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Ego Depletion and Delay of Gratification

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EGO DEPLETION AND DELAY OF GRATIFICATION

by

SHRINIDHI SUBRAMANIAM

(Under the Direction of Janie H. Wilson)

ABSTRACT

Ego depletion suggests that self-control draws from a limited resource. Therefore, resistance to

immediate temptation can be impaired when that resource is depleted. Participants performed a

difficult or easy serial subtraction task (cognitive processing) in front of or in the absence of a

video camera (social processing). Participants then completed a delay-of-gratification task where

they either chose the immediate, small reward of 1 research participation credit or waited for a

larger amount of credit. Participants who completed a difficult task while being recorded by a

video camera waited a shorter period of time for more credit than those who performed an easier

version of the task while being recorded. Ego depletion, resulting from the interaction of

cognitive and social processing, reduced participants' ability to delay gratification and earn a

greater reward.

INDEX WORDS: Self-control, Ego depletion, Delay of gratification, Arousal

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DEDICATION

I dedicate the following pages to the two most influential people in my life, my parents. First, to

my father M.S. Subramaniam, who teaches me that hard work and diligence lead to success.

Second to my mother, Lakshmi Subramaniam, who, by her words and her actions, makes me a

believer in the importance of education. Thank you both for your unconditional love and praise,

your support and your example.

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CHAPTER 1

INTRODUCTION

Self-control is an integral component of the human behavioral repertoire. People are often faced with the decision to do what feels pleasurable immediately or forgo the action in favor of meeting long-term goals. Dieting, exercise, and getting an education all require mastery over the self. Adaptive use of self-control results in greater physical health, positive educational outcomes, financial stability, and an overall higher quality of life (Hagger, Wood, Stiff, & Catzisarantis, 2010). Maladaptive behaviors attributed in part to a lack of self-control such as alcohol abuse, procrastination, overeating, gambling, and criminality are dangerous to the individual and society. Although self-control is often attributed to disposition, the immediate store of self-control can easily be depleted by simple experimental manipulations (Baumeister, Bratslavsky, Muraven, & Tice, 1998). The purpose of the present study is to examine if prior exercise of self-control resources affects people's ability to forgo immediate, small rewards for delayed, larger rewards.

Ego Depletion

The concept of ego depletion stems from the assumption that people have a limited ability to control themselves. In other words, acts of self-control draw from a finite resource. Thus, when a person employs energy from this resource, subsequent acts of self-control become more difficult (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000). Ego depletion is brought about experimentally by thought-control, affect-regulation, choice and volition, cognitive processing, and social-processing tasks. These tasks are presumed to be ego depleting because they cause decrements in subsequent tasks of persistence, performance, and endurance. Control groups performing either simpler versions of these tasks or

other tasks not requiring self control do not display these same decrements (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

In a series of experiments, Baumeister, Bratslavsky, Muraven, and Tice (1998) depleted participants by asking them to (a) eat unappealing food when a more appealing alternative was present, (b) make a choice to make a speech, and (c) suppress their emotions. All of these methods caused participants to give up on subsequent tasks more easily than related control groups. In the last experiment of the series, participants were asked to cross off the letter *e* on a page wherever it appeared. The ego-depletion group (which only crossed off an *e* if the letter was not next to or one space away from another vowel) had to focus more attention and energy on the task than the control group (which crossed off all instances of the letter *e*). Next, participants were shown a video and asked to either press a buzzer (active response) or take their hand off a buzzer (passive response) to end the video. Ego depleted individuals were more likely to choose the passive response option than those in the control group. Baumeister and colleagues concluded that "depleted people are more prone to continue doing what is easiest, as if carried along by inertia" (p. 1261).

Baumeister (2002) proposed that ego depletion is a conservation strategy. When the ego is somewhat depleted, the self makes choices designed to conserve its energy for a time when self-control strength is needed in the future. The finding that a depleted person is more likely to choose a passive response option in a subsequent task makes sense in this light. It is evolutionarily adaptive to do what is easy and conserve energy for self-control later. Research supporting this conclusion has demonstrated that if participants anticipate more difficult tasks after being depleted, they do more poorly on those later tasks than control groups who are

depleted but do not anticipate future tasks (Baumeister & Heatherton, 1996; Muraven, Shmueli & Burkley, 2006).

Ego depletion has been extended to more real-life situations, such as interacting with negative people, drinking alcohol, and making everyday choices. Zyphur, Warren, Landis, and Thoresen (2007) conducted a customer-service simulation. Their goal was to determine if interactions with negative people are ego depleting. Participants acted as customer service employees in a negotiation situation. The researchers randomly assigned participants to interact with a positive customer (control condition) or a negative customer (ego-depletion condition). Participants then attempted an unsolvable block puzzle while eating from a bowl of candy. Results indicated that participants who had an interaction with a negative person gave up more easily on the block puzzle than those who had an interaction with a positive person. Interestingly, participants in the negative-interaction condition also consumed more candy than those in the positive-interaction condition.

In order to examine drinking behavior, Muraven, Collins, and Nienhaus (2002) depleted half of their participants using a thought-suppression task while the other half of their participants completed a simple arithmetic task (control condition). Men who had to suppress their thoughts drank significantly more beer than those in the control condition when they were expecting a driving test. This example is a frightening failure of self-control, for depleted people may not be able to control their drinking when they are expecting to drive later.

In fact, many everyday decisions tie into ego depletion. Vohs and colleagues (2008) found that the simple act of choosing can be ego depleting. Participants in the experimental conditions made a choice about consumer goods, products, occupations, or course offerings. Participants who had to make choices drank less of an unsavory beverage, showed less pain

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tolerance, persisted less on unsolvable puzzles, and procrastinated more than no-choice control groups. Furthermore, ego depletion is not simply an artifact of the laboratory setting. Vohs and colleagues conducted a field study in a shopping mall to assess the extent to which the choices shoppers make affect later self-control. The researchers approached shoppers with a questionnaire with items about the choices they made that day (e.g., how many choices they made, the importance of those choices, and the carefulness with which they made those choices). Participants then completed a series of arithmetic problems. People who reported making many choices while shopping performed more poorly on arithmetic problems compared to people who did not have to make as many choices even when controlling for fatigue, hours spent shopping, and demographic information. All of these studies fit the limited resource model of self-control proposed by Baumeister.

An alternative explanation for ego depletion, presented by Schmeichel and colleagues (2010), is that an act of self control temporarily increases approach motivation. This form of motivation stems from the desire for success, pleasure, and reinforcement (Elliot, 1999). Therefore, participants who are ego depleted want to engage in behaviors that are personally rewarding, perhaps because these behaviors are immediately gratifying. For example, participants in the aforementioned experiment by Muraven and colleagues (2002) drank more beer following a thought suppression task than participants who did not have to engage in a depleting activity. Perhaps depleted participants increased in the approach motivated behavior of drinking alcohol because it causes immediate gratification. One of the experiments conducted by Vohs and colleagues (2008) found that depleted participants procrastinated studying for a math exam by reading magazines and watching television more than control participants. Approach motivation explains the finding in that reading magazines and watching television are more

immediately rewarding activities than studying. Schmeichel did not discount the limited resource theory of self-control, but suggested that increases in approach motivation work in combination with decreases in self-control resources to result in ego depletion.

Regardless of the reason for ego depletion, energy appears to be in flux. If ego depletion relies on some energy source, then physiological evidence of this source should exist. Galliot and Baumeister (2007) proposed that glucose, the brain's source of fuel, is impacted by acts of self control because effortful processes require much glucose. Low glucose, therefore, should lead to lapses in self-control. In fact, Galliot and colleagues (2007) found that simple acts of self-control led to a drop in blood glucose levels. Participants who had to control their attention while watching a video showed larger drops in blood glucose levels than those who watched the same video without controlling their attention. In addition, they found that low glucose resulting from controlled attention led to subsequent decrements in performance on a Stroop task when compared to a control group. Finally, they demonstrated that the administration of glucose after controlling attention led to increased performance on a Stroop task when compared with a placebo-control group.

Although glucose has been linked to self-control, simple physiological cardiovascular measures like heart rate and blood pressure have yet to be reported in relation to ego depletion. These measures could provide some insight into potential relationships between arousal and ego depletion. Heart rate has been used to measure anxiety, arousal, and mental workload. For example, tasks that require a great deal of working memory tend to decrease the intervals between heart beats (Jorna, 1992). Similarly, Carroll and colleagues (1986) found that a difficult arithmetic task resulted in increased heart rate. Cosenzo and colleagues (2004) found that a difficult serial subtraction task (subtract by seven) resulted in increases in heart rate and diastolic

blood pressure when compared to an easy serial subtraction task (subtract by one). More recent brain research has indicated that blood pressure and heart rate are predictive of cerebral blood flow during arithmetic tasks and that these vital measurements increased during the tasks (Duschek, Werner, Kaplan, & del Paso, 2008).

