Table E.2 (cont.)

*Descriptive Statistics of the Overall Sample*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Blood Oxygen at STROOP[b] Pre (beats/min) | 111.00 | 49.00 | 100.00 | 97.89 | 4.76 | -10.05 | .23 | 104.09 | .46 |
| Blood Oxygen at STROOP[b] Post (beats/min) | 112.00 | 95.00 | 100.00 | 98.34 | .61 | -.82 | .23 | 7.15 | .45 |
| Blood Oxygen at Rest Pre (beats/min) | 111.00 | 84.00 | 108.00 | 98.11 | 1.90 | -2.74 | .23 | 33.69 | .46 |
| Blood Oxygen at Rest Post (beats/min) | 111.00 | 91.00 | 100.00 | 98.04 | 1.10 | -3.63 | .23 | 19.12 | .46 |
| Subjective Effort | 122.00 | 1.00 | 10.00 | 5.32 | 2.20 | .03 | .22 | -.74 | .44 |
| Subjective Fatigue | 122.00 | 1.00 | 10.00 | 4.57 | 2.14 | .02 | .22 | -.62 | .44 |
| Subjective Hunger | 121.00 | 1.00 | 10.00 | 6.12 | 2.39 | -.42 | .22 | -.66 | .44 |
| Self-Control Questionnaire | 124.00 | 82.00 | 178.00 | 122.50 | 16.51 | .26 | .22 | .24 | .43 |

[a.] *Denotes the combined responses for both COL control task completed by the Normal Weight control group and the COL experimental task for the experimental groups.*

[b.] *All participants were given the STROOP task.*

Table E.3

*Descriptive Statistics for the Normal Weight Control Group*

| Variable | N | Min | Max | Mean | SD | Skew. | SE | Kurt. | SE |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 32.00 | 19.00 | 27.00 | 21.13 | 1.98 | 1.71 | .41 | 2.93 | .81 |
| Height (inches) | 32.00 | 59.50 | 75.00 | 65.14 | 3.71 | .38 | .41 | -.14 | .81 |
| Weight (lbs) | 32.00 | 109.00 | 168.00 | 134.72 | 16.68 | .31 | .41 | -.80 | .81 |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$ (inch)) | 32.00 | 20.08 | 23.82 | 22.25 | 1.12 | -.20 | .41 | -1.14 | .81 |
| Waist Circumference (inches) | 32.00 | 30.25 | 40.50 | 37.47 | 2.10 | -1.46 | .41 | 3.54 | .81 |
| Hip Circumference (inches) | 32.00 | 25.00 | 38.00 | 29.13 | 2.80 | 1.03 | .41 | 2.11 | .81 |
| Waist/Hip Ratio | 32.00 | .66 | .97 | .78 | .07 | .89 | .41 | .89 | .81 |
| Blood Glucose (BG) at Baseline (mg/dL) | 32.00 | 77.00 | 127.00 | 99.19 | 11.38 | .67 | .41 | .55 | .81 |
| BG Crossing-out-letters Control (COLc) (mg/dL) | 32.00 | 78.00 | 138.00 | 99.59 | 14.26 | 1.08 | .41 | 1.39 | .81 |
| BG STROOP (mg/dL) | 31.00 | 75.00 | 118.00 | 97.65 | 10.78 | -.31 | .42 | -.30 | .82 |
| BG Rest (mg/dL) | 31.00 | 74.00 | 123.00 | 98.84 | 10.33 | -.19 | .42 | .36 | .82 |
| BG at Baseline – BG COLc task | 32.00 | -22.00 | 15.00 | .41 | 8.21 | -.26 | .41 | .69 | .81 |
| BG COLc task – BG STROOP | 31.00 | -31.00 | 12.00 | -2.48 | 8.59 | -1.39 | .42 | 3.31 | .82 |
| BG STROOP – BG 10-minute Rest | 31.00 | -8.00 | 10.00 | 1.19 | 4.90 | -.30 | .42 | -.46 | .82 |
| BG Baseline – BG STROOP | 31.00 | -15.00 | 23.00 | 1.35 | 8.60 | .48 | .42 | .33 | .82 |
| BG Baseline – BG 10-minute Rest | 31.00 | -14.00 | 21.00 | .16 | 8.32 | .31 | .42 | .31 | .82 |
| BG COLc task – BG 10-minute Rest | 31.00 | -11.00 | 29.00 | 1.29 | 9.03 | 1.13 | .42 | 1.94 | .82 |
| COLc Correct Responses | 32.00 | 40.00 | 542.00 | 395.69 | 100.35 | -1.42 | .41 | 3.74 | .81 |
| COLc Omission Errors | 32.00 | 6.00 | 97.00 | 49.50 | 27.26 | .26 | .41 | -1.20 | .81 |
| COLc Commission Errors | 32.00 | .00 | 7.00 | 1.00 | 1.57 | 2.21 | .41 | 6.02 | .81 |
| COLc Errors (Om & Com) | 32.00 | 7.00 | 99.00 | 50.50 | 27.78 | .25 | .41 | -1.24 | .81 |
| Correct STROOP Responses | 32.00 | 334.00 | 729.00 | 536.16 | 106.97 | .10 | .41 | -.66 | .81 |
| Incorrect Stroop Responses | 32.00 | 3.00 | 41.00 | 18.66 | 10.81 | .47 | .41 | -.65 | .81 |
| Heart Rate at Baseline Pre (beats/min) | 28.00 | 51.00 | 121.00 | 83.32 | 16.27 | .15 | .44 | -.04 | .86 |
| Heart Rate at Baseline Post (beats/min) | 27.00 | 52.00 | 114.00 | 84.41 | 15.58 | .13 | .45 | -.53 | .87 |
| Heart Rate at COLc Pre (beats/min) | 27.00 | 62.00 | 120.00 | 84.26 | 15.65 | .57 | .45 | -.30 | .87 |
| Heart Rate at COLc Post (beats/min) | 27.00 | 56.00 | 135.00 | 86.22 | 18.57 | 1.14 | .45 | 1.39 | .87 |
| Heart Rate at STROOP Pre (beats/min) | 26.00 | 46.00 | 113.00 | 82.35 | 15.40 | .22 | .46 | .60 | .89 |
| Heart Rate at STROOP Post (beats/min) | 26.00 | 53.00 | 130.00 | 85.58 | 15.58 | .78 | .46 | 1.90 | .89 |

Table E.3 (cont.)

*Descriptive Statistics for the Normal Weight Control Group*

| Variable | N | Min | Max | Mean | SD | Skew. | SE | Kurt. | SE |
|---|---|---|---|---|---|---|---|---|---|
| Heart Rate at Rest Pre (beats/min) | 25.00 | 50.00 | 116.00 | 76.64 | 14.49 | .90 | .46 | 1.33 | .90 |
| Heart Rate at Rest Post (beats/min) | 26.00 | 45.00 | 110.00 | 76.88 | 15.67 | .49 | .46 | .07 | .89 |
| Blood Oxygen at Baseline Pre (beats/min) | 28.00 | 95.00 | 100.00 | 98.07 | .98 | -1.17 | .44 | 3.15 | .86 |
| Blood Oxygen at Baseline Post (beats/min) | 27.00 | 82.00 | 99.00 | 97.59 | 3.14 | -5.06 | .45 | 26.06 | .87 |
| Blood Oxygen at COLc Pre (beats/min) | 27.00 | 97.00 | 99.00 | 98.33 | .55 | .00 | .45 | -.65 | .87 |
| Blood Oxygen at COLc Post (beats/min) | 27.00 | 98.00 | 99.00 | 98.33 | .48 | .75 | .45 | -1.56 | .87 |
| Blood Oxygen at STROOP Pre (beats/min) | 26.00 | 97.00 | 100.00 | 98.65 | .69 | -.21 | .46 | .18 | .89 |
| Blood Oxygen at STROOP Post (beats/min) | 26.00 | 98.00 | 100.00 | 98.50 | .58 | .66 | .46 | -.48 | .89 |
| Blood Oxygen at Rest Pre (beats/min) | 25.00 | 97.00 | 100.00 | 98.24 | .78 | .69 | .46 | .66 | .90 |
| Blood Oxygen at Rest Post (beats/min) | 26.00 | 97.00 | 100.00 | 98.23 | .71 | .36 | .46 | .43 | .89 |
| Subjective Effort | 32.00 | 2.00 | 10.00 | 5.16 | 2.26 | .55 | .41 | -.54 | .81 |
| Subjective Fatigue | 32.00 | 1.00 | 9.00 | 4.38 | 2.37 | .19 | .41 | -.73 | .81 |
| Subjective Hunger | 32.00 | 1.00 | 10.00 | 5.59 | 2.59 | -.34 | .41 | -1.20 | .81 |
| Self-Control Questionnaire | 32.00 | 88.00 | 159.00 | 124.31 | 18.28 | -.06 | .41 | -.87 | .81 |

