Depletion awareness and self control performance

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DEPLETION AWARENESS AND SELF CONTROL PERFORMANCE

by

Tina L. Donaldson

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Abstract

The current study examined whether awareness of ego depletion had an effect on subsequent tasks requiring self-control. It is possible, that with awareness of depletion, one may be able to make corrections in their behavior to counteract the effects of reduced self-control. The primary question this research set out to answer was whether awareness of depletion would significantly increase or decrease self-control performance. Participants underwent a depletion manipulation to diminish their self-control strength. Next the participants completed a false feedback assessment of self-control, ostensibly designed to measure their level of self-control strength. Participants then received feedback as to whether they were in a depleted or enhanced state. A series of manipulation checks were administered to ensure that the participants believed the feedback and the deception was effective. As a final measure of self-control, participants’ time on task was recorded for completion of a word search puzzle. In Study 1, time to completion and word count were calculated as a measure of persistence and choice of task difficulty (e.g., intermediate, advanced) was evaluated to determine participants’ level of depletion. In Study 2 self-control was measured by recording choice of task difficulty and time to completion. It was posited that awareness of depletion would have a positive effect on self-control performance by acting as motivation for improvement. There were no significant effects revealed in either Study 1 or Study 2. Although results appear to be in the direction predicted, the present hypothesis was not supported by statistical significance.
Depletion Awareness and Self-control Performance

Without awareness there is no choice. Knowledge concerning one’s behavior is a critical element of change. Without this awareness people would simply behave in whatever ways make them feel most comfortable in the present moment. This may lead one to pursue only that which they find most desirable without proper regard to potential consequences. Awareness makes the difference between unconsciously pursuing immediate gratification and consciously choosing behaviors that will be in one’s long-term best interest. Studies have revealed that awareness (e.g., mindful attention) can moderate how motivation effects behavior (Papies, Pronk, Keesman, & Barsalou, 2015) which may lead to an increase in deliberate action.

Since a great portion of human behavior is automatic and occurs without conscious cognizance (Bargh, 1997) focusing on the smaller portion that is within control of the self would be highly advantageous. To illustrate this point consider the following scenario; before a golfer tees off or hits his or her golf ball they would hope to align with the hole as accurately as possible. However, a slight degree of change in the golf stroke could result in a relatively large change in the overall trajectory of the golf ball. The originally small degree of change can result in such a large degree of difference that the golf ball lands nowhere near its projected destination. Self-control is analogous to this small degree of change. Although it accounts for only a small portion of human behavior, it is a crucial component in guiding one toward goal attainment and has a profound impact on the performance outcome. Exerting deliberate, conscious control over one’s behaviors requires this self-control strength.

Self-Control

Self-control has been described as consciously altering one’s habitual behaviors, so they are more aligned with personal values, social expectations, and long-term goals (Baumeister,
Vohs, & Tice, 2007). Resisting temptation, making decisions and suppressing emotions requires self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Self-control has been compared to a limited resource similar to energy. This energy is depleted through acts of volition which draw from the same limited resource pool. With each use, self-control strength can become weaker in the short term. Initiating behavior change requires the use of this limited energy and will leave the reserve temporarily diminished. This diminished state leaves the individual with a reduced capacity for inhibiting their behavior and may lead to an increase in emotions and urges (Muraven, 2012).

To illustrate with an example, when a student needs to maintain focused attention during an exam, they are using their self-control. Based on this model, the student may experience a decrease in regulation capacity for concentrating in their subsequent course work. This energy source is not domain specific, meaning that using self-control to pay attention in class will likely lead to self-control failure in other areas that require this resource such as regulating their emotions and resisting tempting treats. Returning to our previous example; the student may leave the exam and experience an increase in road rage as they drive home due to their depleted state because they are not able to regulate their emotions. They may also indulge themselves with a piece of cake because they are no longer able to resist temptation. This experience is a spillover of depletion from one domain to the next.

The same energy resource is used when making decisions and restraining impulses as is used when coping with emotions or maintaining focused attention (Muraven & Baumeister, 2000). Any attempt to use self-control increases the likelihood of experiencing a depleted state. Therefore, the more self-control one exerts, the more likely it is that they will experience a deterioration in performance on subsequent tasks, at least until they are able to replenish this
resource. When an individual is experiencing this weakened state they are potentially at an increased risk for self-control failure (e.g., eating cake).

**Ego Depletion**

This self-control weakness is known as ego-depletion (Baumeister, Muraven, & Tice, 2000). This depleted state is a temporary reduction in the self’s capacity to regulate behavior. Fortunately there are a number of factors that can thwart ego depletion, such as positive affect, motivation and perception (Clarkson, Hirt, Chapman, & Jia, 2011). Additionally, increased self-awareness has been shown to increase motivation (Carver & Scheier, 1998) and negate the effects of depletion (Alberts, Martijn, & de Vries, 2011).

Along the same lines, prior research has established that perception of ego depletion has a powerful effect on self-regulatory performance (Clarkson, et al., 2011). It has been said that awareness (mindfulness) with an inward focus, improves self-regulation (Scheier & Carver 1998; Masicampo, & Baumeister, 2007) and this self-focused attention may increase internally directed behaviors. Therefore, task performance feedback should increase awareness and have a direct effect on performance outcomes as suggested by prior research. When an individual is made aware of their depleted state, they have the opportunity to compensate by increasing their motivation to perform well.

**Control Theory**

The fact that awareness plays a role in performance outcomes stems from an earlier model of self-regulation known as Control Theory (Carver and Scheier, 1982). This theory suggests that during the self-regulation process, people compare their present state to their ideal goal, to determine whether their performance is satisfactory. This highly complex model posits
that individuals self-monitor their performance through receiving feedback. The portion of the loop responsible for guiding self-monitoring consists of four stages; test, operate, test, and exit (TOTE) (Carver, & Scheier, 1981). The first step in the process is testing reality, or comparing their current state to their ideal standard (i.e. desired weight, financial goal). Next they will perform an operation to resolve any discrepancies. The third step is testing again to verify the standard has been met and if satisfied, exiting the loop and thereby completing the process of self-regulation. This research also suggests that self-awareness is necessary to facilitate self-regulation (Carver, & Scheier, 1981; Baumeister, 2014).

