Elusive Ego Depletion: Limited Resource or Mindset?

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Elusive Ego Depletion: Limited Resource or Mindset?

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Abstract

Ego depletion was previously found to be a robust effect and generally could be explained by one of two theories: the strength model of self-control and mindset theory. Yet, much recent research has faced a replication crisis; the original effect has been elusive, even with replication efforts with large sample sizes. The current study examined 90 university students on their mind-wandering and inhibitory control errors by conditional group (depletion vs. control). I correlated these outcome measures with other measures which ascertained subjects’ beliefs regarding the capacity of their willpower. This project tested two popular accounts of the ego depletion effect: the strength model and the mindset theory. There were significant differences between the two groups on the basis of the depletion task being rated as more difficult, effortful, and frustrating than the non-depleting task. Additionally, motivation between the two groups were not statistically different. Despite such group equivalency in motivation and one condition being significantly different from the other, no significant ego depletion effect which would support the strength model was found. Additionally, although some outcome measures were moderately correlated with participants’ belief about their willpower, there was no evidence for the moderating influence of willpower belief on the ego depletion effect. Thus, this research provides no evidence in support of either the strength model or the mindset theory of ego depletion.

Keywords: ego depletion, strength model, self-control, inhibitory control, mind-wandering, belief about willpower
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The goals of the current study are to provide a thorough examination of a cognitive phenomenon referred to as ego depletion. As such, I will be testing two theories used to explain this ego depletion effect: the strength model of self-control and the mindset theory.

**Strength Model of Self-Control and Ego Depletion Effects**

The strength model of self-control has been largely supported in research since the late 90’s and posits that self-control may draw from a limited resource. In one key research article, Baumeister and colleagues proposed and tested a ‘limited resource’ or strength model of self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998). According to their model, a general, unitary, and finite ‘internal’ resource governs the individuals’ performance on tasks that required self-control. The strength model further posits that self-control works like a muscle and that once an individual utilizes self-control, the individual has more difficulty using self-control in a subsequent task (Baumeister et al., 2007). Yet, once again like a muscle, self-control is capable of being strengthened and trained.

A main source of evidence for this strength model of self-control is a phenomenon known as ego depletion. The ego depletion effect occurs when someone engages in a self-control task and performs worse on a subsequent self-control task (according to the strength model, their self-control resource has been depleted). The original findings initially seemed quite robust, supporting the ego depletion effect across a wide range of tasks with greatly differentiated demands – suggesting that the ego depletion effect is not specific to the use of one task domain (Baumeister et al., 1998). The initial study that posited the strength model used multiple task combinations with domains that seemed vastly unrelated (i.e. keeping oneself from eating cookies and trying to solve impossible puzzles; Baumeister et al., 1998). Additional task combinations often include the letter-e task, the stroop task, giving speeches against one’s own
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beliefs, or writing an essay with certain restraints like not using the letters a or n (Job, Dweck & Walton, 2010; Baumeister et al., 1998). This area of research is normally tested through the sequential task paradigm, in which a participant is exposed to two subsequent self-control tasks. Generally, the participant is presented with a depleting or non-depleting first task and their ‘depletion’ is measured through performance on the second task. Regardless of the task demands of the separate tasks utilized in the sequential task paradigm, the strength model assumes that this depletion in self-control will overlap between cognitive domains and skill sets.

On the basis of the earlier and subsequent research, Hagger et al. (2010) conducted a systematic meta-analysis based on 83 studies. This meta-analysis provided evidence of a robust ego depletion effect, with moderate effect sizes ($d = 0.62$) (Hagger et al., 2010). Ego depletion can have hefty real-life implications and can relate to athleticism, consumerism; according to Vohs and Heatherton (2000) ego depletion is highly related to dieting.

Challenges to the Ego Depletion Effect and the Strength Model

Despite the robustness of this initial effect, recent research has cast some doubt on the robustness or replicability of the original findings. In particular, various methodological and conceptual problems have been pointed out as possible reasons for this replicability problem.

Replication Crisis

Doubt began being cast over the ego depletion effect once several studies were published which were unable to replicate the initial effect. Lurquin et al. (2016), for example, provided considerable evidence against the robustness of the ego depletion effect after finding null results in their pre-registered study. Although Lurquin et al. (2016) used one of the more popular and widely used depletion tasks – the video-viewing attentional control task – those in the depletion condition did not exhibit depletion. Xu et al. (2014) similarly were not capable of replicating the
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effect despite their utilization of an incredibly common depletion task (e-cross task) and two of the most frequently used outcome measures of self-control (modified Stroop and the handgrip task). Across each of their four studies, they found no evidence in support of the depletion effect (Xu et al., 2014). Most notably, another preregistered study conducted across 23 labs (N = 2,141) similarly was not able to observe a significant ego depletion effect. A majority of the labs in the replication effort found effects which encompassed zero with 95% confidence intervals (Hagger et al., 2016).

Research conducted by Carter & McCullough (2014) strongly indicates that publication bias is particularly prevalent in the field of ego depletion research, resulting in continued research into an effect that may not exist. In their review of Hagger et al.’s (2010) meta-analysis, they attempted to correct for small-study effects in order to discern the true effect size of ego depletion. They posit that Hagger et al.’s (2010) previously estimated moderate effect size of ego depletion ($d = 0.62$) was inflated due to publication bias. The fact that this 2010 meta-analysis only drew from published studies likely contributed to this overestimation. Overall, Carter and McCullough (2014) demonstrate the risks of small study effects – for instance, overestimated effect size – and encourage replication as a means of confirming effects despite publication bias.

**Methodological Challenges**

Given these previous issues in replicating what was once considered a robust effect, there may be methodological issues in the designs of these original studies. These issues could include the lack of manipulation checks, the brief length of the first task, and small sample sizes.

**Manipulation check.** A large proportion of the initial ego depletion research did not utilize manipulations checks to assure that the depletion/control tasks were significantly different as rated by their participants. The assumption is present that the task they developed to be
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depleting was such. Additionally, some older studies would not analyze performance on task 1, simply assuming once again that the depletion task is significantly different from the control task without any confirmation of such.

**Limited time on task.** Previous research limited participants’ engagement with the depletion task to 5 minutes, on average – a rather small amount of time to deplete one’s self control resource. In the 2016 multi-lab replication effort, one of the longer depletion tasks (with 150 trials) lasted 7.5 minutes, yet still found no effect. This may indicate that – if the ego depletion effect exists – the first task must be lengthened to bring about an effect (Hagger et al., 2016). Although older studies may have had participants complete task 1 for short periods of time and still elicited an effect, it is clear that these previous studies had a bevy of methodological issues which limited their ability to reliably find an effect.