Table E.4
*Descriptive Statistics of the Normal Weight Experimental Group*

| Variables | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 32.00 | 19.00 | 28.00 | 21.13 | 1.98 | 2.00 | .41 | 4.41 | .81 |
| Height (inches) | 32.00 | 60.00 | 73.50 | 65.49 | 3.46 | .51 | .41 | -.23 | .81 |
| Weight (lbs) | 32.00 | 101.00 | 182.00 | 138.16 | 19.68 | .47 | .41 | .15 | .81 |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | 32.00 | 18.30 | 24.93 | 22.55 | 1.71 | -.59 | .41 | -.40 | .81 |
| Waist Circumference (inches) | 32.00 | 30.00 | 43.00 | 37.59 | 3.01 | -.67 | .41 | .74 | .81 |
| Hip Circumference (inches) | 32.00 | 25.50 | 35.00 | 29.73 | 2.30 | .38 | .41 | -.17 | .81 |
| Waist/Hip Ratio | 32.00 | .68 | .98 | .80 | .08 | .80 | .41 | -.12 | .81 |
| Blood Glucose (BG) at Baseline (mg/dL) | 32.00 | 80.00 | 124.00 | 94.47 | 10.04 | .95 | .41 | 1.01 | .81 |
| BG Crossing-out-letters Experimental (COLe) (mg/dL) | 32.00 | 77.00 | 126.00 | 95.00 | 10.97 | 1.16 | .41 | 1.68 | .81 |
| BG STROOP (mg/dL) | 32.00 | 77.00 | 121.00 | 93.28 | 10.13 | .81 | .41 | .51 | .81 |
| BG Rest (mg/dL) | 32.00 | 70.00 | 122.00 | 93.72 | 10.62 | .57 | .41 | .88 | .81 |
| BG at Baseline – BG COLe task | 32.00 | -15.00 | 15.00 | .53 | 7.08 | .26 | .41 | -.32 | .81 |
| BG COLe task – BG STROOP | 32.00 | -24.00 | 11.00 | -1.72 | 7.73 | -.73 | .41 | 1.16 | .81 |
| BG STROOP – BG 10-minute Rest | 32.00 | -10.00 | 20.00 | .44 | 5.90 | 1.38 | .41 | 3.55 | .81 |
| BG Baseline – BG STROOP | 32.00 | -18.00 | 16.00 | 1.19 | 6.23 | -.35 | .41 | 2.41 | .81 |
| BG Baseline – BG 10-minute Rest | 32.00 | -15.00 | 20.00 | .75 | 6.48 | .47 | .41 | 2.46 | .81 |
| BG COLe task – BG 10-minute Rest | 32.00 | -12.00 | 31.00 | 1.28 | 8.12 | 1.50 | .41 | 4.70 | .81 |
| COLe Correct Responses | 32.00 | 28.00 | 196.00 | 129.25 | 36.24 | -.63 | .41 | .97 | .81 |
| COLe Omission Errors | 32.00 | 3.00 | 73.00 | 22.75 | 19.35 | 1.53 | .41 | 1.37 | .81 |
| COLe Commission Errors | 32.00 | .00 | 63.00 | 4.75 | 11.25 | 4.79 | .41 | 24.91 | .81 |
| COLe Errors (Om & Com) | 32.00 | 3.00 | 80.00 | 27.50 | 22.38 | 1.24 | .41 | .29 | .81 |
| Correct STROOP Responses | 32.00 | 373.00 | 882.00 | 528.06 | 125.60 | 1.21 | .41 | 1.38 | .81 |
| Incorrect Stroop Responses | 32.00 | 5.00 | 60.00 | 21.59 | 12.28 | 1.33 | .41 | 2.14 | .81 |
| Heart Rate at Baseline Pre (beats/min) | 32.00 | 52.00 | 105.00 | 78.56 | 13.71 | .14 | .41 | -.85 | .81 |
| Heart Rate at Baseline Post (beats/min) | 31.00 | 49.00 | 100.00 | 77.55 | 12.21 | -.18 | .42 | .09 | .82 |
| Heart Rate at COLe Pre (beats/min) | 31.00 | 57.00 | 105.00 | 76.39 | 13.39 | .38 | .42 | -.78 | .82 |
| Heart Rate at COLe Post (beats/min) | 32.00 | 53.00 | 122.00 | 82.75 | 14.90 | .23 | .41 | .26 | .81 |
| Heart Rate at STROOP Pre (beats/min) | 31.00 | 57.00 | 99.00 | 78.32 | 9.04 | .36 | .42 | .65 | .82 |

Table E.4 (cont.)

*Descriptive Statistics of the Normal Weight Experimental Group*

| Variables | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Heart Rate at STROOP Post (beats/min) | 31 | 65.00 | 115.00 | 83.00 | 11.15 | .60 | .42 | 1.08 | .82 |
| Heart Rate at Rest Pre (beats/min) | 31 | 51.00 | 100.00 | 73.58 | 11.06 | .06 | .42 | .10 | .82 |
| Heart Rate at Rest Post (beats/min) | 31 | 50.00 | 86.00 | 71.39 | 9.41 | -.56 | .42 | -.01 | .82 |
| Blood Oxygen at Baseline Pre (beats/min) | 32 | 92.00 | 99.00 | 97.53 | 1.67 | -2.54 | .41 | 6.58 | .81 |
| Blood Oxygen at Baseline Post (beats/min) | 31 | 94.00 | 99.00 | 98.06 | .96 | -2.52 | .42 | 10.06 | .82 |
| Blood Oxygen at COLe Pre (beats/min) | 31 | 97.00 | 100.00 | 98.23 | .72 | .21 | .42 | .10 | .82 |
| Blood Oxygen at COLe Post (beats/min) | 31 | 97.00 | 99.00 | 98.22 | .49 | .51 | .41 | .22 | .81 |
| Blood Oxygen at STROOP Pre (beats/min) | 31 | 95.00 | 100.00 | 98.13 | 1.06 | -1.18 | .42 | 1.87 | .82 |
| Blood Oxygen at STROOP Post (beats/min) | 31 | 98.00 | 100.00 | 98.29 | .53 | 1.67 | .42 | 2.14 | .82 |
| Blood Oxygen at Rest Pre (beats/min) | 31 | 94.00 | 100.00 | 98.06 | 1.15 | -1.95 | .42 | 5.54 | .82 |
| Blood Oxygen at Rest Post (beats/min) | 31 | 93.00 | 99.00 | 97.90 | 1.33 | -2.57 | .42 | 7.56 | .82 |
| Subjective Effort | 32 | 2.00 | 9.00 | 5.56 | 2.20 | .00 | .41 | -1.19 | .81 |
| Subjective Fatigue | 32 | 2.00 | 7.00 | 5.03 | 1.53 | -.28 | .41 | -.91 | .81 |
| Subjective Hunger | 32 | 2.00 | 10.00 | 7.31 | 2.05 | -.86 | .41 | .80 | .81 |
| Self-Control Questionnaire | 32 | 92.00 | 178.00 | 123.84 | 18.25 | .63 | .41 | 1.23 | .81 |

Table E.5

*Descriptive Statistics of the Overweight*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 32.00 | 19.00 | 55.00 | 23.38 | 6.94 | 3.59 | .41 | 14.62 | .81 |
| Height (inches) | 32.00 | 57.00 | 72.00 | 65.71 | 3.86 | -.41 | .41 | -.54 | .81 |
| Weight (lbs) | 32.00 | 125.00 | 212.00 | 169.41 | 22.62 | -.01 | .41 | -.59 | .81 |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | 32.00 | 25.28 | 29.91 | 27.47 | 1.42 | .00 | .41 | -1.32 | .81 |
| Waist Circumference (inches) | 32.00 | 36.00 | 53.00 | 41.94 | 3.33 | 1.06 | .41 | 2.79 | .81 |
| Hip Circumference (inches) | 32.00 | 29.50 | 40.00 | 34.45 | 2.89 | .15 | .41 | -.83 | .81 |
| Waist/Hip Ratio | 32.00 | .69 | .97 | .82 | .07 | -.09 | .41 | -.49 | .81 |
| Blood Glucose (BG) at Baseline (mg/dL) | 32.00 | 71.00 | 113.00 | 93.63 | 9.22 | -.22 | .41 | .14 | .81 |
| BG Crossing-out-letters Experimental (COLe) (mg/dL) | 32.00 | 75.00 | 110.00 | 94.53 | 8.77 | -.44 | .41 | .06 | .81 |
| BG STROOP (mg/dL) | 32.00 | 71.00 | 107.00 | 93.00 | 9.03 | -.50 | .41 | -.14 | .81 |
| BG Rest (mg/dL) | 31.00 | 65.00 | 117.00 | 92.19 | 9.20 | -.22 | .42 | 2.60 | .82 |
| BG at Baseline – BG COLe task | 32.00 | -14.00 | 24.00 | .91 | 8.41 | .87 | .41 | 1.06 | .81 |
| BG COLe task – BG STROOP | 32.00 | -19.00 | 12.00 | -1.53 | 7.34 | -.04 | .41 | .12 | .81 |
| BG STROOP – BG 10-minute Rest | 31.00 | -13.00 | 26.00 | -1.03 | 7.22 | 1.54 | .42 | 5.64 | .82 |
| BG Baseline – BG STROOP | 32.00 | -11.00 | 22.00 | .63 | 7.72 | .97 | .41 | 1.03 | .81 |
| BG Baseline – BG 10-minute Rest | 31.00 | -13.00 | 16.00 | 1.61 | 6.97 | -.13 | .42 | -.46 | .82 |
| BG COLe task – BG 10-minute Rest | 31.00 | -11.00 | 20.00 | 2.65 | 5.94 | .28 | .42 | 1.65 | .82 |
| COLe Correct Responses | 32.00 | 1.00 | 204.00 | 123.19 | 35.04 | -1.13 | .41 | 4.40 | .81 |
| COLe Omission Errors | 32.00 | 4.00 | 121.00 | 33.59 | 29.83 | 1.44 | .41 | 1.57 | .81 |
| COLe Commission Errors | 32.00 | .00 | 114.00 | 9.28 | 20.97 | 4.37 | .41 | 21.23 | .81 |
| COLe Errors (Om & Com) | 32.00 | 4.00 | 214.00 | 42.88 | 43.55 | 2.32 | .41 | 6.90 | .81 |
| Correct STROOP Responses | 32.00 | 336.00 | 824.00 | 504.69 | 107.03 | 1.32 | .41 | 2.31 | .81 |
| Incorrect Stroop Responses | 32.00 | 4.00 | 55.00 | 21.34 | 12.72 | .99 | .41 | .45 | .81 |

Table E.5 (cont.)

*Descriptive Statistics of the Overweight*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Heart Rate at Baseline Pre (beats/min) | 27.00 | 44.00 | 150.00 | 85.15 | 21.87 | .84 | .45 | 2.14 | .87 |
| Heart Rate at Baseline Post (beats/min) | 30.00 | 46.00 | 118.00 | 79.93 | 14.39 | .08 | .43 | .95 | .83 |
| Heart Rate at COLe Pre (beats/min) | 30.00 | 50.00 | 110.00 | 80.97 | 12.90 | -.12 | .43 | .48 | .83 |
| Heart Rate at COLe Post (beats/min) | 30.00 | 45.00 | 118.00 | 83.00 | 14.87 | .22 | .43 | .94 | .83 |
| Heart Rate at STROOP Pre (beats/min) | 30.00 | 59.00 | 103.00 | 78.37 | 12.95 | .25 | .43 | -.77 | .83 |
| Heart Rate at STROOP Post (beats/min) | 30.00 | 58.00 | 116.00 | 85.17 | 12.58 | .05 | .43 | .25 | .83 |
| Heart Rate at Rest Pre (beats/min) | 30.00 | 43.00 | 107.00 | 75.87 | 15.60 | -.18 | .43 | -.32 | .83 |
| Heart Rate at Rest Post (beats/min) | 29.00 | 39.00 | 100.00 | 77.03 | 12.33 | -.83 | .43 | 2.08 | .85 |
| Blood Oxygen at Baseline Pre (beats/min) | 27.00 | 96.00 | 99.00 | 97.96 | .59 | -1.23 | .45 | 4.79 | .87 |
| Blood Oxygen at Baseline Post (beats/min) | 30.00 | 96.00 | 99.00 | 98.07 | .64 | -.90 | .43 | 3.09 | .83 |
| Blood Oxygen at COLe Pre (beats/min) | 30.00 | 97.00 | 99.00 | 98.30 | .53 | .17 | .43 | -.54 | .83 |
| Blood Oxygen at COLe Post (beats/min) | 30.00 | 97.00 | 99.00 | 98.23 | .50 | .42 | .43 | .04 | .83 |
| Blood Oxygen at STROOP Pre (beats/min) | 30.00 | 96.00 | 99.00 | 98.43 | .68 | -1.51 | .43 | 4.07 | .83 |
| Blood Oxygen at STROOP Post (beats/min) | 30.00 | 98.00 | 99.00 | 98.40 | .50 | .43 | .43 | -1.95 | .83 |
| Blood Oxygen at Rest Pre (beats/min) | 30.00 | 97.00 | 108.00 | 98.63 | 1.90 | 4.30 | .43 | 21.69 | .83 |
| Blood Oxygen at Rest Post (beats/min) | 29.00 | 91.00 | 99.00 | 98.00 | 1.41 | -4.56 | .43 | 23.30 | .85 |
| Subjective Effort | 32.00 | 1.00 | 10.00 | 5.50 | 2.17 | -.31 | .41 | -.50 | .81 |
| Subjective Fatigue | 32.00 | 1.00 | 8.00 | 4.16 | 2.33 | .22 | .41 | -.99 | .81 |
| Subjective Hunger | 31.00 | 1.00 | 10.00 | 5.87 | 2.17 | -.05 | .42 | -.23 | .82 |
| Self-Control Questionnaire | 31.00 | 98.00 | 158.00 | 123.23 | 14.88 | .39 | .42 | -.18 | .82 |