Self-control focuses mostly on the operate phase of self-regulation. Receiving external performance feedback allows the individual to make the necessary adjustments in their behavior to facilitate goal attainment. For example, when one desires to lose weight they begin by setting their goal or ideal weight they hope to attain. After beginning an exercise program they may start to feel they have not lost any weight. To measure their performance they weigh themselves on a scale and as a result they decide to eliminate unhealthy foods. Due to this external feedback they are able to make the needed adjustments in their lifestyle to help assist in reaching their weight loss goal. This process of receiving feedback is similar to the idea we are investigating here when individuals are made aware of their level of depletion.

Conservation

There are also times when external feedback may lead one to decrease their performance. Research has provided evidence that people manage their limited self-control resources based on expectations of future regulation demands (Muraven, Shmueli, & Burkley, 2006). When the self-control resource is depleted, it makes sense that one would want to sparingly use the resources they have left. This resource allocation would lead the individual to conserve the
resource based upon the importance of future tasks. The analogy of a bank account has often been used to illustrate this point. For example, when a person has a limited amount of money remaining in their account, the money they have left becomes more precious and one is less likely to squander (Tversky & Kahneman, 1981). The same is true of self-control strength in that the individual is more likely to conserve when this resource is scarce.

The evidence in support of this argument stems from Conservation Theory (Muraven, et al., 2006) which revealed that people have the propensity to exert less effort once their resources are depleted. Individuals may be motivated to conserve their available self-control resources due to their perceived state of depletion, therefore little effort is expended on subsequent tasks. This study also revealed that, when compared to those who did not expect future demands, participants who exerted self-control on a primary task performed more poorly on an intermediate Stroop task when they were told they needed to complete a difficult third task that required self-control (Muraven et al., 2006, Study 4). This observed difference may largely be due to one’s expectation of future self-control demands leading to diminished performance motivation. When participants knew that there was another task that would require self-control resources it increased their desire for conservation of energy reserves.

Essentially, the individual is allocating this limited resource based on their current level of perceived depletion and task importance. Receiving feedback on level of depletion may likewise have an effect on conservation because the individual has been made aware of their decreased level of self-control. This awareness may encourage them to save this limited resource when they expect it will be required in the future. This suggests that knowledge of depletion may increase an individual's motivation to avoid energy expenditures. This outcome is clearly evident in failures of self-control performance. Additionally, when one does not expect
they will need to utilize self-control in the future their tendency to conserve may be reduced, thereby increasing performance outcomes. Revisiting the analogy of the bank account, if one perceives they have additional funds in their account and they do not expect to have to pay any large expenses in the future they may be more inclined to increase their current expenditures.

Motivation

Although an individual may experience depletion and feel the need to conserve resources, there are a number of ways in which depletion can be attenuated. One may alleviate their depleted stat by increasing positive affect, taking breaks and increasing motivation. Additionally, self-awareness has been shown to improve self-regulation through increasing motivation (Carver & Scheier, 1998). Proper incentives such as monetary reward or self-relevant benefits may also provide people with additional motivation (Ryan & Deci, 2000; Muraven & Slessareva, 2003).

Additionally, research has suggested that intrinsic motivation affects self-control performance since intrinsically motivated behavior may be less depleting (Muraven, Gagné, & Rosman, 2008). This research found that exerting self-control for intrinsic reasons was less depleting than exerting self-control for extrinsic reasons. Increasing one's awareness of remaining self-control resources would likely result in a subsequent increase in performance motivation when motivated by autonomous goals.

Awareness

Self-awareness has been shown to increase salience of standards and may encourage the individual to employ additional resources (Alberts, Martijn, & de Vries, 2011). With knowledge of remaining resources the individual is able to allocate the remaining resources to facilitate their
performance and more clearly align with their goal. The external feedback provides a measure of goal performance for comparison between one's current state and their desired outcome (Carver & Scheier, 1982). This is an important realization because research has indicated that people are not able to accurately judge their level of depletion (Clarkson, Hirt, Jia, & Alexander, 2010) and they are largely unaware of their need to compensate. Therefore, without awareness the individual may struggle to reach their goal because they may not adjust their performance.

The Two-Stage Model of self-control (Myrseth & Fishbach, 2009) suggests that the individual must first identify the need for self-control. Self-awareness is essential in identifying a conflict. The second stage, after identifying the self-control conflict, is when one may actively alter their behavior to align with their goals. Implementing the necessary changes in behavior would not occur without the first stage of identification.

Clearly stated, people do not always know when they are depleted. Receiving accurate feedback on performance may assist individuals in managing this resource more effectively and may encourage improved performance on subsequent tasks. Control Theory (Carver & Scheier, 1982) may imply that feedback concerning one's performance would motivate the individual to compensate and make adjustments in their behavior. Knowledge of their depleted state may facilitate one’s capacity to self-regulate (Clarkson et al, 2011) and improve performance outcomes.

Prior Research

Research relevant to the current study (Clarkson et al, 2010; Clarkson et al, 2011) manipulated participant's perception of depletion to determine the impact on self-control performance. The procedure included a 2x3 design in which there was a depleted and non-
depleted group with three conditions; control, depleted feedback and replenished feedback. Some participants were provided with situational feedback regarding their levels of depletion while others were not. Those receiving situational feedback were informed that the yellow paper used in the task would cause their mental resources to be depleted or replenished. The intention was to reveal whether perception of depletion would overcome actual levels of depletion, thereby showing that perception of regulatory resources can impact performance.

