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EGO DEPLETION AND THE INTERNET: CAN WE STUDY EGO-DEPLETION ONLINE?

by

TODD ALLMOND

(Under the Direction of Janie H. Wilson)

ABSTRACT

Exercising self-control depletes a finite resource of energy and reduces the ability to control behavior on subsequent tasks. Baumeister and others refer to the attenuation of self-regulation as ego depletion. Recent research has successfully utilized computer-based depletion manipulations and measures. Previous research has focused on depletion tasks and measures in a laboratory setting, but no known research has extended ego-depletion research to the online environment. The present study attempted to manipulate and measure ego-depletion through an online medium. We hypothesized that participants in the online experimental condition would perform significantly worse on two measures of depletion than participants in the depletion control or empty control condition. Further, we examined the potential for an order effect of depletion measures. Despite using research-supported manipulations and measures of ego-depletion, we found no evidence of depleted states in participants who were randomly assigned to the experimental condition. Further, our results did indicate a main effect of dependent-variable order. In this experiment, completing the first dependent variable did have a significant impact on performance during the second dependent variable.

INDEX WORDS: Ego depletion, Online medium, Self-Control

EGO DEPLETION AND THE INTERNET: CAN WE STUDY EGO-DEPLETION
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DEDICATION

I would like to dedicate this book to my family, and most importantly, my wife Stacie Allmond. Thank you for all of your support during this adventure. I would not be who I am today without you.

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I would first like to thank Dr. Janie Wilson for her support and encouragement over the past two years. You have been a great advisor and great friend these past two years. You are the rare professor that every graduate student hopes for but seldom get the opportunity to work with. One couldn't ask for a better mentor/friend. I would also like to thank Dr. Bradley Sturz. You are a great teacher and mentor and have guided me along my path since my undergraduate work. I greatly appreciate all of your guidance these past few years. I would also like to thank Dr. Jeff Klibert. Your advice in my research opened me to a new field that helped change the direction of my research and future career goals. Thank you all for all your support.

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CHAPTER 1

INTRODUCTION

The body contains a source of energy that individuals use to accomplish tasks (Baumeister, Bataslavsky, Muraven, & Tice, 1998). This internal source is a limited store of energy that can show measurable signs of depletion based on observable behaviors (Baumeister et al., 1998). One category of affected behaviors is self-regulation (i.e., self-control), an effort by people to alter emotions, thoughts, and actions in accordance with their desires. Self-regulation involves the purposeful effort of resisting undesired impulses and persisting with desirable behaviors. Ego depletion can have a significant impact on self-regulation, reducing an individual's ability to monitor and reduce maladaptive behaviors.

Pathways to Ego-Depletion

Self-control can be understood through effortful attention. By focusing attention, people dictate which stimuli in an environment they consciously process and which ones they consciously ignore (Schmeichel, 2006). Schmeichel found that participants who exercised self-control over attention performed significantly worse on a working-memory measure. Because working memory requires effort, Schmeichel showed depletion in energy reserves when one effortful task followed another. The same outcome was found with various types of self-control. Whether controlling visual attention or personal facial expressions, people demonstrated a reduction in working memory. With each act of self-control, cognitive resources deplete (ego depletion) and impair further acts of self-control and attentional control (i.e., lower performance on working-memory measures).

Therefore, the ability to control attention changes over time because it depends on an internal resource that becomes depleted both by acts of self-regulation and self-control (Schmeichel, 2007).

If self-control indeed requires effort and draws from a finite well of energy, use of self-control should also relate to levels of glucose. The human brain heavily relies on glucose as a primary source of energy for functioning (Gailliot et al., 2007). Therefore we would expect self-control and glucose to be positively related. That is, low glucose should correlate with low self-control. Indeed, after performing a depleting task, low glucose preceded significantly poorer performance on a subsequent measure of self-control for depleted individuals than non-depleted individuals (Gailliot et al., 2007). Additionally, participants given a glucose drink after a difficult cognitive task showed reduced or eliminated self-control decrements compared with changes found in participants given a placebo drink (Gailliot et al., 2007). In sum, glucose appears positively related with self-control.

As we can see from the prior examples, research demonstrating the roles of working memory and glucose in ego-depletion provides both cognitive and physiological mechanisms that contribute to a depleted state. Ego depletion does not simply describe an abstract theory of a mysterious energy reserve that has an unknown impact on self-control behavior. Physical drain and cognitive depletion have been qualified.

Physical Self-Control and Ego depletion

Various forms of self-control have been used to induce depletion. For example, resisting the urge to eat chocolate for five minutes resulted in ego depletion and led individuals to spend significantly less time attempting a difficult cognitive task than non-

depleted individuals (Baumeister et al., 1998). All participants were asked to skip a meal before beginning the experiment. Participants were assigned to a radish (control) condition or a chocolate (experimental) condition. After being instructed to resist eating the assigned food for five minutes, all participants attempted an impossible puzzle task. Participants attempted to successfully trace a geometric shape that could not be traced without lifting a pencil/pen from the paper. Physically resisting the urge to eat a desirable food (i.e., chocolate) while hungry led to a depleted state. Ego-depleted participants quit the puzzle task significantly quicker than non-depleted participants.

Similarly, Stucke and Baumeister (2006) used hunger and restriction of eating to induce depletion. All participants were instructed not to eat three hours before the experiment. In the laboratory, one group was instructed to eat as many cookies, chocolate, and cake as they wanted while working on a creativity task. Participants in the ego-depletion condition were told to physically resist eating the same food while completing the creativity task. Similar to Baumeister and colleagues (1998), participants in the ego-depletion condition exhibited significantly less self-control on a subsequent measure. Specifically, participants gave significantly harsher job evaluations of a researcher, demonstrating less self-control to inhibit aggressive impulses than participants in the control condition.

Physical self-control and depleted states are not limited to physically resisting certain desired activities. Exerting physical self-control for as long as possible can also lead to a depleted state. Alberts et al. (2008) had all participants hold a 1.5 kg weight in their hand with the 90 degree angle from arm to torso for as long as possible. After completing the first physical task, participants completed the same task for a second time

but were randomly assigned to concentrate on holding the weight and the sensation in their arm or were assigned to a cognitive distraction task while holding the weight. After completing the second physical task, participants repeated the physical task again (i.e., replication of task 1). In all three physical tasks, latency was recorded from bringing the weight to the 90-degree angle and the participant ceasing the physical task. A latency difference was calculated between the first and third physical task to use as the dependent variable. Participants assigned to the sensation-focus condition held the weight aloft for a significantly shorter duration than participants in the distraction condition. In this case, focusing on physical self-control induced depletion, but being distracted from the physical task did not result in the same level of depletion.

