

## EGO DEPLETION: A RESOURCE MODEL OF VOLITION, SELF-REGULATION, AND CONTROLLED PROCESSING

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Making choices, responding actively instead of passively, restraining impulses, and other acts of self-control and volition all draw on a common resource that is limited and renewable, akin to strength or energy. After an act of choice or self-control, the self's resources have been expended, producing the condition of ego depletion. In this state, the self is less able to function effectively, such as by regulating itself or exerting volition. Effects of ego depletion appear to reflect an effort to conserve remaining resources rather than full exhaustion, although in principle full exhaustion is possible. This versatile but limited resource is crucial to the self's optimal functioning, and the pervasive need to conserve it may result in the commonly heavy reliance on habit, routine, and automatic processes.

Many of the woes that have afflicted human beings relentlessly for centuries seem eminently avoidable if people would only use their powers of reason to make sensible, deliberate choices. When some line of action leads to disaster, bystanders and guardians shake their heads and ask questions such as "What were you thinking? Why on earth did you do that? Didn't you know better?" From spiritual advisors and gurus to existential philosophers, the wise have exhorted people to focus their full conscious attention and freedom of will on what they are doing. At a more mundane level, parents, teachers, and other guardians frequently berate young people for impulsive actions. Crime, violence, unwanted pregnancy, drug addiction, venereal disease, bankruptcy, and premature deaths could be greatly reduced if people would only do what they already know they should. Whatever the joys and rewards of impulsive behavior may be, the costs are immense, and many impulsive acts are eventually regretted as foolish and self-destructive.

The persistent human failure to curb impulse and choose thought-

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fully is not only a major root of personal and social problems, it is also an endlessly fascinating issue for psychology. In the final analysis, the human penchant for bringing avoidable woe on oneself challenges psychology's view of the human being as a rational, information-processing creature guided by self-preservation motives and able to calculate his or her enlightened self-interest. Human beings are set apart from all other earthly creatures by the high extent of their exceptional capacity to control and regulate their own behavior. Why don't people use this capacity more often, for their own benefit?

The present article will propose one central reason for the human failure to regulate one's own behavior (including thoughts and feelings). The central idea is that controlling oneself—especially when this involves overriding one's own impulses, habits, or established tendencies—consumes some limited resource. This resource resembles an energy or strength. When it is depleted, people become less able to control themselves.

The term *control* has a rich history in psychology, and among its influential usages is the recent distinction between automatic and controlled processes (Bargh, 1982, 1997; Schneider & Shiffrin, 1977; Wegner & Pennebaker, 1993). The automatic-controlled distinction is relevant to the present work. The self is the controller of controlled processes, and so the self must expend its resources to exert control. The widespread reliance on automatic processing, habit, routine, and similar patterns may well reflect the fact that it is costly to the self to exert control. Exercise of free will or conscious, deliberate choice exacts a toll on the self, and the self may wish to avoid paying this price much of the time.

### THE SELF AS A STRENGTH RESOURCE

Our central theoretical argument is as follows. There exists a resource that the self uses for a broad variety of volitional activities. These activities include overriding response tendencies such as habits or impulses, making a conscious or deliberate choice, and initiating action (as opposed to being passive). In broad terms, the self's executive function, including all acts of controlling or altering the self and all acts of decision making and initiative, depends heavily on this resource.

We propose that this resource resembles strength or energy. After the self makes some exertion, such as to resist temptation or make a deliberate choice, the self is likely to be depleted. In homage to Freud (1923/1961, 1933/1961), who was one of the first theorists to propose an energy model for the self—or *ego*, in his terminology—we have adopted the term *ego depletion* to refer to this state of diminished volitional resources (Baumeister, Bratslavsky, Muraven, & Tice, 1998a).

Two hypotheses about this resource are crucial. First, the same resource is used for a broad variety of the self's operations. The self does not have different resources for use with affect regulation, performance enhancement, thought suppression, impulse control, active initiative, and responsible choosing. Rather, we propose that the same resource is used for all of these. Given the adaptive power and value of all these activities of the self, the common resource must be regarded as extremely important. Indeed, we think it is one of the self's most important aspects.

Second, the resource is quite limited. As we shall argue, ego depletion is a fairly common occurrence (for review, see Muraven, Baumeister, & Tice, in press). We already suggested that self-control failures are widespread in modern society. If ego depletion does contribute significantly to these failures, then it must be because people are often depleted. A likely reason for this frequency of depletion is that the resource itself is not extensive. If people had an unlimited supply of this energy, then volition would pose no problem, and people would rarely be depleted.

### REGULATORY STRENGTH

The idea that self-regulation involves consuming a limited resource emerged from a review of self-regulatory failures by Baumeister, Heatherton, and Tice (1994). Impressed by such facts as that diets are broken most often and impulsive crimes are most frequently committed late in the evening, when people are tired, and that addictive relapses and other breakdowns occur when people are under stress, these authors speculated that self-control seemed to depend on some form of strength. Like a muscle, the capacity for self-control seemed to lose effectiveness after being used (akin to fatigue).