Results showed that when the feedback was congruent with their actual state of depletion, outcome performance was enhanced. More importantly, the performance outcomes for perceived depletion were independent of actual depleted states. These results were consistent throughout several experiments, however it was not clearly determined whether the situational attribution, perception of depletion, or self-awareness was the primary causal mechanism. There were a number of possible explanations provided for the results, from the congruency of the feedback and whether it was an accurate or inaccurate reflection of their depleted state, to the possibility of the desire to conserve resources or increase motivation.

A follow up study was conducted (Clarkson et al, 2011) using the same methods and the results were consistent suggesting that perception of depletion was enough to lead to a deficit in working memory independent of the actual state of depletion. Using the same procedures as the original experiments, in a 2x3 design, participants were again provided with feedback regarding their levels of depletion. Those who were informed that they were replenished exhibited an increase in working memory compared to those who were lead to believe they were depleted. The results of this research were unclear regarding whether motivation or conservation may have played a role in the findings.
More recent research founded on the principles of perception and reframing (Giacomantonio, Ten Velden, De Dreu, 2016, Study 1) focused on restorative effects of task perception. In two experiments this research manipulated perception of task difficulty. In a 2x2 design, there was a depleted and non-depleted condition in which half of the participants were informed that the task they were instructed to complete was easy but may produces suboptimal results, while the others were told the task was difficult but may yield optimal results. The reframing of the task as easy lead to an increase in performance outcomes for the depleted participants. It was suggested that this finding was a result of less desire to conserve energies since there was no expectation of future demand (Muraven, Shmueli, & Burkley, 2006).

While perception may play a role in the outcomes seen in these experiments, accuracy of feedback may contribute to the underlying psychological process. When feedback is accurate the individual may be better able to regulate their resources and improve their performance. This research leaves the desire for further inquiry into understanding the psychological processes that surface as a result of depletion. Furthermore, it is unclear how these psychological processes lead to reduced or increased effort. With many questions left unanswered it seemed a worthwhile endeavor to investigate these mechanisms further.

**Present Research**

The current study aimed to replicate and extend this research (Clarkson, et al., 2010; Clarkson et al, 2011) through examining the effects awareness of ego-depletion had on self-control performance. For the sake of parsimony, the current research started with a basic design in which all participants were depleted. There were three conditions; control, depleted and enhanced. Findings were focused on main effects of feedback on performance. In the present research the situational feedback was omitted and any attributions made would likely have been
dispositional. The goal of this research was to determine whether feedback regarding level of depletion and awareness of remaining self-control resources would act as motivation to improve performance or increases one's desire for conservation of resources.

Furthermore, the current research examined whether the accuracy of the feedback played a role in performance outcome concerning desire to conserve and performance motivation. It appeared that in the previous research when feedback and state depletion were congruent performance outcomes improved. It is anticipated that this research will make a novel contribution by determining whether the results seen in the aforementioned research are a direct result of the Conservation theory or may be attributed to an increase in motivation. Additionally, the role of this research is to establish self-awareness as a primary component in both of these processes.

**Overview and Hypothesis**

Extending these findings, the present research used similar methods and manipulations as used in previous research (Clarkson et al, 2011) in which participants were given feedback on their levels of depletion that were either congruent with their state depletion or incongruent. Participants first completed a trail making task designed to deplete their self-control resources. Manipulation checks were administered to assess whether participants were motivated to improve their performance or encouraged to conserve their remaining resources upon receiving this feedback. The dependent measure was a word search puzzle that assessed depletion through calculating the time to completion. It was determined that those who took longer to complete the puzzle experienced more depletion.
It was expected that the depleted individuals who were made aware of their depleted state by receiving accurate feedback would be more successful in regulating their self-control performance than those who received inaccurate feedback (e.g., enhanced).

**Pilot Study**

**Method**

**Participants and Design**

A pilot study was conducted to determine the reliability of a new measure of depletion. A connect the dots puzzle was used to deplete self-control strength by completing the puzzle in reverse and at times using only odd or even numbers. A total of 60 undergraduate students\(^1\) from University at Albany participated for partial course credit. Participation was limited to English speaking students, 18 years of age or older.

**Procedure**

Subjects completed three “connect the dots” puzzles numbered 1 through 77 at increasing levels of difficulty. First, participants connected the dots in reverse order, from 77 to 1. Second, participants completed this task again using only even numbers in descending order. Finally, participants connected the dots in descending order using only odd numbers. A control group completed the same connect the dots puzzle in ascending order which is customary for this type of puzzle. This condition was considered to be less depleting since previous learned behavior did not need to be overridden.

**Results**

\(^1\) Mean ages and standard deviations were not reported since the data were lost due to technological failures.
Manipulation Check

Upon completion of the puzzles, a manipulation check was administered to determine level of depletion. This measure consisted of 18 items, measured on a 1-7 Likert scale, with anchors of 1, not at all and 7, very much (e.g., “The trail making task was difficult”, “I had to really concentrate during the trail making task”, “The trail making task required a lot of mental energy”, “The trail making task was exhausting for me”). Higher scoring on these items represents an increase in depleted state. These items indicate that the participants found the task demanding or effortful which suggests the task required self-control strength. Similar items have been validated in prior research (Ainsworth, Baumeister, Ariely, & Vohs, 2014; Dewall, Baumeister, Stillman, & Gailliot, 2007) as indication of a depletion effect.

It was determined that the first manipulation check had a Cronbach’s Alpha of .87. Based on the results of the manipulation check, it was concluded that the new depletion task was considered to be moderately depleting with a scale midpoint of 72 and possible scoring range of 18 to 126 ($M= 71.3$) with higher scores indicating greater levels of depletion.²

Mood

Mood was assessed using the Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988) to determine that there was no variance between conditions and the performance results were strictly due to the manipulation of depletion. No significant differences were found. Preliminary analysis were conducted but original data was lost due to unforeseen software failure. The results suggested that this new depletion manipulation was valid and this may be

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² Due to repeated technological difficulties, original data were lost. Means, standard deviations, and other statistical analyses are not available for the pilot study.
confirmed with follow up testing. Results from the first manipulation check in Study 1 supported this finding.

