Ego Depletion: Is the Active Self a Limited Resource?

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Choice, active response, self-regulation, and other volition may all draw on a common inner resource. In Experiment 1, people who forced themselves to eat radishes instead of tempting chocolates subsequently quit faster on unsolvable puzzles than people who had not had to exert self-control over eating. In Experiment 2, making a meaningful personal choice to perform attitude-relevant behavior caused a similar decrement in persistence. In Experiment 3, suppressing emotion led to a subsequent drop in performance of solvable anagrams. In Experiment 4, an initial task requiring high self-regulation made people more passive (i.e., more prone to favor the passive-response option). These results suggest that the self's capacity for active volition is limited and that a range of seemingly different, unrelated acts share a common resource.

Many crucial functions of the self involve volition: making choices and decisions, taking responsibility, initiating and inhibiting behavior, and making plans of action and carrying out those plans. The self exerts control over itself and over the external world. To be sure, not all human behavior involves planful or deliberate control by the self, and, in fact, recent work has shown that a great deal of human behavior is influenced by automatic or nonconscious processes (see Bargh, 1994, 1997). But undoubtedly some portion involves deliberate, conscious, controlled responses by the self, and that portion may be disproportionately important to the long-term health, happiness, and success of the individual. Even if it were shown that 95% of behavior consisted of lawful, predictable responses to situational stimuli by automatic processes, psychology could not afford to ignore the remaining 5%. As an analogy, cars are probably driven straight ahead at least 95% of the time, but ignoring the other 5% (such as by building cars without steering wheels) would seriously compromise the car's ability to reach most destinations. By the same token, the relatively few active, controlling choices by the self greatly increase the self's chances of achieving its goals. And if those few "steering" choices by the self are important, then so is whatever internal structure of the self is responsible for it.

In the present investigation we were concerned with this controlling aspect of the self. Specifically, we tested hypotheses of ego depletion, as a way of learning about the self's executive function. The core idea behind ego depletion is that the self's acts of volition draw on some limited resource, akin to strength or energy and that, therefore, one act of volition will have a detrimental impact on subsequent volition. We sought to show that a preliminary act of self-control in the form of resisting temptation (Experiment 1) or a preliminary act of choice and responsibility (Experiment 2) would undermine self-regulation in a subsequent, unrelated domain, namely persistence at a difficult and frustrating task. We then sought to verify that the effects of ego depletion are indeed maladaptive and detrimental to performance (Experiment 3). Last, we undertook to show that ego depletion resulting from acts of self-control would interfere with subsequent decision making by making people more passive (Experiment 4).

Our research strategy was to look at effects that would carry over across wide gaps of seeming irrelevance. If resisting the temptation to eat chocolate can leave a person prone to give up faster on a difficult, frustrating puzzle, that would suggest that those two very different acts of self-control draw on the same limited resource. And if making a choice about whether to make a speech contrary to one's opinions were to have the same effect, it would suggest that that very same resource is also the one used in general for deliberate, responsible decision making. That resource would presumably be one of the most important features of the self.

Executive Function

The term *agency* has been used by various writers to refer to the self's exertion of volition, but this term has misleading connotations: An agent is quintessentially someone who acts on behalf of someone else, whereas the phenomenon under discussion involves the self acting autonomously on its own behalf. The term *executive function* has been used in various contexts to refer to this aspect of self and hence may be preferable (e.g.,

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Epstein, 1973; see Baumeister, 1998). Meanwhile, we use the term *ego depletion* to refer to a temporary reduction in the self's capacity or willingness to engage in volitional action (including controlling the environment, controlling the self, making choices, and initiating action) caused by prior exercise of volition.

The psychological theory that volition is one of the self's crucial functions can be traced back at least to Freud (1923/1961a, 1933/1961b), who described the ego as the part of the psyche that must deal with the reality of the external world by mediating between conflicting inner and outer pressures. In his scheme, for example, a Victorian gentleman standing on the street might feel urged by his id to head for the brothel and by his superego to go to church, but it is ultimately left up to his ego to start his feet walking in one direction or the other. Freud also seems to have believed that the ego needed to use some energy in making such a decision.