The strength model of self-regulation was tested in a series of experiments by Muraven, Tice, and Baumeister (1998). In these studies, participants performed consecutive yet seemingly unrelated acts of self-control, to ascertain whether the second act showed signs of impairment as a result of having done the first act. In Study 1, people who tried to regulate their emotions while watching a sad, upsetting video clip subsequently had poorer stamina on a physical endurance task than people who had seen the same video but had not tried to regulate their emotions. The effects were found regardless of whether participants tried to amplify or stifle their emotional response to the film. Thus, trying to alter one's emotional state apparently depleted some resource that could have been used later to make oneself persist at the handgrip endurance task despite muscular fatigue and pain. The second experiment by Muraven et al. (1998) manipulated efforts to control thoughts. Following the procedure developed by Wegner, Schneider, Carter, and

White (1987), some people were asked to list their thoughts while also trying to avoid any thoughts about a white bear. Others were simply asked to list their thoughts. (An additional control group heard mention of the bear but were not instructed to control their thoughts.) Later, the researchers measured how long participants persisted on a difficult, discouraging task (actually unsolvable anagrams). People who had tried to suppress their thoughts gave up faster on the subsequent anagram task. Thus, trying to regulate their thoughts depleted some resource that might otherwise have helped them persist in the face of failure on a difficult, discouraging task.

Further evidence was provided in two additional studies by Muraven et al. (1998). Trying to regulate thoughts (as in the white bear suppression task) impaired people's subsequent ability to control their emotions, as measured by how much people smiled and laughed in response to a comedy video after they had been instructed to suppress all such displays of mirth. Participants who had to suppress the thought of a white bear reported the same mood, level of arousal, and frustration, and they exerted the same amount of effort, as participants who did not have to exert self-control. The only difference between the two conditions was the amount of self-control required. Last, people's autobiographical narratives of self-regulation failure contained ample signs that such failures occurred when people were depleted because of other demands.

Impulse control was missing from the Muraven et al. (1998) investigation, but a later investigation showed that impulse control consumes the same resource as the others. Baumeister, Bratslavsky, Muraven, and Tice (1998a) exposed food-deprived participants to severe temptation by leaving them alone in a room with cookies and chocolate candies. (Moreover, the cookies had just been baked in the same room, so the delicious aroma pervaded the person's surroundings.) Instead, they were told, they had been randomly assigned to eat only from a bowl of radishes, which they found considerably less appetizing than the chocolates and cookies. For comparison purposes, one control group was permitted to eat from the more desirable foods, and another control group was not tempted with any food. All groups were then tested for persistence on a geometric figure-tracing task, which was actually unsolvable. This measure was adapted from Glass and Singer (1972; modified from Feather, 1961), who used it to measure frustration tolerance and regulatory persistence.

Once again, the findings showed that acts of self-control deplete an important resource. People who had resisted the tempting foods and ate radishes later gave up significantly faster on the figure-tracing task than people in either of the control groups. Apparently, resisting temptation consumed some resource that was then unavailable to help them regulate their task performance.

A subsequent investigation found a similar effect with children (Muraven, 1998b). Children who had to resist the temptation of playing with an attractive toy were subsequently poorer at self-control demonstrated by their inability to draw a line slowly, as compared with children who could play with an attractive toy. There was no sign that mood or emotions moderated these effects.

The notion that resisting temptation draws on the same resource as other acts of self-control predicts that depletion should also have effects in the opposite direction: self-control exercises, such as thought suppression, should impair the ability to resist temptation. One of us recently tested this with adult male social drinkers. Half the sample was initially put through the exercise of suppressing thoughts of a white bear, whereas control participants did not have any initial depletion of self-control. All participants were then told they were going to take a driving simulation test that would include a prize for good performance. Before taking the test, they were given a chance to drink beer. They should have been motivated to limit how much they drank, to avoid impairing their driving performance (and perhaps costing themselves the prize). Participants who were depleted from having performed the thought-suppression exercise were less able to regulate their drinking; they consumed more beer and became more intoxicated than control participants (Muraven & Collins, 1999).

Taken together, these studies suggest that the self uses one common resource for a broad variety of acts of self-control. The four main spheres of self-regulation—controlling thoughts, affect regulation, impulse control, and performance regulation—were all implicated in these studies, and exertions in one of them led to subsequent impairments in another. The reservoir of energy or strength that the self uses for these acts of self-control must be counted among the most important aspects of the self.