Study 1

Method

Participants and Design

There were 74 undergraduate students recruited (49% women, mean age= 19.53, SD= 2.77) from The University at Albany and received partial course credit. Of the 74 participants recruited, one participant’s data had to be removed for insufficient time on task (i.e., less than 30 s), leaving a total of 73. Since the word search could not be completed in less than 2 minutes in our pilot study, it was determined that this participant did not complete the task. Participants were randomly assigned to receive either the control, depleted and enhanced feedback manipulations. Students in all three conditions were equally depleted and then subjected to the performance feedback questionnaire. Upon completing the performance feedback questionnaire they received false feedback regarding their level of self-control strength.

All conditions read the performance feedback ostensibly related to their level of remaining self-control strength after completing the initial trail making task. These results were displayed on the computer screen upon completion of the performance questionnaire. The control group received no feedback on their performance and were directed to continue to the next task. The depleted condition was informed that the results of the performance questionnaire revealed they may be depleted, or experience a decrease in self-control performance. The enhanced condition were provided with the same message although they were told that they may be enhanced, or experience an increase in self-control strength. The study was limited to those
who speak English, and were over the age of 18 years. To determine levels of depletion a final measure of self-control performance was completed.

Procedure

Upon entering the lab, subjects self-selected their individual computer terminals. After reading and indicating their informed consent, participants were asked to silence their phones and place them out of sight. Subjects were then informed that they would be taking part in two related tasks. The first task was to complete a connect-the-dots depletion manipulation which was immediately followed by the computerized questionnaires. Data was collected using Empirisoft 2008, Medialab Research software.

Depletion manipulation. All subjects completed an executive function task designed to deplete their self-control strength. During the trail making task, participants completed three “connect the dots” puzzles numbered 1 through 77 at increasingly difficult levels. First, participants connected the dots in descending order, from 77 to 1. Second, participants completed this task again using only even numbers in descending order. Finally, participants connected the dots in descending order using only odd numbers. This task took approximately 15 minutes.

Because connect the dots puzzles are usually completed in ascending order, reversing the order required participants to override their learned response. Furthermore, completing the puzzle backward while paying attention to only even or odd numbers required additional resources because this required them to utilize two skills simultaneously.

Measures
Mood. Following the connect the dots puzzle, participants completed the Positive and Negative Affect Scale (PANAS) to evaluate their mood states. PANAS – Positive Affect: Cronbach’s α = .86, Negative Affect: Cronbach’s α = .86; (Watson, Clark, & Tellegen, 1988). This scale consists of 10 positive and 10 negative affect items (e.g., Interested, Hostile), rated on a Likert scale using the anchors of 1 (not at all) to 5 (extremely). Control participants also completed the PANAS.

Manipulations

False Feedback Test. Following the PANAS, participants completed a false feedback test consisting of 16 items, measured on a 7-point scale anchored at 1, not at all and 7, very much. This test was constructed to have face validity without any actual diagnosticity. The test included an amalgam of items (e.g., “I do not have much effort to expend on the next task.”, “It takes a lot of effort to concentrate on things right now”) adapted from Muraven & Slessareva (2003), (Appendix 2). This test was ostensibly designed to test the participants' level of remaining self-control resources after completing the connect the dots puzzle.

Feedback manipulation. Following the false feedback test, participants were randomly assigned by the computer to one of three feedback conditions. It is often the case that persuasive messages inadvertently induce reactance. Reactance occurs when individuals feel that their freedom to choose has been thwarted (Brehm, 1966). In the way that being told to calm down may elicit the reverse response and emotionally excite the individual, being told one is depleted or enhanced may lead the individual to react in the opposite manner in an effort to restore his or her sense of autonomy. An inoculation statement (Richards & Banas, 2015) was included in the feedback manipulation (e.g., "while there is a possibility this may have no effect") to help eliminate or reduce reactance. Including restoration postscripts has been shown to decrease
reactance (Bessarabova, Fink, & Turner, 2013). This statement was meant to inhibit reactivity by restoring the individual's sense of agency (Miller et al., 2007).

The following feedback manipulations appeared on the computer screen informing participants that the feedback test had revealed they may experience a depleted or enhanced performance on the next activity;

1. **Depleted feedback**: The previous test has revealed that you are may experience a depletion (a decreased ability for self-control) in performance, while there is a possibility this may have no effect, you should remain aware of this depleted state as you proceed with the next activity.

2. **Enhanced feedback**: The previous test has revealed that you may experience an enhancement (an increased ability for self-control) in performance, while there is a possibility this may have no effect, you should remain aware of this enhanced state as you proceed with the next activity.

3. **Control.** Thank you for your participation, you may now proceed to the next activity.

*Manipulation Check One.* Following the depletion manipulation, participants completed a manipulation check designed to assess level of depletion, consisting of 18 items, measured on a 1-7 Likert scale, with anchors of 1, not at all and 7, very much (e.g., “The trail making task was difficult”, “I had to really concentrate during the trail making task”, “The trail making task required a lot of mental energy?”, “The trail making task was exhausting for me” and “I had to force myself to keep working on the task after I felt like quitting.”), (Appendix 1).

*Manipulation Check Two.* Participants completed a manipulation check consisting of 19 items, measured on a 1-7 Likert scale, the anchors being 1, not at all and 7, very much. The
items were designed to assess level of enhancement (e.g., “I am confident in my ability to perform well during the next activity”), and depletion (e.g., “I could use a break before the next activity.”, and “I have no mental energy left right now”), (Appendix 2).

**Self-Control.** Participants were asked to complete a word search puzzle on the computer. Participants were given written, on screen instructions to make a choice between an intermediate and an advanced level of task difficulty. This choice was recorded, however there was only one puzzle. There were 18 words presented on the left side of the puzzle. The object was to find the words hidden among random letters. Participants were asked to find all words as quickly as possible. When the puzzle was completed in less time it was considered an indication of better performance or a lower level of depletion. Prior research has measured depletion through tasks that assess completion times, indicating that longer times represent increased depletion (DeWall, Baumeister, & Vohs, 2008). In the current study all participants were depleted. It was expected that when participants believed the feedback about their depleted state that they would take longer to complete this activity.

