



Erratum to “Motivation, personal beliefs, and limited resources all contribute to self-control”[☆]

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ABSTRACT

What effects do motivation and beliefs have on self-control? We tested this question using a limited resource paradigm, which generally has found that people show poor self-control after prior exertions of self-control. Recent findings have suggested that motivation and even belief in unlimited willpower can render persons immune to ego depletion. We replicated those findings, but also showed they are limited to cases of mild depletion. When depletion is extensive, the effects of motivation and subjective belief vanished and in one case reversed. After performing only one self-control task, the typical pattern of self-regulation impairment was ameliorated among people who were encouraged to regard willpower as unlimited (Experiment 1) or motivated by task importance (Experiment 2). Those manipulations failed to improve performance among severely depleted persons who had done multiple self-control tasks. These findings integrate ideas of limited resources, motivation, and beliefs in understanding the nature of self-control over time.

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Is self-control a matter of managing a limited energy supply or does it depend more on subjective beliefs and motivations? The purpose of the present research was to assess the contributions of motivation, mindsets, and limited resources in self-control. One current model says that self-control is best understood as a limited resource that becomes drained with use. In support of this model, studies have shown that after people exert self-control, they perform worse on other self-regulatory tasks (Baumeister, Vohs, & Tice, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010; Vohs & Heatherton, 2000).

Other research suggests self-control might be caused more by beliefs, motivation, or mindsets than limited resources. For instance, Schmeichel and Vohs (2009) found that pondering personal values offset the negative effects of depletion. Denson, Jacobson, von Hippel, Kemp, and Mak (2012) found that believing that one has ingested caffeine reduces aggressive responding after depletion. Muraven and Slessareva (2003) showed that offering incentives can overcome depletion, which some have taken to suggest that depletion is not an energy deficit but simply a lack of motivation. Job, Dweck, and Walton (2010) measured and manipulated beliefs, and showed that people who believed in unlimited willpower

were immune to ego depletion. They provocatively proposed that ego depletion is “all in your head,” in effect being a self-fulfilling prophecy due to the possibly mistaken belief that willpower is limited.

The present research addressed the question of motivation and personal beliefs by integrating the findings of Job et al. (2010) and Muraven and Slessareva (2003) with the broader set of ego depletion findings. Our goal was to build on the findings and insights from those works in order to create a broader understanding of self-regulation. More precisely, we hypothesized that personal beliefs and motivations can have substantial and significant effects on self-regulation under conditions of incipient or moderate depletion, but that such effects falter as the reduction of limited resources progresses to more profound levels. Thus, beliefs and motivations play an important role, but they are not the whole story.

Prior work has found that the effects of mild levels of ego depletion are susceptible to influence by attitudes and beliefs. Moller, Deci, and Ryan (2006) showed that making a few aversive, externally constrained choices caused ego depletion, but no such effect was found from making a few pleasant, autonomous choices. Vohs et al. (2008) replicated their findings but also showed that when many decisions had to be made, depletion was observed regardless of whether people enjoyed or disliked the process. Applying similar logic, we reasoned that manipulations of motivation and beliefs might well moderate the effects of mild levels of ego depletion but would have less impact when depletion was severe.

The broader implication would be that ego depletion is a real, potentially powerful condition, but that at mild and moderate levels its

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impact competes with other variables such as subjective beliefs and motivations. Relatively low levels of ego depletion would have relatively small effects, and these could be washed out or reversed by other variables. However, as the extent of energy depletion increases, the scope for influence by other variables would diminish. By analogy, a slightly tired person might perform at a high level when bolstered by subjective motivation or self-confidence – but severe exhaustion would take its toll regardless of such factors.

Ego depletion has been shown to involve self-regulation and self-control (Hagger et al., 2010; Richeson & Shelton, 2003), choice and decisions (Vohs et al., 2008), and rational thinking (Schmeichel, Vohs, & Baumeister, 2003). The procedures for the present studies used all three of these, to increase generality and reduce implicit demand characteristics. Our focus was on the availability of willpower for all tasks, rather than focused specifically on self-control.

Experiment 1

Experiment 1 followed Job et al. (2010) and manipulated belief in limited versus unlimited willpower. Extent of depletion was manipulated by having participants do zero, two, or four depleting tasks prior to the dependent measure. The prediction was that belief in unlimited willpower would counteract ego depletion (reflected in better performance on the dependent measure) when participants had simply done two tasks – but not when they had done four tasks.

Method

Participants

Eighty-three undergraduates (44 female) participated in exchange for extra course credit. Data from five participants were excluded because they failed to pay adequate attention to the tasks: Four participants' were found playing with their cell phones and one fell asleep. Participants were randomly assigned among six conditions in a 2 × 3 design.