Social processing is related to physiological arousal. Blascovich and colleagues (1999) tested the physiological effects of observation during a learned or unlearned task. Participants performed a task they already practiced or one with which they had brief experience in the presence or absence of observers. The results indicated significant changes in heart rate based on observation, with participants who were observed experiencing a greater increase in heart rate when compared to those performing the task alone. Additionally, they found different patterns of heart reactivity according to task experience, with participants performing a learned task in front of an audience experiencing a decrease in peripheral vascular resistance (TPR) and those performing an unlearned task in front of an audience experiencing an increase in TPR. In the biopsychosocial model reported by Blascovich and colleagues, the combination of increased heart rate and TPR found in participants performing a learned task in front of an audience is called a "challenge" pattern, where individuals have sufficient resources to complete a task. The pattern of increased heart rate and TPR found in participants performing an unlearned task in front of an audience is called a "threat" pattern, where individuals do not have sufficient resources to complete a task. This research makes it plausible that heart rate and blood pressure may increase during ego-depleting tasks that require large amounts of cognitive processing, especially while people are being observed.

Delay of Gratification

The delay-of-gratification paradigm involves self-control. The method usually entails a choice between a small, immediate reward or a larger, delayed reward. Much like ego depletion, delay of gratification ties into the concept of "ego strength" or "the ability to postpone immediate gratification for the sake of future consequences, to impose delays of reward on oneself, and to tolerate such self-initiated frustration" (p. 249, Mischel, 1974). In contrast to ego depletion, however, delay of gratification research focuses on the long-term, dispositional ability to exert self control (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Mischel, 1974). Usually, this line of research examines personality correlates associated with the ability or inability to delay a small reward for a larger reward. Mischel conceptualized his findings by explaining that there is a continuum of people who cannot tolerate delays to people who are able to delay rewards for long periods of time. Persons on the no-delay end tend to be more impulsive, less intelligent, more immature, lower in achievement orientation, and more likely to engage in criminal behavior; persons on the high-delay end tend to be more vigilant, less impulsive, more intelligent, higher achieving, and more socially responsible. These findings have been supported longitudinally (Funder, Block, & Block, 1983; Mischel, 1974).

Delay of gratification is primarily studied in young children (e.g., Mischel, Shoda, & Rodriguez, 1989). A series of experiments at Stanford University in the 1970s, led by Walter Mischel, brought the concept of delay of gratification to popular culture. Researchers placed one marshmallow in front of a child and said that if the child waited for them to return, they would give the child two marshmallows. Many of the children ate the one marshmallow right away, while others delayed eating the marshmallow in order to earn two later. During the waiting period, the children were forced to exert so much self-control to resist the one marshmallow that

they engaged in a variety of strange compensatory behaviors. These behaviors were distracting and served to make the waiting period less aversive (Mischel, 1974). In fact, when children employed methods in which to distract themselves (as suggested to them by the researcher) they were able to wait longer than children who were not provided these methods (Mischel, Ebbesen, & Zeiss, 1972; Mischel & Underwood, 1974). These methods included ideation about what they would do with the larger reward, focusing on physically present distracters, and directing cognitive-affective energy toward thinking about positive, "fun" activities (Metcalfe & Mischel, 1999).

Unfortunately, there have been few attempts to study delay of gratification in older children, with a few exceptions. Wulfert, Block, Santa Ana, Rodriguez, and Colsman (2002) studied delay of gratification in adolescents. They found that a choice between a generalized reward ($7 versus $10) and a delay time of 1 week to receive the larger reward brought about similar results for older children as the marshmallows in minutes did for younger children. Funder and Block (1989) offered adolescents (14-year-olds) an immediate monetary reward of $4 per session for 6 sessions or a delayed reward of $28 at the end of the 5 sessions. Adolescents who delayed their gratification reliably exhibited similar personality correlates as theorized in Mischel's continuum. Self-regulation grows with maturity, and Wulfert and colleagues mentioned the difficulty in selecting meaningful rewards and adequate delay times for adults. These two problems have made experimental studies of delay of gratification difficult for older children and adults. Using monetary rewards is expensive, and large delays are time-consuming. As one solution, many researchers use hypothetical monetary rewards with adults (Green, Fry, & Myerson, 1994; Hirsh, Morisano, & Peterson, 2008; Madden, Petry, Badger, & Bickel 1997), but there is difficulty in generalizing these findings to a real-world setting.

A modified version of the simple delay-of-gratification task for adults is in need of conceptualization. In pilot testing the proposed study, the simple delay of gratification methodology was tested on college students ($N = 30$) using chocolate candy as a reward. Much like the marshmallow experiments, the researcher told participants that if they waited for the experimenter to return before eating a small amount of candy (three pieces), they would get 20 pieces. The researcher then observed participants through a two-way mirror to time how long it took them to eat the candy. Participants did not wait dependent on their self-reported levels of self control, but rather based on whether or not they preferred the smaller reward (3 candies) versus the larger reward (20 candies). Delay time was strongly negatively correlated with the preference for the small reward ($r = -0.87$, $p < .05$). This evidence that preference was highly related to the decision to wait does not fit into the delay-of-gratification paradigm. Most participants should prefer the larger reward, and their ability to wait should be determined by their ability to exert self-control (see Mischel, 1974). Therefore, food may not be an adequate reinforcer for adults, who might be dieting or otherwise health conscious. Further pilot testing determined that a more salient reward for college students was research participation credit ($N = 26$). Most participants (75%) preferred two participation credits over one. In addition, 65% of participants were interested in waiting for 2 credits in contrast with the 50% of participants who were interested in waiting for 20 candies (see Figures 1 and 2).

I was interested in waiting for 20 candies

I prefer 3 candies over 20
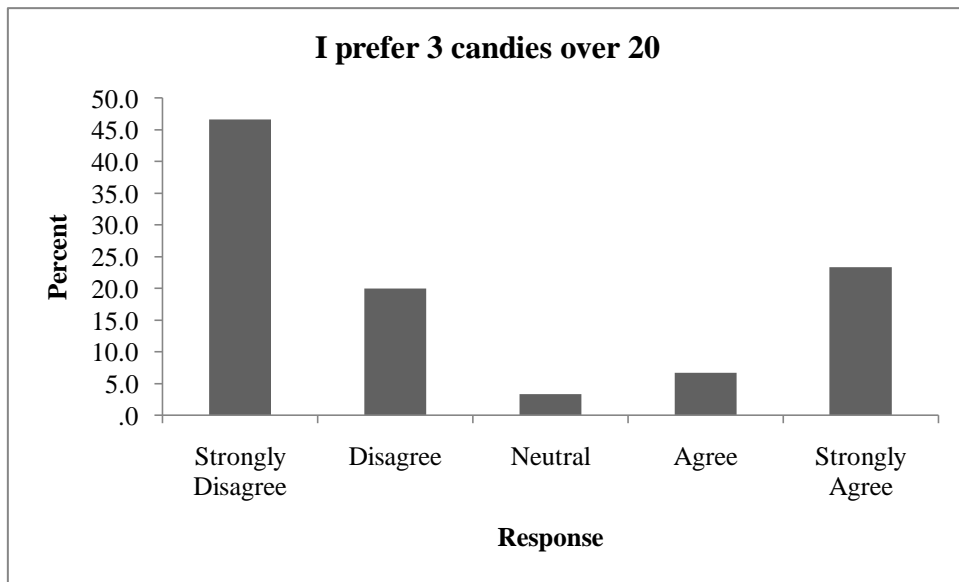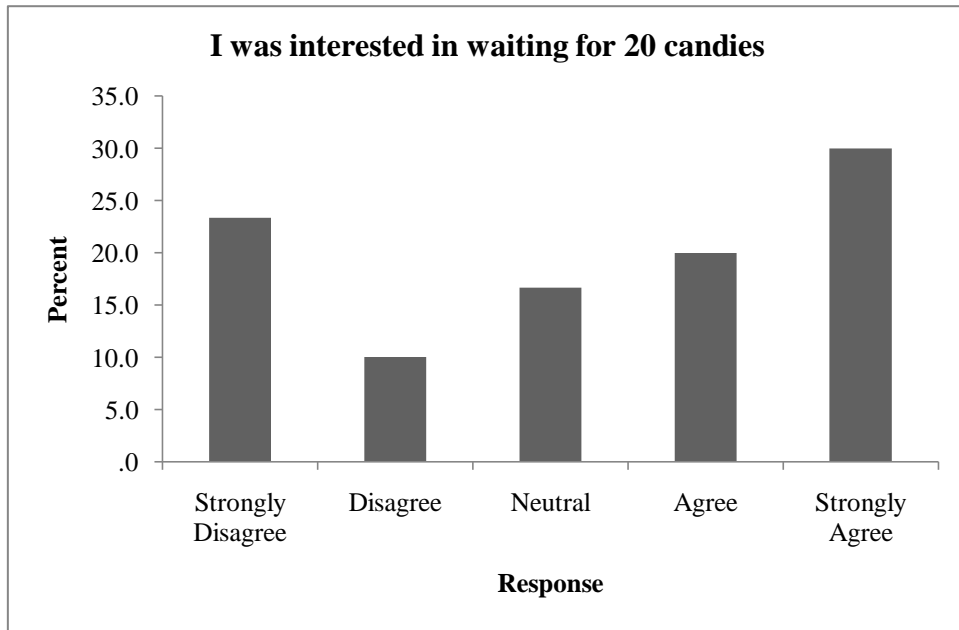
Figure 1. Results of first pilot study testing candy as a reward. The top graph indicates

