



Ego Depletion and Self-Control Failure: An Energy Model of the Self's Executive Function

ROY F. BAUMEISTER

Case Western Reserve University
Cleveland, Ohio, USA

The ability of the self to alter its own responses, including thoughts, emotions, impulsive behaviors, and performances, is powerfully adaptive, and failures of self-control contribute to most personal and social problems. A program of laboratory studies suggests that self-control depends on a limited resource, akin to energy or strength. Acts of self-control and, more generally, of choice and volition deplete this resource, thereby impairing the self's ability to function. These effects appear after seemingly minor exertions because the self tries to conserve its remaining resources after any depletion. Rest and positive affect help restore the self's resources.

Nearly all living things have the capacity to respond to their environments. Some of these responses are innately prepared, and others are learned. When a particular situation or stimulus is encountered, the response flows quickly and reliably. Human beings differ from most other species, however, in that they have an extraordinary capacity to override their responses and change how they act. This capacity involves altering their internal states and processes, and it is responsible for the unprecedented scope and diversity of human behavior. The terms *self-regulation* and *self-control* refer to this capacity to alter or override one's responses, including thoughts, emotions, and actions. (In general, *self-regulation* is the broader term, encompassing both conscious and unconscious processes and sometimes referring to all behavior guided by goals or standards, whereas *self-control* refers more narrowly to conscious efforts to alter behavior, especially restraining impulses and resisting temptations. The distinction is not important in our work.)

Several influential theorists have argued that self-regulation is a kind of master function that integrates many of the self's other activities and processes (e.g., Higgins, 1996). My own efforts to impose some order on the welter of research on the self, proposed that the self is based on three basic experiences which can be used as organizing principles (Baumeister, 1998). The first is the basic awareness of self, which develops into self-knowledge, self-esteem, self-perception, and other cognitive structures. The second involves interpersonal processes such as self-presentation. The third is the executive function, which involves both externally-oriented acts of choice, active initiative, and volition, and internally oriented processes of self-regulation.

Received 15 September 2001; accepted 10 October 2001.

This work was made possible by grant MH-57039 from the National Institutes of Health. It is based on an address to the National Institutes of Health in June, 2000.

Address correspondence to R. Baumeister, Department of Psychology, Case Western Reserve University, Cleveland, OH 44106-7123. E-mail: rfb2@po.cwru.edu

The purpose of this article is to provide a brief overview of the research program that my colleagues and I have conducted in the effort to gain a greater understanding of how the self controls and regulates itself. The central idea is that self-control operates on the basis of a limited resource, akin to energy or strength, that can become depleted through use. The depleted self is then less able to carry out further acts of self-control. The resource is used not only in self-control but also in other acts of volition, and indeed it may be the basis for the self's entire executive function.

Importance of Self-Control

The benefits of self-control can scarcely be overstated. Most major personal and social problems that face the United States involve some degree of failure at self-regulation (see Baumeister, Heatherton, & Tice, 1994, for review). These include addiction, alcohol abuse, drug abuse, eating disorders and binges, unwanted pregnancy, AIDS and other sexually transmitted diseases, debt and bankruptcy, lack of savings, violent and criminal behavior, underachievement in school and work, procrastination, lack of exercise, and cigarette smoking, all of which could be reduced or eliminated if people controlled their behavior better.

Evidence for the benefits of self-control emerged from research with a new trait scale developed by Tangney and Baumeister (2000) to measure individual differences in self-control. People who scored high in self-control reported better outcomes in a broad range of spheres. They had higher grade-point averages in college. They reported fewer eating disorders and alcohol abuse problems. They had less psychopathology and fewer mental health problems across the board. (There was no sign of curvilinearity, contrary to the hypothesis that excessive self-control is linked to obsessive-compulsive symptoms or other problems.) They had better and more stable interpersonal relationships. They had fewer emotional problems and managed their anger better.