Other methods of manipulation have combined both cognitive and physical self-control to induce depletion. Dorris, Power, and Kennefick (2012) tested professional rugby and soccer players to see if a state of ego depletion would significantly impact automated exercise behavior that does not require as much self-control. Exercise behavior that is extensively practiced is classified as automated behavior, which is effortless and needs little attentional capacity (Yarrow, Brown, & Krakauer, 2009). Automatic behavior requires less conscious self-control and therefore should be less impacted by a depleted state. All participants had to balance a leveling stick while counting down from 1000. In the control condition, participants counted down from 1000 by multiples of 5. In the ego-depletion condition, athletes counted down from 1000 by multiples of 7. Although both exercise behaviors were highly practiced and automatic, participants performed significantly fewer press-ups or sit-ups after counting down by 7 (high-difficult cognitive task) than after counting down by 5 (low-difficult cognitive task).

Emotional and Cognitive Self-Control and Ego Depletion

Inducing a depleted state is not limited to exerting physical self-control. Exerting emotional and cognitive self-control also leads to a depleted state. Baumeister and colleagues (1998) assigned all participants to watch a 10-minute clip of a movie. Half of the participants were randomly assigned to suppress all expression of emotions during the movie, while the other half were told to let their emotions flow during the movie. The two groups were further divided and randomly assigned to watch a funny clip involving Robin Williams or a sad clip involving a young mother dying of cancer. All participants then used 13 sets of letters to unscramble and make English words as a taxing cognitive task. Participants instructed to suppress all emotions in both film conditions performed significantly worse on the unscramble task than participants in the control condition. Suppressing emotions, regardless of the type of emotion, resulted in ego depletion and led to significantly worse performance on a subsequent cognitive task.

Fischer, Greitemeyer, and Frey (2007) manipulated the number of rules for a cognitive task. In experiment 3, each participant was given a typed sheet of paper with a page from a statistics books. Participants in the control condition were instructed to read through and cross out all occurrences of the letter 'e'. Participants in the ego-depletion condition were given several difficult rules to follow throughout the same exercise to determine which occurrences of the letter 'e' to cross out. Participants in the ego-depletion condition were significantly less optimistic about their future than participants in the control condition.

Measuring Ego-Depletion

Just as exerting physical, emotional, and cognitive self-control can lead to a depleted state, they are also used as a way to confirm (measure) a depleted state. The state of ego depletion can be measured through tasks that assess motivation to utilize self-control and self-regulation. Alberts and colleagues (2007) found that depleted individuals spent less time squeezing a handgrip. Similarly, depleted individuals spend less time working on difficult tasks. Baumeister and coworkers (1998) had participants attempt two impossible geometric puzzle tasks. Depleted participants spent significantly less time attempting to solve the puzzles. Additionally, Stucke and Baumeister (2006) found that depleted participants exhibited significantly more aggressive behaviors than non-depleted participants, demonstrating a lessened ability to exert emotional restraint (i.e., self-control). Depleted participants exhibited a lessened ability to exert physical self-control (i.e., squeezing a handgrip), emotional self-control (i.e., control aggression), and cognitive self-control (i.e., attempting to solve an impossible puzzle) in subsequent tasks (Alberts, Martijn, Nieuvelstein, Jansen, Vries, 2008; Stucke & Baumeister, 2006; Baumeister et al., 1998). Similar to a muscle, performance at self-control suffers as self-control efforts continue without rest (Baumeister, 2002). As the ability to use self-control deteriorates, it becomes more difficult to suppress emotions and behaviors that normally require self-control (i.e., risk or aggressive impulses).

Computer Based Ego-Depletion Research

Although ego-depletion theory is relatively young, as psychological theories go, it represents a broad experimental topic. Even in a short span of time, ego depletion has been tested in a variety of areas (see literature review above). Multiple studies have

shown that regardless of the type of self-control manipulation used, results consistently show poorer performance on a subsequent measure of self-control relative to control conditions with no prior self-control (e.g., Baumeister et al., 1998; Alberts et al., 2007; Alberts et al., 2008; Dorris et al. 2012; Martijn et al., 2007). Additionally, ego-depletion research has demonstrated a range of behaviors (i.e., aggressive behavior, risk behavior, and positive outlook) that were significantly impacted when individuals were in a depleted state (Stucke & Baumeister, 2006; Unger & Stahlberg, 2007; Fischer et al., 2007).

Prior research occurs in a laboratory setting. Participants are depleted in some way (i.e., physical emotional, or cognitive), and their subsequent self-control is measured. The traditional use of a laboratory in ego-depletion studies has been useful but may compromise generalizability of results based on the potential discomfort of participants in that setting. Furthermore, the laboratory setting necessitates the presence of researchers, confederates, or both (Baumeister et al., 1998; Alberts et al., 2007; Alberts et al., 2008; Martijn et al., 2007; Dorris et al. 2012; Stucke & Baumeister, 2006; Unger & Stahlberg, 2007; Fischer et al., 2007), and the presence of others can influence behavior of participants. Experimenter bias, actions by the experimenter that can influence participant response, can significantly impact the data. One solution to experimenter bias is to limit or eliminate the role of the experimenter in the study. An online experiment for ego depletion may offer this type of control.

To move toward computer-based studies, we can examine the paucity of research utilizing the computer in some way. Schmeichel (2007) used a computer-based self-control manipulation, asking people to type a short story on a computer about a recent

trip they had taken. Participants came into a laboratory and were randomly assigned to one of the story conditions. Those in the control condition were only instructed to keep typing until the researcher told them time had expired. Participants in the experimental condition were told they could not type the letters ‘a’ or ‘n’ in their story. Having to refrain from typing ‘a’ or ‘n’ depleted participants and led to significantly worse performance on a subsequent self-control measure. Specifically, participants who refrained from typing ‘a’ or ‘n’ performed significantly worse at recalling strings of digits in reverse order, indicating limited executive function. Using the same story manipulation to induce ego-depletion, Schmeichel and Vohs (2009) found that participants who used self-control (i.e., not typing ‘a’ or ‘n’) performed significantly worse on a pain-tolerance measure involving immersing a hand in ice water. That is, ego-depleted participants tolerated less pain than non-depleted individuals. Thus, a computer-based task appears to induce ego-depletion.

