MINDFULNESS MEDITATION AND RELAXATION AS METHODS

OF COPING WITH EGO-DEPLETION

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MINDFULNESS MEDITATION AND RELAXATION AS METHODS

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ABSTRACT

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Previous research suggests that the capacity for executive cognition and self-control is limited and fatigued through use, inducing a state known as ego-depletion. Mindfulness meditation is a specific practice of attention regulation that may be an effective technique for ameliorating the effects of ego-depletion. Mindfulness meditation, relaxation, and resting were compared as strategies for coping with ego-depletion. After two weeks' of meditation or relaxation practice, participants performed a tedious task designed to induce ego-depletion in them and then performed the meditation or

relaxation, or sat quietly. Results indicated that the three conditions performed at the

same level. Personality variables indicated that core self-evaluations and extraversion

accounted for a significant portion of the variance. Implications are discussed.

CHAPTER 1

INTRODUCTION

The ability to carry out acts of volition is integral to the human experience. Such acts require executive functioning, the higher-order capacity that allows for cognitive behaviors such as making and carrying out plans, and overriding impulse to make conscious choice (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, 2002). These abilities are also examples of self-control, or management of goal-directed behavior, requiring the capacity to persist at difficult tasks and resist temptation. Lack of ability in self-control is associated with many familiar problems that plague society, such as inappropriate diet, lack of exercise, poor money management, underachievement, unwanted pregnancy, and substance addiction (Baumeister, 2002). Thus, strategies to increase this capacity have significant application for individual and societal benefit. Mindfulness meditation is one behavioral strategy that may be effective in improving self-control abilities.

Ego-Depletion and Self-control

The ability to exercise self-control, regardless of the specific form it may take, appears to originate from a single, common, psychological resource (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, 2002). This resource is limited such that the capacity for self-control decreases with repeated or extended use. The temporary

deficit in this ability is known as ego-depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998).

The pattern of an act of volition leading to ego-depletion has been observed in a number of studies (Baumeister, Bratslavsky, Muraven, & Tice, 1998). In one such study, researchers directed hungry participants in one condition to resist tempting cookies and chocolates, eating radishes instead. Participants in the other two conditions were either told to eat the cookies or were presented with no food whatsoever. They were then presented with a figure-tracing task with no workable solution. Capacity for self-control was measured both as a function of time spent on the task as well as the number of attempts made. Participants who had resisted the chocolate to eat radishes instead persisted at the task for significantly shorter periods of time than either of the other groups, and made fewer attempts to solve it. Those instructed to eat the chocolate and cookies did not differ significantly from participants who were not presented with food. A second study involved participants making a pro- or counter-attitudinal speech. Participants were either assigned to one of these speeches, the low-choice condition, or allowed to choose but encouraged to pick one or the other, the high-choice condition. When presented with the impossible figure-tracing task, participants in the low-choice conditions persisted for equal amounts of time, regardless of whether they made a speech consistent with or counter to their own attitude, while participants in the high-choice condition persisted for significantly less time. Surprisingly, in the high-choice condition, participants making pro- and counter-attitudinal speeches persisted for equally short amounts of time, indicating that it is the act of making a choice that depletes this resource. The researchers had anticipated that the presence of cognitive dissonance would

lead to greater amounts of ego-depletion, but it did not appear to have any effect. In Baumeister and colleagues' third study, participants watched a video clip with emotionally evocative content, either sad and distressing or humorous. These participants were further divided into conditions in which they were told to either suppress or freely allow any emotional reaction to occur. Participants then solved as many anagrams as they could within a six-minute period. Those in the emotion-suppression condition, regardless of the emotion suppressed, solved significantly fewer anagrams than participants who did not attempt to control their emotional reaction.

These three studies also demonstrate the stability of this pattern of ego-depletion across widely varied tasks. Other studies providing support for ego-depletion have observed its occurrence after diverse self-regulative behaviors including thought regulation (Baumeister, 2002), willingly consuming a foul tasting drink (Tice, Baumeister, Shmueli, & Muraven, 2007), performing mental math in physically stressful conditions (Webb & Sheeran, 2003), maintaining a tight physical handgrip on an object (Martijn et al., 2006), as well as other behaviors. Despite the differences in the nature of these tasks, all of them lead to a state of ego-depletion. The application of this capacity to such a widely varied group of behaviors has lead to comparisons with generalized muscular strength in that it demonstrates fatigue after use (Baumeister, 2002; Baumeister, Vohs, & Tice, 2007).

Various explanatory models of self-control have been considered in addition to the muscle or strength analogy, but none of them have been supported by the pattern of evidence (Baumeister, Vohs, & Tice, 2007). One such model is the use of cognitive schemas. However, the use of a schema would be indicated by an improvement in self-

control performance due to priming effects, and research has demonstrated the opposite pattern.

The limitation of the self-control resource is demonstrated by the presence of ego-depletion following a single task of self-control. However, this effect could be due to exhaustion of the resource or a response to conserve it. Athletes conserve their energy after they begin to experience fatigue; it may be that the experience of ego-depletion leads to a similar response. Muraven (1998, as cited in Baumeister, 2002) demonstrated that participants could resist the effects of ego-depletion if given sufficient incentive. A second study involved participants completing two consecutive ego-depleting tasks. Before the second task, however, some participants were told that they would have to perform a third task that would also require self-control. These participants displayed significantly greater amounts of ego-depletion compared to those not told anything prior to the second task. These two studies support the interpretation that the use of the self-control resource stimulates a conservation response as participants ration their strength of self-regulation according to circumstance, similar to athletes.

There is further evidence to support the idea that self-control and ego-depletion are analogous to muscular strength, as resistance to ego-depletion also appears to be a skill than can be improved with practice. Muraven, Baumeister, and Tice (1999, as cited in Baumeister, 2002) had participants practice specific self-regulatory tasks, such as improving posture or recording their dietary habits, for two weeks. Compared to the control groups who had not engaged in such behavior, these participants showed improvements on laboratory measures of ego-depletion and tasks of frustration tolerance. The researchers concluded that the regular practice of self-control appears to help build

resistance to the effects of ego-depletion. Similarly, a study by Oaten and Cheng (2004a, as cited in Baumeister et al. 2006) had participants join a two-month exercise program with weight training and cardiovascular training. Self-regulation abilities were assessed by performance on a visual tracking task that required high amounts of attention vigilance, after completing an ego-depleting task of thought suppression. Participants displayed significant improvements on the attention vigilance task following the exercise program. Another study by the same authors (2004b, as cited in Baumeister et al. 2006) involved participants joining a four-month money management program which involved such self-regulatory tasks like tracking their expenditures and maintaining other financial logs. Money management improved significantly, but their performance on other self-control tasks did as well, such as a visual tracking task. As participants continued through the program, their performance on these measures progressively improved. Other studies have supported global improvements in self-control from engaging in regular practice of specific exercises (see Baumeister et al. 2006 for a review).

Although the pattern of behavior of ego-depletion has been demonstrated in numerous studies, the physiological mechanism behind it is not yet fully understood. Glucose is the brain's primary energy source and is involved in executive functioning (Gailliot et al. 2007). It may be involved in ego-depletion as low blood-glucose levels have been associated with demonstrations of a lack of self-control, such as criminal behavior or alcohol intoxication. Gailliot et al. (2007) examined the connection of ego-depletion and glucose levels across nine experiments. Results indicated that decreases in blood-glucose levels were linked with the experience of ego-depletion, drops in glucose

levels predicted poor performance on persistence tasks, and consuming glucose reduced the effects of ego-depletion.

Research has indicated other factors that reduce or avoid the effects of ego-depletion. According to four studies by Tice et al. (2007), positive affect appears to reduce ego-depletion. In these studies, participants performed a task of self-regulation, followed by the induction of a positive mood through either watching a humorous video or receiving an unexpected gift. These participants performed equally well on measures of self-control as participants who had not engaged in the ego-depleting task. Additionally, these participants performed better than participants who had received a sad or neutral mood induction, or those who had rested briefly. Previous research also supports sleep and rest as strategies to restore the self-control resource (Baumeister, 2002). Social goals, such as the desire to be a good relationship partner or to help others, are also associated with reduced levels of ego-depletion.