Other work has extended these findings. Tice and Baumeister (1997) found that procrastinators (who regulate their time-limited performances ineffectively) suffered greater stress and health problems than other students and also ended up with poorer grades. Engels, Finkenauer, den Exter Blokland, and Baumeister (2000) found that adolescents with high self-control were less likely to engage in delinquent misbehavior such as fighting, vandalism, and petty theft, and they also had better relationships with their parents.

In sum, our work converges with other findings to indicate that self-control is extremely beneficial. In fact, one person's good self-control seems to benefit not only that person but other people around that person and even society at large. Self-control may be contrasted with self-esteem, which at present is widely cultivated and is often regarded as a cause of positive outcomes but which in empirical fact has shown surprisingly little in the way of direct benefits or desirable consequences. If it were up to me to set national policy in psychological matters, I would recommend replacing the cultivation of self-esteem with the cultivation of self-control.

Strength Model

My work has focused on how the self overrides its responses and changes its inner states. This can be regarded as the "operate" phase of the feedback-loop model articulated by Carver and Scheier (1981, 1998). The feedback loop is a supervisory process that tests the current state against standards such as goals and expectations.

When the self is found to fall short of its standards, the feedback loop initiates a process of change in order to bring it closer to its goal. Whereas Carver and Scheier emphasized the testing process, our work has focused on how the change is brought about.

Based on a review of the literature on self-regulation (Baumeister et al., 1994; Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000), we began to suspect that it operated like a strength or energy reserve, akin to the traditional notion of willpower (see Mischel, 1996). A strength model would predict that performance at self-control would grow worse during consecutive or continuous efforts, just as a muscle becomes tired.

We conducted a series of experiments to see what happened to self-control in two consecutive tasks. If self-control operates like an energy or strength, then the first act of self-control will consume some quantity of this resource, and so the person will face the second task with a diminished capacity to engage in self-control. The findings repeatedly supported the strength model. Thus, in a first study (Muraven, Tice, & Baumeister, 1998), people were randomly assigned to regulate their emotions (either amplifying or suppressing their emotions) or not to regulate them while watching a sad, distressing video clip. Afterward, on a seemingly unrelated measure of physical stamina (squeezing a handgrip), the people who had regulated their emotions gave up faster than people who had not engaged in affect regulation. It made no difference whether they had tried to amplify or suppress their emotions—both led to decrements in subsequent stamina. Apparently, trying to regulate emotion consumed some resource that was then less available to help people perform the stamina task.

Another study required people to regulate their thoughts, using a procedure adapted from research on thought suppression (Wegner, Schneider, Carter, & White, 1987). All participants spent several minutes listing whatever thoughts came into their minds. In the crucial condition, participants were told that they could think about anything they wanted except a white bear. After the thought-listing exercise, participants were given a set of anagrams to solve. In reality they were unsolvable, and we measured how long they kept trying before giving up. The people who had tried to suppress the white bear thoughts gave up significantly faster than people in the other conditions (Muraven et al., 1998). Another study showed that suppressing thoughts impaired affect regulation subsequently, in that people were less able to refrain from smiling and laughing in response to a comedy video clip (Muraven et al., 1998). Thus, again, these studies suggested that the first act of self-control depleted some resource of the self, thereby impairing its ability to regulate itself effectively on the second task.

A vivid demonstration of the depletion of inner resources was provided in an investigation using temptation and impulse control (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Participants in the crucial condition were seated in front of a tempting display of chocolates and cookies after having skipped a meal, but they were told to refrain from eating those tasty foods and instead were supposed to eat only from a bowl of radishes. Afterward, these people gave up much faster on a geometric figure tracing puzzle, as compared to people in either of two control groups (one of which was permitted to eat the cookies and chocolates, and the other of which was never exposed to food of any kind). Thus, resisting temptation depleted the self's resources, leaving it less capable of persisting in the face of failure.