A computer-task also has been used to test for ego depletion, offering a computerized dependent variable. Moller, Deci, and Ryan (2006) measured ego depletion by having participants hold down the space bar on a keyboard until they chose to quit the self-control task. Depletion was induced by randomly assigning participants to a controlled-choice or free-choice condition. Participants in the free-choice condition were told it was entirely their choice which side of a “psychology” high-school debate they would argue. Participants in the controlled-choice condition were given a script for one side of the debate labeled “high choice.” Participants in the experimental condition held down the spacebar a significantly shorter amount of time than participants in the control condition, confirming previous research that demonstrated acts of volition induce

depletion. Based on this spacebar measure, the potential to assess ego-depletion online becomes a distinct possibility. Taken together, research by Moller et al. (2006), Schmeichel (2006), and Schmeichel and Vohs (2009) indicate that online ego-depletion research may offer useful research opportunities, and all of the benefits of online research become available.

Benefits of Online Research

Traditional laboratory research routinely utilizes local college undergraduates as participants. Undergraduate students are a convenient population; however, significant results from a sample of one university undergraduate population can have a limited external validity (Mitchell & Jolley, 2010). Results may not accurately reflect behavior that could be measured in other types of populations (e.g., elderly, less educated, representing different cultures, backgrounds, and regions of the country).

However, Internet research makes it possible to increase external validity by having a more diverse sample (Vazire, Srivastava, & John, 2004). Specifically, Vazire et al. state that Internet samples better represent the general population than traditional samples with regards to geographic location, age, gender, and socioeconomic status. Replicating ego-depletion research online could increase the external validity of results, extending what we know about ego depletion to a more diverse sample and further validating outcomes.

In addition to a more diverse sample and enhanced external validity, online research reduces cost, including financial, space, and time commitments. An online study allows for an experiment to be conducted without requiring participants and researchers to coordinate a time and place to conduct the experiment. From a university standpoint, it

frees up limited laboratory space and researchers' schedules, which allows those resources to be allocated to other experiments or academic endeavors.

Whether online or traditional methodology is used for collecting data, research that relies on volunteers is contingent upon honest and effortful responses by participants. Dishonest or effortless responses will not accurately reflect the outcome of a specified manipulation and can contribute to a false conclusion. One preconception about online research is that participants are not sufficiently motivated to provide honest, effortful responses (Vazire et al., 2004.) However, Vazire et al. (2004) demonstrated that Internet participants scored similar discriminant correlations among the Big Five inventory scales as traditional participants. Additionally, certain procedures have been used to screen out unmotivated responses (i.e., analyze discriminant validity and scale reliability of measures used). Finally, online research has the benefit of using self-selected samples that have proven to provide more complete responses than traditional psychology participants (i.e., undergraduate psychology students (Vazire et al., 2004).

Perhaps motivation by participants is impacted by compromised anonymity in a lab setting. Conducting online research can allow for true anonymity for participants, unlike traditional ego-depletion laboratory research. Although complete anonymity in Internet-based research could allow for an individual to potentially participate in an experiment multiple times, tracking such a possibility is becoming easier. Specifically, Vazire et al. (2004) demonstrated that collecting unique information could easily detect individuals that participate multiple times (i.e., IP address), thus eliminating this potential negative outcome. Another detection method is to simply ask if this was the participant's first attempt. Srivastava, John, Gosling, and Potter (2003) found that only 3.4% of

participants in an online study of personality were repeat responders. Fortunately, the identified repeat responders did not significantly impact the results of the data set.

As an added benefit to anonymity, social demands are reduced by eliminating any interaction between participants and experimenters. Individuals who participate in Internet research engage in less socially desirable responding to the dependent measures than traditional participants (Gosling et al., 2004), which may result from not socially interacting with the researcher. Instead, participants receive typed instructions that are uniform across the condition, thus reducing experimenter bias (Mitchell & Jolley, 2010).

As we have seen in the available literature (reviewed above), conducting research online can enhance reliability and reduce bias in the data. Research has demonstrated that data from Internet participants is more reliable than traditional participants (Vazire et al., 2004). Further, data from Internet participants is less susceptible to social-desirability response bias (Gosling et al., 2004; Mitchell & Jolley, 2010). Therefore, an ego-depletion experiment online can offer a robust alternative to laboratory-based studies.

Limitations of Online Ego-depletion Research

Of course, not all ego-depletion research can be replicated online. For example, resisting the urge to eat chocolate for five minutes to induce ego-depletion (Baumeister et al., 1998) would be difficult through an online experiment. Similarly, instructing participants to hold a weight above their head for as long as possible while focusing on the sensation in their arms (Alberts et al., 2008) would be impossible to replicate online with any confidence. Although it might be feasible to replicate similar studies online with a creative design involving digital recording, some ego-depletion manipulations clearly are more practical in the traditional laboratory setting.

Similar to ego-depletion manipulations, some self-control measures would be difficult to replicate online as well. For example, replicating the handgrip measure used by Alberts et al. (2007) could prove difficult. And the sit-up and press-up measure used by Dorris et al. (2012) to test for ego-depletion in athletes would be nearly impossible to execute. Conversely, we should note that a few self-control measures potentially lend themselves to the online environment. For example, trying to solve impossible geometric puzzles (Baumeister et al., 1998), pressing the spacebar key for as long as possible (Moller et al., 2007), or crossing out specific occurrences of the letter 'e' on a provided sheet of paper with meaningless text (Fischer, Greitemeyer, & Frey, 2007) may be candidates for online measures of self-control.

Current Study

Previous research has focused on depletion tasks and measures in a laboratory setting (e.g., Alberts et al., 2008; Baumeister et al., 1998; Vohs & Tice, 2007), but no known research has extended ego-depletion research to the online environment. Computer-based studies are cost-effective and remove the geographic limits of laboratory-based research and assessment. Additionally, computer-based research allows for participant anonymity and reduces social bias. The present study attempted to manipulate and measure ego-depletion through an Internet medium. We tied the present study to existing laboratory research by utilizing previous computer-based depletion and self-control tasks. Therefore, the purpose of the proposed study was to examine the potential for ego-depletion to be promoted and measured in an online environment.

CHAPTER 2

METHOD

Participants

Participants included 219 females and 105 males at a southeastern university. Participant ages ranged from 18-50, with an average age of 19.86 years. Participants were recruited through the Georgia Southern SONA system. The sample contained 210 White, 88 Black, and 11 Hispanic students as well as 15 who indicated Other as ethnicity. Participants received extra credit or course credit for their participation.

Participant variables that were examined were the location students completed the experiment, the number of people around participants during the experiment, and the number of participants who ate or drank during the experiment. The sample contained 167 participants who indicated they completed the experiment at their home and 157 indicated they completed the experiment outside their home. Additionally, 51 participants indicated they ate or drank during the experiment. Lastly, participants indicated the number of people present while they completed the experiment ($M = 4.12$, $SD = 15.34$).