Implementation intentions have been suggested to help resist the effects of ego-depletion (Webb & Sheeran, 2003). These intentions are specifically articulated strategies on how to accomplish goal-directed behavior through detailing a response to an environmental cue. By explicitly stating how, when, and where the individual will respond, there is a reduced need to consciously consider various courses of action when choosing a course of action. Implementation intentions have been used in tasks such as the Stroop task, in which the printed color of a word is incongruous with its meaning (for example, the word "blue" printed in red ink). To avoid being distracted by the meaning of the word, individuals may ignore the word as a whole and instead focus on only the second letter to identify the color. Although reading the entire word is an automatic and

habitual response, the implementation intention facilitates avoidance of this response, thus reducing the need to use the self-control resource. Implementation intentions appear to be a potentially effective strategy for coping with ego-depleting tasks, but may not always be a possibility, depending on the nature of the task.

<div align="center">Mindfulness Meditation</div>

Mindfulness meditation may be an effective behavioral strategy to both avoid the effects of ego-depletion and cope with them effectively when they occurs. To understand its possible benefit, however, it is necessary to discuss the theory and research on mindfulness meditation.

Most forms of meditation involve some degree of attention regulation, with the primary difference being the breadth of focus. On one end of the continuum of attention focus is concentrative meditation, in which the practitioner focuses exclusively on a chosen attention object, such as a mental image or chanted phrase. Mindfulness meditation, at the other end of the continuum, involves a broad focus directed equally all to stimuli occurring in the present moment. Practitioners maintain a cultivated attitude of openness and curiosity to experiences, as if it were their first encounter (Dunn, Hartigan, & Mikulas, 1999; Scherer-Dickson, 2004; Lau & McMain, 2005). Judgment, analysis, interpretation, rumination, and other mental processes are withheld in favor of awareness and observation (Kurash & Schaul, 2006). Practicing mindfulness meditation requires some degree of skill with concentrative meditation, so most forms of training for novice practitioners begin with directing attention to the experience of the breath. When attention inevitably wanders, the individual notes the digression and then gently returns the focus back to the breath. No additional attention is given to the digression, and the

practitioner is to return the attention focus without becoming impatient or frustrated with himself. As the practitioner becomes more comfortable, the attention is broadened from the breath to include all experiences occurring in the present moment, including bodily sensations, thoughts, and emotions, as well as external stimuli (Murphy, 2006). The emphasis on dispassionate observation of passing experiences disrupts the "automatic pilot" of habit-based thinking, feeling, and reacting. Thoughts and emotions are perceived simply as passing occurrences instead of inherently accurate representations of reality (Williams & Swales, 2004). Events are experienced directly, as opposed to being filtered through ruminations on their possible significance, origin, or implication (Bishop et al., 2004). The practitioner may transition from the perceived fight to control thoughts, emotions, and somatic sensations to being free from the need to control (Kostanski & Hassed, 2008).

Several attempts have been made to facilitate empirical study by operationalizing the construct of mindfulness. A definition proposed by Bishop et al. (2004) involves two components, the first of which is control of attention toward experiences in the present moment. The practitioner maintains continuous focus on changing experiences from moment to moment. The second component is the nature of the attitude with which attention is maintained; it is to be one of openness, curiosity, and acceptance of experiences.

Shapiro, Carlson, Astin, and Freedman (2006) proposed a similar definition but included a third component of intention of practice, in addition to attention regulation and attitude. The inclusion of intention returns to the roots of mindfulness meditation in Buddhism, in which the ultimate goal of practice is development of compassion and

attainment of enlightenment. During the secular practice of mindfulness meditation, intention may vary from practitioner to practitioner, and within one's practice. For example, one person may begin practice with the intention of stress reduction, but over time this intention may grow to include developing insight into himself or his relationships with others. Regulation of attention focus on the present moment is the second component and includes both sustained attention and returning the focus of the attention back to the present moment after it has wandered. The ability to disengage from one stimulus to focus on another is known as "switching" and precludes analytical processing of thoughts, emotions, and sensations as they occur. The third proposed component is attitude, defined as the maintenance of an attitude of compassion and curiosity to the events experienced during meditation, without being critical.

A third proposed operationalization of mindfulness was used as the basis for the Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2006, as cited in Carmody and Baer, 2008). Mindfulness is understood to include five elements: Observing, defined as noting internal experiences and external stimuli; describing, or articulating labels for the observed events; acting with awareness, defined as being fully present with one's actions as opposed to acting automatically; non-judging of inner experiences, noting the distinction between labeling experiences and evaluating them; and non-reactivity to inner experience, defined as allowing experiences to occur freely without becoming involved.

In order to justify the practice of meditation, there are three basic assumptions about the effects of regular practice (Lutz, Dunne, & Davidson, 2007). The first assumption is that meditation produces a specific state that may be reproduced. Secondly, the characteristics associated with the state produced by meditation become traits. Lastly,

meditation is a skill that can be improved with practice. Recent research on mindfulness meditation has addressed the validity of these assumptions.

Several studies have provided support for the first assumption, that practicing meditation leads to a reproducible state. Carmody and Baer (2008) examined changes in scores of mindfulness on the FFMQ within the context of an eight-week mindfulness-based stress reduction program, in which participants practiced meditation through sitting meditation, body scan, and practicing yoga in a mindful way. Participants were also encouraged to incorporate mindfulness into their daily lives. Participants displayed statistically significant increases on all five facets of the FFMQ, though observing and non-reactivity to inner experience had the largest effect sizes.

An extension of the first assumption is the premise that mindfulness meditation is a state of consciousness that is different from one induced by concentrative meditation, and separate from relaxation, as some have suggested. One study by Dunn, Hartikan and Mikulas (1999) examined this question by comparing electroencephalographic (EEG) readings of ten individuals. These participants had received ten weeks of training in concentrative meditation and mindfulness meditation. The researchers compared the scans of both forms of meditation and as well as of a baseline reading of eyes-closed relaxation. The results showed different brain wave frequencies and source location patterns for each practice. Despite the small sample size, the researchers came to the conclusion that mindfulness meditation and cognitive meditation are unique forms of cognition and are distinct from relaxation.

Lutz and colleagues (2004) conducted another study of EEG scans and meditation. They took scans of both novice meditators and long-term Buddhist

practitioners, the latter of which had approximately 10,000-50,000 hours of practice. In contrast, the novice meditators, who had no previous experience prior to the study, received training and practiced for one hour per day for a week. Participants practiced a form of meditation called non-referential compassion, which attempts to induce a particular emotional state of loving-kindness, but without focusing on any specific object, person, or group of people. It is similar to mindfulness meditation in the lack of specific attentional focus. EEG scans were taken at baseline, during meditative practice, and then post-meditation. The scans revealed that the experienced practitioners displayed greater amounts of high-amplitude, long-distance gamma wave synchrony at baseline than the novice meditators, and this difference increased during meditation. Neural synchrony, and particularly at the gamma wave frequency, is found with mental processes such as working memory, sustaining attention, or learning. Thus, the patterns on the EEG scans suggest large-scale neural coordination, hypothesized to be the neural process behind higher-order mental and affective functions. The researchers also noted that the high-amplitude gamma wave activity seen in some of the highly experienced practitioners are "the highest reported in the literature in a nonpathological context" (Lutz et al., 2004, p. 16372), suggesting that there is extremely large and precise neural coordination in the fast frequencies. There was also a significant positive correlation between baseline gamma waves and amount of meditation experience ($r = 0.79$), but a weak correlation with age ($r = 0.23$) indicating that this type of neural coordination is not a result of age but amount of practice. Additionally, these differences suggest that regular practice of meditation can change baseline neurological patterns. Two of the basic assumptions of meditation appear to be supported by these findings; regular practice changes state

characteristics into trait characteristics, and meditation is a specific skill that may be improved with practice.

<div align="center">Mindfulness and Ego-Depletion</div>

Research appears to support the claim that mindfulness meditation improves psychological well-being (Ortner, Kilner, & Zelazo, 2007; Carmody & Baer, 2008; Chambers, Lo, & Allen, 2008; Kostanski, & Hassed, 2008). The hypothesized mechanisms of mindfulness suggest that it could be an effective method to both circumvent ego-depletion, as well as recover more quickly than a simple rest state. Research on self-control and ego-depletion has revealed several methods through which the effects of ego-depletion may be reduced or avoided all together, including positive affect, rest, glucose levels, humor and laughter, practice and training, and appropriate incentive (Webb & Sheeran, 2003; Baumeister, Vohs, & Tice, 2007). I hypothesize that mindfulness meditation has the potential to influence ego-depletion through several of these points. Research on the primary mechanisms behind mindfulness and their application to ego-depletion are discussed, focusing on reduction of automatic reactivity, enhancing positive affect, and stress reduction.