Table E.6

*Descriptive Statistics of the Obese Experimental Group*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 26.00 | 19.00 | 43.00 | 24.19 | 6.61 | 1.81 | .46 | 2.52 | .89 |
| Height (inches) | 26.00 | 55.00 | 74.00 | 65.27 | 3.88 | -.11 | .46 | 1.22 | .89 |
| Weight (lbs) | 26.00 | 134.00 | 331.00 | 208.38 | 41.98 | 1.12 | .46 | 1.85 | .89 |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | 26.00 | 30.25 | 47.77 | 34.21 | 5.08 | 1.70 | .46 | 2.05 | .89 |
| Waist Circumference (inches) | 26.00 | 39.25 | 56.50 | 46.14 | 4.52 | .92 | .46 | .74 | .89 |
| Hip Circumference (inches) | 26.00 | 29.50 | 53.50 | 40.08 | 5.72 | .90 | .46 | .66 | .89 |
| Waist/Hip Ratio | 26.00 | .73 | 1.01 | .87 | .08 | .06 | .46 | -.84 | .89 |
| Blood Glucose (BG) at Baseline (mg/dL) | 26.00 | 82.00 | 130.00 | 97.46 | 9.55 | 1.45 | .46 | 4.24 | .89 |
| BG Crossing-out-letters (COLe) (mg/dL) | 25.00 | 82.00 | 119.00 | 97.72 | 11.13 | .29 | .46 | -1.13 | .90 |
| BG STROOP (mg/dL) | 26.00 | 82.00 | 113.00 | 96.12 | 8.37 | .35 | .46 | -.80 | .89 |
| BG Rest (mg/dL) | 26.00 | 79.00 | 116.00 | 96.19 | 9.39 | .17 | .46 | -.77 | .89 |
| BG at Baseline – BG COLe task | 25.00 | -15.00 | 19.00 | .60 | 8.67 | .41 | .46 | -.47 | .90 |
| BG COLe task – BG STROOP | 25.00 | -14.00 | 10.00 | -1.76 | 7.30 | -.28 | .46 | -1.11 | .90 |
| BG STROOP – BG 10-minute Rest | 26.00 | -8.00 | 11.00 | .08 | 4.95 | .58 | .46 | -.15 | .89 |
| BG Baseline – BG STROOP | 26.00 | -17.00 | 28.00 | 1.35 | 8.10 | .92 | .46 | 4.32 | .89 |
| BG Baseline – BG 10-minute Rest | 26.00 | -12.00 | 21.00 | 1.27 | 6.83 | .67 | .46 | 1.74 | .89 |
| BG COLe task – BG 10-minute Rest | 25.00 | -9.00 | 14.00 | 1.88 | 6.40 | .26 | .46 | -.66 | .90 |
| COLe Correct Responses | 26.00 | 29.00 | 365.00 | 136.50 | 61.68 | 1.89 | .46 | 7.02 | .89 |
| COLe Omission Errors | 26.00 | 1.00 | 178.00 | 26.62 | 34.31 | 3.69 | .46 | 15.99 | .89 |
| COLe Commission Errors | 26.00 | .00 | 83.00 | 6.12 | 16.25 | 4.59 | .46 | 22.15 | .89 |
| COLe Errors (Om & Com)[1] | 26.00 | 5.00 | 261.00 | 32.73 | 49.39 | 4.24 | .46 | 19.85 | .89 |
| Correct STROOP Responses | 26.00 | 276.00 | 820.00 | 514.92 | 115.80 | .52 | .46 | .83 | .89 |
| Incorrect Stroop Responses | 26.00 | 4.00 | 49.00 | 22.00 | 9.44 | .60 | .46 | 1.65 | .89 |
| Heart Rate at Baseline Pre (beats/min) | 25.00 | 52.00 | 110.00 | 78.48 | 14.28 | .17 | .46 | -.44 | .90 |
| Heart Rate at Baseline Post (beats/min) | 25.00 | 54.00 | 98.00 | 77.60 | 11.76 | -.28 | .46 | -.78 | .90 |
| Heart Rate at COLe Pre (beats/min) | 22.00 | 66.00 | 99.00 | 78.77 | 10.34 | .57 | .49 | -.72 | .95 |
| Heart Rate at COLe Post (beats/min) | 24.00 | 64.00 | 103.00 | 79.71 | 9.82 | .33 | .47 | -.23 | .92 |
| Heart Rate at STROOP Pre (beats/min) | 24.00 | 57.00 | 123.00 | 76.04 | 14.20 | 1.54 | .47 | 4.10 | .92 |
| Heart Rate at STROOP Post (beats/min) | 25.00 | 60.00 | 110.00 | 80.72 | 12.03 | .49 | .46 | .04 | .90 |
| Heart Rate at Rest Pre (beats/min) | 25.00 | 54.00 | 92.00 | 74.48 | 10.67 | -.19 | .46 | -.97 | .90 |
| Heart Rate at Rest Post (beats/min) | 25.00 | 53.00 | 94.00 | 69.44 | 11.15 | .41 | .46 | -.55 | .90 |

Table E.6 (Cont.)

*Descriptive Statistics of the Obese Experimental Group*

| Variable | N | Min | Max | Mean | SD | Skew | SE | Kurt | SE |
|---|---|---|---|---|---|---|---|---|---|
| Blood Oxygen at Baseline Pre (beats/min) | 25.00 | 82.00 | 99.00 | 97.48 | 3.25 | -4.85 | .46 | 23.98 | .90 |
| Blood Oxygen at Baseline Post (beats/min) | 25.00 | 96.00 | 99.00 | 98.04 | .79 | -.63 | .46 | .43 | .90 |
| Blood Oxygen at COLe Pre (beats/min) | 22.00 | 97.00 | 99.00 | 98.32 | .57 | -.05 | .49 | -.51 | .95 |
| Blood Oxygen at COLe Post (beats/min) | 24.00 | 96.00 | 99.00 | 98.13 | .61 | -1.30 | .47 | 5.93 | .92 |
| Blood Oxygen at STROOP Pre (beats/min) | 24.00 | 49.00 | 99.00 | 96.08 | 10.06 | -4.86 | .47 | 23.71 | .92 |
| Blood Oxygen at STROOP Post (beats/min) | 25.00 | 95.00 | 99.00 | 98.16 | .80 | -2.43 | .46 | 10.07 | .90 |
| Blood Oxygen at Rest Pre (beats/min) | 25.00 | 84.00 | 99.00 | 97.40 | 3.01 | -4.08 | .46 | 17.77 | .90 |
| Blood Oxygen at Rest Post (beats/min) | 25.00 | 96.00 | 99.00 | 98.04 | .68 | -.93 | .46 | 2.72 | .90 |
| Subjective Effort | 26.00 | 1.00 | 10.00 | 5.00 | 2.24 | -.14 | .46 | -.26 | .89 |
| Subjective Fatigue | 26.00 | 1.00 | 10.00 | 4.73 | 2.25 | .14 | .46 | -.01 | .89 |
| Subjective Hunger | 26.00 | 1.00 | 9.00 | 5.58 | 2.37 | -.45 | .46 | -.97 | .89 |
| Self-Control Questionnaire | 25.00 | 82.00 | 138.00 | 116.52 | 14.19 | -.33 | .46 | .04 | .90 |

*Note: Four individuals from the obese experimental group were excluded as outliers.*

