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# Ego Depletion and Self-Regulation Failure: A Resource Model of Self-Control

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Effective self-regulation is an important key to successful functioning in many spheres, and failed self-regulation may be centrally conducive to substance abuse and addiction. The program of research summarized here indicates that self-regulation operates as a limited resource, akin to strength or energy, especially insofar as it becomes depleted after use–leaving the depleted self subsequently vulnerable to impulsive and undercontrolled behaviors (including increased consumption of alcohol). The self's resources, which are also used for decision-making and active responding, can be replenished by rest and positive emotions.

**Key Words:** Ego Depletion, Self-Regulation, Self-Control.

SELF-REGULATION IS AN important key to success in life. Human beings far exceed other animals in the capacity to override their responses, alter their inner states, and in other ways change the course of their behavior. This capacity for self-regulation has allowed human behavior to attain a range of flexibility and complexity that is remarkable. Yet human self-regulation remains limited and sometimes ineffective despite its superiority to what other animals have achieved.

Just as self-regulation is a key to living successfully in human culture, failure of self-regulation is central to many–in fact, probably the majority–of the problems and difficulties that people encounter. Substance abuse, including alcohol and drug addiction, constitutes one clear instance in which many people feel unable or unwilling to bring their behavior in line with their ideals and standards and people find themselves yielding to problematic impulses instead of controlling them. Self-regulation failure is also implicated in sexually transmitted diseases, including AIDS; unwanted pregnancy; underachievement in school; crime and criminality; violence, including domestic abuse; eating disorders; obesity; lack of exercise; gambling problems; failure to save money and excessive personal debt; procrastination; cigarette smoking; marital conflict; and many other problems.

My interest in self-regulation was stimulated in part by recognition of the central importance of self-regulation in many personal and social problems but also in part by its central relevance to theory of self. Multiple authors have recognized that self-regulation is one of the most crucial and far-reaching aspects of selfhood (Carver and Scheier, 1981; Higgins, 1996). Understanding how the self manages and controls itself is indispensable to any adequate theory of self (Baumeister, 1998).

## THREE THEORIES OF SELF-REGULATION

How does self-regulation operate? Based on a literature review, three types of theories were identified, each of which seemed inherently plausible and has its adherents (Baumeister et al., 1994).

The first theory is based on traditional concepts of willpower. It assumes that self-regulation depends on a kind of energy or strength, which is used when the self performs some regulating activity. A tempting impulse may have some degree of strength and so, to overcome it, the self must have an equal or greater amount of strength.

A second theory would treat self-regulation as primarily a cognitive process. In this view, the self contains a stock of knowledge about itself and about the environment and so it processes behavioral options by analyzing the situation and determining the correct course of action, which may entail overriding some motivations or other possible courses of action.

The third theory treats self-regulation as a skill. Developmental psychologists often view the course of child development as a matter of acquiring skills and learning to manage oneself may comprise an important set of such skills.

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In our laboratory, we set out to test these three theories against each other. To do this, we had to find some sphere in which they made competing predictions. One such arena involves the consequences of an initial act of self-regulation. That is, after a person has regulated himself or herself in one domain and a challenge to self-regulation arises in another domain, how does the person perform?

The strength or energy model sees self-regulation as requiring the expenditure of a limited resource. An initial act of self-regulation will consume some of that resource. As a result, performance on the second self-regulation task will be impaired. Just as a muscle grows tired and loses some of its effectiveness, self-regulation becomes depleted after being used.

The cognitive process model, in contrast, would predict improved performance on the second task. When people use some cognitive module, it becomes highly accessible and so its subsequent use is facilitated (as in research on priming) (Bargh et al., 1986; Higgins and King, 1981; Srull and Wyer, 1979,1980). Just as a computer loads a program into active memory when it first uses it, and thereafter the program is ready to use for another task, self-regulation may be more efficient when it is already operating.

Last, the skill model predicts no change on the second task. Skill does not change from one trial to the next, although there will be gradual improvement over many trials. Acquiring a skill is generally a long, slow process of automatization, and consecutive trials do not generally show any reliably noticeable improvement.