**Small N.** Ego depletion research commonly has smaller sample sizes, rarely reaching more than 50 participants per condition. In fact, the average N per condition in this realm of research reaches 27 participants, which in most circumstances would yield a power lower than the recommended 0.80 (Hagger et al., 2010). When the issue of published small sample sizes is combined with the prevalence of publication bias in this field, the average from these small sample studies is often not a good estimate of the actual effect. Thus, the recent replication crisis may be a result of smaller sample sizes in the original research – because their initial effect estimates were overinflated due to their small samples, these studies were published with significant effects which may not have been accurate.
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Conceptual Challenges

In addition to methodological issues, there are also conceptual issues that previous research has neglected to clarify. This includes the unclear effect of task similarity as well as the uncertainty regarding the theoretical explanations of ego depletion.

**Prior study uncertainty on domain effects.** As discussed earlier, many prior studies assumed that ego depletion seems to be domain general and that any combination of tasks will result in the ego depletion effect regardless of how unrelated the tasks may seem. Thus, much uncertainty remains as to whether task overlap is related to self-control depletion. Research in this field often fails to clarify whether the ego depletion effect is domain-specific. Obviously, many actions can fall under the umbrella of self-control, but it remains unclear if stopping oneself from eating a cookie (Baumeister, Bratslavsky, Muraven, & Tice, 1998) is related to something like avoiding thinking of a white bear (Wegner, Schneider, Cater & White, 1987). Due to these seemingly odd task combinations, using tasks with demands that may or may not overlap, it remains unclear whether task similarity has an effect on the ego depletion effect. Replication failures may have occurred in recent research because studies continue to choose tasks that may not overlap in terms of their respective self-control requirements. Thus, to test whether ego depletion can be observed, it may be effective to utilize two tasks that are highly similar and require the same self-control requirement (i.e. inhibition).

**Is it limited resource or mindset?** Although the strength model suggests that ego depletion occurs due to a limited resource of self-control, more recent research has indicated that implicit beliefs about willpower on the behalf of the participant may affect self-control and persistence. According to this mindset theory, depletion does not have to do with resource availability; rather, it relates to implicit beliefs and mindset. Job et al. (2010) found that self-
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regulation was moderated by participant’s belief in the capacity of their willpower rather than self-control being a limited resource. Specifically, Job et al. (2010) found that only those who believed their willpower to be limited demonstrated more ego depletion.

More recently extending this mindset theory, Savani and Job (2017) proposed and provided evidence for the view that the ego depletion effect may be a result of cultural belief systems. Their findings suggested that in Indian cultural contexts, exerting self-control may lead to improved performance on subsequent tasks due to a societal ideology that controlling the self is invigorating rather than exhausting. This factor complicates ego depletion research, as depletion may or may not occur due to a belief in the effect and that this belief may be influenced by societal scripts.

**Present Study**

**Overall Setup**

Figure 1 at right demonstrates the order in which I conducted the present study. After providing consent, participants completed all questionnaire measures; these will be described later. Before receiving instructions for and completing task 1, they were given task 2 (SART) instructions. Then they completed task 1. Task 1 was followed by a manipulation check. Finally, participants completed task 2 and were debriefed before receiving credit for their time.

In my final task (SART) participants must respond to a majority of trials but inhibit their response to certain trials.
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Thus, since the ‘depleted’ ability would be inhibition, I would expect no difference on the trials in which there is no inhibition and see the result of the depletion manipulation on the inhibition trials. Accordingly, my first outcome variable of interest to measure ego depletion is inhibitory control errors or the rate of incorrect responses on inhibition trials. The SART also utilized mind-wandering probes, making it possible to examine mind-wandering as a possible moderator of the ego depletion effect. Thus, in addition to my measure of inhibitory control errors, I examined the rate of mind-wandering as my second outcome variable of interest.

Other research has brought interest to mind-wandering as a potential moderator of the ego depletion effect. Kane & McVay (2009, 2011, 2012) found a major connection between attentional lapses or ‘mind-wandering’ and working memory capacity. Additionally, it seems those with increased mind-wandering have more problems maintaining executive control. Executive control and self-control often overlap, especially in the context of the current study. Inhibition, a major variable of interest in this study, is both an executive control action and a measure of self-control.

Finally, previous research fell short in having a relatively short time on task for the depletion task, which is commonly around or under 5 minutes. In the current study, replication of the ego depletion may be more achievable through lengthening time on the depletion task to 20 minutes.

Goals of The Study and Main Hypotheses

Given the drawbacks in previous ego depletion research noted above, I considered many solutions to more accurately examine the existence of ego depletion in self-control. First, it should be noted that this paper is a preliminary write-up of research that has not yet been
concluded. Thus, there are goals that are laid out in this study that will be completed in the future, i.e. additional analyses and continued running of subjects.

The two interests of the study were to test two theories of ego depletion. The first, the strength model, posits that self-control is an overlapping general resource which could be depleted by a variety of different demands. As discussed earlier, much of the research has failed to clarify the effect of overlapping/related task requirements. Thus, utilizing two tasks under the same cognitive demands – inhibition – explores the depletion effect within one single cognitive action. The intention of the conducted study was to offer some clarification on the significance of domain-specificity by using a condition with two tasks relating to the same domain of cognitive thought (inhibition).

The second theory I wanted to examine, the mindset theory, suggests that ego depletion occurs in those with implicit beliefs regarding their own willpower. This theory assumes that, in those who believe their willpower and self-control is limited, ego depletion will be present. As demonstrated above, previous research has failed to clarify the potential moderating factors on self-control. Thus, I used questionnaires developed to assess participants’ beliefs about the extent and availability of their willpower. Specifically, I used two separate belief about willpower scales (Job et al., 2010; Savani & Job, 2017) which measured both ends of the spectrum of belief: that controlling the self is both invigorating and exhausting. Other questionnaires were utilized because mindset theory may overlap with other measures outside of measures relating to willpower beliefs (i.e. depletion sensitivity scale, action control scale, etc.). Thus, I incorporated the ancillary questionnaire measures to rule out the possibility that other constructs are/are not related to ego depletion.
Hypothesis 1. If the strength model of ego depletion is valid, motivation between the two conditional groups would be equivalent prior to task 2 as well as performance (% accuracy) on the non-inhibition trials of the SART. Those in the depletion condition are predicted to exhibit more inhibitory control errors (incorrect responses on inhibition trials of SART) and higher rates of mind-wandering.