These findings also suggest that the resource involved is quite limited. Five minutes of resisting the temptation to eat forbidden cookies, a brief period of trying not to show any sadness when watching a distressing film clip, or a few minutes' worth of trying not to think about a white bear are small acts of self-control that were sufficient to produce significant reductions in subsequent self-control efforts. In fact, people who had resisted the chocolate temptation for 5 minutes showed more than a 10-minute reduction in their persistence on the unsolvable puzzles later. The ego is apparently quite vulnerable to depletion. Work in other areas and laboratories has provided converging evidence. Influential stress studies by Glass and Singer (1972; for review see also Cohen, 1980) found that coping with unpredictable noise extracted what they called a "psychic cost" in that it reduced subsequent performance on proofread-

ing, frustration tolerance, and the Stroop Color-Word task (all of which involve self-control), compared with people who coped with predictable noise, controllable noise, or no noise. The unpredictable noise presumably is most difficult for people to adapt themselves to, and so self-regulatory resources should be most depleted in that condition, hence the subsequent impairments in self-control.

Addiction research is also relevant because recovering from an addiction presumably requires considerable resistance to temptation, and so the self's resources should be depleted as a result. The common complaint that people gain weight once they quit smoking has been explained in many different terms, including symptom substitution in oral cravings and an appetite-suppression effect of nicotine, but ego depletion offers another possible explanation: because the difficult task of resisting cigarettes drains the self's resources, so the person cannot simultaneously regulate eating effectively. This explanation has the added advantage that it fits the greater impact that smoking cessation has on dieters (Duffy & Hall, 1988). Thus, trying to regulate eating (by dieting) and smoking (by quitting) simultaneously may exceed the self's resources, and eating increases. In contrast, non-dieters are by definition not trying to regulate their eating, and so quitting smoking does not compete with dieting for the self's same resources. As a result, quitting smoking does not lead to an increase in eating among non-dieters.

Evidence about recovery from alcohol also suggests that ego depletion may play a role. Alcoholics who abstain from drinking have been reported to exhibit increases in irritability, nervousness, obsessive thoughts, and impaired concentration (Ludwig & Stark, 1974), all of which suggest impaired self-control (i.e., in regulating affect and thought).<sup>1</sup>

Meanwhile, coping with stress consumes regulatory resources, too, and such coping is associated with smoking relapse. That is, former smokers are more likely to give into temptation and take up the habit again after regulating and coping with stress (Shiffman et al., 1996). To conclude, a broad range of converging evidence from multiple sources, including controlled studies of special populations and laboratory tests with normal students, confirms the view that self-regulation depends on

1. To be sure, other explanations are possible. Addictive withdrawal may directly cause some of these effects, with or without depletion. Likewise, alcohol serves important functions in enabling people to escape self-awareness (Hull, 1981), and inability to escape the self may cause some degree of stress (Baumeister, 1991). Still, even if these alternative causal processes are correct, depletion may make an independent contribution, and depletion may also contribute to spiral processes with escape from self (Vohs & Baumeister, in press).

a limited resource. The self cannot control itself effectively in multiple spheres simultaneously or even sequentially.

### CHOICE AND VOLITION

Self-control is not, of course, the only controlled process or the only form of volition. Would ego depletion patterns extend to involve choice and initiative? Several studies have focused on this question.

The first attempt was reported by Baumeister et al. (1998a). That study borrowed a choice procedure from cognitive dissonance research (Linder, Cooper, & Jones, 1967). According to this widely used procedure, people are induced to make counterattitudinal speeches. In one condition, their own responsible choice is made salient to them, such as when the experimenter says, "I want to make it clear that the decision whether to perform this task is entirely up to you." In contrast, other participants are told that they have no choice or are simply given instructions on what to do without asking for their consent or decision. Many studies have used this procedure to investigate cognitive dissonance processes, and typically the choice manipulation is followed by a measurement of the dependent variable of attitude or attitude change. For present purposes, however, the attitudinal consequences were irrelevant. Our question was whether making a deliberate, responsible choice would deplete the ego, causing an impairment in a subsequent, seemingly unrelated task. Linder et al. (1967) had reported that people in the free-decision condition typically paused for up to 30 seconds to think about the issue before agreeing to the procedure. That half minute presumably involved some intrapsychic decision-making process that could well entail some expenditure of the self's resources.

The dependent measure that Baumeister et al. (1998a) selected for this experiment was the same one used in the chocolate versus radish study: persistence on the unsolvable geometric figure-tracing task. As expected, participants gave up faster when they had previously gone through a choice process to perform the counterattitudinal behavior, as opposed to merely being assigned that same behavior. Somewhat surprisingly, people who had chosen to perform a pro-attitudinal behavior—in this case, to make a speech favoring low tuition rates—showed the same degree of depletion as those who chose the counterattitudinal behavior. Thus, depletion resulted from the act of choice, regardless of the behavior that was chosen.

A more recent study by Baumeister, Twenge, and Tice (1998) has confirmed that making choices can deplete the self. In this study, people were instructed to make a large number of choices. Under the guise of marketing research, people were confronted with a long series of

pairwise choices among products, such as between different kinds of candy bars, differently scented candles, or different colored t-shirts. They were told that their choices would have personal relevance, insofar as at the end of the study they would receive one of the products they had selected. Control subjects merely rated the same products without making choices between them.