Reducing Reactivity

Mindfulness meditation may have its most powerful effect on avoiding, reducing or recovering from ego-depletion by reducing an individual's automatic reactivity to negative experiences, thereby increasing tolerance. The act of meditating provides repeated practice of dispassionate observation of thoughts and emotions, thus allowing for the immediate recognition and cessation of rumination, increasing self-efficacy regarding attentional control (Melbourne Academic Mindfulness Interest Group, 2006).

As maintaining a judgmental and critical attitude tends to exacerbate negative aspects of experiences, the emphasis in mindfulness meditation on openness and acceptance may lessen that effect. Refraining from using labels such as "good" or "bad" encourages openness to new interpretations of experience.

Related to the reduction of automatic reactivity, Shapiro et al. (2006) discuss the construct of *reperceiving* as a mechanism behind mindfulness. This construct involves the metacognitive understanding that experiences perceived by the individual are separate from the person herself, that the perceiver is more than the perceived. Shapiro and colleagues break reperceving into four more basic mechanisms. Firstly, the individual cultivates moment-to-moment awareness, which increases the degree of sensitivity of observation. Secondly, through maintaining openness to all experiences and increasing the degree and breadth of observation, the individual receives a greater amount of data. Improved access to information leads to greater accuracy in assessing situations, necessary for effective self-management, thus leading to improvements in this ability. In addition to improved self-control, the authors also suggest that another benefit is a more clear awareness of one's personal values in comparison to those value systems established by culture or family, providing conscious choice in these issues. The final mechanism of reperceiving is increasing exposure to both pleasant and unpleasant experiences and stimuli, thus increasing tolerance and decreasing tendencies to seek pleasure and avoid discomfort.

Several of the suggested mechanisms behind reperceiving and mindfulness have direct implications to self-control and ego-depletion. As stated, Shapiro and colleagues propose that self-control requires accurate information about the consequences of choices

so that behavior may be adjusted appropriately; thus, improving skills in mindfulness would likely improve skills of self-control. The fourth suggested mechanism, increasing tolerance, may have the most potential for coping with ego-depletion. Exhibiting self-control through persistence at an unpleasant task or resisting temptation requires an ability to tolerate the temporary discomfort. Attentional control may therefore be a component of tolerance, through disengagement of attention from the distraction of unpleasant quality of the experience, and returning it back to performing the task at hand. This disengagement would not be an avoidance of the discomfort, as mindfulness explicitly includes openness to negative as well as positive experience, but rather reducing the amount of distraction caused by the discomfort. Tolerance may therefore be increased by learning to accept unpleasant experiences and improving control over attention. Increased tolerance of the taxing qualities of an ego-depleting task may lead to reduced ego-depletion, as well as improved ability to cope with the effects of ego-depletion, potentially leading to reduced impairment. There is evidence to suggest that mindfulness meditation has these effects.

Ortner, Kilner, and Zelzo (2007) hypothesized that cognitively processing a negative stimulus uses up some of the overall cognitive resources. They performed two studies to examine the degree of emotional reactivity attenuated by the practice of mindfulness meditation. Both studies included the Emotional Interference Task (EIT), in which participants were presented with either an image designed to induce neutral, positive affect, or negative affect. Participants were asked to rate whether a tone played after the presentation of the image was high or low by pressing a key as quickly as possible. Tones were played either one or four seconds after the presentation of the

image, and reaction times were compared across the two stimulus onset asynchrony conditions and the image affect conditions. Emotional interference was judged to be the degree of delay in reaction time for positive or negative affect images as compared to neutral images. The authors also included a Picture Rating Task (PRT), in which the participant indicated the intensity of feelings invoked by an image on a Likert scale. The pictures for the rating task included neutral, positive, and negative images presented randomly. The first study conducted this procedure with participants from a local Buddhist meditation center who had been practicing between one month and 29 years. Results indicated that the amount of meditation experience held by the participant negatively correlated with the reaction time for negative affect images on the EIT at both the one second and four second delay, and for positive affect images at the four second delay. These results suggest that training in mindfulness meditation reduces prolonged emotional reactivity to stimuli. The second experiment included these same procedures but also included skin conductance responses (SCRs) and a skin conductance level (SCL). The researchers used an experimental design, comparing participants undergoing seven weeks of either mindfulness meditation or body awareness and relaxation meditation (RM), as well as a wait-listed control group. Assessments were conducted before and after the training. Results showed emotional interference across all three groups for the negative affect images with the one second delay, but only the RM and control groups showed the interference at the four second delay, indicating that the mindfulness group had disengaged their attention from the image. The difference between the groups was statistically significant. Both the mindfulness group and RM reported reduced ratings of emotional intensity of the images during PRT after the

intervention, while the control group remained unchanged. This finding was supported by changes in SCRs. However, only the meditation group displayed a reduction in the baseline SCL after the treatment, implying state reductions of distress. The changes in the physiological measures indicate that the benefits of mindfulness meditation goes beyond expectancy or relaxation.

Further evidence of the benefits of mindfulness meditation and attention control are supported by Valentine and Sweet (1999), who found that participants who practiced mindfulness meditation displayed improved sustained attention to both expected and unexpected stimuli. Participants who practiced concentrative meditation only showed improvements in sustained attention to expected stimuli. Given the apparent role of attention regulation and emotional reactivity, these studies add further support for the hypothesis that mindfulness meditation may be an effective method for coping with ego-depletion.

Other studies have compared the effects of meditation on pain tolerance. Wacholtz and Pargament (2005) compared secular-focused transcendental meditation, spiritually-focused transcendental meditation, and progressive muscle relaxation on tolerance of holding their hands in a bucket of ice water, a highly ego-depleting task. Transcendental meditation is distinct from both concentrative and mindfulness meditation as practitioners repeat spoken mantras while exhibiting no control over their attentional focus, a technique which practitioners believe allow for achieving transcendence of awareness. Participants practiced one of the three techniques for 20 minutes per day for two weeks before the pain tolerance assessment. Before placing their hands in the cold water, participants practiced their technique for 20 minutes. Pain tolerance was assessed

by length of time that participants kept their hand in the water. Results indicated that participants in the spiritually-focused group tolerated the ice water for almost twice as long as the other two groups, leading to the conclusion that the spirituality was a necessary component of meditation. As stated, transcendental meditation is different from mindfulness meditation due to the lack of attentional control, so it is significantly limited in its generalizability. However, this study suggests that meditation has potential as a method of reducing reactivity and increasing tolerance.

The objective labeling of affective experiences may be involved in the reduction of emotional reactivity (Creswell, Way, Eisenberger, & Lieberman, 2007). Practitioners of mindfulness, particularly novice meditators, are frequently encouraged to articulate observations of experience as it occurs through statements like "Here is sadness". In one study, participants who received a high trait mindfulness score underwent MRI scan during a labeling task. They verbally articulated affect expressed by individuals in photographs as well as participated in a gender-labeling task. The scans revealed that during the affect-labeling task, there was increased and widespread activation of prefrontal cortex and decreased bilateral amygdala activity, a pattern most strongly demonstrated by participants with high scores of trait mindfulness and likewise weakest for those who scored lowest. The authors suggest that the act of articulating a verbal label for affect may disrupt the automatic emotional responses to stimuli, and practice of mindfulness meditation may improve the capability of the prefrontal cortex to regulate situational reactivity in the limbic system.

Chambers, Lo, and Allen (2008) examined the degree of influence of executive cognition, specifically attention focus, on psychological well-being. Deficits in attention

regulation may be a key element in depression (Depue & Collins, 1999; Strauman, 2002, both cited in Chambers, Lo, & Allen, 2008), rumination (Treynor, Gonzalez, & Nolen-Hoeksema, 2003, as cited in Chambers, Lo, & Allen, 2008), and anxiety (Wells, 2002, as cited in Chambers, Lo, & Allen, 2008). The researchers posited that as attention regulation can be improved with training, benefits may include the capability of focusing and thus controlling one's reaction to stress. Following a 10-day intense mindfulness mediation retreat, novice practitioners showed significant improvements in sustained attention and working memory, as well as improvements on self-reported scores of depression, reflective rumination, and negative affect. One particularly interesting finding is that their scores on the negative affect scale of the Positive Affect Negative Affect Scale decreased, but their positive affect scores did not increase, providing further support that mindfulness training reduces reactivity and brings the individual to a more centered position.