The muscle analogy suggests that, with steady exercise, strength and stamina should gradually increase. We tested this hypothesis in a longitudinal study

(Muraven, Baumeister, & Tice, 1999). Over the course of two weeks, participants performed various exercises in self-regulation, such as improving their posture, keeping track of what they ate, or regulating their emotions. These participants then showed significantly improved self-control (on laboratory measures) relative to a control group of participants who had not performed such exercises. To clarify, there are in principle two ways in which strength could be improved, and we found only one of them. Exercise may give a muscle greater initial power or it can give it more stamina (so that it can continue to perform at top capacity for a longer time). We found the latter, not the former. The exercises in self-control appear to have improved people's ability to resist the debilitating pattern of resource depletion.

Alternative explanations could be suggested for some of these findings, and we have conducted additional studies to rule them out. These include (a) the view that early quitting depends on recognizing the tasks as impossible, (b) the view that participants feel they have done enough to satisfy the experiment already before the measure, (c) the possibility that the self-control task was more unpleasant than the control conditions, and (d) the notion that the first exertion of self-control creates negative affect which impairs the willingness to control the self on the second task. Readers interested in those debates may wish to consult the empirical publications (Baumeister et al., 1998; Muraven et al., 1998). Those articles also considered alternative models of self-control, including ones that depicted it as based on cognitive schemas and knowledge structures or as a skill.

Taken together, these results suggest that a broad assortment of self-regulatory efforts draw upon a common resource and deplete it. The capacity for self-control depends on a single stock of a resource that operates like an energy or strength. Our procedures involved most of the major kinds of self-regulation—specifically, we had people regulate their thoughts, their emotions, their impulses, and their task performance. In most studies, the manipulation involved one domain and the dependent measure a different domain. A common resource is thus used for these seemingly diverse acts of self-regulation. Moreover, the resource seems fairly limited because even brief and seemingly minor exertions in our laboratory tasks were sufficient to deplete it.

Choosing and Deciding

Having concluded that self-control depends on a single, common resource, we returned to consider the self's executive function more generally. Modern self theory has made relatively less progress in understanding the executive, agentic functions of the self than in understanding other aspects of the self (see Baumeister, 1998). A possible reason for this relatively slow progress would be that an energy model was needed to understand how the self chooses, decides, initiates action, and the like. Energy models are far out of fashion in modern psychological theory, and so it seemed plausible that there might be a link between the failure to use energy models and the failure to understand the self as agent.

In short, might the same energy resource used in self-regulation also be needed for other operations of the executive function? We conducted several additional studies to see whether depletion of regulatory resources would affect the self's decision-making and vice versa.

The first of these studies borrowed the choice procedures from cognitive dissonance research. Linder, Cooper, and Jones (1967) found that dissonance only occurred when people went through an inner process of deciding and agreeing to

perform the counterattitudinal task. Baumeister et al. (1998) adapted the manipulation of high or low perceived choice to make a counterattitudinal speech. Instead of measuring subsequent attitudes as dissonance researchers have done, however, we measured persistence on unsolvable geometric puzzles, just as in the radish and cookie experiment described earlier. As predicted, the people who had consented under high choice to make the counterattitudinal speech gave up faster on the unsolvable puzzles, as compared to people who were simply told to make the same speech without having been given any choice in the matter. Thus, making a responsible choice apparently depleted the same resource that was used for self-regulation, producing the same essential effect as we had found by making people resist eating the tempting cookies and chocolates.

Subsequent work has yielded similar conclusions. Twenge, Tice, Schmeichel, and Baumeister (2000) required people to make a long series of choices about commercial products, and this series of choices depleted them, as indicated by their relatively poor ability to make themselves consume a bitter beverage. Control condition participants furnished ratings of their prior usage of the same products, but this did not seem to deplete their ability to make themselves drink the aversive liquid.

Decisions thus affect self-control—would self-control also affect decisions? In yet another study, we had people first regulate their behavior by having to form and then break a habit (of crossing out all instances of the letter “e” in a page of text). This procedure made people more likely to take the passive option in a decision task. In other words, people were more likely to take the line of least resistance, even if it was not to their advantage. Although further replication of this pattern seems desirable, the evidence does suggest that the initial act of self-regulation depleted a resource that would be useful for active volition and rendered people more passive. Thus, again, the same resource is used in self-regulation as in making choices.