Afterward, self-control was measured by seeing how many ounces of an aversive drink people could make themselves consume. Kool-Aid, which has an artificial fruit flavor that (with sugar added) appeals to small children but is generally disliked by adults, was taken unsweetened (i.e., sour) and mixed into a combination of equal measures water and vinegar. The appallingly bad-tasting product was poured into 1-ounce paper cups. Each participant was told that the drink would be healthful but bad-tasting and was encouraged, with the added incentive of a promised payment of five cents per ounce, to drink as much as possible. Although people may desire to consume a healthy drink and earn money, the awful taste of the drink was a profound disincentive, and so people must exert self-control to consume very much.

Once again, the results suggested that acts of choice can be depleting. People who had made choices between products consumed significantly (and substantially) fewer ounces of the drink than people who had merely rated the products. Although the choices were themselves fairly easy and minor, they appear to have accumulated to produce a fatigue effect on the self. Depleted by those choices, participants were unable to make themselves drink as much as participants in the control condition.

These results showed that an act of volition could have the same effect on self-control as a previous act of self-control. To ensure that the relationship was symmetrical, it was necessary to show that acts of self-control could impair subsequent volition in some sphere other than self-control. Baumeister et al. (1998a) accomplished this by showing increased passivity resulting from regulatory depletion. Participants were taught an easy task in which one reads a text and crosses out all instances of the letter "e." Participants were then told to perform a similar task with additional rules, such as not crossing out any "e" that was adjacent or two letters removed from another vowel. These rules required people to override (repeatedly) their newly acquired habit of crossing out every "e," and the overriding satisfied the definition of self-control. In contrast, control participants solved three-digit multiplication problems, which are difficult and mentally taxing but do not involve self-regulation (because one simply follows well-learned procedures rather than having to override incipient responses).

After the initial task, passivity was measured. People were shown a film

of a boring movie and given control over how long they would sit and watch it. For half, continuing to see the movie was passive while quitting was active: They were told that the movie would continue until they pressed the button in front of them, whereupon it would stop. For the others, quitting was passive, whereas continuing required the active response. They had to keep pressing the button to see more of the movie, and the film would stop if they did nothing. Such procedures have been used in previous work to measure or manipulate passivity (Allison & Messick, 1988; Cioffi & Garner, 1996; Fazio, Sherman, & Herr, 1982). By comparing duration of viewing in the active quit versus passive quit conditions, one can assess the relative degree of passivity. Baumeister et al. (1998a) found that depleted participants (who had done the "e" task) were more passive than people in the control (arithmetic problem) condition.

The results of these studies indicate that the self's energy resource is used even more broadly than in self-control. Acts of choice and active initiative apparently draw on the same resource as acts of self-control. The implication is that the self's entire executive function (i.e., the "agent") relies on a small resource that works like an energy well or a muscle and becomes depleted after use.

### CONSERVATION OR EXHAUSTIVE DEPLETION?

We have summarized evidence that acts of self-control or volition deplete some resource, resulting in impairments in subsequent acts of self-control or volition. There are, however different ways that this could come about. One possibility is that the self's resources become severely depleted, like a muscle reaching total exhaustion, after even the relatively simple laboratory tasks we have used. In that case, the self would be unable to perform as well for a time afterward. On the other hand, an alternate possibility is that the initial act of self-control only partly depletes the self. In that case, it could perform effectively afterward, if necessary, but if the need is not great then the self might seek to conserve its diminished resource. To use the muscle analogy, this response would resemble the way that some athletes conserve their energy once they begin to get tired. An athlete in that state might seek economy of movement and might even avoid chasing balls that he or she judges to be poor prospects for success (unlike a fresh athlete who might try for every shot).

This question holds considerable interest for understanding the self. If the self's executive function is genuinely and fully depleted in these studies, to the extent that it would be unable to perform better, then the volitional resource is severely limited. Many people on many occasions would be simply incapable of exercising self-control or making a decision. In contrast, if the conservation hypothesis is correct, then the self's

resource is actually somewhat greater than first appears, and many impairments of self-control or volition might well reflect a decision on the part of the individual to let go to conserve resources in case an emergency arose. Given the broad power and potential adaptive benefits of the self's executive function, some deeply rooted pattern of conserving a diminished resource would be in the individual's best long-term interests. After all, being able to make effective, conscious decisions or to restrain dangerous impulses can be extremely helpful and possibly even life preserving.

This question invokes a version of the ongoing debate about self-control failure. Does it occur because irresistible impulses overwhelm the person, or does it arise when people indulge themselves or otherwise permit their control to lapse? Baumeister et al. (1994) concluded from an extensive review of the literature on self-control failure that some degree of acquiescence is the norm. Relatively few instances of self-control failure involve truly irresistible impulses.

The question of whether depletion leads to conservation or to genuine incapacity was investigated in laboratory work by Muraven (1998a). In one study, he used the simple procedure of offering people money for self-control once they were depleted. More precisely, depleted participants were instructed to drink as much vinegar Kool-Aid as possible. Some were offered 25 cents per ounce, which could potentially add to a sizeable sum. (One participant earned over \$10 American in this condition, although he had to drink 40 ounces of vinegar Kool-Aid.) Others were offered only one cent per ounce.