## EXPERIMENTAL TESTS OF SELF-REGULATION

Self-regulation is generally studied in four spheres: controlling emotions, thoughts, impulses, and task performance. We designed a series of studies in which laboratory participants performed self-regulation in any two of those spheres. The results consistently favored the view of self-regulation as strength or energy, as opposed to cognitive module or skill models.

In one study, participants were first instructed to control their emotional responses to an upsetting video excerpt. Some were told to stifle their emotions (as well as refraining from showing their feelings in their face); others were told to amplify their emotional reactions; while members of a third no-control group watched the video without trying to alter their responses. Afterward, physical stamina was assessed by measuring how long people could squeeze a handgrip exercise device. Participants who had regulated their emotions (in either direction) gave up faster on the handgrip task compared with those who had watched the same film without controlling their feelings. Thus, trying to alter one's emotional reaction seemed to consume some resource, which was therefore less available to enable them to perform well on the handgrip task (Muraven et al., 1998).

In a second experiment, participants performed a thought control exercise. Specifically, they were told to refrain from thinking about a white bear, to the extent they could, following a procedure designed by Wegner, Schneider, Carter, and White (1987). Other participants simply listed their thoughts without controlling them. Afterward, we measured how long participants continued on a frustrating task (attempting to solve anagrams that were in fact unsolvable). Those who had regulated their thoughts gave up faster than other participants. This finding suggested that the thought suppression exercise had depleted some resource. Another study repeated this procedure using solvable anagrams and, again, the participants who had already performed some self-regulation exercise performed worse than others (Muraven et al., 1998).

Impulse control was addressed in another study (Baumeister et al., 1998). Participants were asked to skip a meal before the experiment and then they were confronted with a tempting serving of freshly baked cookies and chocolate. In the important condition, however, they were instructed not to eat the cookies and chocolates and instead consume as many radishes as possible. They were left alone for 5 minutes, ostensibly to let them eat the radishes but actually to maximize the temptation to eat cookies or chocolate. All participants successfully resisted the temptation but it appeared to deplete their self-regulatory strength. On a subsequent measure of persistence at difficult (unsolvable) geometric puzzles, they gave up faster than other participants who had been permitted to eat the cookies or participants who had not been exposed to any food. Thus, resisting temptation consumed an important resource, which was then less available to help the person persist in the face of failure.

## EXECUTIVE FUNCTION IMPAIRED

Further studies showed that the same resource used in self-regulation is also used in other volitional activities of the self, such as choice and decision-making. Making a free, responsible decision to perform a task led to decrements in self-regulation compared with people who performed the same task at the experimenter's instruction but without making the choice themselves (Baumeister et al., 1998). Making a series of choices among consumer products likewise depleted the self's resources, as indicated by lower physical stamina and by reduced success at making oneself consume an aversive (but health-enhancing) drink (Twenge, Baumeister, Tice, and Schmeichel, unpublished data, 2002).

Some decisions offer a passive option, which is selected by doing nothing. Baumeister et al. (1998) found that when the self was depleted by breaking a habit, people were more prone to choose the passive option. Thus, ego depletion makes people more passive, consistent with the view that active volition consumes the same resource required for self-regulation.

The relevance to volition has been confirmed by subsequent work (Schmeichel, Vohs, and Baumeister, unpublished data, 2002). In these studies, we manipulated initial demands by having people engage in self-regulation (such as by stifling feelings or controlling attention), and then we tested their performance on various intellectual tasks. Those tasks that required volition, such as logical reasoning, showed consistent impairments. In contrast, tasks that relied more on automatic processes, such as rote memory, were unaffected. In other work, Vohs and Heatherton (2000) found that resisting food temptation led to subsequent impairments among dieters but not among nondieters. The implication is that people who try to regulate their eating (i.e., dieters) use resources in doing so, but when people do not care to regulate their eating, no resources are expended.

These studies suggest that the self has a single resource, akin to energy or strength. The same resource is used for a broad variety of activities: all forms of self-regulation (including regulating emotions, thoughts, impulses, and task performance), choice, and decision-making; active instead of passive responding; and mental tasks requiring the active manipulation of information (such as in reasoning). The resource appears to be quite limited, insofar as a brief exercise of self-regulation is sufficient to cause significant impairments in subsequent performance.