Procedure

Participants came to the laboratory individually for a study on goals. The first task comprised the manipulation of willpower beliefs and consisted of having participants rate their agreement with biased questionnaire items (Job et al., 2010). One version of the questionnaire promoted belief in unlimited willpower with items such as "Sometimes, it can be very inspiring to think over a matter with great concentration." The other version promoted belief in limited willpower, using items such as "When you think over a matter with great concentration, it can be sometimes tiring." The eight items had high internal reliability ($\alpha = .90$ and $\alpha = .83$ for the limited and unlimited versions).

Next came the depletion manipulation. In the zero-task (no depletion control) condition, participants viewed products on a computer screen for 4 min and wrote phrases or words that occurred to them. They were told that in the end, they would receive one of the products they viewed. That was all. In the two-task condition, participants viewed the same products as in the zero-task condition but made choices from pairs of them for 4 min. They had been told their choices were real and binding: They would receive one of the options they had selected. (And they did.) Making such choices has been shown to cause ego depletion (Vohs et al., 2008). They also performed the Stroop task on the computer for 2 min, during which they had to type the first letter of the font's color, with the screen displaying the name of a color different from the font in which it appeared.

In the four-task (severe depletion) condition, participants first completed the choice and Stroop tasks as in the two-task condition. Next, they watched an excerpt from a comedy video (Eddie Murphy Raw; Townsend, 1987) under instructions to stifle their facial and emotional reactions (Gross, 1998; Schmeichel et al., 2003). Last,

they were given two pages of text and instructions on when to cross out appearances of the letter *e*. Following Baumeister, Bratslavsky, Muraven, and Tice (1998), they crossed out all *e*s on the first page, thereby acquiring the habit of crossing out every instance of the letter *e*; but for the second page they were instructed to cross out every *e* except in cases where a vowel appeared immediately after or two letters prior to the *e*. This required them to override the habit and refrain from crossing out all of the *e*s.

To summarize, this experiment used three conditions that varied in the demandingness of the self-control tasks. Some participants used virtually no self-control (zero-task condition), whereas others used a moderate amount (two-task condition) or used quite a bit (four-task condition) of self-control to perform their initial tasks. The conditions therefore differed in self-control energy, time, and task difficulty.

As dependent measures of self-control ability, all participants completed two measures. The first assessed preferences for delayed versus smaller but immediate rewards. Delay of gratification has been a powerful exemplar of self-control (Loewenstein, Read, & Baumeister, 2003; Mischel, Ebbesen, & Zeiss, 1972). Participants made six intertemporal choices regarding monetary preferences. These started with the choice between \$10 now and \$11 a week hence, with each successive item progressively increasing the latter amount by \$1, ending with the choice of \$10 now versus \$15 in a week (Green, Fristoe, & Myerson, 1994). No legal investment options guarantee a 10% return in a week, so economic rationality would dictate choosing the delayed option on all but the first trial. Hence the measure of self-control consisted of the number of times the participant favored larger delayed over immediate but smaller rewards.

The second measure was the Cognitive Estimation Test (CET; Bullard et al., 2004), comprised of 20 questions that require active, logical thinking and extrapolation in order to generate plausible estimates for unknown quantities (e.g., How much do a dozen, medium-sized apples weigh?; Shallice & Evans, 1978). The CET comes with scoring norms. Two points were given for answers that were between the 25th and 75th percentile of the response range. Responses outside the 90% range were given 0 points, and the (intermediate) rest received 1 point. Thus, high scores indicate better performance. CET scores have been used as a measure of self-control by Schmeichel et al. (2003), who found that decision makers' ability to form reasonable answers to somewhat nebulous questions relied on self-regulatory resources.

Results and discussion

Manipulation check

Following Job et al. (2010), we calculated a manipulation check by comparing the mean in each condition against the scale midpoint of 3.5. A one-sample *t*-test found that both willpower theory conditions endorsed the scale items more than the midpoint: limited ($M = 2.11$, $SD = .58$, $t(77) = 15.32$, $p < .001$); unlimited ($M = 2.31$, $SD = .57$, $t(77) = 12.65$, $p < .001$). Thus, participants agreed with the theory of willpower that was consistent with the bias in their questionnaire.

Self-control

Both measures of self-control were analyzed using a 2 × 3 analysis of variance (ANOVA) with willpower theory (limited versus unlimited) and self-control tasks (0, 2, or 4) as between-subject factors. CET scores were predicted by the interaction of willpower and self-control task conditions, $F(2, 72) = 4.65$, $p < .02$. The main effect of self-control depletion condition was also significant, $F(1, 72) = 9.91$, $p < .01$. The main effect of willpower theory was negligible, $F < 1$ (Fig. 1).

Planned comparisons elucidated the interaction. In the zero-task (no depletion) condition, willpower belief did not alter performance on the CET, $t(72) < 1$. In the two-task condition, participants who had been induced to believe in unlimited willpower outperformed

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