preference for the large reward. The bottom graph indicates preference for the small reward.
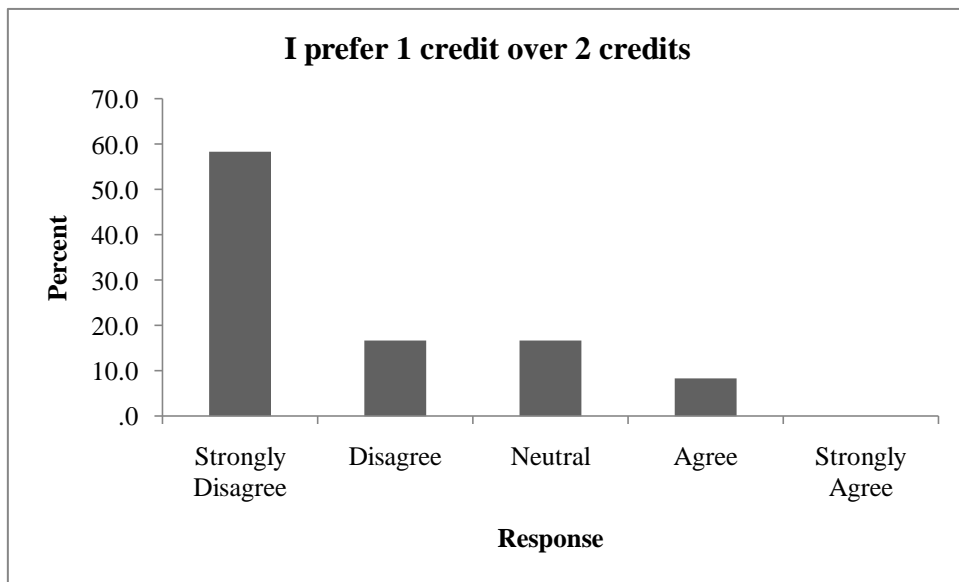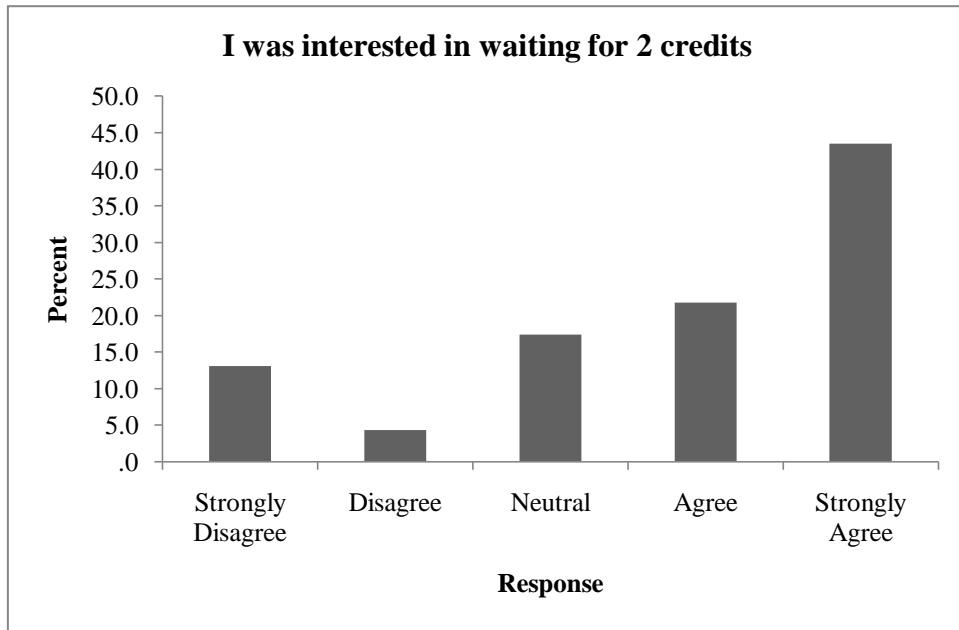
Figure 2. Results of second pilot study testing research participation credit as a reward. The top

graph indicates preference for two credits. The bottom graph indicates preference for one credit.

Ego Depletion and Delay of Gratification

Ego depletion results in marked decreases in persistence at solving puzzles and anagrams, endurance at squeezing a handgrip, physical stamina, and performance in a naval combat simulator game (Baumeister et al., 1998; Vohs et al., 2008; Zyphur et al., 2007). All of these tasks presumably require the use of energy from a limited resource of self-control. Delaying immediate gratification may draw from the same resource. Therefore, an ego-depleting task may affect a person's ability to delay gratification. However, this potential connection has yet to be explored in the literature.

There are several ways that the depletion of self-control resources can influence the ability to delay gratification. First, if ego depletion causes participants give up more easily on subsequent tasks, then depletion may reduce a person's ability to resist immediate temptation (Baumeister et al., 1998). Therefore, participants who are depleted will not wait as long as control participants for a delayed reward. They will terminate the delay sooner to eliminate the aversive effects of waiting. Similarly, if ego depletion leads to an increase in approach motivation, depleted participants will be more motivated to obtain the immediate reward and will wait a shorter period of time than control participants (Schmeichel, Harmon-Jones, & Harmon-Jones, 2010). Conversely, if ego depletion causes people to conserve energy and choose the most passive response, then depleted people will sit back and wait longer for a reward than non-depleted participants. It will use too much energy to terminate a delay (see experiment 4, Baumeister et al., 1998; Baumeister, 2002).

The current study addresses these assumptions. Participants were randomly assigned to an easy or difficult serial-subtraction task (Ritter, Schoelles, Klein, & Kase, 2007) in the presence or absence of a video camera. The difficult serial-subtraction task, subtract 17 from

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5000, involves a high level of controlled cognitive processing. The easier task, subtract 10 from 5000, is presumably accomplished more automatically, and thus, less depleting. Additionally, performing the task in front of a video camera provided social pressure. Participants were told that the video may be reviewed by a research team, indicating future observation. Since the presence of others affects task performance depending on the demands of the task (see Zajonc, 1965), we expected that those who perform an easier task may be facilitated by observation and those who perform the more difficult task may be hindered by observation, and thus more depleted. Following the subtraction task, all participants had the option to wait for a larger amount of research participation credit than the 1 credit they had been promised. The primary dependent measure was the length of time participants waited for more research participation credit. Because the current study employed both cognitive and social processing spheres of depletion, we expected an interaction between the two variables. In other words, the ego depletion effect would not occur when participants performed cognitive processing tasks unobserved, and would occur when participants performed those tasks while being observed. Performance in a serial-subtraction task requires a certain level of arousal. Because participants performed the task unobserved in the no-camera condition, the necessary level of arousal may not exist to produce the level of controlled behavior to bring about ego depletion. For the primary analysis, we hypothesized that participants would delay gratification longer following the easier serial-subtraction task in the presence of a video camera, which required less cognitive processing than the difficult serial-subtraction task. However, if ego depletion resulted in a passive response to the delay task, the opposite results were expected to occur, with those completing a difficult task in the presence of a video camera passively waiting longer than those who performed the easier task in the presence of a video camera.