Hypothesis 2. If the mindset theory of ego depletion effect is valid, the ego depletion effect will be moderated by a limited/non-limited willpower belief in the participant. There will be an interaction between the belief in the capacity of one’s willpower and the conditional manipulation they experience, as reflected by inhibitory control errors and mind-wandering.

Methods

Participants

Ninety participants (33 male, 57 female), drawn from the human subject pool of the Department of Psychology and Neuroscience from the University of Colorado Boulder, took part in this study. The age of each participant ranged from 18 to 30+ (M = 19.2, SD = 1.99). Each participant received partial course credit for participation. This research was approved by the Institutional Review Board at the University of Colorado Boulder.

Participants were randomly assigned to one of two conditions – either the depletion condition (antisaccade) or the control condition (prosaccade). As previously referenced, a meta-analysis of 83 ego depletion studies found a robust effect size of 0.62 (Cohen’s d, Hagger et al., 2010). Given the conducted power analyses in this previous meta-analysis, 84 participants are necessary in each condition to test a two-tailed hypothesis. The attained goal of 50 subjects per condition does not surpass the necessary amount of subjects to detect an effect of 0.62 (Cohen’s d) at 80% power, but does surpass the typical sample size of much of the previous ego depletion
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research (n = 27 per cell, Hagger et al., 2010). Additional data collection will continue until I reach my goal of 100 participants per cell, exceeding the number suggested by Hagger et al. (2010).

Overall Procedures

Figure 1 provides a schematic illustration of the overall procedures. Each participant was tested individually in one of three research rooms in sessions lasting approximately 1 hour. The experimenter remained in the room for the entirety of each session and read from a script during each session to minimize experimenter bias. Yet, after giving instructions for each section of the study, the experimenters were instructed to remain behind a barrier made from desks, filing cabinets, and other furniture items while participants completed all tasks and questionnaires. Thus, during completion of the real trials of each task, the experimenter was obscured from the participants’ view. This was done to prevent the participants’ performance from being affected by the direct viewing of the experimenter. Excluding the consent form, all questionnaires and surveys were conducted via computer in the lab.

It should be noted that the instructions for the SART/outcome task are given immediately after the completion of the questionnaire, before the instructions for the saccade tasks. This limits the time gap between the depletion/control task and the outcome task, enhancing the possible ego depletion effect.

Questionnaires

Prior to completion of the first task, the subject completed a series of questionnaires. Participants completed the questionnaire(s) using the online Qualtrics survey platform. The full questionnaire included fifty-eight questions across five different scales from previous ego depletion research. The various items included two “belief about willpower” questionnaires (Job
A “depletion sensitivity scale” (Salmon et al., 2014), a “self-control scale” (Baumeister et al., 1998), and an “action control scale” (Kuhl & Kazén, 1994). All of the questionnaire items can be found in Appendix A. This portion lasted approximately 5-10 minutes.

Belief about willpower 1. The initial belief about willpower scale is intended to measure participant’s beliefs regarding willpower over self-control and includes 12 questions with two subsets (Job et al., 2010). The first subset consists of 6 questions which regard strenuous mental activity (i.e. “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again”; Job et al., 2010). The second subset examined resisting temptations and was also 6 questions (i.e. “Resisting temptations makes you feel more vulnerable to the next temptations that come along”).

Belief about willpower 2. The second belief about willpower scale similarly examined participants’ beliefs regarding their ability to persist through exerting self-control.

Depletion sensitivity scale. The depletion sensitivity scale consisted of 15 questions. These items assessed the participants’ sensitivity to ego depletion (i.e. “After I have made a couple of difficult decisions, I can be truly mentally ‘depleted’”).

Self-control scale. The self-control scale is composed of 13 questions which simplistically examined the participants’ self-control (i.e. “I am good at resisting temptation”).

Action control scale. Finally, the action control scale I utilized is a subset of an original 36 item action control scale. The subset I used is referred to as the ‘Decision-related action orientation vs. hesitation’. These items assessed whether participants were action oriented in 12 circumstances, providing two possible responses (i.e. “When I know I must finish something
soon: A. I have to push myself to get started. B. I find it easy to get it done and over with.”). In
the previous examples, one of the two responses represented an ‘action-oriented’ decision.

**Depletion/Control Task**

Saccade tasks are commonly used as an executive control task and can be made easily
applicable in the context of ego depletion research. The control and depletion variations of this
task have both been adapted from the dependent measure task utilized in Dang et al. (2017).
However, the version used in the current study was simplified so that there are only two
responses rather than three. The instructions for the saccade tasks were presented onscreen for
the participant and read aloud by the experimenter. Instructions can be found in the appendix.

Essentially, the depletion variant forced participants to engage their inhibitory control by
directing them to look to the opposite side of the screen as a flashing cue. In the control variant,
participants looked to the same side of the screen as the cue and thus did not use inhibitory
control.

The flashing cue presented in the saccade task flashes on-screen for a fixed period of time
(150 milliseconds). The stimulus – one of three letters (either B, P, or R) – will be presented on
the side of the screen corresponding to the task designation (depletion or control) for 150
milliseconds as well. There were 12 practice trials, followed by 4 blocks of actual trials, with 126
trials per block. Throughout the entire task, there were 504 trials total. Both conditions –
depletion and control – lasted the same amount of time and ran for approximately 20 minutes.

The justification of this task as a utilization of self-control follows the idea, generally
supported by ego depletion research, that in order for a task to utilize self-control, one must have
to override a predominant and/or habituated response. In the case of this task, the predominant
response would be to look towards the flashing stimulus. Yet, in the depletion variant of this
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task, the purpose was to override the predominant response by actively looking at the opposite side of the screen as the attention-drawing stimulus, thus making it a self-control task.

Outcome Task

The SART (sustained attention to response task) is often used as a test of working memory and is considered a type of go/no-go or inhibition task. For the current study, the SART was adapted from a version of the task utilized in McVay & Kane (2009). As noted previously, instructions were first given after completion of the questionnaire and before completion of the first task. At this time, they also completed a set of 14 practice trials of the SART. After completion of the first task, the participant received a refresher of the instructions before completion of the SART. As with the depletion/control task, the instructions were presented onscreen for the participant and were read verbatim aloud by the experimenter. For the real trials, participants were instructed to respond by pressing the space bar when they saw an animal word and to not press the space bar when they saw a vegetable word.