Table E.7

*Preliminary Correlational Statistics for the Overall Sample*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age (years) | - | | | | | | | | | | |
| 2. Height (Inches) | .17 | - | | | | | | | | | |
| 3. Weight (Pounds) | .26** | .51** | - | | | | | | | | |
| 4. Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | .19* | .05 | .88** | - | | | | | | | |
| 5. Waist Circumference (inches) | .24** | .31** | .90** | .87** | - | | | | | | |
| 6. Hip Circumference (inches) | .29** | .24** | .81** | .82** | .80** | - | | | | | |
| 7. Waist/Hip Ratio | .06 | .24** | .49** | .44** | .67** | .10 | - | | | | |
| 8. Blood Glucose (BG) at Baseline (mg/dL) | -.03 | -.08 | -.02 | .02 | -.03 | .03 | -.09 | - | | | |
| 9. BG Crossing-out-letters[a] (COL) (mg/dL) | -.02 | .04 | .01 | -.02 | .01 | .01 | -.01 | .74** | - | | |
| 10. BG STROOP[b] (mg/dL) | -.02 | .10 | .07 | .02 | .06 | .05 | .01 | .71** | .75** | - | |
| 11. BG Rest (mg/dL) | -.02 | .04 | -.02 | -.05 | -.02 | -.04 | .01 | .76** | .77** | .83** | - |
| 12. BG at Baseline[a] – BG COL task | .01 | .17 | .05 | -.04 | .06 | -.01 | .11 | -.22* | .50** | .17 | .14 |
| 13. BG COL task[a] – BG STROOP[b] | .01 | .09 | .10 | .05 | .08 | .06 | .05 | -.22* | -.47** | .15 | -.09 |
| 14. BG STROOP – BG 10-minute Rest | -.01 | -.12 | -.17 | -.12 | -.15 | -.17 | -.02 | .12 | .08 | -.23* | .35** |
| 15. BG Baseline – BG STROOP[b] | -.01 | -.23* | -.11 | .02 | -.10 | -.02 | -.13 | .43** | .05 | -.32** | -.04 |
| 16. BG Baseline – BG 10-minute Rest | -.01 | -.15 | .02 | .11 | .01 | .11 | -.13 | .37** | -.01 | -.15 | -.33** |
| 17. BG COL task[a] – BG 10-minute Rest | .00 | .01 | .05 | .05 | .05 | .08 | -.03 | .13 | .50** | .03 | -.17 |
| 18. COL[a] Correct Responses | -.10 | -.10 | -.37** | -.38** | -.40** | -.32** | -.30** | .14 | .12 | .14 | .18* |
| 19. COL[a] Commission Errors | .15 | .15 | .15 | .08 | .11 | .03 | .15 | .02 | .05 | .01 | .02 |
| 20. COL[a] Omission Errors | -.03 | .07 | -.06 | -.10 | -.08 | .00 | -.11 | .05 | .02 | .01 | .00 |
| 21. COL[a] Errors (Om & Com) | .03 | .11 | .01 | -.05 | -.03 | .01 | -.03 | .05 | .04 | .01 | .01 |
| 22. Correct STROOP[b] Responses | .11 | .05 | -.08 | -.13 | -.08 | -.08 | -.04 | -.04 | .06 | .15 | .05 |
| 23. Incorrect STROOP[b] Responses | .04 | .27** | .23* | .12 | .19* | .06 | .23* | -.04 | .07 | -.02 | -.01 |
| 24. Self-Control Questionnaire | -.06 | -.09 | -.11 | -.09 | -.14 | -.15 | -.05 | .00 | -.04 | -.10 | -.11 |
| 25. Subjective Effort | .00 | .02 | .04 | .03 | .00 | .01 | .00 | -.09 | -.05 | -.14 | -.14 |
| 26. Subjective Fatigue | -.05 | .03 | -.03 | -.04 | -.01 | .07 | -.07 | -.07 | -.09 | -.13 | -.16 |
| 27. Subjective Hunger | -.13 | -.02 | -.10 | -.09 | -.11 | -.07 | -.09 | -.29** | -.34** | -.39** | -.38** |

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

[a.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[b.] *All participants were given the STROOP task.*

Table E.7 (Cont.)

*Preliminary Correlational Statistics for the Overall Sample*

| | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 25. | 26. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12. BG at Baseline[a] – BG COL task | - | | | | | | | | | | | | | | |
| 13. BG COL task[a] – BG STROOP[b] | -.51** | - | | | | | | | | | | | | | |
| 14. BG STROOP – BG 10-minute Rest | -.04 | -.42** | - | | | | | | | | | | | | |
| 15. BG Baseline – BG STROOP[b] | -.50** | -.49** | .47** | - | | | | | | | | | | | |
| 16. BG Baseline – BG 10-minute Rest | -.50** | -.18 | -.32** | .69** | - | | | | | | | | | | |
| 17. BG COL task[a] – BG 10-minute Rest | .56** | -.70** | -.35** | .14 | .44** | - | | | | | | | | | |
| 18. COL[a] Correct Responses | -.02 | -.02 | .09 | -.02 | -.09 | -.06 | - | | | | | | | | |
| 19. COL[a] Commission Errors | .11 | -.09 | .02 | .02 | .00 | .11 | -.21* | - | | | | | | | |
| 20. COL[a] Omission Errors | .01 | -.05 | -.02 | .06 | .08 | .10 | .32** | .38** | - | | | | | | |
| 21. COL[a] Errors (Om & Com) | .06 | -.08 | -.01 | .05 | .07 | .13 | .18 | .69** | .93** | - | | | | | |
| 22. Correct STROOP[b] Responses | .13 | .10 | -.18 | -.26** | -.13 | .04 | .17 | -.06 | -.08 | -.09 | - | | | | |
| 23. Incorrect STROOP[b] Responses | .14 | -.11 | .03 | .00 | -.03 | .09 | -.06 | .23* | .07 | .15 | -.06 | - | | | |
| 24. Self-Control Questionnaire | -.06 | -.10 | -.05 | .10 | .15 | .14 | .02 | -.16 | .03 | -.04 | .08 | -.24** | - | | |
| 25. Subjective Effort | .06 | -.09 | .00 | .07 | .07 | .09 | -.09 | .18 | .06 | .11 | .03 | .11 | .09 | - | |
| 26. Subjective Fatigue | -.01 | -.03 | -.04 | .09 | .13 | .06 | -.09 | .13 | .14 | .16 | -.10 | .03 | -.10 | .18 | - |
| 27. Subjective Hunger | -.12 | .03 | .00 | .11 | .12 | -.04 | -.06 | -.07 | .05 | .01 | -.02 | .09 | .16 | .12 | .33** |

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

[a.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[b.] *All participants were given the STROOP task.*

Table E.8

*Preliminary Correlational Statistics for the Normal Weight Control Group*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age (years) | - | | | | | | | | | | |
| 2. Height (Inches) | -.12 | - | | | | | | | | | |
| 3. Weight (Pounds) | -.13 | .91** | - | | | | | | | | |
| 4. Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | -.02 | -.02 | .39* | - | | | | | | | |
| 5. Waist Circumference (inches) | -.09 | .66** | .77** | .39* | - | | | | | | |
| 6. Hip Circumference (inches) | -.11 | .45* | .48** | .17 | .37* | - | | | | | |
| 7. Waist/Hip Ratio | -.02 | .40* | .49** | .30 | .79** | -.27 | - | | | | |
| 8. Blood Glucose (BG) at Baseline (mg/dL) | -.03 | -.10 | -.17 | -.25 | -.13 | .11 | -.22 | - | | | |
| 9. BG Crossing-out-letters Control (COLc) (mg/dL) | -.15 | .05 | .06 | -.03 | .11 | .16 | .01 | .82** | - | | |
| 10. BG STROOP (mg/dL) | -.20 | -.04 | -.08 | -.14 | -.02 | -.03 | -.01 | .70** | .80** | - | |
| 11. BG Rest (mg/dL) | -.19 | -.01 | -.12 | -.31 | .06 | -.02 | .07 | .72** | .77** | .89** | - |
| 12. BG at Baseline – BG COLc task | -.21 | .23 | .34 | .30 | .37* | .11 | .33 | .03 | .60** | .44* | .37* |
| 13. BG COLc task – BG STROOP | .00 | -.06 | -.12 | -.11 | -.14 | -.27 | .04 | -.54** | -.65** | -.06 | -.15 |
| 14. BG STROOP – BG 10-minute Rest | .05 | .07 | -.08 | -.34 | .17 | .02 | .16 | -.04 | -.13 | -.32 | .14 |
| 15. BG Baseline – BG STROOP | .22 | -.06 | -.11 | -.14 | -.13 | .20 | -.28 | .46** | .16 | -.31 | -.16 |
| 16. BG Baseline – BG 10-minute Rest | .20 | -.10 | -.06 | .06 | -.23 | .19 | -.38* | .50** | .24 | -.13 | -.25 |
| 17. BG COLc task – BG 10-minute Rest | -.02 | .02 | .16 | .29 | .04 | .24 | -.12 | .53** | .69** | .23 | .07 |
| 18. COLc Correct Responses | .08 | -.14 | -.12 | .04 | -.19 | .06 | -.22 | -.13 | -.20 | -.06 | .00 |
| 19. COLc Commission Errors | -.35* | -.15 | -.06 | .23 | .09 | .06 | .05 | -.09 | -.05 | -.04 | -.01 |
| 20. COLc Omission Errors | .01 | .22 | .34 | .34 | .26 | .21 | .16 | -.02 | .03 | -.08 | -.13 |
| 21. COLc Errors (Om & Com) | -.01 | .21 | .33 | .35 | .26 | .21 | .16 | -.02 | .02 | -.08 | -.13 |
| 22. Correct STROOP Responses | -.12 | -.06 | -.01 | .09 | .04 | -.06 | .10 | .06 | .14 | .26 | .18 |
| 23. Incorrect Stroop Responses | .02 | .33 | .28 | -.08 | .32 | .12 | .26 | .16 | .29 | .31 | .34 |
| 24. Self-Control Questionnaire | -.10 | -.08 | -.07 | .00 | -.14 | -.06 | -.10 | -.19 | -.24 | -.49* | -.44* |
| 25. Subjective Effort | -.02 | -.03 | -.09 | -.13 | -.06 | -.18 | .07 | -.39* | -.18 | -.29 | -.21 |
| 26. Subjective Fatigue | -.16 | .26 | .34 | .24 | .24 | .20 | .14 | -.02 | -.01 | -.18 | -.21 |
| 27. Subjective Hunger | -.34 | .25 | .30 | .22 | .15 | .16 | .07 | -.33 | -.40* | -.49** | -.46** |

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

Table E.8 (Cont.)

*Preliminary Correlational Statistics for the Normal Weight Control Group*

| | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 23. | 26. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12. BG at Baseline – BG COLc task | - | | | | | | | | | | | | | | |
| 13. BG COLc task – BG STROOP | -.42* | - | | | | | | | | | | | | | |
| 14. BG STROOP – BG 10-minute Rest | -.18 | -.19 | - | | | | | | | | | | | | |
| 15. BG Baseline – BG STROOP | -.42* | -.65** | .34 | - | | | | | | | | | | | |
| 16. BG Baseline – BG 10-minute Rest | -.33 | -.56** | -.24 | .83** | - | | | | | | | | | | |
| 17. BG COLc task – BG 10-minute Rest | .50** | -.85** | -.36* | .43* | .66** | - | | | | | | | | | |
| 18. COLc Correct Responses[1] | -.17 | .22 | .12 | -.11 | -.19 | -.28 | - | | | | | | | | |
| 19. COLc Commission Errors | .05 | .07 | .07 | -.06 | -.10 | -.11 | .15 | - | | | | | | | |
| 20. COLc Omission Errors | .07 | -.10 | -.09 | .10 | .16 | .14 | .30 | .30 | - | | | | | | |
| 21. COLc Errors (Om & Com)[1] | .07 | -.09 | -.09 | .09 | .15 | .13 | .30 | .35* | .99** | - | | | | | |
| 22. Correct STROOP Responses | .16 | .04 | -.18 | -.26 | -.16 | .06 | .31 | .02 | .14 | .14 | - | | | | |
| 23. Incorrect Stroop Responses | .28 | -.02 | .03 | -.13 | -.15 | .00 | .19 | .01 | .36* | .35* | .12 | - | | | |
| 24. Self-Control Questionnaire | -.15 | -.22 | -.02 | .19 | .21 | .22 | -.16 | -.16 | .06 | .05 | .17 | -.21 | - | | |
| 25. Subjective Effort | .23 | .04 | .19 | -.15 | -.26 | -.14 | .04 | .03 | -.10 | -.10 | .20 | .13 | .28 | - | |
| 26. Subjective Fatigue | .01 | -.10 | -.05 | .22 | .26 | .12 | .01 | .25 | .38* | .39* | -.31 | .17 | -.01 | .09 | - |
| 27. Subjective Hunger | -.24 | .10 | .11 | .19 | .13 | -.16 | .18 | .33 | .49** | .50** | .01 | .07 | .27 | .05 | .54** |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.9