The crossword puzzle required the individual to maintain prolonged attention and has been shown to be cognitively demanding (Hardy, Nelson, Thomason, Sternberg, Katovich, Farzin, et al., 2015). Similar tasks, such as number searches or solving partial word fragments, (Gailliot, Baumeister, DeWall, Maner, Plant, et. al., 2007) have been used in previous research as measures of self-control strength. Tasks requiring prolonged, effortful persistence have been considered to be a reliable measure of self-control performance. The aforementioned activities require the participant to override their impulse to quit the frustrating task thereby exhibiting self-control.
Before advancing to the final self-control task, subjects were asked to indicate whether they had completed the puzzle by selecting either a 1 for yes or 2 for no. Then they were asked how many words they had found. Self-control was evaluated on three levels; accuracy, time to completion and difficulty level selected. Accuracy was determined by the number of correct items found. The puzzle was selected based on a moderate difficulty level.

Demographic information. Lastly, demographic questions pertaining to age, race, and education were collected. Finally, participants were debriefed and thanked for their participation.

Results

First Manipulation check

The first manipulation check was designed to detect levels of depletion. Given that all participants were highly depleted a significant variation in depletion was not expected at this stage. Due to technological difficulties the data collected for the first manipulation check was unreliable. It is a possibility that the scores were combined with the scoring from the second manipulation check and therefore the output may not be valid.³

Task Difficulty

There were no significant effects revealed for choice of puzzle difficulty $F (2, 71) = .409, p = .67$, or as a predictor in performance $B = .252, SE = .793, t (70) = .317, p = .752$. Each group selected the advanced level the same number of times on average.

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³ Due to the technological malfunctions throughout Study 1, original data were lost and remaining data were determined to be unreliable. Analysis of the two manipulation checks were not conducted.
Mood

Significant variance in mood should not be evident in order to determine that the results were due to the depletion manipulation. No significant differences were found for positive affect, \( F(2, 71) = 1.79, p = .175 \), or negative affect, \( F(2, 71) = .194, p = .82 \).

Second Manipulation check

Data was not recorded for the second manipulation check due to a computer malfunction.

Self-control Performance

To examine the variance in self-control performance between the three conditions, an analysis of variance (ANOVA) with planned contrasts was performed for completion time. Study1 revealed no significant difference between the control, depletion and enhanced manipulations, \( F(2, 71) = 2.167, p = .121 \).

Although Study 1 resulted in what appeared to be null findings, we cannot be confident in these results due to the technical problems experienced during this study. With the loss of data for the second manipulation check it is difficult to determine whether the manipulations were effective. There may be mixed results (e.g., motivation, conservation) in the underlying factors in performance that need to be assessed. The aim of Study 2 was to determine whether the participants felt motivated to increase their performance once they were informed they were depleted or alternatively selected to conserve their self-control energies.

Another possible explanation for the apparent lack of variance was that participants in the enhanced condition may have conserved their energies. Because they were informed that their performance was enhanced they may have felt it was not necessary to put forth the
additional effort and therefore contributed to a decrease in overall performance. To determine which of these mechanisms were responsible for the performance outcome, a manipulation check was added in Study 2 before the final measure of self-control.

**Table 1.** Means and standard deviations for PANAS, manipulation check and time on task in Study 1.

<table>
<thead>
<tr>
<th></th>
<th>Depleted</th>
<th>Enhanced</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condition</strong></td>
<td><strong>M (SD)</strong></td>
<td><strong>M (SD)</strong></td>
<td><strong>M (SD)</strong></td>
</tr>
<tr>
<td>n = 24</td>
<td>n = 24</td>
<td>n = 26</td>
<td></td>
</tr>
<tr>
<td>1. Positive affect</td>
<td>30.50 (7.25)</td>
<td>26.13 (9.31)</td>
<td>29.08(8.17)</td>
</tr>
<tr>
<td>2. Negative affect</td>
<td>15.75 (5.49)</td>
<td>14.83 (6.71)</td>
<td>16.15(6.31)</td>
</tr>
<tr>
<td>3. Manipulation Check 1</td>
<td>73.13 (7.49)</td>
<td>69.00 (7.75)</td>
<td>71.88(7.15)</td>
</tr>
<tr>
<td>4. Time to completion</td>
<td>6.57 (3.58) min</td>
<td>5.87 (2.05) min</td>
<td>6.83(3.46) min</td>
</tr>
</tbody>
</table>

*Note:* Higher scores represent an increased level of depletion.

**Discussion**

A second manipulation check was included in Study 2 to help determine the underlying mechanism responsible for the outcome performance. It is conceivable that participants may have been equally motivated to increase performance as well as to conserve their resources after receiving the performance feedback. Depending upon whether participants believed the feedback they may have adjusted their performance to accommodate the depleted or enhanced state. This possibility may account for the current findings.
As previously mentioned, when an individual is aware of their depleted state it would be more likely that they are able to compensate or make adjustments in their level of effort on the task thereby increasing their motivation. Along the same lines, when one perceives that one’s performance may be enhanced it is plausible that they determined less effort was needed and may not have increased their motivation leading to an adverse effect on performance.

Upon further consideration it may have been possible that the participants in the depleted condition decided to conserve their self-control resources once they were made aware of their depleted state. This would have resulted in a decrease in performance. Conversely, when participants were told they may experience an increase in self-control strength this may have potentially increased their motivation to perform well by decreasing conservation need. Finally, in both conditions it is conceivable that the performance was a result of self-fulfilling prophecy (Merton, 1948). The second manipulation check was designed to address these concerns. Unfortunately, due to software problems, this data was lost.

