

Restoring the self: Positive affect helps improve self-regulation following ego depletion [☆]

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Abstract

Previous work has shown that acts of self-regulation appear to deplete a psychological resource, resulting in poorer self-regulation subsequently. Four experiments using assorted manipulations and measures found that positive mood or emotion can counteract ego depletion. After an initial act of self-regulation, participants who watched a comedy video or received a surprise gift self-regulated on various tasks as well as non-depleted participants and significantly better than participants who experienced a sad mood induction, a neutral mood stimulus, or a brief rest period.

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One of the most powerful and dramatic features of human psychology is the capacity for volition, including choice and self-regulation. Recent work has suggested that self-regulatory operations consume a resource that is depleted afterward. When people override their responses, they are subsequently less successful at controlling themselves or responding actively, even in a seemingly unrelated sphere of activity (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998; Vohs & Faber, 2007; Vohs & Heatherton, 2000). The implication is that some resource akin to energy or strength is expended in these processes, creating a state that has been dubbed ego depletion.

How can people recover from ego depletion and become again capable of effective self-regulation? Clearly, the self's resources do not remain depleted forever—otherwise the course of adult life would be a progressive (and most likely

rapid) downward spiral in the capacity for self-control. Rest and sleep seemingly provide one common way of replenishing the self's resources, but what else?

The present research was designed to investigate the possibility that positive emotion or mood may counteract ego depletion and facilitate self-regulation. That is, brief experiences of positive emotion may help the self reassert its volitional powers.

Several past findings make it plausible that positive emotional states would facilitate self-regulation even in a depleted self, although direct tests of the hypothesis have been lacking. Creativity, by definition, involves the production of new products or solutions, and so it is likely that the creative process involves overriding habit, routine, and other automatic responses. Positive emotion does appear to facilitate creativity (Isen, 1984, 1987), and one possible mechanism for this beneficial effect is that positive affect empowers the self to override standard, habitual, and other uncreative modes of thought.

Another possible link is the energizing effect of positive emotion. Thayer's (1989) biopsychological model of

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emotion proposes that emotions are linked to general bodily arousal, which has conscious components of energy (versus tiredness) and tension (versus calmness). In previous work, self-reports of physical tiredness have sometimes, but not always, increased after ego depletion (Baumeister et al., 1998; Muraven et al., 1998). Hence it seemed plausible that positive affect would counteract the tired aspect of depletion and effectively replenish the depleted resource.

The strongest suggestion that positive affect can replenish a depleted self-regulatory system is found in the work of Fredrickson and her colleagues. Positive emotions can undo some of the harmful physiological effects caused by negative emotions (e.g., Fredrickson, 2001; Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000) or even create an upward spiral of positive affect (Fredrickson & Joiner, 2002). Fredrickson and Levenson (1998) showed that positive emotions sped recovery from the cardiovascular sequelae of negative emotions. Participants were shown a fear inducing filmstrip, and after that they watched other filmstrips that elicited either positive, neutral, or negative emotions. Participants who viewed the films that induced positive emotions showed the most rapid return to their baseline levels of cardiovascular activation. Spontaneous smiling had similar effects. The implication is that one of the functions of positive emotions is to return the person to a neutral physiological state and undo the cardiovascular effects of negative emotions. If one of the roles of positive emotion is to return the body to its neutral state, it is plausible that positive emotion can counteract the negative effects of ego depletion.

Operationalizations

The self-regulation tasks used in the present studies adapted procedures used in previous self-regulation research, all of which were based on requiring participants to override responses. To manipulate ego depletion, some participants engaged in an initial self-regulation task. For Studies 1 and 3, we instructed participants to suppress thoughts about a white bear after planting the idea of that thought, based on a procedure by Wegner, Schneider, Carter, and White (1987). Stifling unwanted thoughts is a standard exercise in self-regulation (mental control). The manipulation in Study 2 (from Muraven et al., 1998) required participants to form a habit and then break it, and we assumed that breaking a habit is an important form of self-regulation. For Study 4, participants had to resist the impulse and desire to eat tempting, delicious snack foods (Baumeister et al., 1998).