Each word was presented for 300 milliseconds followed by the string of “XXXXXXXX” which lasted for 1 second, allowing the participant 1.3 seconds in total to respond. The SART had 135 trials per block with four blocks comprising the task, making for 540 trials in total. As the instructions indicate, this task included thought probes to measure the rate of mind wandering occurring during this task. There were 9 of mind-wandering probes per block, making for 36 probes in total across the four blocks. When prompted, the participant simply responds whether their thinking was on-task or off-task just prior to the appearance of mind-wandering probe. The outcome task in entirety ran for approximately 20 minutes.

It should be noted that the proportion of animal words to vegetable words not equal. For every one vegetable trial, they were eight animal trials, making for 120 animal trials and 15
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vegetable trials in every block. This was done to create the habituated response in participants which they were intended to inhibit for vegetable trials. The full instructions for both the depletion/control task and the outcome task can be found in Appendix B.

Additional Measures

Before the participant completed the task to which they were assigned, they answered the following question: “How motivated are you to do well on the following task?” which they answered on a 9-point Likert scale (‘1’ = not at all, ‘9’ = extremely). Additionally, once the participant completed the depletion task, they were asked four questions as a manipulation check answered on the same 9-point Likert scale as above; these items originate from Baumeister’s original research (Baumeister et al., 1998):

- How difficult did you find this task?
- How tired do you feel after the task?
- Did you feel frustrated during the task?
- How much effort did the task require?

Additionally, participants were asked by the experimenter their gender and whether they were a native English speaker; the experimenter logged this information in a separate document, along with any additional pertinent comments regarding the participant’s behavior throughout the course of the experiment. These behavioral anomalies included examples of not following task instructions properly, not continuing to engage fully with the tasks through the entirety of the task length, and other behaviors which will be discussed more in depth later.
Exclusions

Before discussing the results and the conducted analyses, it is pertinent to acknowledge the people I chose to remove from the data set before my analyses. In total, I excluded 26 participants from analyses for a variety of reasons, 12 from the depletion condition and 14 from the control condition. Four participants were excluded for the following reasons: being a non-native English speaker, filling out the incorrect consent form, or otherwise engaging in behavior that may have affected their performance on the tasks (i.e. texting during tasks, being under the influence, becoming distracted during tasks, etc.).

An additional 21 participants (10 in the depletion condition, 11 in the control condition) were excluded from data analysis because either their task 1 (antisaccade/prosaccade) or task 2 (SART) data was not present. Unfortunately, due to a bug in a previously used version of PsychoPy (1.85.4), several data files were not saved. I decided that all participants with missing files for the outcome task should be excluded, since I would not be able to discern their rate of depletion or non-depletion without seeing their performance on said task (n = 1). Additionally, I excluded all subjects missing task 1 files to avoid the need for differential analyses between the full data set and those missing their task 1 data files (n = 20).

Finally, two additional participants would have been excluded for their performance on the outcome task (SART). These participants performed at less than my designated performance cut off of 75 percent accurate for animal trials for which no self-control is required (only habitual responses are needed). Yet, in these two cases, these participants had already been excluded for other reasons outside of their performance.
It should be noted that in my exclusion criteria, it was originally dictated that I would exclude anybody who did not complete any of the tasks in full. The argument could be made that these cases should be examined more in depth as they may be indicative of severe ego depletion. Luckily, none of my participants dropped out of the study and thus this does not need to be examined.

Table 1. Group Equivalency by Condition

<table>
<thead>
<tr>
<th>Scales</th>
<th>Total N= 90</th>
<th>Depletion Condition (Antisaccade) n= 48</th>
<th>Control Condition (Prosaccade) n= 42</th>
<th>Differences (df = 88)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belief About Willpower 1</td>
<td>5.23 (0.70)</td>
<td>5.22 (0.94)</td>
<td>5.23 (1.17)</td>
<td>-0.06</td>
</tr>
<tr>
<td>Willpower 1 – Subset 1:</td>
<td>5.24 (0.63)</td>
<td>4.28 (1.35)</td>
<td>4.36 (1.53)</td>
<td>-0.26</td>
</tr>
<tr>
<td>Strenuous Mental Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belief About Willpower 2</td>
<td>4.43 (0.89)</td>
<td>4.40 (1.36)</td>
<td>4.43 (1.50)</td>
<td>-0.12</td>
</tr>
<tr>
<td>Depletion Sensitivity Scale</td>
<td>5.61 (0.72)</td>
<td>5.64 (1.02)</td>
<td>5.58 (1.16)</td>
<td>0.25</td>
</tr>
<tr>
<td>Self-Control Scale</td>
<td>5.47 (0.94)</td>
<td>5.51 (1.29)</td>
<td>5.49 (1.33)</td>
<td>0.05</td>
</tr>
<tr>
<td>Action Control Scale</td>
<td>4.03 (1.62)</td>
<td>4.16 (2.23)</td>
<td>4.02 (2.48)</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Mean values for individual questionnaires by conditional group, column at right reflects group differences from an independent samples t-test, none of which were significant.

Preliminary Analyses

Group equivalence. As shown in Table 1, there are no significant differences between the two conditions for the first belief about willpower scale, \( t(88) = -0.06, p = 0.95 \). This is also true for the first subscale of this belief about willpower scale, \( t(88) = -0.26, p = 0.80 \). The second belief about willpower scale also reflected equivalency between condition, \( t(88) = -0.12, p = 0.90 \). There were no condition differences between ratings for the depletion sensitivity scale as well, \( t(88) = 0.25, p = 0.80 \). Additionally, there were no differences between the depletion and control conditions for the self-control scale, \( t(88) = 0.05, p = 0.96 \). Finally, there were also no condition differences for the action control scale, \( t(88) = 0.28, p = 0.78 \). This was to be expected,
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as the questionnaire is given to participants before any condition manipulation takes place. Thus, it is unsurprising that there are no significant differences between groups, as at that point in the experiment, there should be no differences by condition.