CHAPTER 2

METHOD

Participants

The sample consisted of 126 undergraduate introductory psychology students (45 males, 81 females). Participants were 18 to 26-years of age and were mostly freshmen (35%) and sophomores (46%) in college. Participants mostly identified themselves as White (57%) or Black or African American (29%). Recruitment took place on the Psychology Department SONA system; participants signed up as a course requirement or for extra credit in Introduction to Psychology (although non-research options were available to all students). The primary researcher randomly assigned participants to task difficulty (64 easy, 63 difficult) and camera (64 no-camera, 63 camera) conditions.

Instrumentation

A Samsung digital blood pressure monitor (model SS-303) measured heart rate and blood pressure. A Panasonic AG-188 video camera mounted on a tripod recorded participants assigned to the camera condition during the ego depleting task.

The researcher administered five different scales to participants. The 17-item Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988; see Appendix A) measured mood. The BMIS contained two mood subscales: Arousal/Calm (12-items) and Pleasant/Unpleasant (16-items). The first 16-items were a list of adjectives (e.g., "happy," "lively," "sad") that participants rate the extent to which they feel on a 0-4 scale (XX = Definitely do not feel, X = Do not feel, V = Slightly feel, VV = Definitely feel). The last item measured self-reported overall mood on a scale of -10 (very unpleasant) to 10 (very pleasant).

The 13-item Brief Self-Control Scale (BSCS; Tangney, Baumeister, & Boone, 2004; see Appendix B) measured self-reported levels of self-control. Participants indicated how much the 13 statements reflected how they typically were on a 1-5 scale (1 = not at all, 5 = very much). Items included "I am good at resisting temptation," "I often act without thinking through the alternatives," and "I have a hard time breaking bad habits." Several items were reverse scored because agreement with those items indicated low self-control (items 2-5, 7, 9, 10, 12, and 13). A high score on the scale indicated high self-control.

The shortened 11-item Multidimensional Perfectionism Scale (Frost, Marten, Lahart, & Rosenblate, 1990; see Appendix C) measured perfectionism. For each item, participants circled the number closest to how they would describe themselves on a 7-point scale (1 = Strongly Disagree, 7 = Strongly Agree). The items reflected two factors: Concern over mistakes (CMA; 9-items; e.g., "People will think less of me if I make a mistake") and personal standards (PS; 2-items; e.g., "It is important to me that I be thoroughly competent in everything I do"). No items were reverse scored. Higher scores on the perfectionism subscales reflected higher levels of perfectionism.

Due to the mathematical nature of the ego depletion task, the Revised Mathematics Anxiety Scale (Plake & Parker, 1992; see Appendix D) measured discomfort with mathematics. This 24-item scale contained two factors: Learning Math Anxiety (LMA; 16-items) and Math Evaluation Anxiety (MEA; 8-items). Overall, the scale asked participants to rate their anxiety in math-related situations on a scale of 0-4 (0 = No Anxiety, 4 = Extreme Anxiety). Items in the LMA factor included "Buying a math textbook" and "Watching a teacher work an algebraic equation on the blackboard." Items in the MEA factor included "Taking an examination (quiz) in

a math course" and "Waiting to get a math test returned in which you expected to do well." No items were reverse scored. Higher scores on the subscales indicated high levels of math anxiety.

A 4-item questionnaire acted as a confound check and qualitative report of the delay period (see Appendix E). Two items were confound checks to evaluate whether participants had an obligation after the experiment and if they were concerned that they would miss an obligation if they waited longer in the delay task. A free-response item asking what the participant thought about while they were waiting illuminated cognitive strategies adults used during a delay period. The final item in the questionnaire asked participants how long they thought they waited in the delay period. Finally, the researcher administered a 7-item demographics measure with age, sex, ethnicity, year in college, GPA, and importance of academic achievement (see Appendix F).

Procedure

Each researcher tested participants one at a time. It was important that participants did not have access to entertainment or time-keeping during the delay because they served as distractions and prevented the use of self-control (see Mischel, 1974, pp. 265- 268). Therefore, each participant placed their belongings (including watches, cell phones, books, etc.) inside a locked room before starting the experiment. The participant then went into a small room with only a table and chair and sign an informed consent sheet with the title "Cognitive Energy and Reinforcement." The participant completed the Brief Mood Introspection Scale to establish a baseline mood. Upon completion of the scale, the researcher measured the participant's baseline heart rate and blood pressure.

The serial-subtraction task immediately followed heart-rate and blood-pressure collection. The researcher randomly assigned participants to task difficulty and camera conditions. The researcher set up the camera and gave participants assigned to a difficult task

with a camera ($N = 31$) the following instructions: "Subtract the number 17 from 5000 as many times as you can and as quickly and accurately as possible until you are stopped. Say each answer loudly. You will be recorded by a video camera to check your accuracy. The video may be reviewed by a research team. I will give you a few minutes of privacy to complete the task." The researcher gave participants assigned to complete the difficult task without the camera ($N = 31$) the following instructions with no camera present, "Subtract the number 17 from 5000 as many times as you can and as quickly and accurately as possible until you are stopped. Say each answer loudly. I will give you a few minutes of privacy to complete the task." The researcher set up the camera and gave the following instructions to participants assigned to complete the easy task in front of the camera ($N = 31$): "Subtract the number 10 from 5000 as many times as you can and as quickly and accurately as possible until you are stopped. Say each answer loudly. You will be recorded by a video camera to check your accuracy. The video may be reviewed by a research team. I will give you a few minutes of privacy to complete the task." The researcher gave the following instructions to participants assigned to complete the easy task with no camera ($N = 32$): "Subtract the number 10 from 5000 as many times as you can and as quickly and accurately as possible until you are stopped. Say each answer loudly. I will give you a few minutes of privacy to complete the task."

After the researcher gave the instructions to the participant according to their assignment to the independent variables and started the camera (for those in that condition), participants had four minutes to subtract until the researcher stopped them. While the participant performed the task, the researcher waited around the corner, not visible to the participant, and recorded the participant's responses to check for accuracy. An overall accuracy score was calculated by the researcher. Following the task, the researcher measured the participant's heart rate and blood

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pressure. The participant then completed the BMIS for a second time to determine if mood is affected by ego depletion.

Upon completion of the BMIS, the experimenter placed a buzzer in front of the participant and gave the following instructions, "For this experiment you have the opportunity to wait for more research participation credit. You get 1 credit for participating. However, the longer you wait, the more credit you can earn. Ring this buzzer when you are ready to stop waiting and we will move on to the final phase of the experiment." The researcher did not tell participants how long they would be gone, but in fact the cutoff time was 40-minutes for all participants in all conditions who do not press the buzzer. The time it took (in minutes and seconds) for participants to press the buzzer was recorded as the dependent variable. If participants did not press the buzzer before the cutoff, their delay time was recorded as 40-minutes. When the participant pressed the buzzer (or waited 40 minutes without pressing the buzzer), the researcher returned to the room and gave the participant the 4-item questionnaire assessing confounds and perceived wait time. The researcher then measured the participant's heart rate and blood pressure for the third and final time.

Following heart rate and blood pressure collection, participants completed the Brief Self Control Scale, Perfectionism Scale, Math Anxiety Scale, and demographics. Demographics were always last, but the researcher randomized the ordering of the other scales. The procedure took no more than 90 minutes. The researcher rewarded participants with 2 research participation credits if they stay longer than 50 minutes for the entire experiment.

CHAPTER 3

RESULTS

Preliminary Analyses

Analysis of experimenter effects**:** A one-way analysis of variance (ANOVA) tested the potential effect of researcher on participants' delay time. Experimenter had no effect on delay time, $F(2, 123) = .66$, $p = .52$, $d = .21$, in that participants delayed gratification similarly for experimenters one ($M = 17.17$, $SEM = 1.55$), two ($M = 15.48$, $SEM = 3.74$), and three ($M = 20.44$, $SEM = 2.96$).

Analysis of gender effects: An independent samples t-test analyzed the potential effect of participant gender on delay time. Gender was not related to delay time, $t(124) = .65$, $p = .52$, $d = .12$, in that males ($M = 18.72$, $SEM = 2.10$) delayed gratification for the same length of time as females ($M = 16.97$, $SEM = 1.63$).