To measure self-regulation, Study 1 measured how much of an unpleasant beverage participants could make themselves drink (thus requiring them to overcome their dislike of the taste; e.g., Baumeister, DeWall, Ciarocco, & Twenge, 2005). Study 2 measured persistence on a frustrating but solvable task, on the assumption that participants would prefer to move on and do something else and therefore had to push themselves to continue performing the task (Baumeister et al., 1998). Study 4 also measured persistence but

on an unsolvable task, which is presumably especially discouraging (Baumeister et al., 1998). Study 3 measured performance on a handgrip task, which requires physical stamina (Muraven et al., 1998). As one's hand grows tired and sore, one must exert self-control to resist the impulse to quit so as to continue squeezing the handles.

The emotion manipulations were likewise adapted from previous work. Giving people a surprise gift of this nature has been shown to be an effective way to create positive emotional reactions (Isen, 1984; Isen, Nygren, & Ashby, 1988), and so we used it to induce positive mood in Study 1. Studies 2 and 4 induced positive mood by having participants watch a videotape of a stand-up comedy performance by Robin Williams, and Study 3 used a stand-up comedy video featuring Eddie Murphy. These were compared against affectively neutral controls (a video about dolphin communication, or simply a rest period with no stimulus) and in Study 3 also a sad video with an excerpt from *Terms of Endearment* showing a mother saying goodbye to her young children as she prepares to die.

Study 1

Method

Fifty-one introductory psychology students took part for class credit. Two dropped out for dietary reasons and one's data were lost due to equipment failure (spilled Kool-Aid). They were randomly assigned among conditions in this and all subsequent studies. Upon arrival, each participant was told that the session actually consisted of two separate studies, a cognitive thought listing study and a health study. After giving informed consent, participants were asked to list all their thoughts for a 5-min period. In the thought suppression (depletion) condition, participants were also instructed to avoid thinking about a white bear during the task and to mark their recording sheet any time the thought of a white bear occurred to them. In the control (no depletion) condition, participants were told that participants in other conditions had to restrict various specific thoughts (like a white bear) but they were free to think about anything they liked. Participants were left alone to do the thought-listing task.

The experimenter returned for the mood induction phase. The experimenter explained that she had a small gift to thank participants (in addition to their credit) for taking part, and she gave them a small bag of candy tied with a ribbon. Participants in the neutral mood condition received a receipt verifying their participation. The experimenter said she was giving them these things now because the first experiment was finished.

All participants were moved to a different room for the second experiment, which was administered by a different experimenter (who was not informed of what condition the participant was in). They were told their task was to drink as much as they could of this beverage, which was healthful but tasted bad. It consisted of unsweetened orange Kool-Aid mix combined with water and vinegar, and pretest

Table 1
Results of 4 studies

Study	Neutral depleted	Neutral not depleted	Positive depleted	Positive not depleted	Measure of self-regulation
1	2.67	5.58	5.50	4.92	Ounces
2	326	498	496	555	Seconds
3	–11.3		+0.57		Sec (change)
4	8.83		12.55		Minutes

Note. Higher positive scores indicate better self-regulation on all measures. Study 3 also contained a sad mood condition with mean of –9.9.

participants rated it as moderately unpleasant. Newspaper and magazine articles were provided to explain that vinegar is good for one's health. Participants were asked to drink as many 1-ounce cups as they could. About 15 s after each cup, the experimenter asked "Are you ready for another cup?" until the participant refused. Participants were encouraged to eat saltine crackers after drinking the beverage. A final questionnaire was followed by careful debriefing with probe for suspicion. Crucially, no participant suspected that the two tasks were related.

Results and discussion

Manipulation check

Participants were asked to rate how tired, thoughtful, excited, happy, worn out, sad/depressed, angry, calm they had felt at the end of the thought-listing task. Participants who had to suppress their thoughts felt more tired than participants who had to list their thoughts, $F(1,43) = 27.43$, $p < .0001$ and more worn out than participants in the thought listing condition, it $F(1,43) = 32.89$, $p < .0001$, suggesting that the manipulation was effective at inducing depletion. No other effects were significant.

Drinking

Self-regulation was measured in terms of the total number of ounces of vinegar Kool-Aid participants drank. Table 1 presents the means. An ANOVA revealed a significant interaction between mood and initial task, $F(1,44) = 4.19$, $p < .05$. Neither the main effect for mood nor the main effect for initial task was significant, both $F_s < 2$, *ns*. Thus, positive mood did not increase drinking in general.