Table 2. Manipulation Checks by Condition

<table>
<thead>
<tr>
<th>Manipulation Checks:</th>
<th>Depletion Condition (Antisaccade) n=48</th>
<th>Control Condition (Prosaccade) n=42</th>
<th>Differences (df = 88)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>t (p)</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td>7.094 (1.791)</td>
<td>7.404 (1.604)</td>
<td>-0.666</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>0.781 (.413)</td>
<td>0.924 (.265)</td>
<td>-1.945</td>
</tr>
<tr>
<td><strong>Frustration</strong></td>
<td>5.75 (2.184)</td>
<td>4.786 (2.465)</td>
<td><strong>2.051</strong>*</td>
</tr>
<tr>
<td><strong>Effort</strong></td>
<td>7.188 (1.615)</td>
<td>6.095 (1.836)</td>
<td><strong>3.764</strong>*</td>
</tr>
<tr>
<td><strong>Difficulty</strong></td>
<td>7.125 (1.703)</td>
<td>4.786 (2.242)</td>
<td><strong>4.831</strong>*</td>
</tr>
<tr>
<td><strong>Fatigue</strong></td>
<td>6.958 (1.882)</td>
<td>6.809 (2.038)</td>
<td>-0.042</td>
</tr>
</tbody>
</table>

Note. Bolded values indicate significant p value; number of asterisks is indicative of level of significance: *p < 0.05; **p < 0.01; ***p < 0.001.

Manipulation check. Table 2 demonstrates that there were no significant condition differences for motivation before the task, which was expected, \( t(88) = -0.67, p = 0.51 \).

Additionally, performance on the depletion task was notably less than the performance on the control task (78.1% and 92.4% accuracy respectively), \( t(88) = -1.945, p = 0.055 \). Although the difference between the conditions does not reach statistical significance, the p is close enough to 0.05 to suggest that the conditions still marginally differ by accuracy. Notably, the depletion task (antisaccade) was rated as significantly more difficult, \( t(88) = 4.83, p = < 0.0001 \), frustrating, \( t(88) = 2.05, p = < 0.05 \), and effortful, \( t(88) = 3.76, p = < 0.05 \), than the control task (prosaccade). The only post-task rating that did not significantly differ between the two conditions was the fatigue rating, \( t(88) = -0.04, p = 0.97 \).
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Table 3. SART Performance and Measures by Condition

<table>
<thead>
<tr>
<th>Measures</th>
<th>Depletion Condition (Antisaccade) n = 48</th>
<th>Control Condition (Prosaccade) n = 42</th>
<th>Differences (df = 88)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Mean (SD) 6.71 (1.66)</td>
<td>Mean (SD) 6.50 (1.99)</td>
<td>t = 0.54, p = 0.59</td>
</tr>
<tr>
<td>Animal Trials</td>
<td>Correct 0.96 (0.05)</td>
<td>Correct 0.97 (0.05)</td>
<td>t = -0.61, p = 0.54</td>
</tr>
<tr>
<td>Vegetable Trials</td>
<td>Incorrect 0.53 (0.20)</td>
<td>Incorrect 0.51 (0.21)</td>
<td>t = 0.59, p = 0.59</td>
</tr>
<tr>
<td>Mind-wandering</td>
<td>0.30 (0.20)</td>
<td>0.31 (0.21)</td>
<td>t = -0.18, p = 0.18</td>
</tr>
</tbody>
</table>

Mean values for SART (sustained attention to control task) measures by conditional group, column at right reflects group differences from an independent samples t-test.

Primary Analyses: Testing Hypothesis 1

As summarized in Table 3, my preliminary results reflected no difference between groups on my measure of motivation as well as performance on SART for animal accuracy. The difference for motivation between the depletion and control condition was not significantly different, \( t(88) = 0.54, p = 0.59 \). This is to be anticipated as there should be no difference in motivation previous to completion of task 2 (SART). Thus, if there were an ego depletion effect, it could not be attributed to a difference in motivation between the two condition groups.

Additionally, there was no difference in the accuracy for answering animal trials correctly, \( t(88) = -0.61, p = 0.54 \). This was similarly an anticipated result as the purpose of the task is to inhibit one’s response on only the vegetable trials, thus there should not be a difference reflected on the animal trials, as this does not pertain to one’s inhibitory control. Additionally, the participant’s performance on animal trials should be examined to assure that participants are actually responding on those trials and thus habituating a behavior of responding on the majority of trials. This creates a precedent for errors on vegetable trials being due to a lack of inhibitory control.
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As for my variables of interest which may reflect ego depletion – inhibitory control errors and mind-wandering – the results are quite interesting. Inhibitory control errors for the SART would be reflected by the errors on the vegetables trials only. That is, it is considered an error when a participant responds on vegetable trials in which they should have inhibited the predominant habituated response. Yet, it was found that there was no significant difference between the depletion condition ($M = 0.53, SD = 0.20$) and the control condition ($M = 0.51, SD = 0.21$), $t(88) = 0.59, p = 0.56$. Additionally, there were no condition differences in terms of reporting mind-wandering between the depletion ($M = 0.30, SD = 0.20$) and control condition ($M = 0.31, SD = 0.21$), $t(88) = -0.18, p = 0.86$. These results are inconsistent with Hypothesis 1 and hence challenge the strength model.

Table 4. Questionnaire Correlations

<table>
<thead>
<tr>
<th>Scale</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Belief About Willpower 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Willpower 1 – Subset 1: Strenuous Mental Activity</td>
<td>0.65***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Belief About Willpower 2</td>
<td>0.64***</td>
<td>0.73***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Depletion Sensitivity Scale</td>
<td>-0.66***</td>
<td>-0.58***</td>
<td>-0.65***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Self-Control Scale</td>
<td>0.17</td>
<td>0.06</td>
<td>0.17</td>
<td>-0.39**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Action Control Scale</td>
<td>0.27</td>
<td>0.05</td>
<td>0.13</td>
<td>-0.44**</td>
<td>0.63***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Mind-Wandering</td>
<td>-0.08</td>
<td>-0.14</td>
<td>-0.11</td>
<td>0.18</td>
<td>0.07</td>
<td>-0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Inhibitory Control Errors (% incorrect responses on vegetable trials)</td>
<td>-0.34*</td>
<td>-0.15</td>
<td>-0.23</td>
<td>0.33*</td>
<td>-0.03</td>
<td>-0.08</td>
<td>0.09</td>
<td></td>
</tr>
</tbody>
</table>

Note. Bolded values indicate significant correlation; number of asterisks is indicative of level of significance: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. 
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Primary Analyses: Testing Hypothesis 2

Correlation. As displayed in Table 4, I created a correlation matrix that demonstrates the correlations between each one of my measures. The first belief about willpower scale was correlated with its own first subset, \( r(88) = 0.65, p < 0.001 \). The first and second belief about willpower scales were also highly correlated, \( r(88) = 0.64, p < 0.001 \). The first belief about willpower scale was negatively correlated with the depletion sensitivity scale, \( r(88) = -0.66, p <0.001 \). The first subset of the initial belief about willpower scale was significantly correlated with the second belief about willpower scale, \( r(88) = 0.73, p < 0.001 \). That subset was also negatively correlated with the depletion sensitivity scale, \( r(88) = 0.58, p < 0.001 \). The depletion sensitivity scale negatively correlated with the second belief about willpower scale, \( r(88) = -0.65, p < 0.001 \), as well as the self-control scale, \( r(88) = -0.39, p < 0.01 \), and the action control scale, \( r(88) = -0.44, p < 0.01 \). Finally, the action control scale was highly correlated with the self-control scale, \( r(88) = 0.63, p < 0.001 \). The remaining correlations between the measures fell below the level of significance, as is displayed in Table 4.