Mood Analyses: Two 2 (task difficulty) X 2 (camera condition) analyses of variance (ANOVA) analyzed potential differences in the two factors of mood (arousal/calm, pleasant/unpleasant) following the serial-subtraction task. Mood arousal did not differ between the levels of task difficulty, $F(1, 122) = .60$, $p = .44$, $d = 14$, or camera condition, $F(1, 122) = .51$, $p = .48$, $d = .13$, and there was no interaction between task difficulty and camera condition, $F(1, 122) = .00$, $p = .98$, $d = .01$. Pleasantness of mood did not differ between the levels of task difficulty, $F(1, 122) = 1.20$, $p = .28$, $d = .20$, or camera condition, $F(1, 122) = 2.41$, $p = .12$, $d = .28$, and there was no interaction between task difficulty and camera conditions, $F(1, 122) = .55$, $p = .46$, $d = .13$.

Primary Analyses

Delay of Gratification: A 2 X 2 analysis of variance (ANOVA) analyzed the effect of task difficulty (easy versus difficult) and camera condition (presence versus absence) on the delay of gratification. No significant main effects of task difficulty, $F(1, 122) = .83$, $p = .36$, $d = .17$, or camera condition, $F(1, 122) = .11$, $p = .74$, $d = .06$, existed. However, ANOVA revealed a significant interaction between task difficulty and camera condition, $F(1, 122) = 6.23$, $p = .01$, $d = .45$. Fisher's protected t-tests revealed that delay of gratification differed only within the camera condition, $t(60) = 2.42$, $p = .02$, $d = .63$, such that those who performed a difficult serial subtraction task in the presence of a camera ($M = 12.85$, $SEM = 2.81$) pressed the buzzer more quickly and, thus, delayed gratification less than those who performed an easy serial subtraction task in the presence of a camera ($M = 21.47$, $SEM = 2.19$, see Figure 3). No other cell-mean comparisons reached significance ($p > .05$).

Physiological analysis: Three 2 X 2 (task difficulty X presence of camera) analyses of covariance (ANCOVAs) analyzed heart rate, diastolic blood pressure, and systolic blood pressure. The covariates included baseline measurements of each, respectively. ANCOVA of heart rate revealed no significant main effects of task difficulty, $F(1, 120) = 1.09$, $p = .30$, $d = .19$, or camera condition, $F(1, 120) = .00$, $p = .95$, $d < .01$. However, the analysis revealed a significant interaction between task difficulty and camera condition, $F(1, 120) = 4.19$, $p = .04$, $d = .38$, that mirrored the delay-of-gratification results. Fisher's protected t-tests further analyzed the interaction and revealed that participants who performed a difficult task in front of a camera had a greater increase in heart rate ($M = 7.65$, $SEM = 1.54$) than those who performed an easy task in front of a camera ($M = 2.90$, $SEM = 1.54$), $t(120) = 2.18$, $p = .03$, $d = .40$ (see Figure 4).

Analyses of diastolic blood pressure revealed no significant main effects of task difficulty, $F(1, 119) = .22$, $p = .64$, $d = .09$, or camera condition, $F(1, 119) = .11$, $p = .74$, $d = .06$. Additionally, the analysis revealed no significant interaction between task difficulty and camera condition, $F(1, 119) = .82$, $p = .37$, $d = .17$.

Analyses of systolic blood pressure revealed no significant main effects of task difficulty, $F(1, 120) = .07$, $p = .79$, $d = .06$, or camera condition, $F(1, 120) = .00$, $p = .98$, $d < .01$. However, the analysis revealed a significant interaction between task difficulty and camera condition, $F(1, 120) = 4.26$, $p = .04$, $d = .38$. Fisher's protected t-tests further analyzed the interaction and revealed that participants who performed a difficult task in front of a camera had a larger change in systolic blood pressure ($M = 6.2$, $SEM = 3.08$) than those who performed an easy task in front of a camera ($M = -0.83$, $SEM = 3.04$), $t(57) = 2.42$, $p = .02$, $d = .64$ (see Figure 5).

Correlations

Correlations analyzed potential relationships between all continuous variables and delay of gratification. The variables included age, grade point average, accuracy at the serial-subtraction task, overall math anxiety score, overall self-control score, and concern over mistakes and personal standards subscales of perfectionism. None of the variables significantly correlated with delay of gratification ($p > .05$).
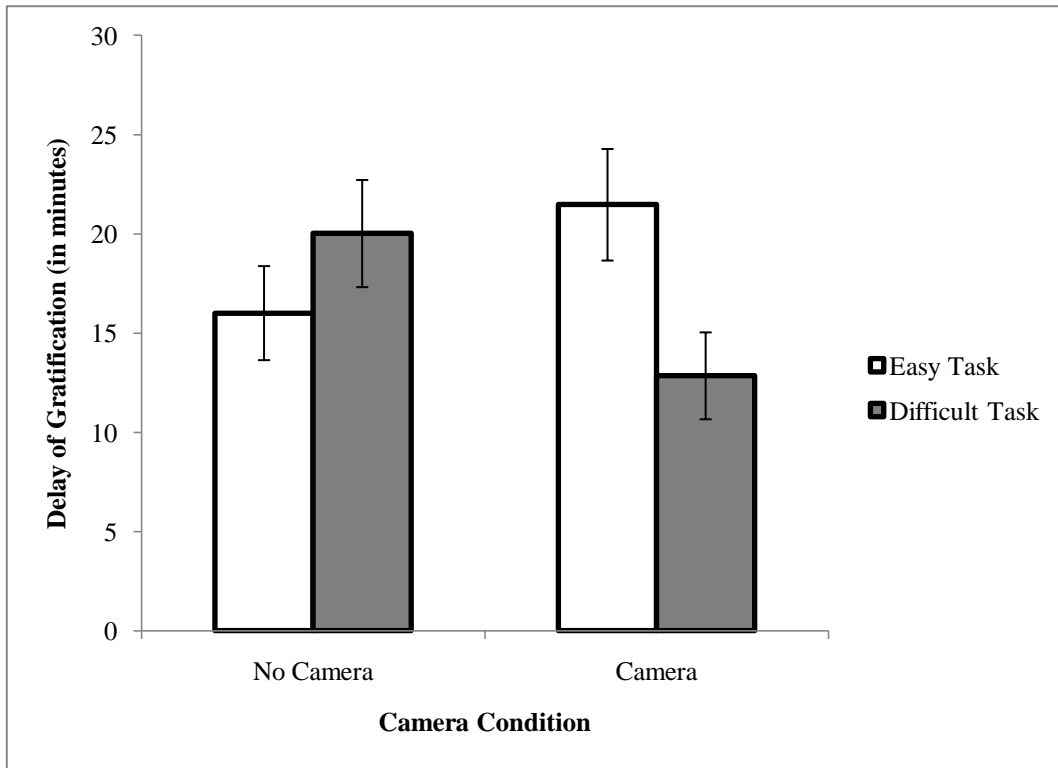
Figure 3. Graph of task difficulty within camera conditions for delay of gratification. Indicates a

significant interaction: There is a difference in the delay of gratification between easy and