Additional evidence of psychological benefits arising out of reduced reactivity is described by Carmody and Baer (2008). After participating in a mindfulness-based stress reduction program, participants displayed significantly improved scores on psychological well-being, perceived stress levels, and psychological symptoms. Analyses indicated that the improvements in stress and symptoms were mediated completely by developing mindfulness skills, and partially mediated improvements in psychological well-being.

Research into rumination, depression, and mindfulness meditation provides further evidence of the ability of mindfulness to reduce reactivity. Research suggests that mindfulness training decreases level of depression for patients with various mood disorders for whom standard cognitive-behavioral therapy and/or pharmacotherapy had

limited effect (Kenny & Williams, 2006), patients with a lifetime history of mood disorder (Ramel, Goldin, Carmona, & McQuaid, 2004), or with residual depressive symptoms (Kingston, Dooley, Bates, Lawlor, & Malone, 2007). Additionally, there is evidence that it reduces risk of relapse among participants with a history of severe depression (Ma & Teasdale, 2004) and is superior to both distraction as a method of coping with rumination (Broderick, 2005) as well as relaxation (Jain et al., 2007). Each of these studies suggested that the key element in mindfulness was the ability to reduce reactivity, thus breaking through ruminative processes.

Furthermore, research done by Walter Mischel on self-control adds support to the potential benefits of using mindfulness meditation to cope with the effects of ego-depletion. In one of his early studies, he examined the preference of a smaller, immediate reward versus a delayed, larger reward with regard to cheating in a game of skill for adolescents (Mischel, 1964). He found that preference for the delayed reward was associated with resistance to temptation, as demonstrated by a delay in yielding to temptation. Likewise, preference for immediate reward was related to decreased ability to resist temptation. More recently, Mischel and Ayduk (2002) have hypothesized that engaging in self-control requires the individual to distance herself from the negative arousal associated with difficult or frustrating tasks. Maintaining control over one's attention is necessary to reduce impulsive reactions that would undermine the pursuit and attainment of goals. Such attentional control and reduced reactions are both characteristics of mindfulness meditation, and as such, add further support for the hypothesis that engaging in this form of mental training would improve one's capacity to cope with the effects of ego-depletion.

Training in Self-Control

 As discussed earlier, research has indicated that training in one form of self-control appears to strengthen this ability in general, leading to increased resistance to ego-depletion regardless of the domain of the task trained or the task assessed. Incorporating a new routine into one's daily life constitutes a form of self-control. Additionally, performing mindfulness meditation requires repeated practice of attention regulation in maintaining the focus of attention and switching back to this focus once it has wandered.

Positive Affect

 Previous research on self-control suggests that positive affect can reduce the degree of ego-depletion (Tice et al., 2007). A study by Davidson and colleagues (2003) found evidence that mindfulness-based therapies may increase pre-frontal left-sided anterior activation, an area that has been associated with positive affect. Meditation-naïve participants who were in a mindfulness-based stress reduction program had EEG scans taken before and after the program. The researchers also assessed levels of antibody titers in response to a vaccine against influenza, an indication of immune strength, as recent research suggests there is a link between pre-frontal left-sided anterior activation, positive affect, and immune function. Results indicated statistically significant increases in left-sided anterior activation among the mindfulness-based stress reduction treatment group after completion of the program, as well as evidence of stronger immune function, compared to the controls.

Stress Reduction and Rest

Research has indicated that sleep and rest appear to reduce the levels of ego-depletion as well (as cited in Baumeister, 2002), another method through which practicing mindfulness meditation may be an effective way to increase recovery from an ego-depleting task. One study examined the effects of a mindfulness-based stress reduction program for medical and premedical students (Shapiro, Schwartz, & Bonner, 1998). At the completion of the program, participants displayed decreased levels of anxiety and global psychological distress while levels of empathy and spirituality increased, results which were replicated with the wait-listed control group. The benefits of the program remained constant with different researchers being involved and during the examination period. In another study, Tang and colleagues (2007) have found evidence that after five days of 20 minute integrative training in a Chinese form of awareness-focused meditation, known as integrative body-mind traditions, stress-related levels of cortisol dropped while attention and self-control scores improved. As the ability to enact self-control appears to be replenished by rest, practicing mindfulness meditation may be an effective method of coping after an ego-depleting task.

Through the mechanisms of reducing reactivity, practicing self-control, increasing positive affect, and decreasing stress, mindfulness meditation appears to have great potential as both a coping method that may minimize ego-depletion, and a way to increase self-control, thus circumventing ego-depletion. This study examined the effects of mindfulness meditation (MM), progressive muscle relaxation (PMR), and sitting quietly on the effects of ego-depletion. Progressive muscle relaxation is a technique to achieve somatic relaxation through the alternate tensing and relaxing of muscle groups.

This relaxation technique is compared to the meditation as they both include a relaxation component as well as some degree of self-control, as participants in both groups will need to change their daily schedules enough to incorporate practice. Therefore, the primary hypothesis is that participants in the mindfulness meditation condition will display the least amount of ego-depletion of the three groups. The second hypothesis is that participants in the progressive muscle relaxation will demonstrate less ego-depletion than participants in the control group.

<div align="center">Personality Traits and Ego-Depletion</div>

Research in personality and industrial/organizational psychology has indicated that certain personality traits are associated with superior job performance. The Big Five personality traits, comprised of neuroticism, extraversion, openness to experience, conscientiousness, and agreeableness. Chamorro-Premuzic and Furnham (2008) found that openness to experience and conscientiousness correlated with academic performance. Additionally, the personality construct made up of core self-evaluations has also been examined. Core self-evaluations are a higher-order trait comprised of self-esteem, self-efficacy, locus of control, and low neuroticism, or emotional stability (Judge, Eraz, & Bono, 1998). Positive self-concept may be linked with job performance through higher levels of motivation as well as improved ability due to increased social capacities. Positive core self-evaluations have also been connected to improved job performance, including on persistence on anagrams (Eraz & Judge, 2001, as cited in Bono & Judge, 2003). The correlational relationships between core self-evaluations and the Big Five personality traits are approximately the same as those between neuroticism and the other four traits. As there has been little research done in the influence of personality traits and

ego-depletion, these personality traits were included in this study. The third and last

hypothesis of this study is that that higher levels of conscientiousness and core self-

evaluations will be associated with increased task persistence.

CHAPTER 2

METHOD

Data Collection Procedures

Participants were recruited from undergraduate psychology courses and received course credit for their participation. They were instructed that the research examined the effects of focused concentration and introspection on academic-related tasks. Groups of participants were randomly assigned to the control group and the meditation or relaxation treatment conditions. Data collection occurred at two points in time. At time one (T1), personality data were collected and participants were trained for the experimental conditions. At time two (T2), two weeks after T1, participants returned for the ego-depletion task and subsequent persistence assessment task. An overview of the three experimental conditions follows below.

Experimental Treatments

Mindfulness Meditation

At the initial session, participants in the Mindfulness Meditation (MM) condition received initial training in a group setting by the researcher before having filled out a personality questionnaire. Participants were introduced to the meditation technique twice for 30 seconds at a time, twice for a one-minute duration, and once for a minute and a half duration. Participants were then asked to practice MM at home for six days per week

for the two weeks with the assistance of a 13-minute guided meditation audio file posted on the university website. The guided meditation script contained four two-minute long pauses. Frequency of practice was monitored by site access statistics on the website as well as through email and phone correspondence with participants. Due to some of the technological limitations on the part of the participants, the file was posted both as a streaming audio or a downloadable file. Participants were instructed to download the file only if the streaming server did not work, and that they would need to remain in frequent contact with the researcher to track their practice. Participants who downloaded the file reported the frequency of practice when contacted by phone. Participants in this condition practiced with the file on average of 9.70 days (SD 4.30) out of the requested 12 days.

Progressive Muscle Relaxation

During the first session, participants in the Progressive Muscle Relaxation (PMR) condition received a 15-minute guided training session in the PMR technique with an abridged script (Goldfriend & Davison, 1994) before filling out a personality questionnaire. Participants practiced the technique with the aid of a 15-minute long audio file posted as both streaming and downloadable on the university website. Participants were asked to practice this technique six days a week for two weeks. Frequency of practice was monitored through site access statistics as well as correspondence with participants. Participants in this condition practiced on average of 9.90 days (SD 2.88) out of the requested 12.