As for my questionnaire measures, the mind wandering measures, and my measure of inhibitory control errors, most of the correlations were nonsignificant. There was a significant negative correlation between my measure of inhibitory control errors (errors on vegetable trials) and my first belief about willpower scale, \( r(88) = -0.34, p <0.05 \). Additionally, that measure of inhibitory control errors correlated with the depletion sensitivity scale, \( r(88) = 0.33, p <0.05 \). Though it was not anticipated that my measure of inhibitory control errors would significantly correlate with any of my questionnaire measures, all of those correlations have just passed significance and may become nonsignificant with my planned addition of participants.
Regression analyses. As shown in Table 5, there were no significant interactions between the condition and any of my questionnaire measures as reflected by my two primary outcome variables: mind wandering and inhibitory control errors. Thus, none of the questionnaire measures significantly predicted mind wandering or inhibitory control error differences by condition. Yet, as discussed with my correlations above, the first belief about willpower scale did significantly predict inhibitory control errors, $\beta = -0.24$, $p < 0.05$, such that those who reported believing that they could not effectively persist through strenuous mental

<table>
<thead>
<tr>
<th>Table 5. Regression Results</th>
<th>Inhibitory Control Errors (% incorrect on vegetable trials)</th>
<th>Mind Wandering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale</strong></td>
<td><strong>$\beta$ ($p$)</strong></td>
<td><strong>$\beta$ ($p$)</strong></td>
</tr>
<tr>
<td><strong>Belief About Willpower 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.04 (0.67)</td>
<td>-0.03 (0.11)</td>
</tr>
<tr>
<td>Scale</td>
<td><strong>-0.24 (0.03)</strong>*</td>
<td>-0.14 (0.22)</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.06 (0.55)</td>
<td>-0.14 (0.19)</td>
</tr>
<tr>
<td><strong>Willpower 1 – Subset 1: Strenuous Mental Activity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.06 (0.56)</td>
<td>-0.02 (0.85)</td>
</tr>
<tr>
<td>Scale</td>
<td>-0.13 (0.22)</td>
<td>-0.21 (0.05)</td>
</tr>
<tr>
<td>Interaction</td>
<td>0.01 (0.96)</td>
<td>-0.06 (0.56)</td>
</tr>
<tr>
<td><strong>Belief About Willpower 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.05 (0.63)</td>
<td>-0.03 (0.74)</td>
</tr>
<tr>
<td>Scale</td>
<td>-0.14 (0.21)</td>
<td>-0.2 (0.07)</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.02 (0.89)</td>
<td>0.04 (0.73)</td>
</tr>
<tr>
<td><strong>Depletion Sensitivity Scale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.06 (0.58)</td>
<td>-0.21 (0.84)</td>
</tr>
<tr>
<td>Scale</td>
<td><strong>0.23 (0.03)</strong>*</td>
<td>0.17 (0.13)</td>
</tr>
<tr>
<td>Interaction</td>
<td>0.11 (0.29)</td>
<td>0.15 (0.18)</td>
</tr>
<tr>
<td><strong>Self-Control Scale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.06 (0.56)</td>
<td>-0.03 (0.86)</td>
</tr>
<tr>
<td>Scale</td>
<td>0.01 (0.98)</td>
<td>0.24 (0.82)</td>
</tr>
<tr>
<td>Interaction</td>
<td>-0.02 (0.84)</td>
<td>-0.12 (0.27)</td>
</tr>
<tr>
<td><strong>Action Control Scale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>0.06 (0.57)</td>
<td>-0.19 (0.86)</td>
</tr>
<tr>
<td>Scale</td>
<td>-0.13 (0.23)</td>
<td>-0.17 (0.87)</td>
</tr>
<tr>
<td>Interaction</td>
<td>0.04 (0.71)</td>
<td>-0.18 (0.08)</td>
</tr>
</tbody>
</table>

*p < 0.05; **p < 0.01; ***p <0.001, bold statistics are significant, italicized statistics are marginally significant.
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activity or resist temptations demonstrated less inhibitory control. Additionally, the depletion sensitivity scale predicted inhibitory control errors, $\beta = 0.23, p < 0.05$, such that those who reported being sensitive to depletion similarly reflected lower rates of inhibitory control.

Importantly, however, outside of those two significant findings, none of the other questionnaire measures significantly mediated the ego depletion effect for either inhibitory control or the mind-wandering measure. This lack of significant interaction effects is inconsistent with Hypothesis 2 and challenges the mindset theory of ego depletion.

Discussion
The current study examined ego depletion using an experimental design that was intended to resolve several previous limitations in research on this topic. Specifically, this study tested two accounts of ego depletion: the strength model (H1) and the mindset theory (H2).

Evaluating the Two Main Hypotheses

Hypothesis 1. As indicated multiple times over, it seems that the previously supported strength model may not be an entirely accurate depiction of the process of self-control. Once again, the strength model of ego depletion posits that there is a limited resource of self-control and the resulting depletion occurs across a variety of different tasks. Original studies found depletion effects using task combinations that seemingly had no overlap in their cognitive requirements.

Thus, for my current study, I implemented two tasks with demands which required the skill of inhibition. When utilizing two conditions which draw upon the same skill set, it seems intuitive that an observable effect would be greater depletion. Yet, even with my conditions matched on the basis of having the same demands, I found no depletion effect. Additionally, the motivation before the initial task was equivalent in both conditions. Not only this, but the
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manipulation check completed after task 1 assured that the depletion condition was rated as significantly more frustrating, effortful, and difficult than the control condition. Similarly, increasing task length to 20 minutes did not make it possible to detect an effect. Thus, if the effect does exist, it either is not applicable to the population I drew from, or the effect size is incredibly small and needs a large sample size to detect the effect. Overall, my research provided no evidence in support of the strength model of self-control. Additionally, any other explanations of the ego depletion effect may need to be considered given that the strength model is continuously seeming less valid.