difficult tasks only for the camera condition.
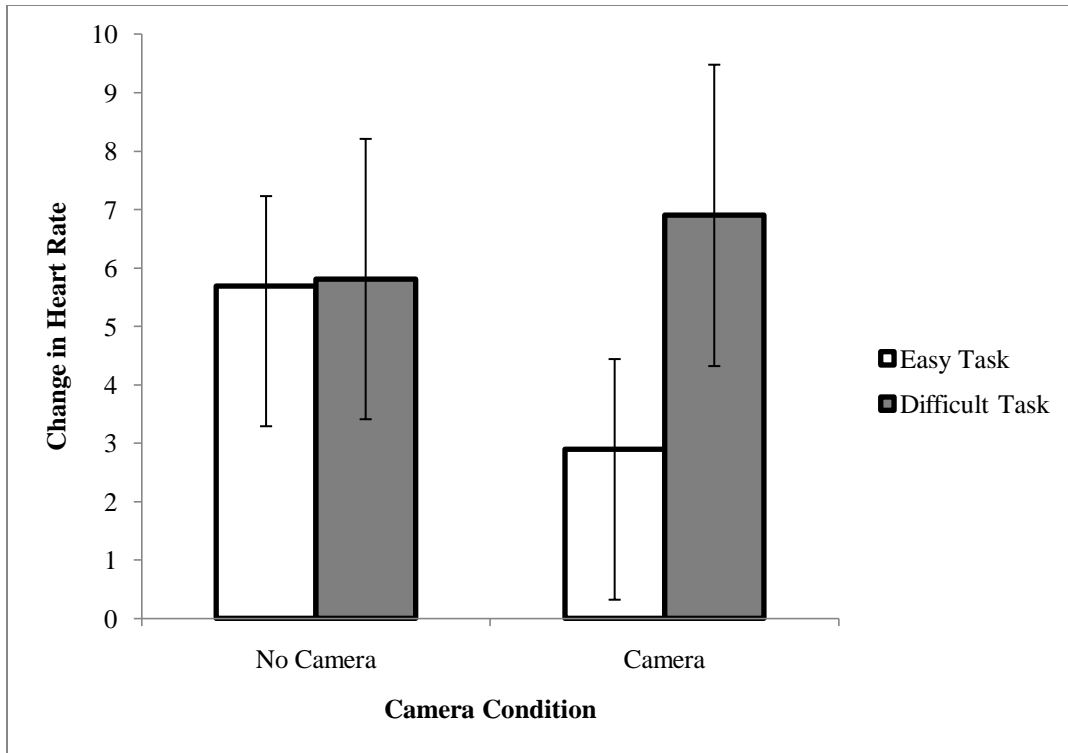
Figure 4. Graph of task difficulty within camera conditions for heart rate. Indicates a significant interaction: There was a difference in the change in heart rate between easy and difficult tasks only for the camera condition.
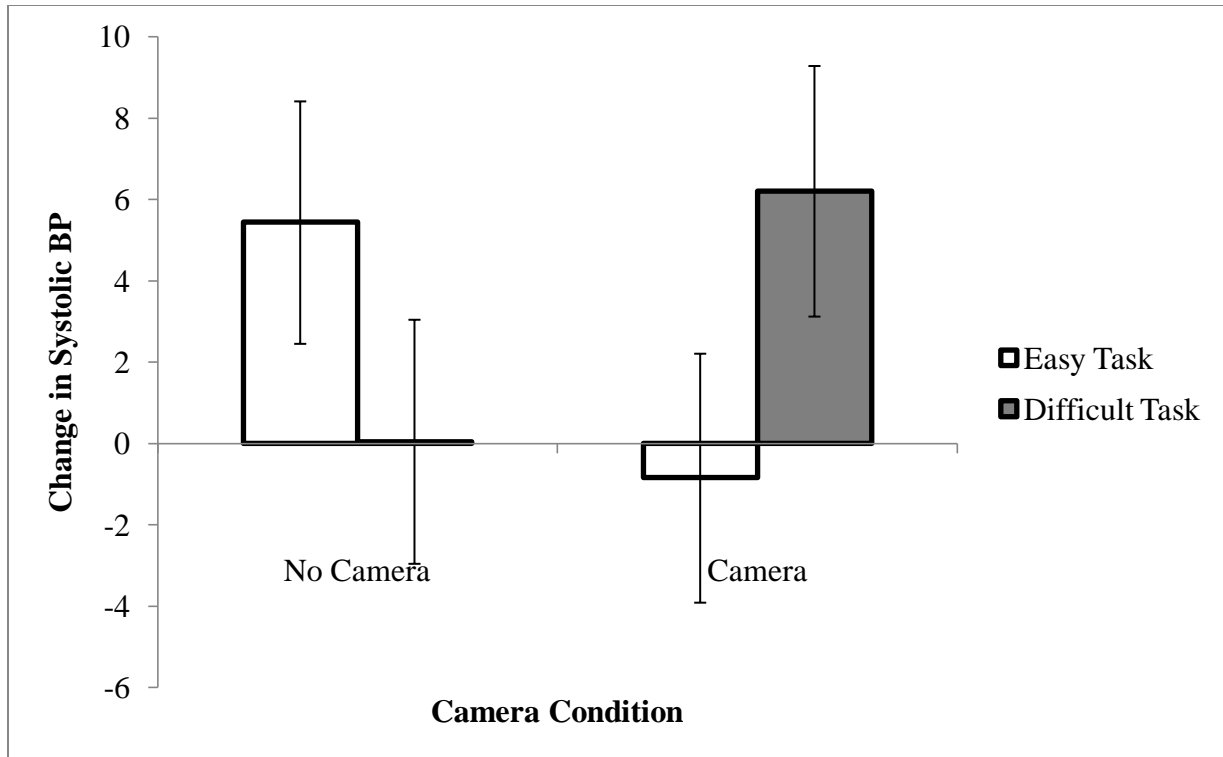
Figure 5. Graph of task difficulty within camera conditions for systolic blood pressure. The

results indicated a significant interaction: There was a difference in the change in systolic blood

pressure between easy and difficult tasks only for the camera condition. Levene's test for the

equality of variances was significant ($p = .03$), therefore the degrees of freedom were adjusted in

post-hoc testing.

CHAPTER 4

DISCUSSION

These results support and build upon the hypothesis that ego depletion affects delay of gratification. Specifically, completing a difficult cognitive task in the presence of a camera leads to decrements in the ability to wait for a delayed, larger reward when compared to easier processing in the presence of a camera. This finding is consistent with both the limited resource theory of self-control proposed by Baumeister and colleagues (1998) as well as the approach motivation theory elaborated by Schmeichel and colleagues (2010). In the presence of a video camera, engaging in difficult cognitive processing consumed more resources than easier processing. Participants were then forced to conserve their resources and were less able to delay gratification. Additionally, approach motivation, or the desire for success, pleasure, and reinforcement, increased with the depletion of limited resources. Therefore, participants experienced an increase in the approach motivated behavior of ending an aversive delay to accept an immediate reward.

The finding that delay of gratification was affected by previous exercise of self-control is contrary to the idea that self-control, manifested in the ability to delay gratification, is solely a dispositional trait of the individual. Mischel (1974) proposed that ability to delay rewards lies in a continuum. Longitudinal research by Mischel and colleagues found that several demographic traits correlated with the ability to delay, such as maturity, academic achievement, and impulsivity. However, correlations revealed no significant relationships between delay and these traits in the current study, perhaps because ego depletion impacted and changed the individual ability to delay.

Ego Depletion and Arousal

Ego depletion research tends to focus on one sphere of self-control at a time. The current study addressed both cognitive and social processing combined and revealed an interesting interaction: Difficult cognitive processing combined with a social stressor leads to a diminished ability to postpone immediate rewards for delayed, larger rewards. The lack of depletion when people complete the same cognitive processing tasks in the absence of a social stressor suggests that people need to reach a certain level of arousal to deplete self-control resources.

The Yerkes-Dodson Law relates the strength of a stimulus to the learning of new behavior (Yerkes & Dodson, 1908). Yerkes and Dodson trained mice to discriminate white and black boxes using varying levels of electric shock intensity. First, they found that mice trained using medium levels of shock learned the discrimination more quickly than those tested with low and high shocks. Next, they found that when the discrimination was made easier by increasing the contrast between white and black boxes, mice receiving high levels of shock learned the discrimination more quickly than those receiving lower levels of shock. Finally, when they decreased the contrast between the boxes, which made the discrimination more difficult, they found that mice receiving lower levels of shock learned the discrimination more quickly than those receiving higher levels of shock. They concluded that differing strengths of stimuli affect the rapidity of learning differently based on the ease or difficulty of a discrimination task. Arousal theory, based on the Yerkes-Dodson Law, relates arousal to performance. It assumes that there is an optimum level of arousal necessary to perform a task. The theory is graphically represented by an inverted u-shaped curve, with maximum performance occurring with a medium level of arousal and minimum performance occurring with low and high levels of arousal. However, research has found that the shape of the curve is variable and depends on task

difficulty, as Yerkes and Dodson posited. The easier the task, the more arousal aids performance. The more difficult the task, the less tolerant the organism is to arousal and the more arousal hinders performance.

There appears to be a relationship between arousal and depletion, and this relationship needs to be further analyzed. We speculate that participants who are aroused differ in their use of self-control strength based on task difficulty. Those performing an easy task may be aided by arousal, resulting in the use of less cognitive resources to complete the task. Those performing a difficult task may be negatively affected by arousal, resulting in their use of more cognitive resources to complete the task. Therefore, people who performed the difficult task were more depleted, and the depletion reflected in the differing ability to delay gratification.