Control Group

The control condition did not receive any training or have any homework. Participants filled out the personality questionnaire at the first session and then returned two weeks later for the assessment session.

Measures

Demographics

Participants answered five questions regarding their gender, age, major, number of credit hours taken so far, and class rank. These questions were placed at the end of the personality questionnaire and therefore collected at time one. A total of 127 participants were initially recruited for this study. Sixteen participants (13%) were part of the pilot study, leaving a total of 111 participants in the actual experiment. In the experiment, 80 participants (72%) were female and the mean age was 22.39. Breakdown by class rank is as follows: 17 freshmen (15.3%), 21 sophomores (18.9%), 35 juniors (31.5%), and 37 seniors (33.3%). One participant listed class rank as "sophomore/junior". Psychology was the most commonly listed major (64 participants, 57.7%), followed by biology (five participants, 4.5%), mass communication (five participants, 4.5%, exercise sports and science (four participants, 3.6%), undecided majors (four participants, 3.6%), and criminal justice (three participants, 2.7%). Other or dual majors comprised 23.4% of the sample with 26 participants. Table 1 lists the demographic information. Twenty-eight (25%) were randomly assigned to the control condition, 39 (35%) to the meditation condition, and 44 (40%) to the relaxation condition. Attrition rates were high, with a total of 34 participants (31%) dropping out of the study, leaving 21 in the control condition, 27 in the meditation condition, and 29 in the relaxation condition.

Table 1

Demographics of Complete Sample

Gender	N	Percentage of Total
Male	31	27.9
Female	80	72.1
Class Rank[a]	N	Percentage of Total
Freshmen	17	15.3
Sophmore	21	18.9
Junior	35	31.5
Senior	37	33.3
Major	N	Percentage of Total
Psychology	64	57.7
Biology	5	4.5
Mass Communication	5	4.5
Exercise and Sports Science	4	3.6
Undecided	4	3.6
Criminal Justice	3	2.7
Other	26	23.4
Age	Mean	Standard Deviation
	22.39	5.47
Credit Hours	Mean	Standard Deviation
	68.88	37.04

[a] *Does not include one participant who listed "Sophomore/Junior"*

Neuroticism

Participants responded to 10 items from the International Personality Item Pool

(IPIP: Goldberg, 1999) to measure their level of neuroticism. For this and all of the

scales, participants indicated the degree to which statements accurately described them. All scales used a five-point Likert response scale, with one indicating "very inaccurate", three indicating "neither inaccurate nor accurate", and five indicating "very accurate". Items from this scale and each of the other personality scales were randomly scrambled in order to potentially offset the consistency motif, a contaminant to survey scores (Podsakoff & Organ, 1986). Examples of the neuroticism items include "I have frequent mood swings", "I feel comfortable with myself" (reverse scored), and "I panic easily". Internal consistency reliability for scores on the neuroticism scale resulted in Cronbach's alpha of .78.

Extraversion

Extraversion was measured with 10 items from the IPIP (Goldberg, 1999). Examples of items include "I make friends easily", "I am the life of the party", and "I don't like to draw attention to myself" (reverse scored). Cronbach's alpha for scores on this scale was .88.

Openness-to-Experience

Openness-to-experience was measured with 10 items from the IPIP (Goldberg, 1999). Examples of items include "I have a vivid imagination", "I am not interested in abstract ideas" (reverse scored), and "I avoid philosophical discussions" (reverse scored). Cronbach's alpha for scores on this scale was .62.

Agreeableness

Agreeableness was measured with 10 items from the IPIP (Goldberg, 1999). Examples of the items include "I suspect hidden motives in others" (reverse scored), "I

insult people" (reverse scored), and "I accept people as they are". Scores on this scale resulted in α = .78.

Conscientiousness

Conscientiousness was measured with 10 items from the IPIP (Goldberg, 1999). Item examples include "I make plans and stick to them", "I waste my time" (reverse scored), and "I don't see things through" (reverse scored). For scores on this scale α was .85.

Core Self-Evaluations

Interspersed with the items designed to measure the other personality traits, were 12 items to measure Core Self-evaluations (CSE: Judge, Erez, Bono, & Thoresen, 2003). The CSE trait is a higher-order trait comprising the four lower-order, more facet-specific traits of self-esteem, self-efficacy, locus of control, and neuroticism, but evaluated as a single scale. Items measuring CSE include "When I try, I generally succeed", "I determine what will happen in my life", and "Sometimes when I fail I feel worthless" (reverse scored). Participants indicated the degree to which the statements accurately described them on the same five-point Likert scale described above. Scores on this scale resulted in α of .85.

Number of Days Practiced

For participants in the meditation or relaxation conditions, the number of days in which they practiced their assigned technique was recorded. This information was obtained through website statistics by the total number of times participants clicked on the link to access the audio file. Some participants who had technical difficulties accessing this file online downloaded it instead, and kept the researcher updated on their

practice. Participants were asked to practice six days a week for two weeks, for a total of 12 days of practice.

Ego-Depletion Measures

Performance was assessed through persistence at an impossible anagram task. Participants were given a list of anagrams and asked to solve as many as they could, although 16 out of the 25 anagrams were impossible. Length of persistence at this task was used as a proxy indicator of degree of ego-depletion, with longer persistence times indicating less ego-depletion and shorter persistence times indicating greater ego-depletion. Persistence times were capped at 20 minutes.

Pilot Study

There is no known research on typical lengths of time to solve a list of impossible anagrams, so I allowed 20 minutes to solve 10 anagram "words". Initial pilot testing indicated that 20 minutes would likely be appropriate. However, 44% of participants were taking the full 20 minutes, so the list was shortened to five items. Twenty-eight percent of participants continued to take the full 20 minutes, however, so then the list was lengthened to 25 items. Initially, participants persisted for a variable amount of time, giving the impression that the ceiling effect had been removed. The list of 25 items was used for the rest of the experiment. However, analyses in the end indicated that 53% of participants persisted for 20 minutes. Participants who attempted the 10-anagram or five-anagram task were included in the pilot test and excluded from analyses.

Participants in this pilot test had a mean age of 19.75 (SD 1.44). Three (18.8%) were male and 13 (81.3%) were female. Seven participants (43.8%) were in the control

condition, four (25.0%) in the meditation condition, and five (31.3%) were in the

relaxation condition.

<center>Experimental Treatment Procedure</center>

Training Sessions for Treatment Variables

At the initial session, participants were told that the study was examining the

influence of focused concentration and introspection on academic related tasks.

Participants in the meditation and relaxation conditions received guided training. All

participants completed the personality inventory and scheduled a time to return for the

assessment two weeks later.

The training for the mindfulness meditation, at T1, was done so incrementally.

Participants were first introduced to the concept of mindfulness meditation as a form of

awareness of the habitual thoughts and impulses. Then participants were instructed to

focus on the physical sensation of breathing for 30 seconds. Participants tried it for

another 30 seconds, after having received the suggestion to count the number of times

that they breathe in and out as a way to maintain focus. There was a small amount of

discussion about coping with the inevitable stray thoughts that occur during the practice

by labeling the action as "thinking" before returning focus to the breath, and then

participants practiced for 60 seconds. Participants were then reminded to maintain

patience with themselves during the process before practicing for another 60 seconds.

Before the final practice session of 90 seconds, participants were reminded that

mindfulness meditation means to pay attention to the present and letting go of thoughts of

the future or the past. Thus, the initial training session included a total of four and a half

minutes of guided practice with the researcher.

The home practice consisted of listening to the 13-minute audio file. Interspersed with four two-minute long pauses for practice, participants were guided to focus on their breath without attempting to change it and the physical sensations associated with it, such as the expansion of the abdomen. The audio track also reminded participants to build awareness of occasions when their minds wander to and refocus on the breath without losing patience. Participants were asked to practice by listening to this audio file six times per week for two weeks.

Participants in the progressive muscle relaxation condition also received training at T1 and practiced at home with the guidance of a 15-minute audio file. The training at T1 consisted of following the same guidance as the audio track. Practice consisted of alternately tensing and relaxing specific body parts, such as the right or left hand, or muscle groups such as the muscles in the face. With each muscle group, participants are directed to focus their attention on the physical sensation of tension and compare it to the sensation of relaxation. There are no extended pauses in this audio track as there is with the mindfulness meditation track.