**Hypothesis 2.** In addition to the strength model of self-control, I also explored and tested the mindset theory of ego depletion. This theory, as explained previously, assumes that – rather than self-control being a finite resource which spans multiple domains of action – willpower and self-control is regulated by one’s own beliefs regarding such.

Yet, once again, I found no significant evidence which supported this theory. Although there were significant correlations found between subjects’ beliefs about willpower and inhibitory control errors, I found no interaction by conditional group. Thus, those who believed that strenuous mental activity drained their resources or were susceptible to temptations had significantly more inhibitory control errors. Yet, this effect was not significant as an interaction between those in the depletion condition and the control condition. Given that the depletion condition was rated significantly more frustrating, effortful, and difficult, one would assume that those in the depletion condition who reported more belief that their self-control was limited would reflect lower inhibitory control errors and mind-wandering. Yet, this was not the case; thus, indicating no support towards the mindset theory of ego depletion.
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Limitations and Future Directions

As noted earlier, this write-up is a preliminary version of a study that is still being completed. As such, in the complete version, there will be several additional analyses which will discussed later. Additionally, data collection will continue until I achieve 100 participants in each conditional group for a total of 200 participants. This goal exceeds the suggested N for ego depletion research. Thus, it is possible that the final results and conclusion might be different from the ones reported here with the addition of those subjects.

Another limitation was that I did not exclude on the basis of performance for the first task. Normally, it would be quite important to at least do an additional analysis of the data set excluding all those performing at less than chance accuracy. In other words, one should exclude those who are not engaging fully with the depletion/control task or who do not understand instructions to assure that the original findings were not affected substantially by those performances. Yet, when I analyze the final data set, I will conduct analyses excluding those on the basis of performance for task 1 in order to acknowledge this drawback of my current design.

Additionally, given the way I constructed my first task, it would have been possible to track performance through the task to discern if there is a pattern in the rate of ego depletion, i.e. a potential decline in accuracy and performance over the duration of the task. I not only lengthened previously used tasks, but plan on analyzing performance over the extent of the task. In doing so, I created a more reliable means of tracking performance by simply having more trials and a larger data set to work with, lessening the likelihood of outlying trials significantly affecting the analysis. Although this was not implemented for this honors thesis, it will be used in a future write up of this project. Outside of what I plan on doing on this specific project in the coming months, this experiment encourages us to consider many aspects of the concept of self-
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control which have not yet been considered. In the future, it would likely be massively informative to explore the effect of domain matching on the ego depletion effect. Additionally, continued null results in support of the strength model may lead to an entire restructuring of the field’s understanding of self-control.

With a major goal simply being to try to replicate the previous effect, it is clear that there is a massive issue in the field in terms of replication. Lurquin and Miyake (2017) discusses how it is obvious that replication in psychological research needs to be incentivized and encouraged. It seems hugely problematic to continue to develop new research on the basis of research that is largely unconfirmed. This is more a problem of the culture of publishing. As of right now, researchers are encouraged to develop original ideas for experimentation rather than being encouraged to confirm previous effects and research. Thus, researchers explore a lot of interesting new ideas but it remains unclear as to whether or not the original effects are reliable. Given the course of ego depletion research, this may be the case with the strength model. In other words, original research was not necessarily badly done by any means, there was simply a lack of confirmative efforts to assure the originally discovered effects were reliable.

Generally, it seems that ego depletion research needs to largely restructured and reformed given the previous research in the field. Since much recent research has had such problem replicating evidence in favor of the strength model or the mindset theory of self-control, it seems necessary to consider alternative explanations for the original effects. These explanations may include the low sample sizes of early research in combination with publication bias, resulting in a large body of research of published studies with significant effects that may not accurately represent or capture the effect. Moreover, the body of published research may skew the calculation of the effect size. The strength model or the mindset theory may be accurate but if
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that is the case, it seems the effect sizes of each case – particularly the strength model – has been massively overestimated. Not to mention the fact that there are multiple other explanations for this possible effect.

It is possible that ego depletion may be extremely sensitive to experimenter bias, as the lab I conducted the current study through has continuously found null effects for ego depletion. Lurquin et al. (2016), a previous replication attempt from our lab, found no significant evidence for ego depletion. Additionally, our lab’s contribution to the Hagger et al. (2016) meta-analysis was similarly nonsignificant, but in the direction of a negative ego depletion effect. Thus, eliciting an ego depletion effect may be related and highly sensitive to experimenter influence. The researchers in the lab which conducted my research are highly trained and regimented; they follow scripts for explaining the various instructional portions of the experiment and are trained on the appropriate responses to give in the event of additional questions from participants. Yet, given the lack of evidence our lab has found in support of ego depletion, it is possible that there are factors associated with our research assistant protocol which results in no discernable effect.
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Appendix A: Questionnaire Items

Belief About Willpower 1 (Job et al., 2010):

For the following scale, all questions marked with (R) were reverse coded.

Subset 1 – Strenuous Mental Activity:

1. Strenuous mental activity exhausts your resources, which you need to refuel afterwards (e.g. through taking breaks, doing nothing, watching television, eating snacks).
2. After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again.
3. When you have been working on a strenuous mental task, you feel energized and you are able to immediately start with another demanding activity. (R)
4. Your mental stamina fuels itself. Even after strenuous mental exertion, you can continue doing more of it. (R)
5. When you have completed a strenuous mental activity, you cannot start another activity immediately with the same concentration because you have to recover your mental energy again.
6. After a strenuous mental activity, you feel energized for further challenging activities. (R)

Subset 2 – Resisting Temptations:

7. Resisting temptations makes you feel more vulnerable to the next temptations that come along.
8. When situations accumulate that challenge you with temptations, it gets more and more difficult to resist the temptations.
9. If you have just resisted a strong temptation, you feel strengthened and you can withstand any new temptations. (R)
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10. It is particularly difficult to resist a temptation after resisting another temptation right before.

11. Resisting temptations activates your willpower and you become even better able to face new upcoming temptations. (R)

12. Your capacity to resist temptations is not limited. Even after you have resisted a strong temptation you can control yourself right afterwards. (R)

Belief About Willpower 2 (Savani & Job, 2017):

1. Imagine you are working on a very difficult task that requires your full concentration for 1 hr. Do you believe that right after this, you would feel tired and sleepy, or would you feel fresh and energetic?