**Study 2**

Study 2 was intended to address the limitations found in Study 1. Because the second manipulation check was not recorded in Study 1 it was included again in Study 2. This manipulation check addressed the differences in level of depleted (e.g., "I am mentally exhausted") or enhanced (e.g., "I feel focused and ready for the next activity") states as a result of the false feedback manipulation. The items were written to determine whether participants believed the feedback they received (e.g., "If I had not taken the assessment, I would think my performance would be the same on both tasks"). Additionally, items were included to determine whether individuals felt the need to conserve resources (e.g., "I purposely saved some energy for the next task") or felt motivated to increase performance (e.g., "Now that I know my
performance may be effected I can make up for it"). Finally, we included items that addressed willpower beliefs (e.g., "My self-control has no effect on how I perform on tasks"). This missing data may be a crucial component in determining the underlying mechanism of motivation for performance enhancement or performance depletion on the final task and the experiment was repeated a second time with a new subject pool.

Method

Participants and Design

There were 73 participants were recruited for Study 2 (47% women; 1 gender neutral or unspecified gender, mean age= 19.22, SD=1.26). Participants were undergraduate students from University at Albany and received partial course credit. Of the 73 subjects recruited for this study, 4 had insufficient data for time on task and 9 unengaged responders were omitted from the data analysis, leaving a total of 60 students.

Procedure

Study 2 was essentially a replication of Study 1, utilizing the same measures and procedures. Only the modifications are listed in this section, and all other measures were the same.

Manipulation Check Two. In Study 1, the second manipulation check consisted of 19 items. In Study 2, four additional items were added (e.g., "I feel energized for new activities", "I feel mentally fatigued"), (Appendix 1). Participants completed the second manipulation check (MC2) consisting of 23 items, measured on a 1-7 Likert scale, the anchors being 1, not at all and 7, very much.
Revisions to the final measure of self-control strength include the addition of a quality control item to verify the completion of the word search puzzle. The participants were asked what words were displayed on the screen once the puzzle was completed. The correct answer was "you win". Participants who did not have the correct answer may not have been paying attention or they may have quit before completing the puzzle. It is conceivable that the several participants who quit without finishing the puzzle may have done so as a result of their level of depletion.

Additionally, in Study 1 participants were given the option of quitting before finishing the word search puzzle. In Study 2, this option was removed and participants were asked to complete the puzzle in its entirety. In Study 1 participants self-reported the number of words found, in Study 2 this was not required since students were expected to finish.

Results

First Manipulation check

The first manipulation check was designed to detect levels of depletion. Reliability was acceptable as the coefficient alpha was .86. This study was designed to detect the main effects only. Provided that all participants were highly depleted, a significant variation in depletion was not expected, $F (2, 57) = 0.679, p = 0.510$, and that was revealed in the data.

Task Difficulty

Selection of task difficulty was measured by recording a choice between an intermediate and advanced level word search puzzle. As found in Study 1, again in Study 2 there were no
significant differences evident for choice of task difficulty $F(2, 57) = 1.41, p = .253$, or as a predictor in performance $B = -.008, SE = .023, t(58) = -.338, p = .737$.

**Mood**

Significant variance in mood was not expected, this confirms that the results were due to the depletion manipulation. No significant differences were found for positive affect, $F(2, 57) = 2.89, p = .06$, or negative affect, $F(2, 57) = 1.04, p = .359$.

**Second Manipulation check**

The results showed that there was no significant variance in either the depleted items, $F(2, 70) = 0.555, p = 0.577$, or enhanced items $F(2, 57) = 0.421, p = 0.658$. Additionally, no significant differences were found in the motivation, conservation or belief items between the three conditions. Further analysis on each of the 23 individual manipulation check items revealed a difference only on item (i.e. “If I had not taken the assessment, I would have thought that my performance would be the same on both tasks”) $F(2, 57) = 4.993, p = 0.009$. This item revealed a significant difference in believability between the depleted ($M=4.50, SD=1.445$) and enhanced ($M=4.46, SD=1.14$) conditions when compared to the control group ($M=3.35, SD=1.668$) this implies that the feedback provided did indeed have an impact.

**Secondary Analysis**

Items on this scale were subjected to a Principal Components analysis with a Varimax rotation, which revealed six independent factors based on eigenvalues greater than 1. The items loaded on six factors which were named Depletion, Enhancement, Motivation, Feedback, Conservation, and Belief. Taken together these six factors explain 73% of the variance. The only significant group difference was for the factor loading on believability of feedback, $F(2,$
The conservation item, “I purposely saved some energy for the next task”, revealed that none of the participants in any condition purposefully saved their self-control resources, $F(2, 57) = .024, p = 0.976$. This may indicate that all conditions were motivated to perform well and that they were depleted from the original depletion manipulation.

**Self-Control Performance**

To examine the variance in self-control performance between the three conditions, an analysis of variance (ANOVA) was conducted. Study 2 revealed no significant difference between the control, depletion and enhanced manipulations, $F(2, 57) = 0.325, p = 0.724$

Unengaged responders whose scores fell below the *a priori* level of 0.50 $SD$ were removed based on their composite scores for each questionnaire. This data clearly demonstrated lack of participation relevant to the composite scores of other participants. Additionally, the response patterns indicated that the participants had answered all items the same across the scale. Data from participants who finished the puzzle in less than a minute was also removed from the time on task portion of the analysis. Our pilot testing indicated that it is not possible for the puzzle to be completed in under two minutes. The average time to completion of the puzzle across all conditions was 6.5 minutes. Self-control performance was measured based upon time to completion, therefore those who did not complete the puzzle were not considered in the analysis.

Although time on task was removed for participants who quit before completion of the puzzle, the data were still included in the overall analysis (i.e. manipulation checks). Failing to complete the puzzle may demonstrate that the participant was experiencing a depleted state as exhibited by the lack of persistence. It is important to note there was one outlier that took over
20 minutes to complete the puzzle in the depleted condition; this may represent extreme depletion. The fastest completion time was 3.22 min in the enhanced condition and the slowest time to completion was 20.66 min in the depleted condition.

Table 2. Means and standard deviations for total scores on PANAS, Manipulation checks, time on task measures in Study 2.