## INCREASING STRENGTH

The question of how to increase people's capacity for self-regulation is of particular importance to researchers and therapists concerned with addiction because of the possibility that improved strength might enable some people to resist temptation and overcome addiction. The findings about regulatory depletion suggest an important reason that people may initially succumb to drug and alcohol problems, namely because their resources have already been expended elsewhere (e.g., coping with work stress, relationship problems). But how can strength be replenished or increased?

One answer is that rest, in particular sleep, appears to replenish the self after depletion (Baumeister et al., 1994). Most forms of self-regulation failure escalate over the course of the day, becoming more likely and more frequent the longer the person has been deprived of sleep. Meanwhile, sleep deprivation produces impairments in self-regulation akin to ego depletion.

Research in our own laboratory has begun to suggest that positive emotional experiences seem to speed recovery from ego depletion. That is, after resources have been expended in self-regulation, a pleasant emotional experience will restore (to some extent) the self's capacity to regulate itself subsequently (Baumeister, Dale, Dhavale, and Tice, unpublished data, 2002).

Producing a lasting increase in the person's regulatory strength is potentially even more important than enabling it to recover after depletion. We already noted that self-regulation appears to work like a muscle in that it becomes tired after exercise. The muscle analogy also suggests, however, that self-regulation might improve as a delayed result of exercise.

Some preliminary findings support the view that regular exercise of self-regulation can improve strength. In a longitudinal study, some participants performed various self-regulation exercises every day for 2 weeks. Some sought to improve their posture whenever possible. Others kept track of their eating, and others sought to regulate their emotions. Overall, these participants showed improvement in self-regulatory capabilities (as measured in a laboratory test of depletion) compared with a control group who did not perform any such exercises for the 2 weeks (Muraven et al., 1999). In another study, students performed regulatory exercises such as using their nondominant hand, speaking in complete sentences, and avoiding contractions, and these exercises also led to apparent improvements in subsequent self-regulation (Oaten, Cheng, and Baumeister, unpublished data, 2002). Although these studies both showed considerable fluctuations in the data, reflecting the difficulties of longitudinal real-world interventions, they do tentatively support the view that self-regulatory capacity can be enhanced through regular exercise.

## ALCOHOL AND OTHER IMPULSES

Recent work has applied the ego depletion theory to specific problems of impulse control. Muraven, Collins, and Nienhaus (2002) conducted a laboratory experiment in which ego depletion was manipulated by having participants engage in the white bear thought-suppression exercise. The control group performed arithmetic problems, an activity that can be effortful and unpleasant but that does not require the self to regulate itself (because the problems are solved by following standard, well-learned procedures). The participants expected to take a simulated driving task later. In between, they were given the opportunity to sample beer. If they wanted to do well on the driving task, they should, of course, restrain their alcohol intake. Participants in the control group did so, but those whose resources were depleted by the thought suppression exercise drank more alcohol and ended up with a higher level of alcohol in their blood. These findings indicate that, when the self's resources are depleted, it is less likely to control its alcohol intake effectively.

In a quite different context, Vohs and Faber (unpublished data, 2002) showed that impulsive purchasing is more common when the self's resources have been depleted. Participants who had previously engaged in self-regulation scored higher on a measure of impulse purchasing and expressed willingness to spend higher amounts of money for the same products compared with participants whose resources were not depleted.

## CONCLUSIONS AND IMPLICATIONS

My colleagues and I have conducted a program of research designed to investigate the nature of self-regulation. All our findings suggest that it operates like a muscle or a well of energy. It becomes depleted through use and takes time (and rest) to replenish itself. Regular exercise can strengthen it, consistent with traditional wisdom of building character.

The human capacity for self-regulation must be regarded as an impressive evolutionary advance over what has been observed in other species. Still, the capacity for self-regulation is limited. Most likely the capacity for self-regulation was biologically difficult to achieve, requiring certain cognitive capabilities (such as the capacity to envision a future) and the energy resource that is expended in self-regulation. Because this resource is so limited, people may often find themselves without enough of it to bring their behavior in line with their goals and ideals.

The implication is that one important path into substance abuse and addiction is through ego depletion. When the self's resources have been expended in other tasks, people have less left over to control their impulsive and appetitive behaviors. Learning more about how to maintain, increase, and replenish this resource may therefore hold one promising key to helping people avoid addiction.

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