Recent research has convincingly illuminated the self's nearly relentless quest for control (Brehm, 1966; Burger, 1989; DeCharms, 1968; Deci & Ryan, 1991, 1995; Langer, 1975; Rothbaum, Weisz, & Snyder, 1982; Taylor, 1983, 1989; White, 1959). It is also known that when the self feels highly responsible (accountable) for its actions, its cognitive and behavioral processes change (Cooper & Scher, 1994; Linder, Cooper, & Jones, 1967; Tetlock, 1983, 1985; Tetlock & Boettger, 1989). Active responses also have more powerful effects on the self and its subsequent responses than do passive ones (Allison & Messick, 1988; Cioffi & Garner, 1996; Fazio, Sherman, & Herr, 1982). The processes by which the self monitors itself in order to approach standards of desired behavior have also been studied (Carver & Scheier, 1981; Duval & Wicklund, 1972; Wegner, 1994; Wegner & Pennebaker, 1993).

Despite these efforts, it is hard to dispute that understanding of the executive function remains far more vague and rudimentary than other aspects of self-theory. Researchers investigating cognitive representations of self have made enormous progress in recent decades (for reviews, see Banaji & Prentice, 1994; Fiske & Taylor, 1991). Likewise, there has been considerable progress on interpersonal aspects of selfhood (e.g., Leary, 1995; Leary & Kowalski, 1990; Schlenker, 1980; Tesser, 1988). In comparison, understanding of the self's executive function lags behind at a fairly primitive level.

Ego Depletion

The notion that volition depends on the self's expenditure of some limited resource was anticipated by Freud (1923/1961a, 1933/1961b). He thought the ego needed to have some form of energy to accomplish its tasks and to resist the energetic promptings of id and superego. Freud was fond of the analogy of horse and rider, because as he said the rider (analogous to the ego) is generally in charge of steering but is sometimes unable to prevent the horse from going where it wants to go. Freud was rather vague and inconsistent about where the ego's energy came from, but he recognized the conceptual value of postulating that the ego operated on an energy model.

Several modern research findings suggest that some form of energy or strength may be involved in acts of volition. Most of these have been concerned with self-regulation. Indeed, Mischel (1996) has recently proposed that the colloquial notion of willpower be revived for self-regulation theory, and a literature review by Baumeister, Heatherton, and Tice (1994) concluded that much evidence about self-regulatory failure fits a model of strength depletion.

An important early study by Glass, Singer, and Friedman (1969) found that participants exposed to unpredictable noise stress subsequently showed decrements in frustration tolerance, as measured by persistence on unsolvable problems.[1] Glass et al. concluded that adapting to unpredictable stress involves a "psychic cost," which implies an expenditure or depletion of some valuable resource. They left the nature of this resource to future research, which has not made much further progress.

Additional evidence for a strength model was provided by Muraven, Tice, and Baumeister (1998), whose research strategy influenced the present investigation. Muraven et al. sought to show that consecutive exertions of self-regulation were characterized by deteriorating performance, even though the exertions involved seemingly unrelated spheres. In one study, they showed that trying not to think about a white bear (a thought-control task borrowed from Wegner, 1989; Wegner, Schneider, Carter, & White, 1987) caused people to give up more quickly on a subsequent anagram task. In another study, an affect-regulation exercise caused subsequent decrements in endurance at squeezing a handgrip. These findings suggest that exertions of self-control do carry a psychic cost and deplete some scarce resource.

To integrate these scattered findings and implications, we suggest the following. One important part of the self is a limited resource that is used for all acts of volition, such as controlled (as opposed to automatic) processing, active (as opposed to passive) choice, initiating behavior, and overriding responses. Because much of self-regulation involves resisting temptation and hence overriding motivated responses, this self-resource must be able to affect behavior in the same fashion that motivation does. Motivations can be strong or weak, and stronger impulses are presumably more difficult to restrain; therefore, the executive function of the self presumably also operates in a strong or weak fashion, which implies that it has a dimension of strength. An exertion of this strength in self-control draws on this strength and temporarily exhausts it (Muraven et al., 1998), but it also presumably recovers after a period of rest. Other acts of volition should have similar effects, and that is the hypothesis of the present investigation.