The energy resource indicated by our results is thus not restricted to self-control but appears to be central to the self’s executive function generally, including acts of choice, volition, active instead of passive responding, and taking responsibility. We therefore favored the term *ego depletion* to describe the condition that arises when the self’s resources have been expended and the self is temporarily operating at less than full power.

Conservation or Exhaustion?

The self’s capacity for regulating itself appears to be limited. For example, Baumeister et al. (1998) found that a mere five minutes of resisting the temptation to eat cookies and making oneself eat radishes instead reduced subsequent persistence on difficult puzzles from 21 minutes to 8 minutes—a difference of approximately two standard deviations.

But how limited is it? There are two ways to interpret these findings of ego depletion. One is that the self’s capacity for regulating itself is indeed radically reduced even by these seemingly minor laboratory manipulations. According to this view, the self’s stock of energy is extremely small.

On the other hand, one could read these findings as indicating conservation rather than exhaustion. According to this view, the initial exercise does deplete the self’s resources, not to a catastrophic degree, but enough to motivate the person to conserve what is left. This view would be most consistent with the analogy to a muscle. Athletes do not exert themselves at maximum output right up to the point of exhaustion. Rather, once their muscles begin to have fatigue, they conserve their energy. In the same way, the self might be conserving its reduced resources in case an urgent decision had to be made or a powerful impulse needed to be stifled.

Evidence of conservation was provided by Muraven (1998) who showed that the effects of ego depletion could be resisted if the stakes were high enough. When relatively substantial amounts of money were contingent on performance on the second self-control task, people were able to perform well despite having engaged in a previous self-control task. If the self's resources were truly exhausted, the incentives would make little or no difference, because the self would be utterly incapable of further regulation. Instead, the results suggested that the depleted self simply disdains to exert itself for relatively unimportant tasks and instead conserves its energy for important tasks.

Muraven's (1998) second study provided a different kind of evidence for conservation. The main part of the design was the same as in other studies, namely having people perform two consecutive (but seemingly unrelated) acts of self-control. The crucial change was that prior to the second task, some people were told that there would be a third task that would also require self-control. These people gave up significantly faster than other participants on the second task—presumably because they were saving their resources for the third task.

Taken together, these results suggest that the self's capacity for self-regulation is indeed limited, but not as limited as one might think at first blush. Acts of self-regulation and volition deplete the resource, but they do not exhaust it utterly. Rather, the depletion is sufficient to set off a conservation process. New challenges are apparently evaluated for their importance. If they are not highly important, the self holds back from exerting itself, but when something important does arise, the self is willing to expend more of its remaining resources.

Replenishment

Somehow, the resources expended by acts of self-control and volition are gradually replenished. (If they were not, then each act of depletion would be permanent, and the self would soon cease to function altogether!) Sleep and rest provide one way to replenish the self. Assorted evidence about patterns of self-control failure reviewed by Baumeister et al. (1994) indicated that well-rested people have better self-control. Few self-control failures occur first thing in the morning, when people have had a good night's sleep. On the contrary, self-control seems to grow gradually weaker as the day wears on. Diets are broken in the evening, impulsive crimes and violent acts occur most often after midnight, addictive relapses occur later in the day, and so forth. Gambling casinos, which depend for their profits on impulsive behavior, are often deliberately designed with no clocks and no external windows so that people will not realize how late it has gotten, and the bright lights and loud noises may help keep them awake past their normal hours—thereby reducing the likelihood that any given customer will make the sensible, self-disciplined decision to cut his or her losses and go to bed before losing any more money.

Positive emotions also seem to have some value for replenishing the self's stock of energy and its capacity for self-regulation. Tice, Dale, and Baumeister (2000) conducted several studies to assess the effects of positive affect on the depleted self. These followed the usual procedure of having participants engage in two consecutive, seemingly unrelated acts of self-control. In between the two, however, some participants received an induction of positive or negative mood. The people who were put into a positive mood showed less evidence of ego depletion, suggesting that the good emotional state helped counteract the depleting effect of the first task.