Ego-Depletion Task as the Dependent Variable

For the assessment session, all participants were given a letter search task comprised of a two page single-spaced document and a list of five rules. For a 15-minute period, participants crossed out all instances of the letter "e" on the document with the five exceptions listed in the rules. This task was to induce a state of ego-depletion onto participants and has been used in previous ego-depletion studies (Baumeister et al., 1998). All participants were given a digital timer to keep track of time spent on the exercise. After they completed this task, participants either practiced the meditation or

relaxation with the aid of the audio file on a mp3 player provided by the researcher or sat quietly for a 15 minute period for those in the control condition. Participants then alerted the researcher that they were ready to continue to the next part. Participants were given a list of anagrams to solve, with 16 out of the 25 being impossible, and were asked to signal the researcher when they had solved as many as they could. Persistence on this task was recorded according to an analogue wall clock and rounded to the nearest five seconds, but capped at 20 minutes. After attempting the anagrams, participants were debriefed and exited the laboratory.

CHAPTER 3

RESULTS

Personality Measures

Differences Based upon Attrition

Due to the relatively high attrition rate, independent sample *t*-tests were conducted to determine if those who dropped out of the study before completion differed on personality traits from those who remained in the study until completion. Given the amount of time required of participants in the meditation and relaxation conditions, as well as the two-week duration of the study, high attrition rates were expected. Participants who remained in the study displayed higher scores for agreeableness ($t = -2.77, p < .01$) and lower scores on extroversion ($t = 2.56, p < .05$) than did those who dropped out. The difference in agreeableness scores may be as a result of the desire to assist the researcher, as there was significant face-to-face time with the researcher during recruitment and the initial portion of the study, which may have engendered a sense of obligation among some participants. The indication that less extroverted (i.e. more introverted) participants persisted longer is also unsurprising as the meditation and relaxation tasks were both solitary tasks which may have appealed less to extroverted participants. There were no other significant differences on the measured personality variables between participants who remained in the study and those who

dropped out of the study. An overview of the mean scores on all measured variables for

the experimental participants is in Table 2.

Table 2

Means and Standard Deviations for Measured Variables[a]

	All participants		Control group		Mindfulness Meditation		Progressive Muscle Relaxation	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Neuroticism	2.54	.63	2.46	.57	2.62	.71	2.53	.61
Extroversion	3.49	.77	3.40	.78	3.39	.84	3.65	.68
Openness	3.49	.52	3.43	.52	3.51	.56	3.53	.48
Agreeableness	3.92	.55	4.07	.47	3.96	.64	3.78	.48
Conscientiousness	3.48	.64	3.67	.69	3.49	.69	3.34	.53
Core Self-Evaluations	3.72	.62	3.80	.60	3.70	.64	3.67	.63
Persistence time[b]	15.29	5.55	16.75	5.18	16.01	5.12	13.57	5.92
Age	22.87	6.17	24.67	8.76	22.93	6.41	21.52	2.47
Credit Hours Taken	69.91	37.58	75.14	30.86	61.70	44.68	73.89	34.51

[a] Analyses only for the 77 participants who completed the assessment
[b] Measured in minutes

Practice Adherence

Participants were asked to practice the meditation or relaxation six days per week for two weeks, yielding a total of 12 practice sessions. The average number of days practiced for participants in the meditation condition was 9.70 (SD 4.30) days, and 9.90 (SD 2.88) for participants in the relaxation condition. Imperfect practice adherence rates remained despite reminder emails and phone calls from the researcher.

Correlation Results

All Participants

As displayed in table 3, correlations were computed between all variables, using pairwise deletion and two-tailed significance tests. Of the demographic variables of gender, age, and number of credit hours taken, only age and credit hours were statistically significantly correlated ($r = .27$, $p < .05$) with older students reporting more credit hours taken. The correlations between age and gender and between gender and credit hours taken were non-significant.

Correlations were also computed between the personality variables. Core self-evaluations correlated significantly with several of the Big Five personality traits. Core self-evaluations was correlated with extraversion at $r = .46$ ($p < .01$), with conscientiousness at $r = .41$, ($p < .01$), and with neuroticism at $r = -.64$ ($p < .01$). This high, negative correlation is unsurprising considering neuroticism is one of the traits included in core self-evaluations. Among the Big Five traits themselves, several traits correlated significantly with each other. Openness-to-experience correlated significantly with extroversion ($r = .23$, $p < .05$), as did agreeableness and conscientiousness ($r = .29$, $p < .05$). The remaining correlations were non-significant.

The measured variables also included the dummy coded treatment groups and the number of days practiced. Membership in the meditation or relaxation conditions correlated negatively with each other ($r = -.57$, $p < .01$). Number of days practiced correlated with the meditation condition ($r = .36$, $p < .01$) and the relaxation condition ($r = .40$, $p < .01$). Considering that only participants in the treatment groups had practice days, the correlation between number of days practiced and both dummy codes is unsurprising.

Additional statistically significant correlations include the correlation between several personality traits and some of the demographic variables. For example, neuroticism and gender were correlated at $r = .23$ ($p < .05$), with women displaying greater levels of neuroticism than men. Agreeableness also correlated positively with gender ($r = .33$, $p < .01$), indicating a higher degree of agreeableness for women than men. Age and conscientiousness were also correlated at $r = .30$ ($p < .01$), such that older persons were more conscientious. The remaining correlations were non-significant.

The dependent variable of persistence time at the anagram task only correlated significantly with participation in the relaxation condition at $r = -.24$ ($p < .05$). The correlation indicates that participants in the relaxation group persisted for shorter lengths of time compared to the control group. As participation in the meditation condition compared to the control condition did not correlate with persistence time, the two groups persisted for similar lengths of time.

Table 3

Correlations of Variables for All Participants and the Control Group

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Gender	-	.21	.12	-.02	.02	-.32	.32	.12	.06	-	-	-	.51*
2. Age	.09	-	.07	-.02	-.31	-.39	.32	.32	-.26	-	-	-	-.03
3. Credit Hours	-.06	.27*	-	.09	-.10	.08	-.13	-.07	.03	-	-	-	.20
4. Neuroticism	.23*	-.15	-.18	-	-.28	-.01	-.08	-.60**	-.65**	-	-	-	-.04
5. Extroversion	.16	-.17	-.14	-.14	-	.39	-.07	.09	.69**	-	-	-	.27
6. Openness	-.11	-.07	-.05	-.03	.23*	-	-.29	-.37	.24	-	-	-	.23
7. Agreeableness	.33**	.22	-.18	-.21	-.04	.03	-	.58**	.20	-	-	-	.21
8. Conscientiousness	.07	.30**	.02	-.20	.12	-.08	.29*	-	.57**	-	-	-	.08
9. Core Self-Evaluations	-.06	.07	.19	-.64**	.46**	.18	.17	.41**	-	-	-	-	.33
10. Relaxation	.06	-.17	.08	-.01	.16	.05	-.20	-.17	-.06	-	-	-	-

Table 3-Continued

Correlations of Variables for All Participants and the Control Group

11. Meditation	-.15	.01	-.16	.09	-.10	.02	.06	.01	-.02	-.57**	-	-	-
12. Number of Practice Days	.01	-.04	.03	.11	.11	-.01	-.17	-.09	-.05	.40**	.36**	-	-
13. Length of persistence time [a]	.07	.08	.02	-.17	-.12	.21	.13	-.03	.22	-.24*	.01	-.14	-

Note: Correlational statistics for the control group appear over the diagonal, while correlations for the entire sample appear below the diagonal. Meditation and relaxation conditions were dummy coded so that for each variable, 0 = control group and 1 = treatment.
Gender: 1 = male, 2 = female.
[a] Measured in minutes
* $p < .05$
** $p < .01$

Control Group

Table 3 displays correlation statistics for all variables for participants in the control group. As such, there are no correlations displayed for participation in the relaxation or meditation conditions, or for number of days practiced as no practice was required. For the demographic variables of gender, age, and number of credit hours taken, there were no significant correlation statistics.

There were several significant correlation statistics among the personality subscales. Neuroticism correlated negatively with conscientiousness ($r = -.60$, $p < .01$) and core self-evaluations ($r = -.65$, $p < .01$). As neuroticism is one of the core self-evaluations, and as these evaluations correlated strongly with conscientiousness ($p < .01$), this finding is logical. Agreeableness correlated with conscientiousness as well ($r = .58$, $p < .01$). Core self-evaluations had a significant correlation with extraversion ($r = .69$, $p < .01$) and conscientiousness ($r = .57$, $p < .01$).