Experiment 1

Experiment 1 provided evidence for ego depletion by examining consecutive acts of self-control. The study was originally designed to test competing hypotheses about the nature of self-control, also known as self-regulation. Clearly the control over self is one of the most important and adaptive applications of the self's executive function. Research on monitoring processes and feedback loops has illuminated the cognitive structure that

[1] These researchers also showed that an illusion of controllability eliminated this effect. From our perspective, this implies that part of the stress involves the threat or anticipation of continued aversive stimulation, which the illusion of controllability dispelled. In any case, it is plausible that the psychic cost was paid in terms of affect regulation, that is, making oneself submit and accept the aversive, unpredictable stimulation.

processes relevant information (e.g., Carver & Scheier, 1981; Wegner, 1994), but the actual process by which an organism alters its own responses or subjective states is far less well understood. At least three different models of the nature of self-regulation can be proposed. Moreover, these three models make quite different predictions about the effectiveness of self-control immediately after an exertion of self-control in some unrelated sphere. Experiment 1 provided a test of these three competing predictions by requiring participants to engage in two seemingly unrelated acts of self-control.

One model views self-regulation as essentially a skill. In this model, people gradually develop the skill to regulate themselves over long periods of time. On any given occasion, however, skill remains roughly constant across repeated trials (except for small and gradual learning effects), so there should be little or no change in effectiveness of self-control on two successive exertions within a short time.

Another model portrays self-regulation as essentially a knowledge structure. In this view, self-control operates like a master schema that makes use of information about how to alter one's own responses or states. On the basis of this model, an initial act of self-regulation should prime the schema, thereby facilitating subsequent self-control. Another version of this view would be that the self-regulatory system is normally in a standby or depowered mode until it is pressed into action by one act of self-control. Once activated, the system would remain in operation ("on") for a time, making further acts of self-control easier.

A third model states that self-regulation resembles energy. In this view, acts of self-regulation involve some kind of exertion that expends energy and therefore depletes the supply available. Unless the supply is very large, initial acts of self-regulation should deplete it, thereby impairing subsequent self-control.

Thus, the three models respectively predict no change, an increase, or a decrease in effectiveness of self-control following an initial act of self-control. Other models are possible, such as the possibility that self-regulation involves a collection of domain-specific but unrelated knowledge structures, so that an initial act of self-control should prime and therefore facilitate self-control in the same sphere but produce no change in other, unrelated spheres. Still, these three models provide sufficiently conflicting predictions about the sequence of unrelated acts of self-control to make it worth conducting an initial test.

In the present research, we used impulse control, which to many people is the classic or paradigmatic form of self-control. More precisely, we manipulated self-control by instructing some hungry individuals to eat only radishes while they were faced with the tempting sight and aroma of chocolate. Thus, they had to resist the temptation to perform one action while making themselves perform a similar but much less desirable action. We then sought to measure self-control in an unrelated sphere, by persistence at a frustrating puzzle-solving task. A series of frustrating failures may often make people want to stop doing the task, and, so, self-control is needed to force oneself to continue working.

If resisting temptation depends on skill, then this skill would predict no change in persistence under frustration. If resisting temptation involves activating a knowledge structure or master schema, then priming this schema should facilitate self-control, and people should persist longer on the puzzles. Finally, if resisting temptation uses some kind of strength or energy, then this will be depleted afterward, and subsequent persistence should decrease.

Method

Participants. Data were collected in individual sessions from 67 introductory psychology students (31 male, 36 female) who received course credit for taking part.

Procedure. Participants signed up for a study on taste perception. Each participant was contacted to schedule an individual session, and at that time the experimenter requested the participant to skip one meal before the experiment and make sure not to have eaten anything for at least 3 hr.

The laboratory room was carefully set up before participants in the food conditions arrived. Chocolate chip cookies were baked in the room in a small oven, and, as a result, the laboratory was filled with the delicious aroma of fresh chocolate and baking. Two foods were displayed on the table at which the participant was seated. One display consisted of a stack of chocolate chip cookies augmented by some chocolate candies. The other consisted of a bowl of red and white radishes.

The experimenter provided an overview of the procedures, secured an informed consent, and then elaborated the cover story. She explained that chocolates and radishes had been selected for the taste perception study because they were highly distinctive foods familiar to most people. She said that there would be a follow-up measure for sensation memory the next day, and so she asked the participant to agree not to eat any chocolates or radishes (other than in the experiment) for 24 hr after the session.