*Preliminary Correlational Statistics for the Normal Weight Experimental Group*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age (years) | - | | | | | | | | | | |
| 2. Height (Inches) | -.03 | - | | | | | | | | | |
| 3. Weight (Pounds) | .04 | .85** | - | | | | | | | | |
| 4. Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | .08 | .18 | .67** | - | | | | | | | |
| 5. Waist Circumference (inches) | .15 | .51** | .62** | .45* | - | | | | | | |
| 6. Hip Circumference (inches) | -.08 | .40* | .49** | .37* | .24 | - | | | | | |
| 7. Waist/Hip Ratio | .19 | .07 | .09 | .07 | .56** | -.66** | - | | | | |
| 8. Blood Glucose (BG) at Baseline (mg/dL) | .46** | .06 | .12 | .13 | .28 | .09 | .13 | - | | | |
| 9. BG Crossing-out-letters Experimental (COLe)* (mg/dL) | .32 | .09 | -.02 | -.16 | .09 | -.03 | .09 | .78** | - | | |
| 10. BG STROOP (mg/dL) | .19 | .26 | .31 | .22 | .25 | .15 | .08 | .81** | .73** | - | |
| 11. BG Rest (mg/dL) | .41* | .11 | .21 | .24 | .27 | -.01 | .21 | .81** | .72** | .84** | - |
| 12. BG at Baseline – BG COLe task | -.16 | .05 | -.20 | -.44* | -.25 | -.18 | -.05 | -.21 | .50** | -.01 | -.03 |
| 13. BG COL task – BG STROOP | -.20 | .22 | .43* | .52** | .20 | .23 | -.02 | -.04 | -.46** | .27 | .08 |
| 14. BG STROOP – BG 10-minute Rest | .41* | -.26 | -.17 | .06 | .05 | -.26 | .24 | .06 | .03 | -.21 | .36* |
| 15. BG Baseline – BG STROOP | .43* | -.32 | -.32 | -.15 | .04 | -.09 | .08 | .30 | .06 | -.32 | -.07 |
| 16. BG Baseline – BG 10-minute Rest | .05 | -.07 | -.15 | -.19 | -.01 | .15 | -.14 | .23 | .03 | -.12 | -.39* |
| 17. BG COLe task – BG 10-minute Rest | -.11 | -.02 | -.29 | -.54** | -.22 | -.04 | -.16 | .00 | .41* | -.11 | -.34 |
| 18. COLe Correct Responses[1] | -.37* | .12 | .01 | -.12 | -.04 | .32 | -.33 | .01 | -.03 | .04 | -.20 |
| 19. COLe Commission Errors | .32 | -.18 | -.22 | -.16 | -.10 | -.31 | .19 | -.12 | .11 | -.12 | .08 |
| 20. COLe Omission Errors | -.09 | -.05 | .12 | .31 | .21 | .20 | .00 | -.12 | -.24 | -.17 | -.19 |
| 21. COLe Errors (Om & Com)[1] | .09 | -.13 | -.01 | .19 | .13 | .02 | .09 | -.16 | -.15 | -.21 | -.12 |
| 22. Correct STROOP Responses | -.16 | .11 | -.18 | -.46** | -.16 | -.01 | -.13 | .05 | .27 | .19 | .05 |
| 23. Incorrect Stroop Responses | .15 | .27 | .12 | -.16 | .02 | -.10 | .10 | -.25 | -.03 | -.23 | -.19 |
| 24. Self-Control Questionnaire | -.03 | -.09 | .11 | .33 | -.03 | .04 | -.04 | .07 | .14 | .00 | -.02 |
| 25. Subjective Effort | .12 | .04 | .15 | .20 | .06 | .03 | .04 | .14 | .19 | .11 | .06 |
| 26. Subjective Fatigue | .18 | .04 | .15 | .22 | .16 | .15 | -.01 | .18 | .08 | .17 | .11 |
| 27. Subjective Hunger | -.26 | -.06 | .10 | .29 | .11 | .12 | -.02 | -.35 | -.32 | -.39* | -.41* |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.9 (Cont.)

*Preliminary Correlational Statistics for the Normal Weight Experimental Group*

| | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 23. | 26. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12. BG at Baseline – BG COLe task | - | | | | | | | | | | | | | | |
| 13. BG COLe task – BG STROOP | -.65** | - | | | | | | | | | | | | | |
| 14. BG STROOP – BG 10-minute Rest | -.04 | -.31 | - | | | | | | | | | | | | |
| 15. BG Baseline – BG STROOP | -.33 | -.50** | .43* | - | | | | | | | | | | | |
| 16. BG Baseline – BG 10-minute Rest | -.28 | -.20 | -.50** | .57** | - | | | | | | | | | | |
| 17. BG COLe task – BG 10-minute Rest | .65** | -.72** | -.43* | .17 | .55** | - | | | | | | | | | |
| 18. COLe Correct Responses[1] | -.06 | .10 | -.43* | -.05 | .35 | .22 | - | | | | | | | | |
| 19. COLe Commission Errors | .33 | -.31 | .35 | .01 | -.31 | .04 | -.64** | - | | | | | | | |
| 20. COLe Omission Errors | -.19 | .11 | -.04 | .09 | .12 | -.08 | -.18 | .00 | - | | | | | | |
| 21. COLe Errors (Om & Com)[1] | .00 | -.06 | .14 | .08 | -.05 | -.04 | -.47** | .50** | .86** | - | | | | | |
| 22. Correct STROOP Responses | .34 | -.13 | -.25 | -.23 | .00 | .30 | .54** | -.16 | -.31 | -.35* | - | | | | |
| 23. Incorrect Stroop Responses | .31 | -.26 | .06 | -.03 | -.08 | .21 | -.15 | .54** | .04 | .31 | -.12 | - | | | |
| 24. Self-Control Questionnaire | .13 | -.20 | -.03 | .11 | .13 | .21 | .05 | -.23 | .08 | -.05 | .01 | -.37* | - | | |
| 25. Subjective Effort | .09 | -.13 | -.08 | .05 | .12 | .18 | -.24 | .17 | .38* | .41* | -.25 | .13 | .22 | - | |
| 26. Subjective Fatigue | -.14 | .11 | -.08 | .03 | .10 | -.05 | -.13 | .29 | .16 | .29 | -.20 | .06 | -.08 | -.01 | - |
| 27. Subjective Hunger | .00 | -.06 | -.08 | .07 | .14 | .11 | .10 | -.05 | .15 | .10 | -.22 | .18 | .32 | .19 | .00 |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.10

*Preliminary Correlational Statistics for the Overweight Experimental Group*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age (years) | - | | | | | | | | | | |
| 2. Height (Inches) | .25 | - | | | | | | | | | |
| 3. Weight (Pounds) | .21 | .92** | - | | | | | | | | |
| 4. Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | -.05 | .14 | .51** | - | | | | | | | |
| 5. Waist Circumference (inches) | .22 | .46** | .65** | .62** | - | | | | | | |
| 6. Hip Circumference (inches) | .23 | .19 | .30 | .38* | .43* | - | | | | | |
| 7. Waist/Hip Ratio | .02 | .27 | .36* | .27 | .59** | -.48** | - | | | | |
| 8. Blood Glucose (BG) at Baseline (mg/dL) | -.01 | -.18 | -.15 | .00 | -.06 | .07 | -.12 | - | | | |
| 9. BG Crossing-out-letters Experimental (COLe) (mg/dL) | .06 | .05 | -.01 | -.10 | .03 | .18 | -.13 | .56** | - | | |
| 10. BG STROOP (mg/dL) | .10 | .04 | -.02 | -.13 | .03 | .12 | -.09 | .64** | .66** | - | |
| 11. BG Rest (mg/dL) | .12 | .11 | .01 | -.21 | .01 | .15 | -.14 | .72** | .78** | .69** | - |
| 12. BG at Baseline – BG COLe task | .07 | .25 | .16 | -.10 | .10 | .11 | -.01 | -.51** | .42* | -.02 | .02 |
| 13. BG COLe task – BG STROOP | .06 | -.02 | -.02 | -.05 | .01 | -.06 | .05 | .12 | -.38* | .44* | -.08 |
| 14. BG STROOP – BG 10-minute Rest | .01 | .05 | -.03 | -.15 | -.10 | .01 | -.10 | .11 | .17 | -.38* | .41* |
| 15. BG Baseline – BG STROOP | -.12 | -.26 | -.16 | .16 | -.11 | -.07 | -.04 | .44* | -.10 | -.40* | .05 |
| 16. BG Baseline – BG 10-minute Rest | -.16 | -.36* | -.18 | .33 | -.04 | -.09 | .05 | .39* | -.29 | -.06 | -.36* |
| 17. BG COLe task – BG 10-minute Rest | -.08 | -.02 | .08 | .27 | .15 | .07 | .08 | -.29 | .26 | -.11 | -.40* |
| 18. COLe Correct Responses[1] | .12 | .05 | .05 | .00 | .20 | .13 | .09 | .11 | .21 | .11 | .01 |
| 19. COLe Commission Errors | .12 | .32 | .36* | .17 | .20 | -.10 | .30 | .11 | .19 | .11 | -.01 |
| 20. COLe Omission Errors | .01 | .13 | .22 | .30 | .27 | .35* | -.04 | -.06 | .04 | -.04 | -.23 |
| 21. COLe Errors (Om & Com) | .06 | .24 | .33 | .29 | .28 | .19 | .12 | .01 | .12 | .03 | -.16 |
| 22. Correct STROOP Responses | .19 | -.09 | -.14 | -.17 | -.16 | -.17 | -.01 | -.09 | -.16 | .11 | .08 |
| 23. Incorrect Stroop Responses | -.02 | .27 | .27 | .08 | .16 | -.21 | .35 | -.13 | -.12 | -.30 | -.25 |
| 24. Self-Control Questionnaire | -.01 | -.24 | -.19 | .06 | -.04 | -.11 | .02 | .27 | .14 | .27 | .16 |
| 25. Subjective Effort | -.12 | -.25 | -.21 | .03 | -.12 | -.17 | .06 | -.12 | -.15 | -.44* | -.32 |
| 26. Subjective Fatigue | -.11 | -.30 | -.37* | -.25 | -.28 | .20 | -.44* | -.09 | -.14 | -.25 | -.21 |
| 27. Subjective Hunger | -.31 | -.16 | -.09 | .14 | -.12 | .09 | -.20 | -.24 | -.35 | -.44* | -.39* |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.10 (Cont.)