When comparing the other variables to each other, persistence on the anagram task correlated significantly with gender ($r = .51$, $p < .05$). There were no other statistically significant correlations.

Mindfulness Meditation Group

Table 4 displays the correlation statistics for participants in the mindfulness meditation condition. Among the demographic variables of gender, age, and number of credit hours taken, there were no statistically significant correlations.

Several correlations between personality subscales were significant. Core self-evaluations and neuroticism correlated at $r = -.66$ ($p < .01$), again logical as neuroticism is considered one of the components of these core self-evaluations. These evaluations

correlated positively with conscientiousness ($r = .38$, $p < .05$) and extraversion ($r = .47$, $p < .05$).

Among the other variables, there were two other statistically significant correlations. Gender correlated with agreeableness ($r = .41$, $p < .05$) and number of days practiced ($r = .41$, $p < .05$). This correlation indicates that women were associated with higher degrees of agreeableness and larger numbers of practice days. It is interesting to note that persistence times had no statistically significant correlations with any variables.

Progressive Muscle Relaxation Group

Table 4 displays the correlational statistics for the relaxation group. Age and number of credit hours correlated t $r = .72$ ($p < .01$). There were no other statistically significant correlations.

The personality variables only showed two significant correlations. Core self-evaluations correlated negatively with neuroticism ($r = -.60$, $p < .01$) and positively with agreeableness ($r = .37$, $p < .05$).

There were three other significant correlations between variables. Neuroticism and gender correlated at $r = .60$ ($p < .01$) There were no other correlations between variables for participants in this condition. It is interesting to note that, like participants in the meditation condition, the dependent variable was not significantly correlated with any variables.

Table 4

Correlations of Variables for the Meditation and Relaxation Conditions

	1	2	3	4	5	6	7	8	9	10	11
1. Gender	-	.10	-.17	.09	.12	.07	.41*	.03	-.08	.41*	.15
2. Age	-.19	-	.36	-.22	-.01	.21	.11	.29	.27	.28	.10
3. Credit Hours	-.11	.72**	-	-.26	-.14	-.20	-.21	.11	.18	.14	-.06
4. Neuroticism	.60**	-.34	-.18	-	-.06	-.10	-.36	-.01	-.66**	.30	-.24
5. Extroversion	.29	-.17	-.22	-.15	-	.35	-.11	.22	.47*	.18	-.10
6. Openness	-.16	.08	-.06	.01	-.08	-	.17	.09	.17	-.12	.32
7. Agreeableness	.27	.20	-.17	-.07	.22	.13	-	.01	.09	-.15	.15
8. Conscientiousness	.05	.13	-.03	-.13	.12	.02	.37*	-	.38*	.19	.04
9. Core Self-Evaluations	-.14	.30	.32	-.60**	.34	.16	.23	.29	-	-.07	.13
10. Number of Practice Days	-.19	.30	.29	-.27	-.04	-.20	.10	-.01	.18	-	.13
11. Length of persistence time [a]	-.23	.02	.05	-.19	-.32	.16	-.07	-.35	.19	.13	-

Note: Correlational statistics for the meditation group appear over the diagonal, while correlations for the relaxation group appear below the diagonal. Gender: 1 = male, 2 = female.

[a] Measured in minutes

* $p < .05$

** $p < .01$

Regression Assumptions

The regression tests included the Durbin-Watson statistic which was 1.36. This statistic detects the presence of first-order autocorrelation among the residuals. When it deviates from the value of 2.0 by a large margin, there is evidence of autocorrelation among the residuals. A lack of autocorrelation is a key assumption underlying multiple regression and therefore, all conclusions derived from the regression analysis should be interpreted in light of this statistic.

Previous research has indicated correlation between the core self-evaluation construct and the Big Five personality traits (Judge, Erez, & Bono, 1998; Bono & Judge, 2003). To make sure that multicollinearity was not a problem in this regression, collinearity statistics of tolerance and the variance inflation factor (VIF) were included in the analysis. The presence of multicollinearity is evidenced by VIF values above 10 (Tabachnick & Fidell, 1996), but the highest VIF value present in this analysis was 2.67. Therefore, multicollinearity does not appear to have been a problem.

Regression Results

A hierarchical regression was run with dummy coded variables to incorporate the categorical variables of condition assignment. The regression results are displayed in table 5. In step one (i.e. the first model), the length of time persisted on the impossible anagram task across the three conditions were compared. The model yielded an *F*-score of 2.42, which was non-significant. Since Cohen and Cohen (1983) require that the *F* statistic be significant before interpreting beta weights as tests of hypotheses, such tests were not undertaken. As such, mindfulness meditation and progressive muscle relaxation did not significantly differ from the control group with regard to the dependent variable.

In the second step of the hierarchical regression (i.e. model two) the three experimental conditions as well as the personality variables were entered into the regression equation. The change-in-F-score was statistically significant (2.30, $p < .05$) and accounted for an additional 16% of the variance in the dependent variable, in addition to the 6% explained in step one. The overall model was statistically significant, with an F-score of 2.39 ($p < .05$) accounting for a total of 22.0% of the variance in the dependent measure. In this model, participants in the relaxation condition approached significance ($ß = -.25$, $p < .1$). Extroversion was significant with $ß = -.28$, $p < .05$, as was core self-evaluations ($ß = .36$, $p < .05$). Openness approached significance with a beta weight of .21 ($p < .1$). These results indicate that lower levels of extroversion and higher levels of core self-evaluation are associated with longer persistence times. Membership in the relaxation condition approached statistical significance, and may have reached significance with a larger sample, as sample size is considered to be one of the easiest means of increasing statistical power (Cohen, 1988). These results do not support the hypothesis that participants in the meditation or relaxation conditions would persist for longer periods of time than participants in the control condition, nor that participants in the meditation condition would persist longer than those in the relaxation condition. However, the hypothesis that core self-evaluations would predict persistence despite ego-depletion was supported.

Table 5

Regression Results for Persistence Length of Time as the Dependent Variable

| Predictors | Model 1 | | | Model 2 | | | Confidence Interval | | Effect Size [a] |
	B	SE B	ß	B	SE B	ß	Lower Bound	Upper Bound	
Constant/Control Group	16.75	1.19	-	7.12	9.10	-	-11.04	25.28	-
Dummy 1 (Relaxation)	-3.17	1.56	-.28	-2.847	1.56	-.25[†]	-5.97	.272	.04
Dummy 2 (Meditation)	-.73	.59	-.06	-.88	1.53	-.08	-3.93	2.17	.00
Neuroticism	-	-	-	.05	1.29	.01	-2.52	2.61	.00
Extroversion	-	-	-	-1.99	.93	-.27*	-3.85	-.13	.05
Openness	-	-	-	2.21	1.21	.21[†]	-.21	4.64	.04
Agreeableness	-	-	-	.60	1.18	.06	-1.74	2.95	.00
Conscientiousness	-	-	-	-1.65	1.09	-.19	-3.83	.53	.03
Core Self-Evaluations	-	-	-	3.24	1.57	.36*	.11	6.37	.05

Table 5-Continued

Regression Results for Persistence Length of Time as the Dependent Variable

Δ *F*-score $_{(df1, df2)}$	-	$2.30_{(8, 68)}$*	
ΔR^2	-	.16	
F-score $_{(df1, df2)}$	$2.42_{(2, 74)}$	$2.39_{(8, 68)}$*	
R^2	.06	.22	
Adjusted R^2	.04	.13	

[a] Squared semi-partial correlation
[†] $p < .10$
* $p < .05$

CHAPTER 4

DISCUSSION

Treatment Groups and Performance

Neither of the regression models indicated that condition membership significantly predicted variance in the dependent variable of persistence time on the anagram task, when the alpha level was set to .05. However, in the second model, participation in the relaxation condition was significant when alpha was set to .1. Mean differences between the groups indicated that participants in the relaxation condition persisted for shorter lengths of time on the anagram task than did those in the relaxation and meditation conditions. Given the small sample sizes involved, it may be that this difference would have been significant with more participants.

It is interesting to note that participants in the meditation and control conditions persisted for nearly the same amount of time. There may have been several issues at play.