The results favored the conservation theory. The high reward (25 cents per ounce) eliminated the effects of ego depletion. Even when people have already expended some of the self's resources, they can perform well if the stakes are high. Impairments are introduced mainly when the stakes are low. This, of course, would be precisely the pattern of optimal adaptation: conserve the self's valuable remaining energy when it can be done safely and with little cost, but continue to expend it when the immediate situation offers important outcomes.

The pattern of conservation was shown in a further study by Muraven (1998a). People were initially depleted and then assigned a second self-control task. Before the second task, some were alerted that a third task was to follow and that this one would require a difficult exertion of self-control. Specifically, they were told that the third task required them to refrain from laughing at a comic video, and the video was described as so funny that it was extremely hard to avoid laughing. These people, who had an incentive to conserve their resources, gave up faster on the second task (cold pressor, which involves holding one's hand in a bucket of ice water for as long as possible). People who had been equally de-

pleted on the first task but did not anticipate a third self-control task did better on the second task.

These results support the reassuring conclusion that the self's ability to function is not (even temporarily) destroyed after a brief episode of resisting temptation, controlling emotions, suppressing thoughts, making choices, or similar tasks. Full depletion remains a theoretical possibility, but it would probably require considerably more exertions by the self to reach that point. Possibly some of the patterns observed among trauma victims or burnout sufferers reflect genuine and extensive depletion of the self. Among participants in our laboratory studies, however, the consequences of depletion are probably mediated by some attempt at conservation. Once the self has exerted self-control or made a choice, it recognizes that its resources are somewhat diminished, and it seeks to conserve the remaining resources.

Informal observations from other work also point toward conservation. Vigilance research, for example, has established that vigilant performance deteriorates steadily over repeated trials (Parasuraman, 1984), and the observed patterns suggest that ego depletion may be at work. Researchers in this area have found, however, that the deterioration stops and even typically reverses when the participant knows that the study is almost over. To most vigilance researchers, this pattern represents merely an annoying bit of error variance, and they handle it by removing the participant's wristwatch beforehand and not letting him or her know when the end of the procedure is imminent. To us, however, it suggests that the decline in vigilance reflects depletion and conservation, where the participant conserves resources for the long, demanding task, but when the participant knows the study is almost over, he or she feels free to expend more of the remaining regulatory strength.<sup>2</sup>

## BUILDING AND REBUILDING

Traditional metaphors for the capacity for self-control include will-power and strength of character. Both power and strength can be used to describe muscles, and so these views have depicted the faculty of self-control as resembling a muscle. The findings on ego depletion do make the muscle analogy plausible. Like a muscle, the person's capacity

2. Researchers who study sleep deprivation have told us of similar patterns. The longer someone goes without sleep, the worse he or she performs, except that as the contracted period of sleeplessness approaches its end, the person may abruptly perform better again. The implication is likewise that the sleep-deprived person conserves resources until the end of the ordeal is imminent.

for self-control becomes fatigued after exertion, whereupon the person begins to conserve the remaining power.

If the muscle analogy is to prove apt, however, a further prediction must be tested. In the long run, muscles gain strength from exercise. Can self-control also be improved by exercise?

There is some evidence to suggest that the answer is yes. For example, alcoholics who have succeeded in breaking that addiction are subsequently more successful than others at conquering the addiction to smoking nicotine (Breslau, Peterson, Schultz, Andreski, & Chilcoat, 1996; Zimmerman, Warheit, Ulbrich, & Auth, 1990). Overcoming one addiction may build the strength necessary to overcome another. Even within the same problem, people who succeed at self-cure generally do so only after multiple attempts (Schachter, 1982). This pattern suggests that they in some way get better at quitting smoking, and one plausible mechanism for this gradual improvement is an increase in strength through exercise.

Still, it seemed desirable to conduct a direct test of the hypothesis that exercise can strengthen self-control. Because the short-term effect of exercise is opposite to the long-term one, a one-shot laboratory study provides a poor way of investigating the possible strengthening of self-control through exercise, and so a longitudinal design is needed. One preliminary version of this was conducted by Muraven, Baumeister, and Tice (1999). Participants were assigned various self-control exercises to perform for a 2-week period. One group was assigned to try to improve posture (e.g., sitting and standing straight). Another kept a diary of foods eaten. Another was told to engage in affect regulation as often as possible.