Participants in the chocolate and radish conditions were then asked to take about 5 min to taste the assigned food while the experimenter was out of the room. In the radish condition, the experimenter asked the participant to eat at least two or three radishes, and in the chocolate condition, the participant was asked to eat at least two or three cookies or a handful of the small candies. Participants were reminded to eat only the food that had been assigned to them. The experimenter left the room and surreptitiously observed the participant through a one-way mirror, recording the amount of food eaten and verifying that the participant ate only the assigned food. (To minimize self-awareness, the mirror was almost completely covered with a curtain.)

After about 5 min, the experimenter returned and asked the participant to fill out two questionnaires. One was the Brief Mood Introspection Scale (BMI; Mayer & Gaschke, 1988), and the other was the Restraint Scale (Herman & Polivy, 1975). Then the experimenter said that it was necessary to wait at least 15 min to allow the sensory memory of the food to fade. During that time, she said, the participant would be asked to provide some preliminary data that would help the researchers learn whether college students differed from high school students in their problem-solving ability. The experimenter said that the participant would therefore be asked to work on a test of problem solving. The problem solving was presented as if it were unrelated to the eating, but in fact it constituted the main dependent measure.

There was also a no-food control condition. Participants assigned to this condition skipped the food part of the experiment and went directly to the problem-solving part.

The problem-solving task was adapted from a task used by Glass et al. (1969), adapted from Feather (1961). The puzzle requires the person to trace a geometric figure without retracing any lines and without lifting his or her pencil from the paper. Multiple slips of paper were provided for each figure, so the person could try over and over. Each participant was initially given several practice figures to learn how the puzzles worked and how to solve them, with the experimenter present to answer any questions. After the practice period, the experimenter gave the participant the two main test figures with the instructions

> You can take as much time and as many trials as you want. You will not be judged on the number of trials or the time you will take.

> You will be judged on whether or not you finish tracing the figure. If you wish to stop before you finish [i.e., solve the puzzle], ring the bell on the table.

Unbeknownst to the participant, both these test figures had been prepared so as to be impossible to solve.

The experimenter then left the room and timed how long the participant worked on the task before giving up (signified by ringing the bell). Following an a priori decision, 30 min was set as the maximum time, and the 4 participants who were still working after 30 min were stopped by the experimenter at that point. For the rest, when the experimenter heard the bell, she reentered the room and administered a manipulation check questionnaire. When the participants finished, the experimenter debriefed, thanked, and dismissed them.

Results

Manipulation check. The experimenter surreptitiously observed all participants during the eating phase to ascertain that they ate the stipulated food and avoided the other. All participants complied with the instructions. In particular, none of the participants in the radish condition violated the rule against eating chocolates. Several of them did exhibit clear interest in the chocolates, to the point of looking longingly at the chocolate display and in a few cases even picking up the cookies to sniff at them. But no participant actually bit into the wrong food.

The difficulty of the eating task was assessed on the final questionnaire. Participants in the radish condition said that they forced themselves in an effortful fashion to eat the assigned food more than participants in the chocolate condition, $F(1, 44) = 16.10, p < .001$. They also rated resisting the nonassigned food as marginally significantly more difficult, $F(1, 44) = 3.41$, $p < .07$. During the debriefing, many participants in the radish condition spontaneously mentioned the difficulty of resisting the temptation to eat the chocolates.

Persistence. The main dependent measure was the amount of time participants spent on the unsolvable puzzles. A one-way analysis of variance (ANOVA) indicated significant variation among the three conditions, $F(2, 64) = 26.88, p < .001$. The means are presented in Table 1. Pairwise comparisons among the groups indicated that participants in the radish condition quit sooner on the frustrating task than did participants in either the chocolate condition, $t(44) = 6.03, p < .001$, or the no-food (control) condition, $t(44) = 6.88, p < .001$. The chocolate condition did not differ from the no-food control condition, $t < 1$, *ns*.