*Preliminary Correlational Statistics for the Overweight Experimental Group*

| | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 23. | 26. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12. BG at Baseline – BG COLe task | - | | | | | | | | | | | | | | |
| 13. BG COLe task – BG STROOP | -.53$^{**}$ | - | | | | | | | | | | | | | |
| 14. BG STROOP – BG 10-minute Rest | .06 | -.67$^{**}$ | - | | | | | | | | | | | | |
| 15. BG Baseline – BG STROOP | -.59$^{**}$ | -.38$^{*}$ | .57$^{**}$ | - | | | | | | | | | | | |
| 16. BG Baseline – BG 10-minute Rest | -.72$^{**}$ | .27 | -.39$^{*}$ | .53$^{**}$ | - | | | | | | | | | | |
| 17. BG COLe task – BG 10-minute Rest | .59$^{**}$ | -.44$^{*}$ | -.37$^{*}$ | -.22 | .14 | - | | | | | | | | | |
| 18. COLe Correct Responses | .09 | -.11 | -.11 | .01 | .13 | .26 | - | | | | | | | | |
| 19. COLe Commission Errors | .08 | -.09 | -.14 | .00 | .15 | .28 | .23 | - | | | | | | | |
| 20. COLe Omission Errors | .10 | -.09 | -.26 | -.03 | .24 | .43$^{*}$ | .25 | .45$^{**}$ | - | | | | | | |
| 21. COLe Errors (Om & Com) | .11 | -.11 | -.24 | -.02 | .23 | .43$^{*}$ | .28 | .79$^{**}$ | .90$^{**}$ | - | | | | | |
| 22. Correct STROOP Responses | -.07 | .32 | -.05 | -.23 | -.21 | -.34 | -.15 | -.07 | -.22 | -.18 | - | | | | |
| 23. Incorrect Stroop Responses | .02 | -.23 | .08 | .19 | .14 | .18 | .04 | .21 | .06 | .14 | -.30 | - | | | |
| 24. Self-Control Questionnaire | -.15 | .17 | -.19 | .00 | .20 | .04 | -.24 | -.25 | -.19 | -.25 | .18 | -.18 | - | | |
| 25. Subjective Effort | -.03 | -.36$^{*}$ | .21 | .37$^{*}$ | .22 | .19 | -.08 | .16 | .04 | .11 | .20 | .21 | -.05 | - | |
| 26. Subjective Fatigue | -.04 | -.14 | .11 | .18 | .10 | .03 | .03 | .00 | .01 | .01 | .11 | -.07 | -.16 | .37$^{*}$ | - |
| 27. Subjective Hunger | -.10 | -.13 | .05 | .22 | .20 | .09 | -.11 | -.03 | .15 | .09 | .06 | -.02 | -.08 | .41$^{*}$ | .40$^{*}$ |

** *Correlation is significant at the .01 level (2-tailed).*

* *Correlation is significant at the .05 level (2-tailed).*

Table E.11

*Preliminary Correlational Statistics for the Obese Experimental Group*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age (years) | - | | | | | | | | | | | | |
| 2. Height (Inches) | .31 | - | | | | | | | | | | | |
| 3. Weight (Pounds) | .08 | .66** | - | | | | | | | | | | |
| 4. Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | -.12 | .12 | .82** | - | | | | | | | | | |
| 5. Waist Circumference (inches) | -.02 | .45* | .83** | .76** | - | | | | | | | | |
| 6. Hip Circumference (inches) | .22 | .39* | .81** | .76** | .76** | - | | | | | | | |
| 7. Waist/Hip Ratio | -.23 | .29 | .40* | .32 | .71** | .08 | - | | | | | | |
| 8. Blood Glucose (BG) at Baseline (mg/dL) | -.24 | -.06 | .08 | .15 | -.12 | .00 | -.17 | - | | | | | |
| 9. BG Crossing-out-letters Experimental (COLe) (mg/dL) | -.15 | .00 | .06 | .06 | -.06 | -.11 | .01 | .66** | - | | | | |
| 10. BG STROOP (mg/dL) | -.19 | .25 | .22 | .05 | .16 | .09 | .12 | .60** | .76** | - | | | |
| 11. BG Rest (mg/dL) | -.24 | -.01 | -.03 | -.07 | -.14 | -.16 | -.08 | .74** | .82** | .85** | - | | |
| 12. BG at Baseline – BG COLe task | .08 | .09 | -.02 | -.11 | .04 | -.14 | .19 | -.26 | .56** | .31 | .24 | - | |
| 13. BG COLe task – BG STROOP | .01 | .28 | .17 | -.02 | .28 | .27 | .14 | -.31 | -.65** | .01 | -.26 | -.48* | - |
| 14. BG STROOP – BG 10-minute Rest | -.14 | -.44* | -.42* | -.22 | -.53** | -.45* | -.35 | .40* | .26 | -.08 | .46* | -.08 | -.51** |
| 15. BG Baseline – BG STROOP | -.08 | -.33 | -.13 | .12 | -.30 | -.09 | -.32 | .56** | -.01 | -.33 | -.01 | -.63** | -.38 |
| 16. BG Baseline – BG 10-minute Rest | .00 | -.08 | .15 | .30 | .03 | .22 | -.13 | .38 | -.20 | -.34 | -.34 | -.69** | -.09 |
| 17. BG COLe task – BG 10-minute Rest | .11 | .04 | .13 | .18 | .09 | .04 | .11 | .07 | .54** | .06 | -.05 | .61** | -.75** |
| 18. COLe Correct Responses | .16 | -.48* | -.23 | .00 | -.23 | -.17 | -.22 | -.08 | .22 | -.02 | .07 | .30 | -.32 |
| 19. COLe Commission Errors | .08 | .21 | .02 | -.12 | -.09 | .03 | -.15 | .21 | .13 | .16 | .23 | .02 | .09 |
| 20. COLe Omission Errors | .00 | -.01 | -.14 | -.17 | -.23 | -.08 | -.28 | .17 | .01 | .09 | .25 | -.01 | .00 |
| 21. COLe Errors (Om & Com) | .03 | .06 | -.09 | -.16 | -.19 | -.05 | -.24 | .19 | .04 | .11 | .25 | -.01 | .02 |
| 22. Correct STROOP Responses | .35 | .26 | .09 | -.11 | .09 | .10 | .02 | -.33 | -.21 | -.04 | -.23 | .12 | .25 |
| 23. Incorrect Stroop Responses | .03 | .21 | .47* | .41* | .37 | .34 | .18 | .25 | .16 | .37 | .30 | -.07 | .19 |
| 24. Self-Control Questionnaire | -.07 | .09 | .14 | .13 | .11 | -.12 | .28 | -.05 | -.08 | -.13 | -.05 | -.04 | -.04 |
| 25. Subjective Effort | .16 | .35 | .42* | .31 | .27 | .48* | -.09 | .17 | .05 | .16 | -.07 | -.09 | .10 |
| 26. Subjective Fatigue | .03 | .16 | -.08 | -.20 | -.03 | .00 | -.01 | -.37 | -.30 | -.25 | -.37 | .11 | .11 |
| 27. Subjective Hunger | .24 | -.24 | -.14 | -.02 | -.11 | -.06 | -.11 | -.15 | -.19 | -.13 | -.17 | -.12 | .17 |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.11 (Cont.)

*Preliminary Correlational Statistics for the Obese Experimental Group*

| | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 23. | 26. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14. BG STROOP – BG 10-minute Rest | - | | | | | | | | | | | | |
| 15. BG Baseline – BG STROOP | .54** | - | | | | | | | | | | | |
| 16. BG Baseline – BG 10-minute Rest | -.08 | .79** | - | | | | | | | | | | |
| 17. BG COLe task – BG 10-minute Rest | -.19 | .02 | .16 | - | | | | | | | | | |
| 18. COLe Correct Responses | .16 | -.08 | -.21 | .16 | - | | | | | | | | |
| 19. COLe Commission Errors | .18 | .09 | -.03 | -.05 | -.39* | - | | | | | | | |
| 20. COLe Omission Errors | .31 | .11 | -.10 | -.24 | -.21 | .90** | - | | | | | | |
| 21. COLe Errors (Om & Com) | .28 | .11 | -.08 | -.23 | -.27 | .95** | .99** | - | | | | | |
| 22. Correct STROOP Responses | -.37 | -.34 | -.13 | .02 | .13 | .09 | -.08 | -.03 | - | | | | |
| 23. Incorrect Stroop Responses | -.07 | -.09 | -.05 | -.15 | .21 | .05 | .03 | .04 | .23 | - | | | |
| 24. Self-Control Questionnaire | .12 | .08 | .00 | -.05 | -.01 | -.05 | .05 | .02 | -.08 | -.08 | - | | |
| 25. Subjective Effort | -.41* | .03 | .33 | .25 | -.34 | .31 | .09 | .16 | .04 | -.12 | -.33 | - | |
| 26. Subjective Fatigue | -.29 | -.17 | .00 | .16 | -.39* | .35 | .21 | .26 | -.05 | -.10 | -.18 | .21 | - |
| 27. Subjective Hunger | -.12 | -.05 | .03 | -.13 | .22 | -.28 | -.29 | -.29 | .05 | .13 | -.07 | -.22 | .12 |