Both before and after the 2 weeks of exercise, participants underwent laboratory measures of self-control and depletion. By comparing performance before versus after the exercise period, the researchers were able to conclude that the two weeks of exercise did lead to improvements in self-control, at least relative to a control group who did not perform exercises during the intervening two weeks.<sup>3</sup>

A muscle can gain strength either in terms of power (for maximum exertion) or stamina (resistance to fatigue). In the longitudinal study, the

3. Unfortunately, the overall significance of the finding was partly because of the fact that the control group performed worse at the second occasion, which may have been caused by students' exertions in connection with midterm exams (and coincided with the week of the second testing). The experimental groups (who received their follow-up testing the same week and therefore might also have been expected to suffer and adverse effect of exams) showed slight improvements in absolute terms. Further research is clearly needed on this point.

improvements in self-control conformed to the stamina pattern rather than increased power. At the second laboratory session, people who had been exercising self-control were less affected by a depletion manipulation, but their initial level of self-control did not differ from the control group or from their own baseline 2 weeks earlier. These results tentatively suggest that the first benefit of exercising self-control is a greater capacity to resist the debilitating effects of ego depletion.

Although the results combined from all experimental groups showed an overall benefit of exercising self-control, the results were not consistent across type of exercise. The posture exercise was most successful at improving self-control. In contrast, the affect regulation exercise yielded results no different from the no-exercise control group. Thus, if one seeks to improve self-control, the exercise of trying to regulate one's feelings is not promising. Possibly this is because people often regulate their emotions anyway. Alternatively, it may be because affect regulation typically relies on indirect strategies (e.g., distracting oneself, or seeking pleasure) rather than direct control, and so the person fails to use and hence fails to exercise the "muscle," that is, the ego's capacity for control.

Although these results are preliminary and require further investigation, they do alter the implications that could be drawn from the ego depletion studies. Those studies consistently found impairments of self-control, choice, and volition following from acts of self-control, and some people might conclude from them that the most prudent or desirable strategy is to avoid exerting self-control whenever possible (so as to avoid depleting the valuable resource). This would hardly be a socially desirable message, but it could be reasonably inferred from the evidence that self-control depletes the ego. In contrast, the longitudinal findings suggest that regular exercise of self-control may be far more beneficial to the individual in the long run, because it may increase the capacity for control and volition.

Any consideration of the possibly harmful effects of depletion must address the question of how the ego replenishes the resources that have been expended. It does not seem plausible that once the ego has exerted itself through choice or control, the resources it expended are permanently gone. Longitudinal findings suggest the opposite; like exercising a muscle, acts of self-control and volition cause short-term fatigue but the capacity recovers to an even stronger level after a period of rest.

Rest and especially sleep do seem to restore the self's powers of volition. Many observations suggest that people can regulate themselves more effectively when they are well rested (e.g., in the morning) than when they are tired (e.g., late in the day, or when deprived of sleep; for review see Baumeister et al., 1994). For example, smokers who were abstaining from smoking performed much more poorly on a test of vigi-

lance (or attention regulation), compared with to their performance when they were allowed to smoke. The longer the period of abstinence, the worse the smokers performed. Moreover, after sleeping, abstaining smokers performed much better, which led the authors to conclude "...many of the psychological effects of smoking abstinence may build-up fresh each day" (Parrott, Garnham, Wesnes, & Pincock, 1996; p. 391). Similarly, dieters mainly break their diets at night, when presumably they are tired from regulating their eating all day (Grilo, Shiffman, & Wing, 1989; Stunkard, Grace, & Wolff, 1955). Likewise, it seems that for bulimics, most binges occur late in the day, when the person is tired and the self's resources are depleted (Johnson & Lason, 1982).

The opportunity to rest and recover seems crucial to the success of self-control. In fact, Hartmann and Brewer (1976) found that the need for sleep increases during times of stress or emotional disturbances. Presumably, dealing with stress or strong emotions requires considerable self-regulation and therefore self-control strength. People who are stressed need to rest, possibly to regain the self-control strength needed to deal further with the stress. Meanwhile, sleep deprivation appears to cause progressive impairments in the capacity for self-regulation, consistent with the idea that sleep is essential for replenishing the depleted resource. For example, sleep deprivation leads to worsening moods, decreased ability to concentrate, and reduced motivation (Mikulincer, Babkoff, Caspy, & Sing, 1989). Sleep deprivation has also been found to cause apathy, anxiousness, and irritability (Murray, 1965). Although sleep deprivation may be an unusual and artificial extreme, a similar pattern of findings has emerged regarding sleep disturbances. Sleep disturbances, such as insomnia and sleep apnea, are linked to psychopathologies such as depression, anxiety, and obsessive-compulsive disorder (Coursey, Buchsbaum, & Frankel, 1975; Kales & Kales, 1975; Marks & Monroe, 1976; Monroe, 1967; Monroe & Marks, 1977). Lack of sleep may undermine people's ability to exert self-control. For example, anxiety may cause insomnia, and the resulting tiredness may reduce people's capabilities to deal with anxious feelings. In a study of uncommonly tired undergraduates, Montgomery (1983) concluded that fatigue is both a cause and a result of emotional disturbance.