The main hypothesis was that a happy mood would replenish the self's regulatory capacity and thus offset the effects of the initial act of self-control. Consistent with this hypothesis, participants in the thought suppression/pleasant mood condition drank as many ounces of the beverage as the participants who did not have to suppress their thoughts, as Table 1 shows. These data suggest that the happy mood entirely eliminated the self-regulation impairment that initial act of self-control produced.

Study 2

The design and predictions for Study 2 were exactly the same as for Study 1, but all the procedures were changed.

Method

Participants were 93 students (52 male) from introductory psychology. Participants in the depletion condition were first given a page of text and instructed to cross out the letter "e" each time it appeared. Most participants quickly learned to scan the page and mark every "e," so that the habit was established. Then they were given a second page and told to cross out every "e" except if it was adjacent to another vowel or one letter removed from another vowel. Thus, the second page required participants to override (in some instances, on a case by case basis) their by now habitual response of marking every "e". No-depletion control participants did not perform any crossing-out task.

Each participant then viewed a film clip that had been selected and pretested for affective impact. Positive mood was induced by watching a comedy video, whereas neutral mood was evoked with the dolphin communication video.

The next task (the dependent measure) was then explained. It was a "Roll-Up" game, in which the apparatus requires the player to manipulate two metal rods so as to roll a ball uphill and then drop it into a goal. This version was poorly made and hence was exceptionally frustrating and difficult. The experimenter showed how to play and specified that she would not keep track of the participant's scores. The participant was told to ring a bell when he or she did not wish to play any more. The experimenter left the room but used a stopwatch to time the duration of persistence. When the bell rang, the experimenter returned, administered the final questionnaires, then debriefed the participant.

Results and discussion

Manipulation checks

Participants who watched the comedy video rated themselves as happier than those who watched the neutral video, both during, $F(1,88) = 25.82$, $p < .001$, and after the video, $F(1,89) = 15.27$. On items asking when the participant felt no emotion, neutral condition participants reported those non-feelings more than comedy-watching participants, again both during and after the film, $F(1,89) = 16.76$, $p < .01$, and $F(1,89) = 16.26$, $p < .01$, respectively.

Persistence

The dependent measure of self-regulation involved persistence on the task. The means are shown in Table 1. Because males liked the game more than females, we included gender as covariate. ANCOVA yielded main effects for depletion, $F(1,88) = 4.95$, $p < .05$, and mood, $F(1,88) = 5.04$, $p < .05$. A planned contrast comparing the depleted/neutral mood condition against the other three conditions combined was significant, $F(1,89) = 8.76$, $p < .01$. For that contrast, the depleted/neutral condition was weighted –3 and each other condition was weighted +1. Thus, the main prediction was confirmed. Ego depletion led

to relatively low persistence, but positive mood offset and counteracted that effect.

Study 3

Study 3 sought to replicate the beneficial effect of positive mood using yet a different measure of self-regulation (handgrip stamina performance). It also added a sad mood induction condition, in case all different moods might counteract the effects of regulatory depletion.

Method

Participants were 42 students (26 female) from introductory psychology classes. They were told the study was investigating cognitive and physical exertion. After giving informed consent, they furnished a baseline measure of handgrip stamina. The apparatus is a commercially available hand exerciser consisting of two handles and a metal spring. They were told to squeeze the handles together and maintain that grip for as long as they could. A small wad of paper was inserted between the far end of the handles, so that when the grip relaxed (under pressure from the spring) the wad would fall out, thereby furnishing a clear and objective signal to stop timing. The experimenter timed how long the participant held the handles squeezed.

Next, all participants performed the thought suppression exercise (as the depletion condition in Study 1). There was no no-depletion control.

For the mood manipulation, participants were told that they would have a 5-min break to relieve any effects of their exertion from the previous tasks before beginning the second series of cognitive and physical tasks. Participants in the positive affect condition were told that while they rested they would watch a brief humorous movie clip. Those in the neutral condition were simply told to take a 5-min break to rest, with no specific instructions. Those in the negative affect control group watched a sad movie clip depicting a dying woman saying her last goodbye to her two young sons.

After this rest period, all participants completed the Brief Mood Introspection Scale (Mayer & Gaschke, 1988). Then they performed the handgrip task again. They were then carefully debriefed, with probe for suspicion. In particular, no participant expressed any suspicion that suppressing thoughts should reduce handgrip squeezing performance, nor that positive affect should reduce that effect.