Since we tested the sphere of social processing to produce depletion, it is necessary to examine its effects on arousal. Half of the participants in the current experiment performed a cognitive task in the presence of a video camera. The researcher told the participants that the video may be reviewed by a research team. In effect, the camera represented an audience. Social facilitation theory suggests that the presence of others impacts performance on a task. A landmark experiment by Norman Triplett (1898) found that children wound a string on a fishing reel more rapidly if they performed the task with other people than when they performed it alone. Other research, however, found that the presence of others led to decrements in performance of a maze task and decreased learning of nonsense syllables (Pessin, 1933; Pessin & Husband, 1932). These conflicting results led to Robert B. Zajonc's (1965) integration of arousal theory and social facilitation. Zajonc suggested that the presence of an audience increases arousal. This arousal, in turn, facilitates the performance of easier tasks and inhibits performance of harder tasks. Simpler, well-learned motor tasks like stringing a fishing reel are aided by arousal. More

complicated tasks like performing a maze are negatively impacted by arousal. Later research demonstrated that the presence of others creates arousal (Mullen, Bryant, & Driskell, 1997) and that arousal and performance differ by task difficulty (Blaskovich et al., 1999).

Arousal theory and social facilitation offer one explanation the interaction between task difficulty and camera-condition in the current experiment. Participants who completed a difficult task in the presence of a camera delayed gratification less than those who completed an easier task in the presence of a camera. Participants in the no-camera condition equally delayed gratification. Perhaps the presence of a camera implied the presence of an audience, which increases arousal. Therefore, those performing an easy task in front of the camera experienced social facilitation, may have used fewer resources to complete the task, and experienced less depletion. Those performing a difficult task in front of the camera experienced the inhibitory effects of arousal, used more resources, and experienced more depletion.

<center>Ego Depletion and Physiological Arousal</center>

Quite noteworthy was the pattern of change in heart rate and systolic blood pressure that mimicked the primary analysis, where an interaction occurred between cognitive and social processing. Participants who completed an easy task in the presence of a camera experienced a lesser increase in heart rate than those who completed a difficult task in the presence of a camera. Additionally, participants who completed an easy task in the presence of camera experienced a decrease in systolic blood pressure, while participants who completed a difficult task in the presence of a camera experienced an increase in systolic blood pressure. The change suggests, again, that arousal is implicated in ego depletion.

Experimenters commonly use heart rate and blood pressure as a measure of arousal and mental workload (Carroll et al., 1986; Cosenzo & Francina, 2001; Jorna, 1992). Specifically,

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Blascovich and colleagues (1999) detailed the Biopsychosocial Model of challenge and threat. Participants who completed learned and unlearned tasks alone showed no difference in performance and arousal, whereas those who completed the same tasks in the presence of an audience experienced increased cardiac reactivity (heart rate). Moreover, the trend in physiological arousal followed a challenge pattern for those completing a learned task: Increase in heart rate and decrease in peripheral vascular resistence. While a threat pattern occurred in those who completed an unlearned task: Increase in heart rate and decrease in peripheral vascular resistance. The authors suggest that a threat pattern results from inadequate resources to complete a task.

The current results combine with previous research to suggest that ego depletion creates a physiological change that may mimic a threat or challenge pattern of arousal depending on task difficulty. Arousal may then interact with task difficulty to deplete cognitive resources. The depletion causes decrements in subsequent acts of self-control. Subsequent research is warranted to illuminate and expand relationships among ego depletion and physiological measures.

<center>Buffering Ego Depletion</center>

Although ego depletion has consistently lowered performance, persistence, and endurance at self-control tasks, several researchers found ways to overcome these effects. Webb and Sheeran (2003) found that implementation intentions, or instructions on how to perform when a cue appears, can remove ego depletion effects. They compared three groups: A depleted group instructed to name the color of a word on a Stroop task, a control group who simply read the word, and an implementation intention group who named the color of the word but were given instructions (implementation intentions) to make the task easier. Participants in the implementation intentions condition persisted significantly longer at subsequent unsolvable

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puzzles than the depleted group (and persisted as long as a non-depleted control group), thus overcoming depletion. Perhaps mental preparedness allowed participants to overcome the effects of difficult cognitive processing and conserve self-control strength.

Low motivation may play a role in ego depletion. In fact, Muraven and Slessareva (2003) found that people can overcome depletion if they have enough motivation. Participants engaged in a thought-suppression task and subsequently completed a difficult geometric tracing task. Participants who had to suppress their thoughts but who were told that the task would benefit people with Alzheimer's disease persisted longer than those who were not told of the benefits of the task. Similarly, when participants completed a speech-control task and later practiced a game, those who were told that practice would improve performance persisted longer than those who were told that practice would not help. Finally, the researchers found that a monetary incentive would reduce ego-depletion effects. Depleted participants who were offered more pay (25 cents per ounce) to drink an unsavory beverage drank significantly more than those offered a low pay per (1 cent per ounce). Thus, all of the participants with more motivation persisted as much as control groups who were not depleted to begin with, demonstrating a buffer to ego depletion.

Distraction during a depleting task can reduce the resources necessary to complete the task. Indeed, Alberts and colleagues (2008) found that attentional strategies aid in overcoming ego depletion. Participants were depleted using a muscle endurance task (keeping a 2-lb weight lifted at a 90-degree angle). Participants lifted the weight again, measuring subsequent self-control. Those who shifted their attention by performing a mental calculation task while lifting the weight endured longer than participants who simply focused on their muscles. These findings suggested that shifting attention facilitated performance of a depleted individual during a subsequent task; distraction from challenge buffers against depletion.

In addition to explicit strategies to overcome depletion, several researchers assessed the role of automatic processes, specifically priming with persistence, to overcome ego depletion (Alberts et al., 2007; Martijn et al., 2007). Alberts and colleagues found that priming with persistence prevented ego depletion. Participants in the ego-depletion condition engaged in a difficult cognitive task, while control participants performed an easy version of the task. Half of the participants were primed with persistence in a scrambled-sentence task; remaining participants received neutral sentences. Depleted participants who were primed with persistence endured at squeezing a handgrip longer than those who were not primed with persistence. In fact, the priming removed the ego depletion effect completely, bringing the endurance of the depleted participants equal to the control group. In their second experiment, Alberts and colleagues depleted participants using an attention-control task (high versus low) followed by visual priming of persistence (screensaver with a message of persistence versus a neutral screensaver). Participants who were depleted and primed with a persistent screensaver reached the level of a control group and endured significantly more at squeezing a handgrip than the depleted-neutral screensaver group. Martijn and colleagues (2007) found the same buffering effects when they primed participants with an example of a persistent person.

Although negative affect has been ruled out as an alternate explanation for ego depletion (see Hagger et al., 2010), research has found positive affect induction buffers against depletion. Tice, Baumeister, Shmueli, and Muraven (2007) conducted a set of experiments demonstrating that positive affect prevents ego depletion. In the first experiment, participants engaged in a thought-suppression task, while the control group thought freely. The researcher induced positive mood in half the participants (by giving them a surprise gift), while the other half simply received a note that they participated. Depleted participants in the gift condition drank more of

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an unsavory beverage than those who were depleted and simply given a receipt. Furthermore, depleted participants who received the gift drank as much as those who were not depleted initially. In the second experiment, half of the participants completed a difficult cognitive-processing task, and the other half completed an easy version of the task. Participants then watched a funny or neutral video. Depleted participants who watched the funny video persisted longer in a game than those who were depleted and watched a neutral video. The third experiment used the same thought-suppression task as the first, but added a sad video to the mood induction phase. Results indicated that depleted participants who watched a funny video endured at squeezing a handgrip longer than depleted participants who watched the neutral or sad video, showing that positive affect (not affective arousal in general) helped to overcome ego depletion. Finally, the fourth experiment used a resistance-to-temptation task to induce ego depletion. All of the participants were told to eat radishes while the aroma of chocolate chip cookies filled the room to produce ego depletion. Then, the researchers showed participants either a funny, sad, or neutral video to manipulate affect. Participants who watched the funny video persisted longer at unsolvable puzzles than those who watched the sad or neutral video. Thus, participants overcame ego depletion by enhancing mood.

Future studies can employ the methods of implementation intentions, increased motivation, attentional strategies, priming, and positive mood induction to buffer the effects of ego depletion on the delay of gratification. Delay of gratification literature focuses on distraction. Attentional strategies like ideation can reduce the aversiveness of a delay period (see Mischel, Ebbersen, & Zeiss, 1972; Mishel & Underwood, 1974). Perhaps these strategies can remove the effects of ego depletion completely. The current study assessed cognitive strategies during the delay period by asking what participants thought about during their wait (Appendix E, Item 3).