Apart from sleep and rest, is there any way to restore a depleted self? Preliminary studies by Baumeister, Dale, and Tice (1998c) suggest that positive affect can have such an effect. These studies induced ego depletion by having people learn to cross out every "e" in printed text and then have to override that habit to follow more complex rules about crossing out only certain instances of "e." Depletion led to impaired performance on solvable anagrams (Study 1) and to reduced persistence on a difficult task (Study 2), but these effects were eliminated among people

in whom a positive emotional state had been induced by having them watch a brief comic video just before the final task. Although these results are encouraging, they must be regarded as tentative and preliminary given the many competing theories about how emotional states affect cognitive processing, persistence, and self-regulation, and because one control condition in the first study produced an unexpected and ambiguous performance mean.

If further work does continue to support this pattern, it could have valuable implications for both theory and application. In practical terms, knowing that positive affect replenishes the self's resources could be useful for people who wish to restore their capacity for self-regulation or decision-making after a depleting experience. Meanwhile, emotion theory might recognize that restoring the self is an important function for positive emotional states.

### IMPLICATIONS FOR MOTIVATED COGNITION

Although the research on ego depletion has only begun to address issues of motivated cognition, several lines of implications for theory development and future investigation can be articulated. Clearly, the most direct implications concern the regulation of cognitive processes *per se*. We have already discussed simple regulation patterns, such as vigilance (i.e., controlling attention), concentration, and thought suppression. Regulation of more complex cognitive processes is also possible, however. Baumeister and Newman (1994) proposed that these be analyzed according to intuitive scientist and intuitive lawyer models. The scientist is understood as a truth seeker, and so this model corresponds to attempts to increase accuracy in inference and decision making. In contrast, the lawyer is employed to make the best possible case for a predetermined conclusion, and so the regulatory goal is to guide cognitive processes toward the preferred endpoint.

Prejudice is one sphere in which the quest for the truth may conflict with preferred conclusions. Individual differences exist in the degree of motivation to avoid prejudice (Dunton & Fazio, 1997). Prejudice may often operate in an automatic fashion, whereas controlled (regulatory) processes are necessary to override prejudice and arrive at unprejudiced conclusions (Devine, 1989). Depletion should therefore produce more prejudiced judgments, at least among people who normally try to resist prejudice.

We have some preliminary evidence consistent with this notion, although replications are needed before conclusions can be drawn with confidence. In preliminary studies, Caucasian participants who scored high on motivation to control prejudice were affected by ego-depleting

procedures. When not depleted, these people typically rated Caucasian and African American stimulus persons equally. When they were depleted, however, their ratings of the African-Americans became more negative. People who scored low in motivation to avoid prejudice showed no difference as a function of ego depletion (Muraven, Baumeister, Dhavale, & Holland, 1999). Thus, ego depletion increased prejudicial responses only among people who normally try to inhibit such responses, suggesting that, for these people, overcoming prejudice depends on the self's volitional resources.

In general, people describe themselves quite favorably, especially when communicating with relative strangers, and this favorability appears to be an automatic pattern (Tice, Butler, Muraven, & Stillwell, 1995). Paulhus and Levitt (1987) concluded that people have a pattern of "automatic egotism" such that the default or automatic response is to depict the self in highly favorable terms. Modesty and judicious self-criticism require a controlled response to restrain the self-enhancing tendencies (Banaji & Steele, 1989). Hence, ego depletion should make people more boastful, confident, self-enhancing, and otherwise favorable about themselves. We have some preliminary findings consistent with this view: after ego depletion such as the white bear suppression task, people rated themselves more favorably on a variety of measures (Baumeister & Sommer, 1998).

On the other hand, the Freudian view that defense mechanisms consume energy is plausible and would suggest that the effects of ego depletion may be more complex than a simple push toward egotistical inflation. Freud's defense mechanism theory was probably psychology's first theory about motivated cognition, and recent laboratory work has provided fairly good support for many specific parts of that theory (for review see Baumeister, Dale, & Sommer, 1998). Negative, critical feedback may threaten one's self-esteem, and warding off this threat can involve regulatory efforts to override the immediate implications, reframe the implications, and otherwise discredit and defuse the threat. Under some circumstances, therefore, it is plausible that ego depletion would weaken the self's defenses by depriving one of the energy required to function. As a result, self-esteem would become more vulnerable than usual to threat and loss.

### CONCLUSION

Energy models are far out of fashion in contemporary psychology. Yet modern psychology has also failed to provide an adequate understanding of the self's executive function, and it is possible that the avoidance of energy models has contributed to the inability to understand this crucial



feature of the self. In this article, we have suggested that one important feature of the self is a resource that operates like strength or energy. Acts of volition—choice, decision making, active instead of passive response, and self-regulation—consume this resource. Viewed in this way, the self cannot be reduced to being simply a cognitive structure or a residue of interpersonal, societal processes. Cognitive structures and interpersonal processes are important to the self, but so is this resource of energy that the self uses when it takes action.

Our research has begun to provide a picture of this vital resource that the self uses. First, the same resource is apparently used in many seemingly different acts. The self does not use different resources for making choices, restraining impulses, suppressing thoughts, and conquering passivity; instead, the same resource appears to be involved in all the self's diverse acts of volition. The broad application of this resource underscores its importance for psychology's understanding of the self.