Materials

Qualtrics is an online software program that allows researchers to conduct a wide variety of online data collection. It can be customized to many different formats to meet the need of each individual experiment, survey, or other research projects.

The Brief Introspection Mood Scale (BRIM) is a mood adjective scale that consists of 8 mood categories, with 2 adjectives used for each category and response options were limited to a 4-point likert scale (Appendix A) (Mayer & Gasche, 1988). After reverse scoring all negative adjectives, all responses were added together for a total

score. The total score was used as the final score on the BRIM. The BRIM was used to ensure that depletion occurred due to previously exerting self-control and not due to mood (Baumeister et al., 1998; Alberts et al., 2007).

The Big Five Inventory (BFI) is a widely used self-report questionnaire that measures the five dimensions of personality: openness, conscientiousness, extraversion, agreeableness, and neuroticism (John, Naumann, & Soto, 2008; John, Donohue, & Kentle, 1991; Benet-Martinez & John, 1998). The BFI is a 44-item self-report inventory that consists of short phrases (Appendix B). Final scoring for the BFI results in 5 scores, one for each of the five dimensions of personality. Response choices were limited to a 5-point likert scale, which ranged from “disagree strongly” to “agree strongly.” Scoring each subscale involved reverse scoring and converting each subscale to a T score, all of which was detailed in the scoring section of the BFI.

Procedure

Participants logged in to Qualtrics and selected “My Recent Trip” to begin the study. Students read a digital informed-consent form and accepted or declined to continue with the experiment. The experiment utilized a digital variation of an ego-depletion manipulation used in Baumeister et al. (1998) and Fischer et al. (2007), which had participants cross out various occurrences of the letter ‘e’ in meaningless text. Participants were randomly assigned to one of three ego-depletion conditions: experimental, control task, and empty control. Those in the experimental group were instructed to retype the text below the instructions on the computer screen but not type the letter ‘e’ when retyping the text except when another vowel followed the ‘e’ in the same word (e.g., “read”) or when a vowel was one letter removed from the letter ‘e’ in

either direction (e.g., vowel). Participants in the control group were instructed to retype the same text but not type the letter ‘e’ when retyping the text. Students in both the experimental and control conditions were instructed to only click the ‘Next’ button when they had completed the task. Participants in the empty-control condition did not retype any text, which allowed us to establish a true baseline measure (Mitchell & Jolley, 2010). Instead, participants in the empty-control condition were immediately directed to complete the dependent measures. The second independent variable was order of outcome measures, and participants were also randomly assigned to one of the two orders of outcome measures.

Following the manipulation, participants completed the two dependent measures. In the “key” task, participants were instructed to press and hold down the equal-sign key with their right index finger on the computer keyboard for as long as they would like. In the “word” task, participants were instructed to type as many words as possible that began with the letters ‘p’, ‘t’, ‘s’, ‘l’, and ‘n’. They were also instructed to put a space between each word and not use any references for assistance (e.g., a dictionary). Upon completion of the first dependent measure, all participants continued to the second dependent measure. For both dependent measures, participants indicated they were ready to quit by clicking the ‘Next’ button. The order of the two dependent variables was counterbalanced. Thus, approximately half of participants in each condition completed the word task before the equal-sign key task, and the other half completed the equal-sign key task before the word task.

After completion of the second dependent measure, all participants were then directed to the questionnaire sections of the experiment. Students completed the Brief

Mood Introspection Scale (Mayer & Gaschke, 1988) and the Big Five Inventory (John et al., 2008; John et al., 1991; Benet-Martinez & John, 1998). Participants then completed an environmental questionnaire that asked where they completed the experiment, the approximate number of people in the room, and did they eat or drink during the experiment. Upon completion, participants completed a brief demographics survey and were thanked for their time.

Design

This study utilized a 2 x 3 (dependent variable order x ego-depletion condition) multivariate analysis of variance (MANOVA) between-groups design. The primary independent variable was the 'e' letter removal task. The secondary independent variable was order of outcome measures. The first order of dependent variables consisted of the equal-sign key task before the word task. The second order consisted of the word task before the equal-sign key task. Adapted from a similar task utilizing the spacebar key (Moller et al., 2007), the first dependent variable measured how long participants were willing to hold down the equal-sign key on the computer and offered two measures. The equal-sign key task was represented by the number of equal-sign characters produced and the amount of time (in seconds) spent producing the equal-sign characters. The second dependent variable measured how long participants were willing to create and type words that begin with the letters 'p', 't', 's', 'l', or 'n', yielding two quantifiable measure. The word task was quantified by the number of words produced and the amount of time (in seconds) spent producing the words.

We anticipated that ego depletion would be represented by a decreased number of equal-sign characters and words produced that start with the letters 'p', 't', 's', 'l', or 'n'.

We also anticipated a main effect of dependent variable order, such that participants would have spent significantly less time completing the second outcome measure when compared to those participants who completed the same outcome measure first.

A secondary level of analysis was utilized to examine mood and personality as possible covariates. Results from the primary and secondary analyses were then compared to examine if any significant changes occurred after removing mood and personality as possible covariates.

CHAPTER 3

RESULTS

Primary Analysis: Ego Depletion

We analyzed these data using a 2 X 3 (dependent variable order X ego-depletion condition) multivariate analysis of variance (MANOVA) with four dependent measures of ego depletion, two quantifiable measures from each DV. The equal-sign key task was represented by both number of characters produced and time (in seconds) spent producing the characters. The word task was represented by number of words produced and time (in seconds) spent producing the words. Significant effects pertained to dependent variable order; no results indicated ego depletion in the three group conditions ($p > .05$). Tests of a potential interaction between ego depletion and DV order did not reach significance ($p > .05$). Reported means and standard errors indicate estimated marginal means.

The ego-depletion condition did not affect the number of equal-sign characters that students produced, $F(2, 322) = 1.58, p = .21, \text{partial } \eta^2 = .01$. Students in the ego-depletion condition did not type significantly fewer equal-sign characters ($M = 212.86, SEM = 7.27, n = 109$) than students in the control condition ($M = 224.83, SEM = 7.33, n = 107$) and students in the empty control condition ($M = 206.78, SEM = 7.29, n = 108$). Similarly, the amount of time (in seconds) spent typing equal sign characters did not vary based on ego depletion, $F(2, 322) = 1.67, p = .19, \text{partial } \eta^2 = .01$. Students in the ego-depletion condition did not spend significantly less time typing equal-sign characters ($M = 55.77, SEM = 6.27, n = 109$) than students in the control condition ($M = 69.13, SEM =$

6.33, $n = 107$) and students in the empty control condition ($M = 54.31$, $SEM = 6.29$, $n = 108$).