Results

Mood manipulation check

The BMIS furnishes separate measures of mood valence and arousal. On valence, participants who watched the comic movie were in a much more pleasant mood ($M = 12.21$) than participants who watched the sad movie ($M = .78$), $t(40) = 1.92$, $p < .06$. There was no difference on

arousal, $F < 1$, *ns*. Thus, the two film clips were equally arousing, but different greatly in affective tone. Also, the conditions did not differ as to how difficult or unpleasant they found the thought suppression task, nor in how much effort they reported exerting on the handgrip task.

Handgrip stamina

Change in handgrip performance was calculated by subtracting each participant's baseline duration from the final performance measure, and these scores are reported in Table 1. The one-way ANOVA revealed significant variation among conditions, $F(2, 39) = 2.95$, $p < .05$. Participants in the neutral and sad conditions gave up faster on the main trial (after the thought suppression exercise) than on their baseline trial, but those who watched the comedy video showed essentially no change. Planned comparisons indicated that participants who saw the comic movie outperformed participants in the neutral condition, $t(40) = 2.21$, $p < .05$ and participants in the sad condition, $t(40) = 1.96$, $p < .05$. The sad and neutral conditions did not differ in handgrip performance, $t(40) = .253$, *ns*.

Because experts disagree about the suitability of change scores, we tried analyzing final handgrip scores with baseline scores used as covariate. This ANCOVA produced similar (indeed stronger) results, indicating significant variation among conditions, $F(2, 38) = 4.53$, $p < .025$.

In addition, participants' mood valence was related to final performance on the handgrip after controlling for initial handgrip time, $F(1, 39) = 6.057$, $p < .025$. Arousal was not related to handgrip performance, $F(1, 39) = 3.64$, *ns*. These results suggest that, as predicted, positive affect helped counteract the depleting effect of previous exertion of self-control on a subsequent self-control task. Moreover, the improvement in self-control performance appears to have been specific to positive affect and was not a product of arousal, distraction, or other variables. In particular, sad participants reported emotional states that were just as powerful as those who watched the comedy, and so it is not strong emotion per se but rather positive emotion that seems able to counteract ego depletion.

Study 4

Method

Thirty students (18 females) from introductory psychology took part. Four additional ones were discarded, two because they had violated instructions to refrain from eating before the experiment, thereby undermining the depletion manipulation, and two because they claimed to have solved the unsolvable puzzles, thereby ruining the persistence measure.

Participants were asked to refrain from eating for 3 h prior to the session. Upon arrival, each participant entered a room filled with the aroma of freshly baked cookies and was seated at a desk holding a plate of still-warm cookies and M&M candies, as well as a bowl of rad-

ishes. The experimenter explained that the session would involve two separate experiments, one involving taste perception and then later one investigating spatial puzzle solving. They were also told they would watch a video between the two studies.

All participants were told that they had been randomly assigned to the radish-eating condition for the taste study and should therefore eat one or more radishes while refraining from eating any cookies or candy. The experimenter further requested that the participant not eat any chocolate or radishes for 24 h after the experiment, to allow for re-interview by phone regarding taste memory. The purpose of these instructions was to induce regulatory depletion by inducing a desire for chocolate and then getting the participant to resist that temptation, both during the session and for a full day afterward. Participants were left alone for 10–12 min to maximize the temptation, although surreptitious observation ensured that no participants ate any of the candy or cookies (none did, though some appeared to waver and even sniffed the cookies).

After this, the experimenter returned and escorted the participant to a different room, ostensibly to watch a video before the second experiment. Half the participants watched a comedy video, whereas the rest watched the affectively neutral (dolphin communication) video. A manipulation check then measured affect.

The dependent measure was introduced as the start of the second experiment. Participants were instructed to trace a diagram without lifting the pencil or retracing any lines. The experimenter demonstrated with an easy, solvable example and then gave the participant several more difficult (indeed unsolvable) ones to work on. The participant was told to work on the task as long as needed but that it was possible to end the task any time by ringing a bell to summon the experimenter. The participant was left alone (with the door open) to do the task, and the experimenter timed how long the participant worked (until ringing the bell to summon the experimenter). At that point the participant was debriefed, with probe for suspicion. In particular, no participant suspected any connection between the two tasks.

Results and discussion

Manipulation check

Participants who watched the comedy reported happier moods than those who watched the neutral (dolphin) video, both during, $F(1, 28) = 4.43, p < .05$, and after the film clip, $F(1, 28) = 5.71, p < .05$. The conditions did not differ in ratings of being tired, thoughtful, excited, worn out, angry, or calm.