Second, the resource appears to be quite limited. A small or brief exertion often seems sufficient to affect the self afterward, such as by impairing subsequent self-control or increasing passivity. In study after study, evidence indicates that regulating the self or making a choice in one sphere causes impairments of volition in otherwise unrelated spheres. Even when these research findings are understood as efforts to conserve diminished resources instead of truly exhaustive depletion, it is apparent that the available resource is so small that people automatically start to conserve after even a seemingly brief and minor exertion.

The small size of the resource stands in sharp contrast to its broad usage. Many different activities make demands on the same small quantity of energy. This puts the self's daily operation in an important perspective. Like a high-level administrator with a very tight budget, the self must find some way to stretch a small resource to accomplish a great deal. We began this article by noting the paradox that people do not more regularly guide their behavior by rational, enlightened calculations. In retrospect, it is impressive that the self typically does as well as it does. Poor decisions and uncontrolled behavior are to be expected when optimal behavior depends on a resource that is all too easily depleted.

We noted preliminary evidence that exercising self-control can increase the capacity, apparently by strengthening the energy resource that the self uses for volition. In a sense, this is encouraging, for it entails that many current personal and social problems could be ameliorated if people were to increase their strength of character (a traditional term for this resource) by exercising it regularly. In another sense, however, this view is discouraging, because many forces in modern life (e.g., permissive and indulgent parenting, decline of moral standards, advertising, media glorification of impulse and rule breaking, youth gang subcul-

tures) seem to conspire against self-control. The idea of building character by frequent exercise of self-control has an archaic, Victorian connotation. Unless it can be made more relevant and appealing to modern citizens, the 21st century is likely to see further escalations in the broad range of personal and social problems that involve the self's failure to control itself.

The contrast between the broad usages and limited quantity of the self's volitional resource has another important application. Theorists have recently debated how much of current behavior is guided by automatic processes instead of controlled ones. Bargh (1997) noted that the automatic sphere has expanded steadily as new research findings are reported, and he proposed that the influence of truly controlled, deliberate volition may be vanishingly small. Our work suggests why it may be and remain small: it is costly. If volition depends on a limited resource, then the only adaptive, efficient approach to life is to rely heavily on habit, routine, and other automatic patterns most of the time.

Yet even if controlled processes and deliberate volition are a small part of life, they may be decisively important. Many lives are crucially shaped by only a handful of important decisions. Baumeister and Sommer (1997) used the analogy of a steering wheel: Although most cars are probably driven straight ahead 95% of the time, a car without a steering wheel is not 95% as good as a car with one. The proportionally few moments of changing direction are disproportionately important for reaching one's goals. Likewise, the self's small number of acts of deliberate volition may be decisive for enabling it to reach its goals. The limited resource that the self uses for these acts may be among its greatest gifts. Although the resource may seem small in comparison to what we might like it to accomplish, it is probably immensely greater than what any other creature on earth has.

In the first chapter of the Judaeo-Christian Bible, Adam and Eve eat from the Tree of Knowledge and learn the difference between good and evil. The god Yahweh evicts them from the garden, saying that they would become gods themselves if they were to follow up their snack with an apple from the other tree (which conferred eternal life). The implication is that knowing good and evil brings human beings halfway to the status of gods. Our research findings would amend that myth slightly. Not only the knowledge of good and evil, but (also) the ability to alter one's behavior so as to conform to positive standards and goals, is what has elevated human beings above the other creatures in nature's garden. The volitional resource that the self uses for self-regulation and other controlled processes is arguably the most important spark of divinity in human nature. Although it is perhaps a regrettably small spark, its value and cumulative impact can be immense.

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## PRECONSCIOUSLY CONTROLLING STEREOTYPING: IMPLICITLY ACTIVATED EGALITARIAN GOALS PREVENT THE ACTIVATION OF STEREOTYPES

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The current research showed that individuals with chronic egalitarian goals did not have the cultural stereotype for the group African Americans activated when exposed to a picture of an African American. These individuals did show increased accessibility for words related to egalitarianism upon seeing a photograph of an African American. Participants were primed over a series of trials with Caucasian or African American faces. Primes were followed after 200 ms by words. In Experiment 1, a pronunciation task, participants were to speak the word aloud into a microphone. The words were either stereotype relevant or stereotype irrelevant. Individuals without chronic egalitarian goals pronounced stereotype relevant (but not stereotype irrelevant) words faster when they followed stereotypic primes. Chronic egalitarians did not differ in their response times as a function of either word type or prime type: no activation of the stereotype was evidenced. Experiment 2 was a lexical decision task, and words were either related to egalitarianism or were positive words irrelevant to egalitarianism. Chronic egalitarians pronounced egalitarian-relevant (but not egalitarian-irrelevant) words faster when

Experiment 1 was run as the senior thesis for Constance M. Taylor, Princeton University class of 1996.

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