By the same token, the second category of DV failed to yield significant differences across ego-depletion conditions; the numbers of words starting with letters ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ typed did not vary based on manipulation group, $F(2, 322) = 2.05$, $p = .08$, partial $\eta^2 = .02$. Ego-depleted individuals did not type fewer words starting with ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ ($M = 74.90$, $SEM = 5.22$, $n = 109$) than students in the control condition ($M = 62.64$, $SEM = 5.26$, $n = 107$) and students in the empty control condition ($M = 59.16$, $SEM = 5.23$, $n = 108$). Similarly, the amount of time (in seconds) spent typing words that start with ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ did not vary based on ego depletion, $F(2, 322) = 1.20$, $p = .30$, partial $\eta^2 = .007$. Students in the ego-depletion condition did not spend less time typing words that start with ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ ($M = 512.48$, $SEM = 71.60$, $n = 109$) than students in the control condition ($M = 396.36$, $SEM = 72.20$, $n = 107$) and students in the empty control condition ($M = 363.19$, $SEM = 71.83$, $n = 108$).

We found significant main effects for dependent-variable order; specifically, order influenced the number of equal-sign characters students produced, $F(1, 323) = 15.95$, $p < .05$, partial $\eta^2 = .05$. Students who completed the equal-sign task before the word task typed fewer equal-sign characters ($M = 198.00$, $SEM = 5.90$, $n = 165$) than students who completed the word task before the equal-sign task ($M = 231.65$, $SEM = 6.01$, $n = 159$). Similarly, the amount of time (in seconds) spent typing equal-sign characters varied based on dependent-variable order, $F(1, 323) = 13.58$, $p < .05$, partial $\eta^2 = .04$. Students who completed the equal-sign task before the word task spent less time on the equal-sign characters ($M = 46.20$, $SEM = 5.10$, $n = 165$) than students who completed

the word task before the equal-sign task ($M = 73.27$, $SEM = 5.19$, $n = 159$). (See Figure 1.)

In a similar pattern, the numbers of words starting with letters ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ typed varied based on dependent-variable order, $F(1, 323) = 26.14$, $p < .05$, partial $\eta^2 = .08$. Students who completed the equal-sign task before the word task typed fewer words that start with letters ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ ($M = 50.12$, $SEM = 4.24$, $n = 165$) than students who completed the word task before the equal-sign task ($M = 81.02$, $SEM = 4.31$, $n = 159$). Similarly, the amount of time (in seconds) spent typing words that start with ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ varied based on order of the dependent variables, $F(1, 323) = 12.89$, $p < .05$, partial $\eta^2 = .04$. Students who completed the equal-sign task before the word task spent less time typing words that start with letters ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’ ($M = 275.04$, $SEM = 58.16$, $n = 165$) than students who completed the word task before the equal-sign task ($M = 572.98$, $SEM = 59.21$, $n = 159$). (See Figure 2.)

Secondary Analysis: Mood and Personality as Covariates

In exploratory analysis, we conducted the same analysis as above and added mood and personality variables as covariates. The subsequent analysis was a 2 X 3 (dependent variable order X ego-depletion) multivariate analysis of covariance (MANCOVA) with four dependent measures of ego depletion. Mood as a covariate was represented by the Brief Introspection Mood Scale. Personality as a covariate was represented by the Big 5 Personality Traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness). Mood as a covariate did not yield a significant effect ($p > .05$). Four of the five personality traits as covariates (extraversion, agreeableness, conscientiousness, and neuroticism) failed to reveal meaningful group

differences ($p > .05$). However, covarying out the personality trait of openness did reveal significant group differences, $F(1, 323) = 13.60, p < .05$, partial $\eta^2 = .05$.

After controlling for the effects of openness, the numbers of words starting with letters 'p', 't', 's', 'l', or 'n' typed varied based on ego-depletion condition, $F(2, 322) = 3.62, p < .05$, partial $\eta^2 = .02$. Planned contrasts revealed that students in the ego-depletion condition typed significantly *more* words than those in the empty-control condition, $t(215) = 14.93, p < .05$, but not compared to those in the condition controlling for ego depletion, $t(215) = 10.30, p > .05$. (See Figure 3.)