2. Imagine you are working on a very difficult task that requires a lot of concentration for 1 hr. Do you believe that right after this, would it be more easy to concentrate on a different task that is also difficult and requires a lot of concentration, or would it be less easy to concentrate on another difficult task?

3. Imagine you are working on a very difficult task that requires a lot of concentration for 1 hr. Do you believe that immediately after this, you would need a break before you can work on another difficult task that also requires a lot of concentration, or would you be able to concentrate on another difficult task right away without any break?

4. Imagine you are working on very difficult math problems that require a lot of concentration for 1 hr. Do you believe that immediately after this, you would make more silly mistakes on a difficult math test that requires a lot of concentration, or would you make less silly mistakes on a difficult math test?
Depletion Sensitivity Scale (Salmon et al., 2014):

1. When I’m tired, I can’t say no.
2. After I have worked very hard at something, I am not good at reloading to start a new task.
3. I get mentally fatigued easily.
4. When I am (mentally) fatigued, I am easily tempted to do things that are actually no good for me.
5. After I have made a couple of difficult decisions, I can be truly mentally “depleted”.
6. After I exerted a lot of mental effort, I need to take a rest first before I can do another complicated task.
7. It is hard for me to persist with a difficult task.
8. When I’m tired, I have difficulties doing something that needs to be done, instead of doing something fun (e.g., studying instead of watching TV).
9. I cannot make a good decision when I’m stressed.
10. When I’m tired, I have difficulties to suppress my emotions whenever that’s necessary (for example: not falling out with someone you’re angry with).
11. I have difficulties focusing my attention after I exerted a lot of mental effort.
12. When I’m tired I have difficulties concentrating.
13. At the end of a working day I often have difficulties staying focused.
14. When I’m tired I sometimes have difficulties to remain friendly or polite.
15. When I’m tired I rather buy something that I like, even when it’s expensive.

Self-Control Scale (Baumeister et al., 1998):

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

Action Control Scale (Kuhl & Kazén, 1994):

For the following questions, the answers which are bolded indicate the response which is ‘action-oriented’:

1. When I know I must finish something soon:
   (A) I have to push myself to get started.
   **(B) I find it easy to get it done and over with.**

2. When I don’t have anything in particular to do and I am getting bored:
   (A) I have trouble getting up enough energy to do anything at all.
   **(B) I quickly find something to do.**

3. When I am getting ready to tackle a difficult problem:
   (A) It feels like I am facing a big mountain that I don’t think I can climb.
   **(B) I look for a way that the problem can be approached in a suitable manner.**

4. When I have to solve a difficult problem:
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(A) I usually get on it right away.
(B) Other things go through my mind before I can get down to working on the problem.

5. When I have to make up my mind about what I am going to do when I get some unexpected free time:
   (A) It takes me a while to decide what I should do.
   (B) I can usually decide on something to do without having to think it over very much.

6. When I have work to do at home:
   (A) It is often hard for me to get started.
   (B) I usually get started right away.

7. When I have a lot of important things to do:
   (A) I often don’t know where to begin.
   (B) I find it easy to make a plan and stick with it.

8. When there are two things that I really want to do, but I can’t do both of them:
   (A) I quickly begin one thing and forget about the other.
   (B) It’s not easy for me to put the thing that I couldn’t do out of my mind.

9. When I have to carry out an important but unpleasant task:
   (A) I do it and get it over with.
   (B) It can take a while before I can bring myself to do it.

10. When I am facing a big project that has to be done:
    (A) I often spend too long thinking about where I should begin.
    (B) I don’t have any problems getting started.

11. When I have a boring assignment:
    (A) I usually don’t have any problem getting through it.
    (B) I sometimes just can’t get moving on it.

12. When I have an obligation to do something that is boring and uninteresting:
    (A) I do it and get it over with.
    (B) It usually takes a while before I get around to doing it.
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Appendix B: Task Instructions

*Depletion Condition (Antisaccade) Instructions:*

For each trial of this task, the first thing you will see is a + sign. The + sign will be positioned in the center of the screen and you should focus on the +. After a variable amount of time, the + sign will disappear and '=' (the 'cue') will flash on either the left or the right side of the screen. The cue will disappear after a very short amount of time, and a letter (B, P, or R) will appear on the OPPOSITE side of the screen as the cue. The letter will quickly be covered up by the number 8.

For each trial, the goal is to decide whether the letter you just saw was a 'B' or not. If it WAS a B, press 'F' for yes. If it was NOT a B (i.e., P or R), press 'J' for no.

Since the letter will appear only for a short amount of time, it is very important that you move your eyes away from the cue as soon as possible. If you do not, you will not have time to see the letter before it disappears.

*Control Condition (Prosaccade) Instructions:*

For each trial of this task, the first thing you will see is a + sign. The + sign will be positioned in the center of the screen and you should focus on the +. After a variable amount of time, the + sign will disappear and '=' (the 'cue') will flash on either the left or the right side of the screen. The cue will disappear after a very short amount of time, and a letter (B, P, or R) will appear on the SAME side of the screen as the cue. The letter will quickly be covered up by the number 8.

For each trial, the goal is to decide whether the letter you just saw was a 'B' or not. If it WAS a B, press 'F' for yes. If it was NOT a B (i.e., P or R), press 'J' for no.
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Since the letter will appear only for a short amount of time, it is very important that you move your eyes towards the cue as soon as possible. If you do not, you will not have time to see the letter before it disappears.

**SART Instructions:**

The *initial* set of instructions are as follows:

In the center of the screen, you will see words from two different categories. The object is to press the space bar every time you see a member of one category. For example, if the two categories were boy names and girl names, and the correct category is boy names, you should only press the space bar when you see a boy name.

Try to press the space bar as fast as you can when you see the words from the correct category. The words will appear quickly, followed by a string of XXXXXXXXXXX. It is okay to press the spacebar during the string of XXXXXXXXXXX.

You will practice on a few trials now, although you will do the actual task later. Try to press the space bar as fast as you can for boy names.

The *refresher* instructions read as follows:

You have finished the first task. Now you will do the second task following the same rules as previously described. You will be presented with a word in the center of the screen for a short amount of time, followed by a string of XXXXXXXXXXX.

For these real trials, the correct category is animals (e.g., mammals, birds, reptiles, amphibians, fish and bugs). Press the space bar when you see an animal, but not when you see a vegetable. This task will also include thought questions. During the task you may find yourself thinking about something other than the task. Please answer honestly when you see a screen that looks like this:
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What were you thinking about IMMEDIATELY before this screen appeared?

1. The task

2. Something other than the task

You will now do the real trials.
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References


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