<table>
<thead>
<tr>
<th></th>
<th>Depleted Condition</th>
<th>Enhanced Condition</th>
<th>Control Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>n = 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Negative affect</td>
<td>13.36 (4.35)</td>
<td>15.19 (6.44)</td>
<td>14.18 (5.10)</td>
</tr>
<tr>
<td>2. Positive affect</td>
<td>27.73 (8.53)</td>
<td>24.77 (6.08)</td>
<td>26.54 (8.08)</td>
</tr>
<tr>
<td>3. Manipulation Check 1</td>
<td>57.41 (17.32)</td>
<td>59.15 (14.46)</td>
<td>53.75 (18.12)</td>
</tr>
<tr>
<td>4. Depletion Items (MC2)</td>
<td>24.14 (14.10)</td>
<td>24.31 (12.86)</td>
<td>20.75 (12.79)</td>
</tr>
<tr>
<td>5. Enhancement Items (MC2)</td>
<td>54.00 (13.07)</td>
<td>56.81 (6.60)</td>
<td>55.46 (11.49)</td>
</tr>
<tr>
<td>6. Time to completion (min)</td>
<td>6.91 (3.88) min</td>
<td>6.45 (2.45) min</td>
<td>6.46 (2.93) min</td>
</tr>
</tbody>
</table>

Note: Higher scores represent an increased level of depletion or enhancement respectively.

Discussion

The objective of Study 2 was to help elucidate the underlying cause for the null results seen for self-control performance in Study 1. The second manipulation check was added for this purpose. Again null effects were found for all conditions. Although the findings would suggest otherwise, it is conceivable that the subjects did not believe the feedback they received and this may have resulted in the current findings.
It is possible that effects may still be present if the data were examined in an alternative context. For example, considering persistence as a measure of remaining self-control resources the difference between conditions may be more evident when we look at the attrition rates. Although there was not a significant difference in depletion as measured by time on task, it is probable that in the context of task completion a significant difference would be more pronounced. With a focus directed toward persistence as a measure of depletion, there were six participants in the depletion condition who quit the puzzle before they finished. This was measured with the item "Were you able to complete the word search", with 1 indicating yes and 2 indicating no. Overall, there were more participants in the enhanced and control conditions that finished the puzzle. This information would suggest that participants in the depleted condition were not motivated to adjust their performance, but to conserve their resources due to the belief of the feedback they received.

General Discussion

Although there were null results for this experiment, previous research has shown depletion perception can be manipulated (Clarkson, et al., 2010). It stands to reason that bringing awareness to the present moment would increase one's knowledge of their current state and allow them opportunity to correct their behavior. In regard to levels of depletion, awareness has been shown to increase levels of motivation and performance outcome.

The aim of Study 2 was to remedy the shortcomings found in Study 1 concerning the second manipulation check and final measure of self-control performance. In Study 2, the data revealed no significant differences for either the manipulation check or the final measure of self-control performance. Although several experiments have found that self-awareness is able to increase self-control performance (Alberts, Martijn, & de Vries, 2011; Carver & Scheier, 1998)
the current findings do not lend additional support. The lack of significance is believed to be a result of either a weak depletion manipulation, lack of belief in the feedback or a combination of the two.

An alternative explanation could be that subjects did not have adequate motivation to perform at optimal levels. Without a personal investment in performance outcomes there would be little to no effort expended simply due to the lack of personal importance. It may be true that with increases in perceived meaning and self-relevant outcomes (Hart, 2004) that an increase in motivation would have been evident.

This means that the outcome of the word search task had no impact on the students and therefore performance did not matter to them personally. In a real world experience, when outcome is important to the individual, they may be more motivated to change their behavior to increase performance. Using the previous example of weight loss, the goal to lose weight is an important, self-concordant goal and therefore the individual may be more inclined to increase effort when they receive feedback. Because there was nothing to be gained from the outcome by adjusting behavior this may explain why there were no differences between conditions in regard to self-control performance.

Limitations

In the Study 1, the computer malfunctioned on several occasions and failed to record a number of items including the second manipulation check. Study 2 made adjustments to the final measure of self-control performance as well as adding the second manipulation check. This was an essential element in determining whether or not the participants believed the feedback as to whether they were depleted or enhanced. Other limitations addressed included the removal of
participants' option to quit the word search puzzle when they felt they could no longer find any more words and making it mandatory for all participants to complete the measure. Additionally, in Study 1 participants were required to self-report the number of words they found in the word search puzzle. There were several discrepancies noted in this item due to either participant error or fabrication. There were 18 words in total and some students reported finding 20 while others only 3. Another area of concern was that the participants were given the option of a selecting task difficulty and this may have moderated their perception of depletion levels above and beyond the feedback manipulation. Therefore, the depletion manipulation and feedback may not be the only factors to consider in the performance outcome.

It may have been that the order of presentation of the questionnaires played a significant role in the detected level of depletion. Perhaps administering the manipulation check before the dependent measure changed the outcome. To clarify, the results of the depletion activity may have been more pronounced had the word search puzzle been completed immediately after the performance feedback was delivered. Administering the manipulation check prior to the depletion measure may have inadvertently misconstrued the outcome by weakening the effect of the feedback manipulation.

In Study 2, after eliminating all unengaged responders, our sample size was less than desirable with only 16 participants remaining in the depleted condition as compared to 25 in the enhanced and 19 in the control group. Insufficient power and unequal samples may account for the lack of significance in Study 2. Future experiments would benefit from conducting a power analysis prior to running the experiment to determine the sufficient number of participants per condition. Furthermore, the depletion manipulation may not have had an adequate impact to ensure participants were sufficiently depleted.
Future Directions

It would be valuable to run the study again with a different measure of self-control performance as a final measure. There may be considerable variation in the word search outcome that is not due to the feedback manipulation. With a previously tested measure we could expect to find more definitive results. Furthermore, the choice for level of difficulty for the puzzle should be omitted. Participants may have assumed the puzzle was more difficult than it was and this may present a potential confound by increasing their perceived level of depletion. The priming effect of difficulty level may have played a role in the performance outcome.