Many participants reported that they spent their time planning their day or planning for the future, thinking about how long they had to wait, and thinking about the experiment. It would be interesting to see how these cognitions affected delay time. People are notoriously poor at metacognition, so experimental manipulations are necessary to determine if certain thoughts can increase delay time and buffer ego depletion.

<center>Limitations and Future Directions</center>

The current study is the first to report ego-depletion effects related to the delay of gratification offering a useful way to test college students in the delay of gratification paradigm. More experimentation is necessary to conclude that the effect is reliable across the several spheres of self-control. In addition, the interesting interaction between cognitive and social processing should be researched more thoroughly. It is necessary to determine if the presence of a camera consistently interacts with task difficulty to produce differing effects on later self-control. Further, the presence of a person, rather than a camera, can be explored.

We collected heart rate and blood pressure using a simple wrist cuff. More sophisticated measurement techniques, like those used by Blascovich and colleagues (1999), may provide more insight into the physiological mechanisms of ego depletion, particularly whether they conform to the Biopsychosocial Model of Challenge and Threat. For example, measurements of peripheral vascular resistance during ego depletion would confirm that challenge and threat patterns exist during easy and difficult tasks, respectively.

A strength of the current study is the discovery of a meaningful delay-of-gratification task for adults. Early research in the delay of gratification focused on children, who are motivated by food rewards and can only tolerate short delays (Mischel, Shoda, & Rodriguez, 1989). A fifteen-minute delay, which only a few children can tolerate, is easily tolerated by

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adults. Adults may have developed personal strategies to deal with delays, perhaps based on more experience tolerating longer delays. Additionally, adults require more generalized rewards (e.g., money) for the traditional delay-of-gratification task to be meaningful. Research on adolescents and young adults often relies on monetary rewards (Wulfert et al., 2002) or hypothetical monetary rewards (Green, Fry, & Myerson, 1994), which are either costly or difficult to generalize to real-world settings. The current study was both time and cost efficient, using a highly meaningful reward for college students (research participation credit) and a short, 40-minute delay.

The main implications of the present experiment are twofold. First, the ability to delay gratification is dependent on the previous exercise of self-control. Second, physiological arousal may play an important role in the depletion of limited resources. Further examination of these relationships will provide insight into potentially overcoming ego depletion and harnessing the adaptive power of self-control.

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APPENDIX A

BRIEF MOOD INTROSPECTION SCALE

(Mayer & Gaschke, 1988)

INSTRUCTIONS: Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

	Definitely do not feel	Do not feel	Slightly feel	Definitely feel
Lively	XX	X	V	VV
Happy	XX	X	V	VV
Sad	XX	X	V	VV
Tired	XX	X	V	VV
Caring	XX	X	V	VV
Content	XX	X	V	VV
Gloomy	XX	X	V	VV
Jittery	XX	X	V	VV
Drowsy	XX	X	V	VV
Grouchy	XX	X	V	VV
Peppy	XX	X	V	VV
Nervous	XX	X	V	VV
Calm	XX	X	V	VV
Loving	XX	X	V	VV
Fed up	XX	X	V	VV
Active	XX	X	V	VV

Overall, my mood is:

Very Unpleasant   Very Pleasant

-10   -9   -8   -7   -6   -5   -4   -3   -2   -1   0   1   2   3   4   5   6   7   8   9   10
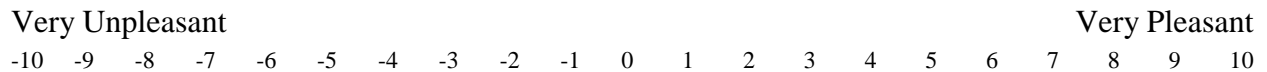
BRIEF SELF-CONTROL SCALE

(Tagney, Baumeister, & Boone, 2004)

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

	Not at all				Very much
1. I am good at resisting temptation.	1	2	3	4	5
2. I have a hard time breaking bad habits.	1	2	3	4	5
3. I am lazy.	1	2	3	4	5
4. I say inappropriate things.	1	2	3	4	5
5. I do certain things that are bad for me, if they are fun.	1	2	3	4	5
6. I refuse things that are bad for me.	1	2	3	4	5
7. I wish I had more self-discipline.	1	2	3	4	5
8. People would say that I have iron self-discipline.	1	2	3	4	5
9. Pleasure and fun sometimes keep me from getting work done.	1	2	3	4	5
10. I have trouble concentrating.	1	2	3	4	5
11. I am able to work effectively toward long-term goals.	1	2	3	4	5
12. Sometimes I can't stop myself from doing something, even if I know it is wrong.	1	2	3	4	5
13. I often act without thinking through all the alternatives.	1	2	3	4	5

APPENDIX C

SHORTENED MULTIDIMENSIONAL PERFECTIONISM SCALE

(Frost, Marten, Lahart, & Rosenblate, 1990)

Please circle the number closest to how you would describe yourself.

1. If I do not do as well as others people, it means I am an inferior human being.

      1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

2. If I fail at work/school, I am a failure as a person.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

3. If I do not do well all the time, people will not respect me.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

4. People will probably think less of me if I make a mistake.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

5. If someone does a task at work/school better than I, then I feel like I failed the whole task.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

6. The fewer mistakes I make, the more people will like me.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

7. If I fail partly, it is as bad as being a complete failure.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

8. I should be upset if I make a mistake.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

9. If I do not set the highest standards for myself, I am likely to end up a second-rate person.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

10. I hate being less than the best at things.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

11. It is important to me that I be thoroughly competent in everything I do.

1   2   3   4   5   6   7
Strongly Disagree   Strongly Agree

APPENDIX D

REVISED MATHEMATICS ANXIETY SCALE

(Plake & Parker, 1992)

Please rate your anxiety level for each of the following examples. Think about the anxiety you would have in that actual situation.

0 = No Anxiety at All   1 = Low Anxiety   2 = Moderate Anxiety   3 = High Anxiety   4 = Extreme Anxiety

	No Anxiety	Low	Moderate	High	Extreme
1. Looking through the pages in a math text	0	1	2	3	4
2. Walking into a math class	0	1	2	3	4
3. Having to use the tables in the back of a math book	0	1	2	3	4
4. Reading a formula in chemistry	0	1	2	3	4
5. Buying a math textbook	0	1	2	3	4
6. Thinking about an upcoming math test one day before	0	1	2	3	4
7. Watching a teacher work an algebraic equation on the blackboard	0	1	2	3	4
8. Being told how to interpret probability statements	0	1	2	3	4
9. Picking up a math textbook to begin working on a homework assignment	0	1	2	3	4
10. Taking an examination (quiz) in a math course	0	1	2	3	4
11. Reading and interpreting graphs or charts	0	1	2	3	4
12. Solving a square root problem	0	1	2	3	4
13. Signing up for a course in statistics	0	1	2	3	4
14. Getting ready to study for a math test	0	1	2	3	4
15. Reading the word "statistics"	0	1	2	3	4
16. Being given a homework assignment of many difficult problems which is due the next class meeting	0	1	2	3	4
17. Listening to a lecture in math class	0	1	2	3	4
18. Waiting to get a math test returned in which you expected to do well	0	1	2	3	4
19. Working on an abstract mathematical problem	0	1	2	3	4
20. Being given a "pop" quiz in math class	0	1	2	3	4
21. Taking an examination (final) in math class	0	1	2	3	4
22. Starting a new chapter in a math book	0	1	2	3	4
23. Listening to another student explain a math formula	0	1	2	3	4
24. Walking on campus and thinking about a math course	0	1	2	3	4

No Anxiety   Low   Moderate   High   Extreme

APPENDIX E

QUESTIONNAIRE

Did you have an obligation after the experiment? (circle one)　　　Yes　　　　　No

　　　If so, what was the obligation? _____

Were you concerned that if you waited, you'd miss an obligation for the day? (circle one)

　　　　　　　　　　　　　　　　　　　　　　　　　　Yes　　　　No

What did you think about while waiting?

_____

_____

_____

_____

_____

_____

_____

_____

_____

How long do you think you waited (in minutes)?　　_____

APPENDIX F

DEMOGRAPHICS

Gender (check one) __M __F

Age (in years) _____

Ethnicity (check one)
_____ White
_____ Black or African American
_____ Native Hawaiian or Pacific Islander
_____ Asian
_____ American Indian
_____ Hispanic or Latino
_____ Other (please specify) _____

Year in college (check one) ____Fresh ____Soph ____Jr ____Sr

GPA _____

Circle the number corresponding to how important you think the following things are:

	Not Important				Very Important
Grades	1	2	3	4	5
Academic Achievement	1	2	3	4	5