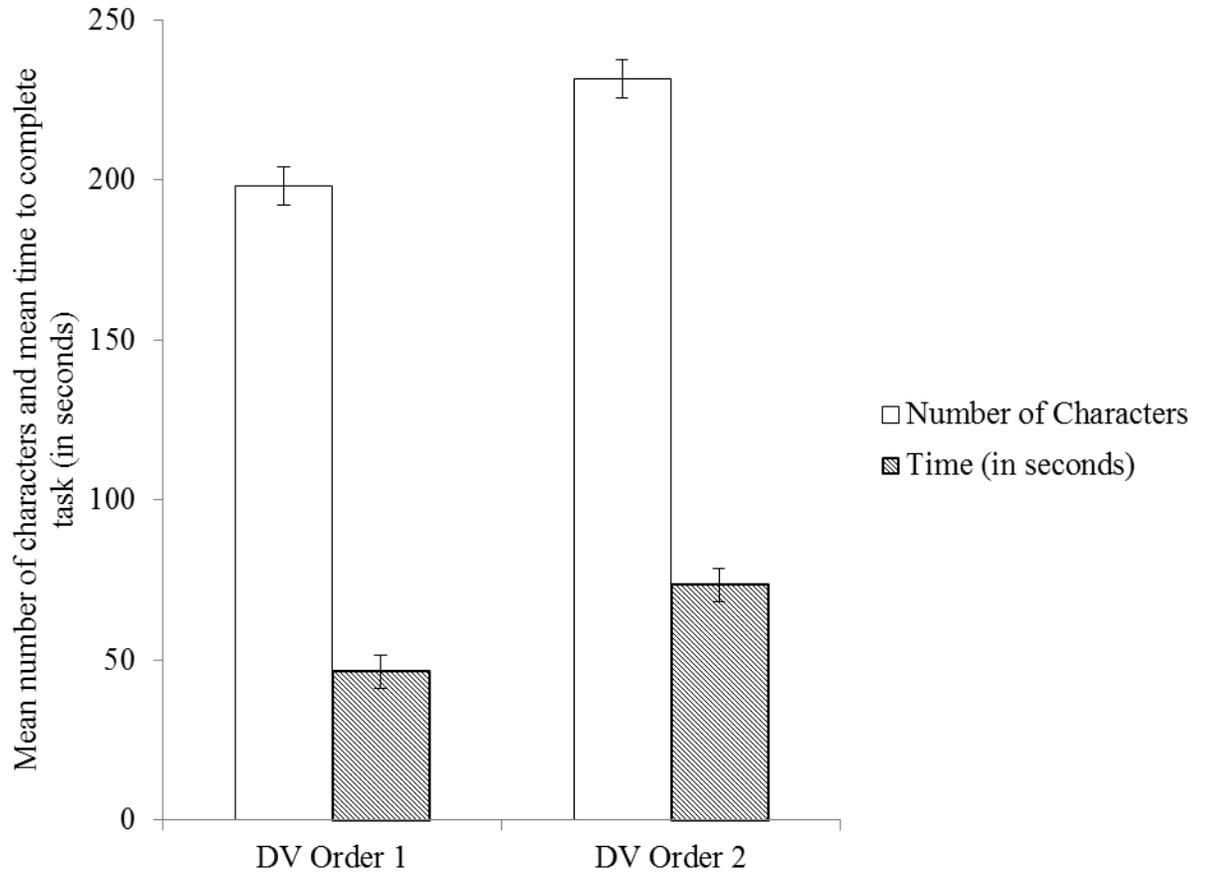


Figure 1. Mean number of characters produced and mean time (in seconds) spent producing the characters. DV Order 1 represents those participants that completed the equal-sign task before the word task. DV Order 2 represents those participants that completed the word task before the equal-sign task. Significant difference is present between both pairs of corresponding bars. Error bars represent standard error.

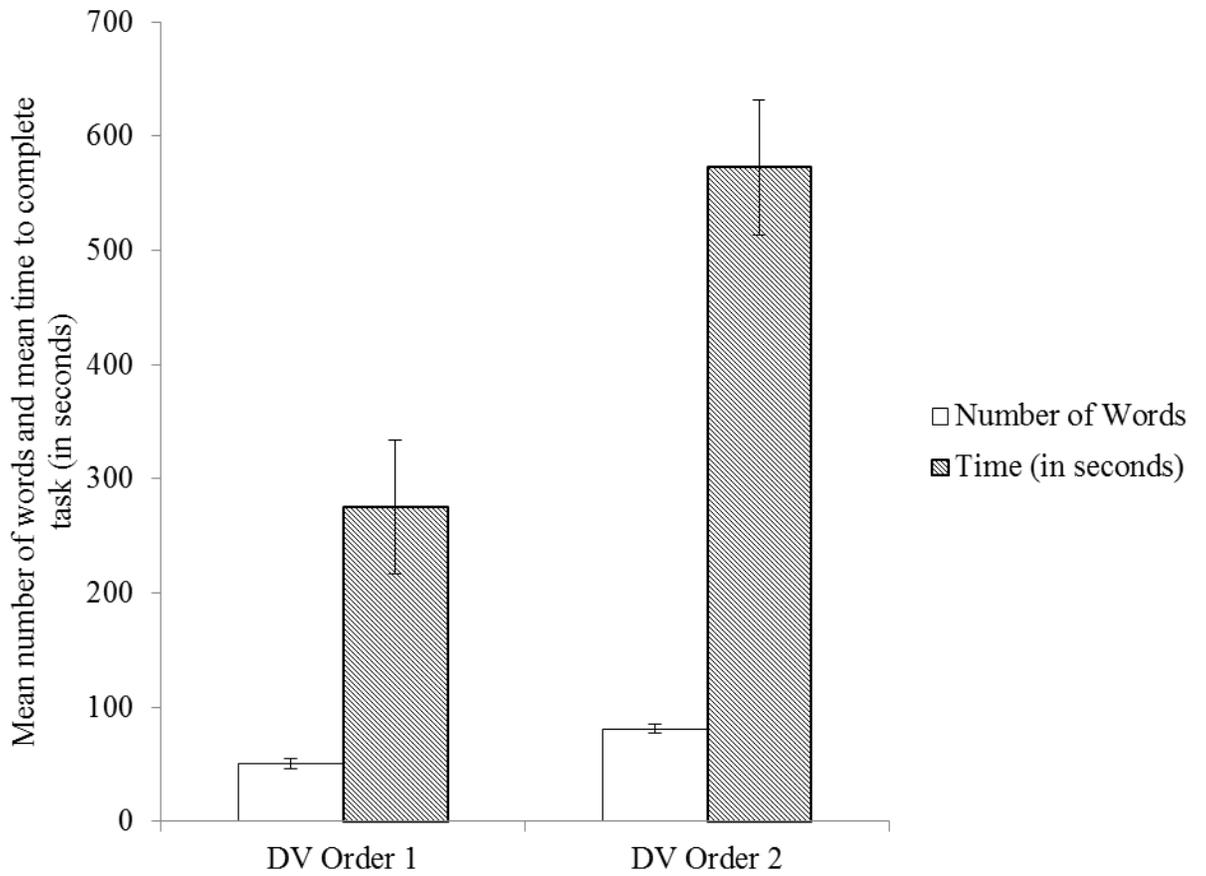


Figure 2. Mean number of words produced and mean time (in seconds) spent producing the words. DV Order 1 represents those participants that completed the equal-sign task before the word task. DV Order 2 represents those participants that completed the word task before the equal-sign task. Significant difference is present between both pairs of corresponding bars. Error bars represent standard error.