*** Correlation is significant at the .01 level (2-tailed).*

** Correlation is significant at the .05 level (2-tailed).*

Table E.12

*One-Way ANOVA Table of Differences Overall and Between Groups for Continuous Variables*

| | Total Sample | | Normal Weight Control (NWC) | | Normal Weight Experimental (NWE) | | Overweight Experimental (OWE) | | Obese Experimental (OBE) | | Group Difference One-way ANOVA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | S.D. | Mean | S.D. | Mean | S.D | Mean | S.D. | Mean | S.D. | *F* | Sig. |
| Age (years) | 22.37 | 5.02 | 21.13 | 1.98 | 21.13 | 1.98 | 23.38 | 6.94 | 24.19 | 6.61 | 3.03 | $.03^{*}$ |
| Height (inches) | 65.41 | 3.68 | 65.14 | 3.71 | 65.49 | 3.46 | 65.71 | 3.86 | 65.41 | 2.68 | .14 | .94 |
| Weight (lbs) | 160.42 | 38.56 | $134.72_{a}$ | 16.68 | $138.16_{b}$ | 19.68 | $169.41_{a,b,c}$ | 22.62 | $208.42_{a,b,c}$ | 41.98 | 48.53 | $.00^{**}$ |
| Body Mass Index (BMI) (weight (lb)*703/height$^2$(inch)) | 26.25 | 5.36 | $22.25_{a}$ | 1.12 | $22.55_{b}$ | 1.71 | $27.47_{a,b,c}$ | 1.42 | $34.21_{a,b,c}$ | 5.08 | 124.25 | $.00^{**}$ |
| Waist Circumference (inches) | 33.02 | 5.51 | $29.13_{a}$ | 2.80 | $29.73_{b}$ | 2.30 | $34.45_{a,b,c}$ | 2.89 | $40.08_{a,b,c}$ | 5.72 | 58.01 | $.00^{**}$ |
| Hip Circumference (inches) | 40.52 | 4.75 | $37.47_{a}$ | 2.10 | $37.59_{b}$ | 3.01 | $41.94_{a,b,c}$ | 3.33 | $46.14_{a,b,c}$ | 4.75 | 45.18 | $.00^{**}$ |
| Waist/Hip Ratio | .81 | .08 | $.78_{a}$ | .07 | $.80_{b}$ | .08 | .82 | .07 | $.87_{a,b}$ | .08 | 7.48 | $.00^{**}$ |
| Blood Glucose (BG) at Baseline (mg/dL) | 96.12 | 10.24 | 99.19 | 11.38 | 94.47 | 10.04 | 93.63 | 9.22 | 97.46 | 9.55 | 2.07 | .11 |
| BG Crossing-out-letters (COL)* (mg/dL) | 96.65 | 11.52 | 99.59 | 14.26 | 95.00 | 10.97 | 94.53 | 8.77 | 97.72 | 11.13 | 1.36 | .26 |
| BG STROOP (mg/dL) | 94.93 | 9.76 | 97.65 | 10.78 | 93.28 | 10.13 | 93.00 | 9.03 | 96.12 | 8.37 | 1.68 | .18 |
| BG 10-minute rest (mg/dL) | 95.18 | 10.14 | $98.84_{a}$ | 10.33 | 93.72 | 10.62 | $92.19_{a}$ | 9.20 | 96.19 | 9.39 | 2.66 | $.05^{*}$ |
| BG at Baseline – BG COL task* | .61 | 7.97 | .41 | 8.21 | .53 | 7.07 | .90 | 8.41 | .60 | 8.67 | .02 | 1.00 |
| BG COL task* – BG STROOP | -1.88 | 7.69 | -2.48 | 8.59 | -1.72 | 7.73 | -1.53 | 7.33 | -1.76 | 7.30 | .10 | .97 |
| BG STROOP – BG 10-minute Rest | .18 | 5.83 | 1.19 | 4.90 | .44 | 5.90 | -1.03 | 7.22 | .08 | 4.95 | .78 | .51 |
| BG Baseline – BG STROOP | 1.12 | 7.60 | 1.35 | 8.60 | 1.19 | 6.22 | .63 | 7.72 | 1.35 | 8.10 | .06 | .98 |
| BG Baseline – BG 10-minute Rest | .93 | 7.12 | .16 | 8.32 | .75 | 6.48 | 1.61 | 6.97 | 1.27 | 6.83 | .24 | .87 |
| BG COL task* – BG 10-minute Rest | 1.76 | 7.46 | 1.29 | 9.03 | 1.28 | 8.12 | 2.64 | 5.94 | 1.88 | 6.40 | .23 | .88 |

* $p < .05$, ** $p < .01$

[1.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2.] *Higher scores indicate greater effort, fatigue, and hunger.*

*Note: Means with the same subscript per measure are significantly different at p <.05 using a Tukey HSD range test.*

Table E.12 (cont.)

*One-Way ANOVA Table of Differences Overall and Between Groups for Continuous Variables*

| Variable | Total Sample | | Normal Weight Control (NWC) | | Normal Weight Experimental (NWE) | | Overweight Experimental (OWE) | | Obese Experimental (OBE) | | Group Difference One-way ANOVA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | Mean | S.D | Mean | S.D. | Mean | S.D. | *F* | Sig. |
| COL Correct Responses[1] | 199.09 | 133.77 | $395.69_a$ | 100.35 | $129.25_a$ | 36.24 | $123.19_a$ | 35.04 | $136.50_a$ | 61.68 | 135.89 | .00** |
| COL Commission Errors | 5.25 | 14.47 | $1.00_a$ | 1.57 | $4.75^a$ | 11.25 | 9.28 | 20.97 | $6.12_a$ | 16.25 | 1.83 | .15 |
| COL Omission Errors | 33.43 | 29.43 | 49.50 | 27.26 | 22.75 | 19.35 | 33.59 | 29.83 | 26.62 | 34.31 | 5.63 | .00** |
| COL Errors (Om & Com)[1] | 38.68 | 37.39 | 50.50 | 27.78 | 27.50 | 22.38 | 42.88 | 43.55 | 32.73 | 49.39 | 2.46 | .07 |
| Correct STROOP Responses | 521.25 | 113.27 | 536.16 | 106.97 | 528.06 | 125.60 | 504.69 | 107.03 | 514.92 | 115.80 | .47 | .70 |
| Incorrect STROOP responses | 20.84 | 9.44 | 18.66 | 10.81 | 21.59 | 12.28 | 21.34 | 12.72 | 22.00 | 9.44 | .54 | .66 |
| Self-Control Questionnaire | 122.28 | 16.71 | 124.31 | 18.28 | 123.84 | 18.25 | 123.23 | 14.88 | 116.52 | 14.19 | 1.28 | .28 |
| Subjective Hunger[2] | 6.12 | 2.39 | $5.59_a$ | 2.59 | $7.31_{a,b}$ | 2.05 | 5.87 | 2.17 | $5.58_b$ | 2.37 | 4.02 | .01* |
| Subjective Fatigue[2] | 4.57 | 2.14 | 4.38 | 2.37 | 5.03 | 1.53 | 4.16 | 2.33 | 4.73 | 2.25 | 1.03 | .38 |
| Subjective Effort on Tasks[2] | 5.32 | 2.20 | 5.16 | 2.26 | 5.56 | 2.20 | 5.50 | 2.17 | 5.00 | 2.24 | .44 | .73 |

* p < .05, **p < .01

[1] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2] *Higher scores indicate greater effort, fatigue, and hunger.*

*Note: Means with the same subscript per measure are significantly different at p <.05 using a Tukey HSD range test.*

Table E.13

*Differences between Blood Glucose (BG) measurements between Overall, Control, and Experimental Groups*

| | Overall Sample | | | Normal Weight Control | | | Normal Weight Experimental | | | Overweight Experimental | | | Obese Experimental | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Paired Diff[2] | *t* | Sig. | Paired Diff[2] | *t* | Sig. | Paired Diff[2] | *t* | Sig. | Paired Diff[2] | *t* | Sig. | Paired Diff[2] | *t* | Sig. |
| BG Baseline – BG Crossing-out-letters (COL)[1] | -.61 | -.84 | .80 | -.41 | -.28 | .61 | -.53 | -.43 | .67 | -.91 | -.61 | .73 | -.60 | -.35 | .64 |
| BG COL task[1] – BG STROOP | 1.88 | 2.67 | .00** | 2.48 | 1.61 | .06 | 1.72 | 1.26 | .11 | 1.53 | 1.18 | .12 | 1.76 | 1.21 | .12 |
| BG STROOP – BG 10-min Rest | -.18 | -.33 | .63 | -1.19 | -1.36 | .91 | -.44 | -.42 | .66 | 1.03 | .80 | .21 | -.08 | -.08 | .53 |
| BG Baseline – BG STROOP | 1.12 | 1.62 | .05* | 1.35 | .88 | .19 | 1.19 | 1.08 | .14 | .63 | .46 | .32 | 1.35 | .85 | .20 |
| BG Baseline – BG 10-min Rest | .93 | 1.55 | .07 | .16 | .11 | .45 | .75 | .66 | .25 | 1.61 | 1.29 | .10 | 1.27 | .95 | .17 |
| BG COL task[1] – BG 10-min Rest | 1.76 | 2.58 | .01* | 1.29 | .80 | .21 | 1.28 | .89 | .19 | 2.65 | 2.48 | .01* | 1.88 | 1.47 | .07 |

* p < .05, **p < .01 for one-tailed test

[1.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2.] *The difference between the pairs is reported in lieu of variable means to manage table size*

Table E.14

*Differences between Blood Glucose (BG) measurements between the Control and Experimental Groups*

| | Normal Weight Control | | | Experimental Groups[2] | | |
|---|---|---|---|---|---|---|
| | Paired Diff[3] | *t* | Sig. | Paired Diff[3] | *t* | Sig. |
| Pair 1 BG Baseline – BG Crossing-out-letters (COL)[1] | -.41 | -.28 | .61 | -.69 | -.81 | .45 |
| Pair 2 BG COL task[1] – BG STROOP | 2.48 | 1.61 | .06 | 1.66 | 2.12 | .04* |
| Pair 3 BG STROOP – BG 10-min Rest | -1.19 | -1.36 | .91 | .18 | .28 | .78 |
| Pair 4 BG Baseline – BG STROOP | 1.35 | .88 | .19 | 1.03 | 1.35 | .18 |
| Pair 5 BG Baseline – BG 10-min Rest | .16 | .11 | .45 | 1.20 | 2.61 | .09 |
| Pair 6 BG COL task[1] – BG 10-min Rest | 1.29 | .80 | .21 | 1.93 | 2.63 | .01* |

* p < .05, **p < .01 for one-tailed test

[1.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2.] *NWE, OWE, & OBE groups.*

[3.] *The difference between the pairs is reported in lieu of variable means to manage table size*

Table E.15

*Summary of Multiple Regression Analyses for variance in BG Changes Accounted for by DSC*

| | Overall Group | | | Normal Weight Control | | | Normal Weight Experimental | | | Overweight Experimental | | | Obese Experimental | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R^2$ | *F* | Sig. | $R^2$ | *F* | Sig. | $R^2$ | *F* | Sig. | $R^2$ | *F* | Sig. | $R^2$ | *F* | Sig. |
| BG Baseline – BG Crossing-out-letters (COL)[1] | .02 | .41 | .52 | .02 | .68 | .42 | .02 | .47 | .50 | .02 | .65 | .42 | .00 | .04 | .85 |
| BG COL task[1] – BG STROOP | .00 | .41 | .52 | .05 | 1.44 | .24 | .04 | 1.29 | .27 | .03 | .82 | .37 | .00 | .03 | .87 |
| BG STROOP – BG 10-min Rest | .01 | 1.06 | .31 | .04 | 1.12 | .30 | .00 | .02 | .88 | .00 | .00 | 1.00 | .02 | .35 | .56 |
| BG Baseline – BG STROOP | .00 | .24 | .62 | .05 | 1.39 | .25 | .02 | .53 | .47 | .00 | .00 | .99 | .00 | .04 | .11 |
| BG Baseline – BG 10-min Rest | .02 | 2.53 | .11 | .05 | 1.47 | .24 | .05 | 1.43 | .24 | .01 | .05 | .83 | .00 | .06 | .81 |
| BG COL task[1] – BG 10-min Rest | .02 | .58 | .63 | .28 | 2.50 | .07 | .07 | .39 | .76 | .04 | .27 | .89 | .09 | .48 | .75 |