As a means of parsing out the mechanism of performance motivation, a third manipulation check could be added that directly assesses participants’ level of depletion by including precise items (e.g., “After receiving the feedback assessment I felt motivated to try harder.”, “After receiving performance feedback I felt as though I needed to save my energy”) following the completion of the dependent measure. As stated above, it would be pertinent to consider the order of administration of the dependent measure and manipulation checks when designing future studies.

Finally, past studies have conducted experiments using non-depleted and depleted participants. It may be advantageous to add a non-depleted condition to the current study to see if there is a difference in motivation and overall performance. Because all students were depleted in this experiment their self-control strength may have been diminished and they may not have paid attention to the feedback provided. The potential for depleted participants to have less focus could not be ruled out as a potential explanation for the findings witnessed in both Study 1 and Study 2. Perhaps a non-depleted condition would help illuminate any main effects for the feedback provided.
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Appendix 1

MANIPULATION CHECK Part 1

Please indicate your agreement with the following statements based upon how you feel right now. Please use the following scale:

1 ------------ 2 -------------- 3 -------------- 4 -------------- 5 -------------- 6 -------------- 7

Not at All                               Somewhat                               Very Much

1. _____ The trail making task was difficult.
2. _____ I had to really concentrate during the trail making task.
3. _____ The trail making task required a lot of mental energy.
4. _____ The trail making task was exhausting for me.
5. _____ I had to force myself to keep working on the task after I felt like quitting.
6. _____ The trail making task took a lot of self-discipline.
7. _____ I have no interest in trying a new activity right now.
8. _____ I was distracted by other thoughts.
9. _____ I know I did my very best on the trail making task.
10. _____ I felt I needed to reserve my energy for future tasks.
11. _____ I had to keep reminding myself to concentrate on the task.
12. _____ During the activity I had to override my instincts in order to complete the task.
13. _____ I used so much energy to concentrate on the last task that I do not feel I can accomplish anything else.
14. _____ Focusing on the trail making activity required very little effort (R).
15. _____ I had no desire to finish the trail making activity, but I did it anyway.
16. _____ I could have tried harder on the trail making task (R).
17. _____ I could not focus on this task because my mind started to wander.
18. _____ This task used all the energy I had left.

MANIPULATION CHECK Part 2 (after feedback)

Please check one: I ________ agree ________ disagree with the test results.
Please indicate your agreement with the following statements based upon how you feel right now. Please use the following scale:

1

2

3

4

5

6

7

Not at All

Somewhat

Very Much

1. _____ I have no mental energy left right now.

2. _____ I could use a break before the next activity.

3. _____ I am confident in my ability to perform well during the next activity.

4. _____ My willpower is unlimited (Belief)

5. _____ I feel focused and ready for the next activity

6. _____ I believe my performance will be decreased on the next task

7. _____ In comparison to the first task, I feel my performance will improve on the next activity

8. _____ I can overcome depletion to perform well on the next task

9. _____ After practicing self-control on the first activity, I feel my performance will improve on the next task (Motivation)

10. _____ Now that I know my performance may be effected I can make up for it (Motivation)

11. _____ I purposely saved some energy for the next task (Conservation)

12. _____ If I concentrate enough, I can perform better on the next task than I did on the first task (Motivation)

13. _____ I am mentally exhausted

14. _____ I am sure I will perform poorly on the next activity

15. _____ If I had not taken the assessment, I would think my performance would be the same on both tasks (Feedback Belief) sig <.05

16. _____ Because of the assessment, I am concerned about my performance on the next activity

17. _____ I still have a choice in how I perform on the next task (Belief in free will)

18. _____ My self-control has no effect on how I perform on tasks (Self-control Beliefs)

19. _____ I feel mentally sharp and alert

20. _____ The previous task was frustrating for me

21. _____ I feel mentally fatigued

22. _____ I do not have much effort to expend on the next task
23. _____ I feel energized for new activities

**Bold items represent Depletion.**

*Italic items represent Enhancement.*
Appendix 2

Risk Evaluation

Please rate how well each of the following statement describes you at the present time.

Please rate each item according to the following scale, from 1 to 7, where 1 means “not at all” and 7 means “very much”. Please indicate only one number for each item.

\[1 = \text{not at all} \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 = \text{very much}\]

1. ______ It will be difficult for me to start a new task right now.
2. _____ I feel mentally sharp and alert.
3. _____ The previous task was frustrating for me.
4. _____ I believe that I will perform well on the next activity.
5. _____ I need to take a break before I can complete another complicated task.
6. _____ It will be easy for me to persist with a difficult task at this moment.
7. _____ I am having difficulties focusing my attention.
8. _____ I am ready for a challenge.
9. _____ I will not have any difficulties staying focused on the next task.
10. _____ I feel energized for new activities.
11. _____ I cannot accomplish one more thing.
12. _____ It takes a lot of effort to concentrate on things right now.
13. _____ I know I will excel under the pressure.
14. _____ I do not have much effort to expend on the next task.
15. _____ I am not having any difficulties concentrating.
16. _____ I feel mentally fatigued.
Appendix 3

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you currently feel the following. Use the following scale to record your answers.

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) PANAS

Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate to what extent you feel this way right now, that is, at the present moment.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Very</td>
<td>A Little</td>
<td>Moderately</td>
<td>Quite a Bit</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Slightly or Not at All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Not at All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Interested
2. Distressed
3. Excited
4. Upset
5. Strong
6. Guilty
7. Scared
8. Hostile
9. Enthusiastic
10. Proud
11. Irritable
12. Alert
13. Ashamed
14. Inspired
15. Nervous
16. Determined
17. Attentive
18. Jittery
19. Active
20. Afraid
Scoring Instructions: Positive Affect Score: Add the scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10 – 50, with higher scores representing higher levels of positive affect.

Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20. Scores can range from 10 – 50, with lower scores representing lower levels of negative affect.

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Appendix 4

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