Implications, Speculations, and Directions for Further Research

For both pragmatic and ethical reasons, the patterns of ego depletion studied in my laboratory have tended to be rather minor. It seems likely that some severe mental health problems reflect more formidable degrees of depletion. Burnout may arise when mental health professionals have exhausted their resources in futile efforts to help people. Trauma victims may become passive and unable to function because the need to cope with the aftermath of trauma (including affect regulation) exhausts their resources. Learned helplessness may be less a matter of inferring non-contingency than a matter of having expended the self's resources in the futile attempt to exert control over an uncontrollable situation. Further work may profitably examine the role of ego depletion in these severe disturbances.

Another promising line of inquiry will be to illuminate the physiological processes associated with depletion and replenishment. If some form of energy is depleted by acts of self-regulation and volition, it should eventually become possible to isolate the physiological mechanisms. Undoubtedly brain processes are involved in self-regulation, and these should change discernibly over the course of ego depletion.

Further work is also needed on how to increase the self's resources and strengthen its capacity for self-regulation. In the long run, clinical therapists may be able to help mentally ill people by designing exercises that will build their capacity for controlling their thoughts, emotions, and impulses.

References

- Baumeister, R. F. (1998). The self. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., pp. 680–740). New York: McGraw-Hill.
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*, 1252–1265.
- Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry*, *7*, 1–15.
- Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.
- Carver, C. S., & Scheier, M. F. (1981). *Attention and self-regulation: A control theory approach to human behavior*. New York: Springer-Verlag.
- Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge, University Press.
- Engels, R., Finkenauer, C., den Exter Blokland, E. A. W., & Baumeister, R. F. (2000). Parental influences on self-control and juvenile delinquency. Manuscript in preparation, Utrecht University, Netherlands.
- Higgins, E. T. (1996). The “self digest”: Self-knowledge serving self-regulatory functions. *Journal of Personality and Social Psychology*, *71*, 1062–1083.
- Linder, D. E., Cooper, J., & Jones, E. E. (1967). Decision freedom as a determinant of the role of incentive magnitude in attitude change. *Journal of Personality and Social Psychology*, *6*, 245–254.
- Mischel, W. (1996). From good intentions to willpower. In P. Gollwitzer & J. Bargh (Eds.), *The psychology of action* (pp. 197–218). New York: Guilford.
- Muraven, M. (1998). Mechanisms of self-control failure: Motivation and limited resources. Unpublished doctoral dissertation, Case Western Reserve University, Cleveland, OH.
- Muraven, M. R., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, *126*, 247–259.

- Muraven, M., Baumeister, R. F., & Tice, D. M. (1999). Longitudinal improvement of self-regulation through practice: Building self-control through repeated exercise. *Journal of Social Psychology, 139*, 446–457.
- Muraven, M., Tice, D. M., & Baumeister, R. F. (1998). Self-control as limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology, 74*, 774–789.
- Tangney, J. P., & Baumeister, R. F. (2000). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. Manuscript submitted for publication.
- Tice, D. M., & Baumeister, R. F. (1997). Longitudinal study of procrastination, performance, stress, and health: The costs and benefits of dawdling. *Psychological Science, 8*, 454–458.
- Tice, D. M., Dale, K. P., & Baumeister, R. F. (2000). Replenishing the self: Positive emotions offset the effects of ego depletion. Manuscript in preparation, Case Western Reserve University.
- Twenge, J. M., Tice, D. M., Schmeichel, B., & Baumeister, R. F. (2000). Decision fatigue: Making multiple personal decisions depletes the self's resources. Manuscript submitted for publication.
- Wegner, D. M., Schneider, D. J., Carter, S. R., & White, T. L. (1987). Paradoxical effects of thought suppression. *Journal of Personality and Social Psychology, 53*, 5–13.

Copyright of *Self & Identity* is the property of Psychology Press (T&F) and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.