It is conceivable that the time measure was affected by something other than persistence, such as speed. That is, the interpretation would be altered if the participants in the radish condition tried just as many times as those in the chocolate condition and merely did so much faster. Hence, we also analyzed the number of attempts that participants made before giving up. A one-way ANOVA on these tallies again yielded significant variation among the three conditions, $F(2, 64) = 7.61, p = .001$. The pattern of results was essentially the same as with duration of persistence, as can be seen in Table 1. Pairwise comparisons again showed that participants in the radish condition gave up earlier than participants in the other two conditions, which did not differ from each other.[2]

Table 1
Persistence on Unsolvable Puzzles (Experiment 1)

Condition	Time (min)	Attempts
Radish	8.35	19.40
Chocolate	18.90	34.29
No food control	20.86	32.81

Note. Standard deviations for Column 1, top to bottom, are 4.67, 6.86, and 7.30. For Column 2, *SD*s = 8.12, 20.16, and 13.38.

Moods. The mood measure contains two subscales, and we conducted a one-way ANOVA on each, using only the radish and chocolate conditions (because this measure was not administered in the no-food control condition). The two conditions did not differ in valence (i.e., pleasant vs. unpleasant) of mood, $F(1, 44) = 2.62$, *ns*, nor in arousal, $F < 1$, *ns*.

Dieting. The analyses on persistence were repeated using dieting status (from the Restraint Scale) as an independent variable. Dieting status did not show either a main effect or an interaction with condition on either the duration of persistence or the number of attempts.

Fatigue and desire to quit. The final questionnaire provided some additional evidence beyond the manipulation checks. One item asked the participant how tired he or she felt after the tracing task. An ANOVA yielded significant variation among the conditions, $F(2, 64) = 5.74, p < .01$. Participants in the radish condition were more tired ($M = 17.96$) than those in the chocolate ($M = 11.85$) or no-food ($M = 12.29$) conditions (the latter two did not differ). Participants in the radish condition also reported that their fatigue level had changed more toward increased tiredness ($M = 6.28$) than participants in either the chocolate ($M = -0.90$) or no-food ($M = 1.76$) conditions, $F(2, 64) = 5.13, p < .01$.

Participants in the radish condition reported that they had felt less strong a desire to stop working on the tracing task than had participants in the other two conditions, $F(2, 64) = 4.71, p < .01$. Yet they also reported forcing themselves to work on the tracing task more than participants in the other two conditions, $F(2, 64) = 3.20, p < .05$. The latter may have been an attempt to justify their relatively rapid quitting on that task. The former may indicate that they quit as soon as they felt the urge to do so, in contrast to the chocolate and no-food participants who made themselves continue for a while after they first felt like quitting.

Discussion

These results provide initial support for the hypothesis of ego depletion. Resisting temptation seems to have produced a psychic cost, in the sense that afterward participants were more inclined to give up easily in the face of frustration. It was not that eating chocolate improved performance. Rather, wanting chocolate but eating radishes instead, especially under circum-

[2] As this article went to press, we were notified that this experiment had been independently replicated by Timothy J. Howe, of Cole Junior High School in East Greenwich, Rhode Island, for his science fair project. His results conformed almost exactly to ours, with the exception that mean persistence in the chocolate condition was slightly (but not significantly) higher than in the control condition. These converging results strengthen confidence in the present findings.

stances in which it would seemingly be easy and safe to snitch some chocolates, seems to have consumed some resource and therefore left people less able to persist at the puzzles.

Earlier, we proposed three rival models of the nature of self-regulation. These results fit a strength model better than a skill or schema model. If self-regulation were essentially a knowledge structure, then an initial act of self-regulation should have primed the schema, thereby facilitating subsequent self-regulation. The present results were directly opposite to that prediction. A skill model would predict no change across consecutive acts of self-regulation, but we did find significant change. In contrast, a strength or energy model predicted that some vital resource would be depleted by an initial act of self-regulation, leading to subsequent decrements, and this corresponds to what we found.

It is noteworthy that the depletion manipulation in this study required both resisting one impulse (to eat chocolate) and making oneself perform an undesired act (eating radishes). Both may have contributed to ego depletion. Still, the two are not independent. Based on a priori assumptions and on comments made by participants during the debriefing, it seems likely that people would have found it easier to make themselves eat the radishes if they were not simultaneously struggling with resisting the more tempting chocolates.