Task persistence

As Table 1 shows, participants who watched the comedy persisted significantly longer than those who watched the affectively neutral video, $F(1, 28) = 4.27, p < .05$. Thus, again,

the positive mood induction appeared to counteract the effect of depletion.

General discussion

Self-regulation is an important key to successful human functioning, but it depends on the expenditure of a limited resource (akin to energy or strength), and so when that resource has been depleted by recent use, people are less effective at self-regulating. The resulting low-resource state of ego depletion can increase proneness to a variety of maladaptive behaviors, ranging from alcohol abuse to aggression (Muraven, Collins, & Nienhaus, 2002; Muraven, Collins, Shiffman, & Paty, 2005; Stucke & Baumeister, 2006). Anything that might counteract the tendency to fail at self-regulation during ego depletion would therefore have both practical and theoretical importance.

The present series of studies repeatedly showed that inducing positive emotion can counteract the effect of ego depletion. All these studies sought to create a state of ego depletion by having participants engage in an initial act of self-regulation and then measured self-regulation on another, seemingly unrelated task. For some participants, positive mood was induced in between the two self-regulation tasks. The positive mood resulted in improvement in self-regulation in all four studies, as compared to participants who performed the same self-regulation tasks but did not have positive mood induced.

We used different procedures and measures to reduce the chances of methodological artifact and alternative explanation. Ego depletion was induced by having participants suppress a forbidden thought (Studies 1 and 3), having them form a habit of crossing out all instances of “e” and then override that habit based on a more complex rule (Study 2), and having them resist the temptation to eat cookies and candy (Study 4). The positive mood inductions included two different comedy videos (Studies 1, 3, and 4) and a surprise small gift (Study 1), and these were compared against an affectively neutral video (Studies 2 and 4), a sad video (Study 3), a rest period with no stimulus (Study 3), and giving a receipt for participation (Study 1). The dependent measures of self-regulation included making oneself drink a bad-tasting though healthy beverage (Study 1), persistence on a difficult and frustrating but achievable skill task (Study 2), persistence on unsolvable puzzles (Study 4), and change in handgrip physical stamina (Study 3). Clearly the results cannot all be explained as stemming from some possible chance remark in one video, or feeling indebted to the experimenter for the gift, or refusing to waste time on unsolvable puzzles.

Moreover, the manipulation and measure of self-regulation were sometimes presented as part of the same investigation (Studies 2 and 3) and sometimes as part of ostensibly separate experiments (Studies 1 and 4), so the results do not depend on any perceived connection or lack thereof. No participants in any study inferred the

hypothesis or surmised that the different procedural steps were connected, so demand characteristics cannot explain these results—indeed, even if the participants had wanted to help confirm the hypothesis, they would not have known what to do. The experimenter who administered the measure in Study 1 was blind to condition and therefore could not have biased the results, deliberately or unwittingly.

Further, the present results suggest that it is specifically a positive mood that counteracts ego depletion. Study 3 showed that an induced sad mood failed to have the same beneficial effect. It also showed that mood valence rather than arousal appears to be the crucial factor. Moreover, Studies 1 and 2 confirmed that the improvement in self-regulation was limited to the depletion condition, insofar as the positive mood failed to have any significant effect on the behavior of participants who had not done the initial task. The implication is that the beneficial effect of the positive mood worked by counteracting the effect of ego depletion rather than causing a broad improvement in self-regulation across the board.

Some aspects of the inner process by which positive mood counteracts ego depletion remain for future research to elucidate. In particular, we cannot be sure whether positive mood actually replenished the resource that had been depleted by the initial self-regulation, as opposed to merely making participants more willing or motivated to continue self-regulating despite their depleted state.

In conclusion, the capacity of the self to exert control over itself, make choices, initiate behavior, and perform other acts of volition is one of its most important functions of the self as well as being highly adaptive. This function is however fairly costly, insofar as it depletes some psychological resource. In many circumstances, people can avoid expending these resources by relying on automatic processes, but sometimes it is necessary or desirable to use the more costly controlled process—whereupon the self is left in a depleted and hence vulnerable state afterward. Although the present results are preliminary, they do suggest one antidote for this weakened state: A dose of positive affect seems to have remarkable power to restore the self's capacity and willingness to exert control and volition. This may well prove to be one of the most important, adaptive, and far-reaching benefits of positive affect.

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