Several participants noted to the researchers that by the end of the letter search task, they had memorized the rules, which could have made the task easier and thus not reaching the desired state of ego-depletion. If this is the case, participants in the control group may not have needed the entire period of 15 minutes to recover from the exercise

and may have gotten bored. Then, when the anagram task was given to them, it may have been a welcome exercise to break feelings of boredom.

Another possibility is that allowing participants to choose their own activities for that 15-minute period may have been an effective form of relaxation while maintaining attentional focus. As participants were told they could spend the time as they liked as it did not include anything cognitively stressful, such as homework as it would be further ego-depleting, or ingesting glucose, as this would facilitate recovery, many participants listened to music on their mp3 players or talked on the phone. Participants were given their choice of activity as being forced to wait extended periods of time with nothing to do may be ego-depleting in and of itself. Participants therefore may have chosen activities that would help them recover from the exercise but keep them relatively alert.

In addition, it is possible that the meditation manipulation was not strong enough. The average number of days with practice was approximately half of what had been asked of participants. Although previous research on the effects of meditation have indicated benefits after 20-minute daily practices for two weeks (Wachholtz & Pargament, 2005), this research involved transcendental meditation, a form which may be easier to master more quickly as compared to mindfulness meditation. Furthermore, many studies on mindfulness meditation have used experienced practitioners or involved six to eight weeks of training mindfulness meditation (Miller, Fletcher, & Kabat-Zinn, 1995; Shapiro, Schwartz, & Bonner, 1998; Davidson et al., 2003; Galantino, Baime, Maguire, Szapary, & Farrar, 2005; Ortner, Kilner, & Zelazo, 2007; Carmody & Baer, 2008). It may be that there is a threshold level of skill required in order for participants to measurably demonstrate improvements on recovery from ego-depletion.

It is also important to note, however, that participants in the mindfulness meditation condition performed no worse than participants in the control condition. To someone who is new to meditation, attempts at keeping one's mind focused on the breath and the present moment may be very similar to attempts at thought suppression or emotion suppression. Both involve a high degree of attention regulation, although one emphasizes suppression and control of thought or emotion content, while the other emphasizes awareness and acceptance, but this distinction may not be immediately obvious to the novice practitioner. Thought or emotion suppression has been used in previous studies as an ego-depleting task (Baumeister et al., 1998; Tice et al., 2007). The audio track included four two-minute long pauses for the listener to practice the meditation, so there was the possibility that the practice itself would be ego-depleting. Despite participants' relatively small amount of experience with this meditation, attempting to practice it did not impair their performance.

Much of these proposed explanations are speculative. However, research in ego-depletion is still in its infancy and thus there are many aspects to the phenomenon that are poorly understood. Additionally, to the author's knowledge, this study is the first to examine the performance of mindfulness meditation within the context of ego-depletion.

<div align="center">Personality and Performance</div>

The regression model indicated that extroversion and core self-evaluations were significant predictors of persistence at the anagram task. Openness to experience was a significant predictor of persistence on the impossible anagram task. Conscientiousness, however, was not significant. Thus, the hypothesis that core self-evaluations would predict performance was supported by the data, while the hypothesis predicting the same

for conscientiousness was not. As core self-evaluations have been linked with job performance, it is not a surprising find. Performing a job is an inherently self-regulatory task and thus includes a degree of ego-depletion already. This study is believed to be the first to look at its relation to task performance within the explicit context of ego-depletion, however. It is surprising that conscientiousness was not a statistically significant predictor. However, it is important to note that this sample comprised undergraduate university students, who as a result may show categorically higher scores of conscientiousness than the general population. If this study was replicated with a different sample, conscientiousness may demonstrate a stronger role.

The statistical significance of extroversion as a predictor of lower persistence was unexpected. It was also one of the differing characteristics between participants who remained in the study compared to those who dropped out. As with the participants who dropped out, extroverted participants may have found the solitary nature of the letter search and anagrams, as well as the intervening time of resting quietly, meditating, or relaxing, to be generally more taxing than introverted participants. To see the influence of extroversion upon self-regulation recovery, ego-depleting tasks and assessment tasks would need to include both solitary and social tasks.

Limitations

There were a number of limitations involved in this study and any conclusions from this research should be interpreted with these limitations in mind. Based on comments made by participants verbally as well as on the feedback form given to the researcher, it is believed that the letter search task was not sufficiently ego-depleting. Many participants stated that by the end of the 15-minute period, they had memorized the

rules. Several participants indicated that they enjoyed the exercise. Most participants reported that the anagram task was extremely frustrating, but few indicated that the letter search task was as well. For these reasons, it is believed that the letter-search task may not have been sufficiently ego-depleting, leading to a lack of variability in the data.

The sample size was diminished as the researcher attempted to eliminate a ceiling effect at the start of the study. There is no known research indicating likely persistence times for anagram tasks, so 20 minutes was chosen. As discussed earlier, lists of ten, five, and 25 anagrams were tested. The list of 25 anagrams was used for the remainder of the study. However, coping with the ceiling effect meant an initial loss of data from 16 participants, leading to relatively small sample sizes.

Thirdly, adherence to practice was less than ideal, with most participants adhering 81.7% of the two-week period. Adherence suffered despite multiple phone calls and emails from the researcher reminding participants of the importance of practicing. Given the relatively small amount of incentive participants received and the significant time commitment involved, it was not surprising that adherence rates were low. As stated previously, many studies on mindfulness meditation involve intense and prolonged training periods. Given that mindfulness meditation is a relatively foreign concept to many, it may require intense and prolonged training to acquire a level of skill from which benefits may be measured. Verbal feedback from participants in the mindfulness meditation condition indicated that some experienced temporary state effects from the practice, but it may not have been enough to make an impact on persistence times.

Ideally, the control condition would engage in "ego-neutral" tasks during the wait period; that is, these tasks would neither cause undue ego-depletion nor be significantly

ego-restoring. There is no known research on what sorts of tasks would comprise "ego-neutral" activities, and it may be unique to the individual. As the participants in the control condition were told to engage in self-directed activities that did not involve mentally challenging tasks (such as homework) or ingesting of food, these self-directed activities may have been chosen for their naturally ego-restoring capabilities. Without knowing if this was the case, however, the relative ego-restoring qualities could not be taken into account during analyses.

Additionally, the timing method for the assessment may not have been precise enough. Timing was to begin when the researcher left the participant and ended when the participant signaled to the researcher that he or she had terminated the task, or after 20 minutes. Due to funding reasons, an analogue wall clock was used to record the time as opposed to a digital watch. The wall clock was difficult to read the precise second for the start and stop times, due to lighting conditions or distance from the clock, so persistence times were rounded to the nearest five seconds. Thus, the exact start and stop times may not have been recorded precisely enough.

Lastly, the sample consisted entirely of undergraduate students in one or more psychology classes, therefore limiting generalizability. Sample characteristics indicate relatively high levels of agreeableness and core self-evaluations, and analysis of participants who completed the study indicated even higher levels of agreeableness and extraversion. Additional research would be required on more diverse samples before any significant conclusions could be drawn.

Future Directions

There are many possible directions for future research on ego-depletion. As stated in the previous section, there is no indication as to appropriate ego-neutral tasks for comparison when examining methods of recovery from ego-depletion. Ego-neutral tasks may not be generalizable beyond the individual, but it may be possible to identify activities or environments in which the self-regulation resource naturally recovers with time and little outside influence. Additionally, personality attributes may mediate the extent to which a task ego-depletes or ego-restores; in this study extraversion and core self-evaluations accounted for a significant portion of the variance in the dependent variable. Although the variance due to extraversion may have been related to the solitary nature of the specific tasks involved, traits such as core self-evaluations may have an underlying mediating or moderating role in self-regulation.

Research should also attempt to ascertain whether there is a threshold level of skill required for people practicing mindfulness meditation to reap benefits. Mindfulness meditation may still hold significant promise as a coping method for ego-depletion. Possible interesting areas for research could include highly experienced meditators compared to new meditators on baseline degrees of ego-depletion following a difficult task, or comparative amounts of ego-restoration after having meditated or performed an alternate activity.

Participants in the relaxation condition indicated shorter persistence times by a marginal statistical significance. Future research should examine the role of physiological relaxation and attentional focus in recovery from ego-depletion. As discussed earlier, maintaining mental alertness may be just as or more important that relaxation in recovery.

Given the significant potential of this research to benefit society in widely varied areas from substance abuse rehabilitation to academic achievement, this is an important topic to be explored further.

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