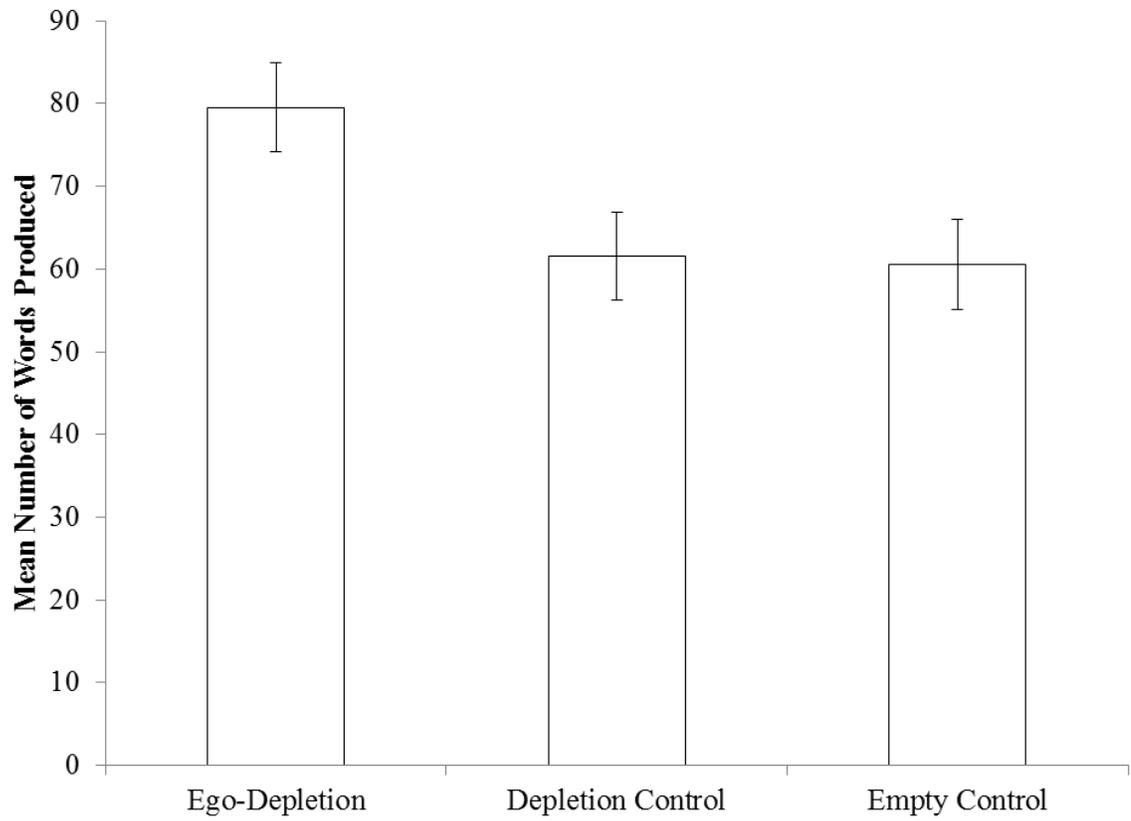


Figure 3. Mean number of words typed that begin with the letters ‘p’, ‘t’, ‘s’, ‘l’, or ‘n’, while controlling for openness from the Big 5 Inventory. Error bars represent standard error.

CHAPTER 4

DISCUSSION

Main Effects

Ego-depletion theory views self-control or willpower as a limited resource model. Intentional acts of self-control deplete a limited internal capacity to exert self-control and can negatively impact future acts of self-control (Inzlicht & Schmeichel, 2012). The present study attempted to manipulate and measure ego-depletion through an Internet medium. The purpose of the proposed study was to examine the potential for ego-depletion to be promoted and measured in an online environment. Despite using research-supported manipulations and measures of ego-depletion, we found no evidence of depleted states in participants who were randomly assigned to the experimental condition. Prior research utilizing the ‘e’ letter task (Baumeister et al., 1998; Fischer et al., 2007) has induced a measurable state of ego depletion in participants that were told to remove all occurrences of the letter ‘e’ except when another vowel followed the ‘e’ in the same word or when a vowel was one letter removed from the letter ‘e’ in either direction. However, employing this manipulation online did not result in a significant reduction in either of two self-control measures. Although prior research (Moller et al., 2006) has found that instructing participants to hold down a specific key following a self-control manipulation resulted in significantly less time on the key task than participants in the control condition, no such effect was found in the present study.

Similarly, the ‘e’ task manipulation did not result in significantly less time on word typing. Participants in the experimental condition did not spend significantly less time, represented by number of words produced and seconds on task, producing words

that begin with the letters 'p', 't', 's', 'l', or 'n'. Again, prior research in a laboratory setting indicated that ego-depletion would alter such a similar word task as the one used in this experiment (Molden et al., 2012). Molden et al. used an anagram task that instructed participants to produce as many words as possible from a set of seven letters. Although the current experiment utilized successful and research-supported manipulations and measures of ego depletion, similar effects did not carry over to the virtual environment. Before concluding ego-depletion manipulations and measures do not produce similar effects through online media, perhaps future research should use alternative methods of inducing ego depletion and various outcome measures as DVs.

Our results did indicate a main effect of dependent-variable order. In this experiment, completing the first dependent variable did have a significant impact on performance during the second dependent variable. As a potential explanation for the carryover effect, completing an ego-depletion dependent variable could induce more depletion that could be seen by a further drop in performance on a subsequent ego-depletion measure. For example, Baumeister et al. (1998) and Fischer et al. (2007) utilized the 'e' letter task to successfully induce depletion, while Molden et al. (2012) had participants type words that only began with certain letters. In all three experiments, participants had to adhere to restricted grammatical rules that required use of self-control. However, the results were mixed in this regard. Participants who completed the equal-sign key task before the word task produced significantly fewer characters and spent significantly less time on the task than participants who completed the word task before the equal-sign key task. Both of these dependent measures were opposite of the expected direction. If in line with ego-depletion theory, we would have expected a measure of self-

control (i.e., the word task) before another self-control measure (i.e., the equal-sign key task) to result in significantly less time and fewer characters when compared to participants who completed the equal-sign key task first.

However, completing the equal-sign task first appeared to have a depleting effect on the second task. Students who completed the equal-sign key task before the word task typed significantly fewer words and spent significantly less time doing so than students who completed the word task prior to the equal-sign key task. In other words, completing the equal-sign task first (ego-depletion measure) resulted in significantly fewer words produced on the second task, an indication of depletion. Overall, we have four significant effects related to dependent variable order; two trended in the expected ego-depletion theory direction and two did not. While it is plausible that the number of words typed and time spent on task provide some evidence of supporting ego-depletion research through an online medium, significantly fewer words produced on the second task does not account for the completely opposite trend for the equal-sign key task measures.

Additionally, when you examine all results from the group and dependent variable order main effects, the bulk of the results outweigh the one possible indicator of depletion (i.e., significantly fewer words as a second task). Perhaps future research should test additional ego-depletion manipulations and measures through an online medium to conclude if ego-depletion research is limited to a traditional lab setting. If so, then the theory of ego-depletion should then examine the limitations of the significant impact a depleted state has on individuals if the effects do not generalize to online mediums. Additionally, future research should also examine possible variables that would explain opposing significant

trends with dependent variable counter-balancing that are outside the classic limited resource model.

Mood, and Personality Factors

The BRIM was administered to assess the potential impact of mood on results (Baumeister et al., 1998; Alberts et al., 2007). No significant difference in mood was found between the three conditions. Additionally, controlling for mood as a covariate did not change reveal a main effect of ego-depletion group. Thus, mood did not explain the results.

Lastly, the Big 5 Inventory was administered to examine the possible impact of personality differences on measures of depletion. Conscientiousness, extraversion, agreeableness, and neuroticism were not significant covariates, and controlling for these four covariates did not reveal a significant main effect of ego depletion. However, openness was a significant covariate. Controlling for openness did result in a significant difference in number of words produced during the word task, with those in the empty-control condition producing significantly fewer words than those in the ego-depletion condition.