[1.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

Table E.16

*T-test for High/Low Dispositional Self-Control for Overall, Control, and Experimental*

| | Overall Sample | | | Normal Weight Control | | | Normal Weight Experimental | | | Overweight Experimental | | | Obese Experimental | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Diff[3] | *t* | Sig. | Mean Diff[3] | *t* | Sig. | Mean Diff[3] | *t* | Sig | Mean Diff[3] | *t* | Sig. | Mean Diff[3] | *t* | Sig |
| Blood Glucose (BG) at Baseline (mg/dL) | 2.35 | -1.17 | .88 | 8.74 | -2.27 | .03* | -.53 | -.14 | .89 | -3.68 | .99 | .33 | 6.34 | -1.42 | .17 |
| BG Crossing-out-letters (COL)[1] (mg/dL) | 1.48 | -.65 | .74 | 10.46 | -2.15 | .04* | -3.88 | -.95 | .35 | -2.59 | .73 | .47 | 2.11 | -.39 | .70 |
| BG STROOP (mg/dL) | 2.63 | -1.36 | .74 | 10.16 | -2.48 | .01** | 1.40 | .37 | .72 | -6.35 | 1.82 | .08 | 5.96 | -1.55 | .14 |
| BG 10-minute rest (mg/dL) | 4.41 | -2.22 | .99 | 10.89 | -3.29 | .00** | 1.93 | .48 | .63 | -1.18 | .30 | .77 | 7.43 | -1.75 | .09 |
| BG at Baseline – BG COL task[1] | -.75 | .48 | .32 | 1.72 | -.58 | .57 | - 3.35 | -1.28 | .21 | 1.09 | -.32 | .75 | -3.83 | .94 | .36 |
| BG COL task[1] – BG STROOP | 1.43 | -.94 | .83 | .57 | -.18 | .86 | 5.28 | 1.91 | .07 | -3.77 | 1.29 | .21 | 3.72 | -1.06 | .30 |
| BG STROOP – BG 10-minute Rest | 1.98 | -1.71 | .86 | .72 | -.40 | .70 | .53 | .24 | .81 | 6.60 | -2.34 | .03* | 1.47 | -.62 | .54 |
| BG Baseline – BG STROOP | .00 | .00 | .50 | -.51 | .16 | .88 | -1.93 | -.83 | .41 | 2.68 | -.86 | .40 | .39 | -.10 | .92 |
| BG Baseline – BG 10-minute Rest | -1.95 | 2.36 | .17 | -1.23 | .40 | .70 | -2.46 | -1.01 | .32 | -3.52 | 1.21 | .24 | -1.09 | .35 | .73 |
| BG COL task[1] – BG 10-minute Rest | -3.46 | 2.21 | .02* | -1.29 | .38 | .71 | -5.81 | -2.01 | .05* | -2.81 | 1.13 | .27 | -4.94 | 1.67 | .11 |
| COL Correct Responses[1] | -15.60 | .59 | .56 | 34.45 | -.95 | .35 | 1.63 | .12 | .91 | -3.12 | .22 | .83 | 3.79 | -.13 | .90 |
| COL Commission Errors | 2.82 | -.39 | .70 | -3.82 | .38 | .71 | 2.84 | .34 | .74 | 3.25 | -.20 | .85 | 21.03 | -.89 | .38 |
| Correct STROOP Responses | -30.92 | 1.40 | .16 | -56.87 | 1.15 | .14 | - 24.01 | -.51 | .62 | -8.13 | .19 | .85 | -18.48 | .33 | .74 |
| Incorrect STROOP responses | 3.12 | -1.40 | .17 | 2.66 | -.68 | .50 | 4.92 | 1.08 | .29 | .88 | -.17 | .87 | 2.57 | -.56 | .58 |
| Subjective Effort on Tasks[2] | -.11 | .26 | .80 | -1.81 | 2.39 | .02* | .30 | .37 | .72 | .53 | -.60 | .56 | 1.26 | -1.19 | .25 |
| Subjective Fatigue[2] | .23 | -.56 | .58 | -.02 | .02 | .99 | -.23 | -.40 | .70 | 1.61 | -1.88 | .07 | -.54 | .49 | .63 |
| Subjective Hunger[2] | -.68 | 1.44 | .15 | -1.46 | 1.61 | .12 | -1.05 | -1.39 | .18 | .41 | -.45 | .66 | .03 | -.02 | .98 |

** $p < .05$, **$p < .01$ for two-tailed test*

[1.] *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2.] *Higher scores indicate greater effort, fatigue, and hunger.*

[3.] *The mean difference is reported in lieu of variable means to manage table size*

Table E.17

*Paired Samples t-test for High/Low Dispositional Self-Control and Blood Glucose (BG) Measurements*

| | High Dispositional Self-Control | | | Low Dispositional Self-Control | | |
|---|---|---|---|---|---|---|
| | Mean Diff[2] | *t* | Sig. | Mean Diff[2] | *t* | Sig. |
| Pair 1 BG at Baseline – BG after Crossing-Out-Letters (COL) task[1] | -1.15 | -.81 | .79 | -.40 | -.47 | .68 |
| Pair 2 BG after COL task – BG after STROOP | 2.82 | 2.14 | .02* | 1.39 | 1.64 | .05 |
| Pair 3 BG after STROOP – BG after 10-minute Rest | 1.05 | 1.10 | .63 | 1.05 | 1.14 | .13 |
| Pair 4 BG after Baseline – BG after STROOP | 2.19 | 2.35 | .01* | .23 | .28 | .39 |
| Pair 5 BG after Baseline – BG after 10-minute Rest | 4.08 | 3.01 | .00** | .63 | .81 | .21 |
| Pair 6 BG after COL task[1] – BG after 10-minute Rest | 1.16 | 1.28 | .10 | -.81 | -1.23 | .89 |

* $p < .05$, ** $p < .01$ one-tailed

[1]. *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

[2]. *The mean difference is reported in lieu of the means of both variables to manage table size*

Table E.18

*Mixed Between-Within Measures ANOVA for Blood Glucose, Blood Oxygen, and Heart Rate Measures*

| Measurements | Normal Weight Control | Normal Weight Experimental | Overweight Experimental | Obese Experimental | Group effect | | Time effect | | Group-by-time interaction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Blood Glucose | | | | | *F* | P | *F* | P | *F* | P |
| Blood Glucose (BG) at Baseline (mg/dL) | | | | | 2.19 | .09 | 2.70 | .05 | .29 | .98 |
| BG Crossing-out-letters (COL)[1] (mg/dL) | 99.00 (11.52) | 94.47 (10.03) | 93.81 (9.32) | 97.12 (9.58) | | | | | | |
| BG STROOP (mg/dL) | 100.13 (14.16) | 95.00 (10.96) | 94.84 (8.74) | 97.72 (11.13) | | | | | | |
| BG 10-minute rest (mg/dL) | 97.65 (10.78) | 93.28 (10.13) | 93.22 (9.09) | 95.96 (8.50) | | | | | | |
| BG Rest | 98.84 (10.33) | 93.72 (10.62) | 92.19 (9.20) | 95.84 (9.41) | | | | | | |
| Blood Oxygen | | | | | 4.69 | .00** | | | 1.20 | .25 |
| Blood Oxygen at Baseline Pre (beats/min) | 98.00 (1.02) | 97.46 (1.75) | 97.96 (.58) | 97.38 (3.54) | | | | | | |
| Blood Oxygen at Baseline Post (beats/min) | 97.50 (3.32) | 98.04 (1.00) | 98.04 (.65) | 97.95 (.74) | | | | | | |
| Blood Oxygen at COL[1] Pre (beats/min) | 98.33 (.56) | 98.24 (.65) | 98.33 (.55) | 98.33 (.58) | | | | | | |
| Blood Oxygen at COL[1] Post (beats/min) | 98.29 (.46) | 98.21 (.49) | 98.22 (.51) | 98.10 (.62) | | | | | | |
| Blood Oxygen at STROOP Pre (beats/min) | 98.67 (.70) | 98.07 (1.09) | 98.40 (.69) | 98.14 (.79) | | | | | | |
| Blood Oxygen at STROOP Post (beats/min) | 98.50 (.59) | 98.32 (.55) | 98.40 (.50) | 98.10 (.83) | | | | | | |
| Blood Oxygen at Rest Pre (beats/min) | 98.29 (.46) | 98.21 (.50) | 98.22 (.51) | 98.10 (.62) | | | | | | |
| Blood Oxygen at Rest Post (beats/min) | 98.17 (.70) | 98.04 (1.13) | 97.96 (1.45) | 98.60 (.70) | | | | | | |
| Heart Rate | | | | | 18.84 | .00** | 1.56 | .16 | .56 | .94 |
| Heart Rate at Baseline Pre (beats/min) | 83.29 (14.87) | 80.07 (13.87) | 85.14 (21.87) | 76.67 (12.72) | | | | | | |
| Heart Rate at Baseline Post (beats/min) | 84.42 (14.67) | 77.93 (12.10) | 80.67 (14.39) | 76.33 (9.60) | | | | | | |
| Heart Rate at COL[1] Pre (beats/min) | 83.58 (15.24) | 76.61 (13.44) | 81.70 (13.06) | 77.81 (9.52) | | | | | | |
| Heart Rate at COL[1] Post (beats/min) | 86.13 (16.53) | 82.11 (15.07) | 83.26 (15.27) | 77.81 (9.53) | | | | | | |
| Heart Rate at STROOP Pre (beats/min) | 81.46 (14.57) | 77.67 (8.87) | 79.59 (12.73) | 76.05 (14.35) | | | | | | |
| Heart Rate at STROOP Post (beats/min) | 86.42 (15.95) | 83.57 (11.14) | 85.37 (12.91) | 80.43 (11.40) | | | | | | |
| Heart Rate at Rest Pre (beats/min) | 77.46 (14.20) | 73.68 (10.85) | 76.85 (15.88) | 74.14 (10.19) | | | | | | |
| Heart Rate at Rest Post (beats/min) | 78.25 (15.42) | 71.68 (9.66) | 76.41 (12.52) | 68.48 (10.35) | | | | | | |

* p < .05, **p < .01

1. *Crossing-out-letters experimental for NWC and Crossing-out-letters control task for NWE, OWE, & OBE groups.*

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