Openness is positively correlated to having a ‘flexible’ cognitive style (e.g., creativity) (Feist, 1998). As a result, it is possible that a significant difference in openness could have impacted the number of words participants produced. However, the number of words produced was in the opposite direction of the expected ego-depletion trend. However, openness is positively correlated with creativity and many ego-depletion measures require some level of creativity. Perhaps future research should administer the

Big 5 Inventory and control for openness, thus possibly reducing within-group variability on cognitive ego-depletion measures.

Limitations

One major limitation of this online research was the inability to observe participant behavior and ensure directions were followed. Using this virtual medium only allowed for participant feedback as an indicator of variability in participant behavior and surrounding environment. Traditional ego-depletion lab research allows experimenters to create a uniform lab environment and better control for extraneous variables in the lab environment, which could impact the results. This online design did not allow for this level of control. Two of these possible extraneous variables were the location students completed the experiment and the number of people around participants during the experiment. These could have introduced enough “noise” that could have significantly impacted power in the statistical analyses, thus possibly eliminating any significant indication of ego depletion in the data. For example, number of people in the room could have significantly impacted attention during the experiment. Inzlicht and Schmeichel (2012) proposed that a process of attention direction is a model through which a depleted state occurs. Specifically, self-control is usually initiated when there is a divergence between a current state (i.e., the experiment) and a desired state (i.e., desirable activities in the environment). In the current study, some students indicated taking the experiment in the presence of others, while others did not.

Similarly, another possible extraneous variable was some participants indicated that they ate or drank during the experiment and others did not. This could also have introduced enough “noise” that could have significantly impacted any indication of ego

depletion in the data. Miller et al. (2012) proposed that acts of self-control do not require a sense of “self.” Instead, self-control relies on executive functions that, in turn, rely on glucose for cognitive energy. Replicating past glucose experiments involving humans (Gailliot et al., 2007), Miller et al. demonstrated that glucose consumption in dogs “buffered” against a depleted state when compared to dogs who consumed an artificial alternative. Both experiments demonstrated the buffering effect glucose consumption can have on later depletion measures, in both humans and dogs. Future online ego-depletion research should not allow these extraneous variables to vary. Instead, future research could instruct participants to complete the experiment in a specific environment that is uniform for all and instruct participants to not eat or drink during the experiment.

However, these instructions for future online research do not allow for experimenters to observe participants and confirm compliance. Experimenters are limited to participant unconfirmed compliance and participant feedback. However, research has shown that comparisons of online and traditional research have shown insignificant differences in results (Vazire et al., 2004). Vazire et al. demonstrated that Internet participants scored similar discriminant correlations among the Big Five inventory scales as traditional participants. Nevertheless, the above-mentioned research did not change the fact that asking participants to comply with these restrictions during an online experiment does not allow for observation to confirm compliance.

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APPENDIX A

THE BRIEF INTROSPECTION MOOD SCALE (BRIM)

	Definitely do not feel	Do not feel	Slightly feel	Definitely feel
Lively	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tired	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Caring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gloomy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jittery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Definitely do not feel	Do not feel	Slightly feel	Definitely feel
Drowsy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grouchy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peppy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Calm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Loving	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fed up	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

APPENDIX B

THE BIG FIVE INVENTORY (BFI)

Self-Description Inventory

Code Name _____ Female Male (check one)

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please choose a number for each statement to indicate the extent to which you agree or disagree with that statement.

Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1-----	2-----	3-----	4-----	5-----

I see myself *as someone who* ...

- | | |
|---|--|
| <p><input type="checkbox"/> 1. is talkative</p> <p><input type="checkbox"/> 2. tends to find fault with others</p> <p><input type="checkbox"/> 3. does a thorough job</p> <p><input type="checkbox"/> 4. is depressed, blue</p> <p><input type="checkbox"/> 5. is original, comes up with new ideas</p> <p><input type="checkbox"/> 6. is reserved</p> <p><input type="checkbox"/> 7. is helpful and unselfish with others</p> <p><input type="checkbox"/> 8. can be somewhat careless</p> <p><input type="checkbox"/> 9. is relaxed, handles stress well</p> <p><input type="checkbox"/> 10. is curious about many different things</p> <p><input type="checkbox"/> 11. is full of energy</p> <p><input type="checkbox"/> 12. starts quarrels with others</p> <p><input type="checkbox"/> 13. is a reliable worker</p> <p><input type="checkbox"/> 14. can be tense</p> <p><input type="checkbox"/> 15. is ingenious, a deep thinker</p> <p><input type="checkbox"/> 16. generates a lot of enthusiasm</p> <p><input type="checkbox"/> 17. has a forgiving nature</p> <p><input type="checkbox"/> 18. tends to be disorganized</p> <p><input type="checkbox"/> 19. worries a lot</p> <p><input type="checkbox"/> 20. has an active imagination</p> <p><input type="checkbox"/> 21. tends to be quiet</p> <p><input type="checkbox"/> 22. is generally trusting</p> | <p><input type="checkbox"/> 23. tends to be lazy</p> <p><input type="checkbox"/> 24. is emotionally stable, not easily upset</p> <p><input type="checkbox"/> 25. is inventive</p> <p><input type="checkbox"/> 26. has an assertive personality</p> <p><input type="checkbox"/> 27. can be cold and aloof</p> <p><input type="checkbox"/> 28. perseveres until the task is finished</p> <p><input type="checkbox"/> 29. can be moody</p> <p><input type="checkbox"/> 30. values artistic, aesthetic experiences</p> <p><input type="checkbox"/> 31. is sometimes shy, inhibited</p> <p><input type="checkbox"/> 32. is considerate and kind to almost everyone</p> <p><input type="checkbox"/> 33. does things efficiently</p> <p><input type="checkbox"/> 34. remains calm in tense situations</p> <p><input type="checkbox"/> 35. prefers work that is routine</p> <p><input type="checkbox"/> 36. is outgoing, sociable</p> <p><input type="checkbox"/> 37. is sometimes rude to others</p> <p><input type="checkbox"/> 38. makes plans and follows through with them</p> <p><input type="checkbox"/> 39. gets nervous easily</p> <p><input type="checkbox"/> 40. likes to reflect, play with ideas</p> <p><input type="checkbox"/> 41. has few artistic interests</p> <p><input type="checkbox"/> 42. likes to cooperate with others</p> <p><input type="checkbox"/> 43. is easily distracted</p> <p><input type="checkbox"/> 44. is sophisticated in art, music, or literature</p> |
|---|--|

Please check: Did you write a number in front of each statement?]