Combined with other evidence (especially Muraven et al., 1998), therefore, it seems reasonable to infer that self-regulation draws on some limited resource akin to strength or energy and that this resource may be common for many forms of self-regulation. In Experiment 1, we found that an initial act of resisting temptation (i.e., an act of impulse control) impaired subsequent persistence at a spatial puzzle task. Muraven et al. found that an act of affect regulation (i.e., trying either to stifle or amplify one's emotional response) lowered subsequent stamina on a physical task, that an initial act of thought suppression reduced persistence at unsolvable anagrams, and that thought suppression impaired subsequent ability to hide one's emotions. These various carryovers between thought control, emotion control, impulse control, and task performance indicate that these four main spheres of self-regulation all share the same resource. Therefore, the question for Experiment 2 was whether that same resource would also be involved in other acts of choice and volition beyond self-regulation.

Experiment 2

Experiment 2 addressed the question of whether the same resource that was depleted by not eating chocolate (in Experiment 1) would be depleted by an act of choice. For this, we used one of social psychology's classic manipulations: High choice versus low choice to engage in counterattitudinal behavior. Festinger and Carlsmith (1959) showed that people change their attitudes to make them consistent with behavior when they have been induced to act in ways contrary to their attitudes. Linder et al. (1967) showed that this effect occurs only when people have been led to see their own (counterattitudinal) behavior as freely chosen, and many studies have replicated these effects.

Our interest was not in the attitudinal consequences of counterattitudinal behavior, however. Rather, our hypothesis was that the act of making the choice to engage in counterattitudinal behavior would involve the self and deplete its volitional resource. As an index of this ego depletion, we measured frustration tolerance using the same task that we used in Experiment 1, namely persistence at unsolvable puzzles. The puzzles, of course, had nothing to do with our independent variable (next year's tuition), and so in all direct ways the two behaviors were irrelevant.

Dissonance research has provided some evidence consistent with the view that making a choice involves an exertion by the self. The original article by Linder et al. (1967) reported that participants in the high-choice (free-decision, low-incentive) condition spent about half a minute deciding whether to engage in the counterattitudinal behavior, even though all consented to do it, whereas low-choice participants did not spend that amount of time. This is consistent with the view that the self was engaging in some effortful activity during the choice exercise. More generally, Cooper and Scher (1994; see also Cooper & Fazio, 1984; Scher & Cooper, 1989) concluded that personal responsibility for aversive consequences is the core cause of cognitive dissonance, and their conclusion puts emphasis on the taking or accepting of personal responsibility for one's actions—thus an active response by the self.

The design of Experiment 2 thus involved having people make a counterattitudinal speech (favoring a large tuition increase, to which most students were opposed) under high- or low-choice conditions. Because our focus was on the active choice making by the self, we also included a condition in which people chose to make a proattitudinal speech opposing the increase. Choosing to engage in a proattitudinal behavior should not cause dissonance (see Cooper & Scher, 1994; Cooper & Fazio, 1984; Festinger, 1957; Linder et al., 1967), but it should still deplete the self to some degree because it still involves an act of choice and taking responsibility. We did not have any basis for predicting whether choosing to engage in counterattitudinal behavior would deplete the self more than choosing to engage in proattitudinal behavior, but we expected that there should still be some depletion.

Method

Participants. Participants were 39 undergraduate psychology students (25 male, 14 female). They participated in individual sessions. They were randomly assigned among four experimental treatment conditions: counterattitudinal choice, counterattitudinal no choice, proattitudinal choice, and no speech (control). To ensure that the issue was personally relevant to all participants, we excluded 8 additional potential participants who were either graduating seniors or who were on full scholarship, because preliminary testing revealed that next year's tuition did not matter to students in these categories.

Procedure. The experimenter greeted each participant and explained that the purpose of the study was to see how people respond to persuasion. They were told that they would be making stimuli that would be played to other people to alter their attitudes. In particular, they would be making an audiotape recording of a persuasive speech regarding projected tuition increases for the following academic year. The topic of tuition raises was selected on the basis of a pilot test: A survey had found that students rated the tuition increase as the most important issue to them.

The experimenter said that all participants would record speeches that had been prepared in advance. The importance of the tuition increase issue was highlighted. The experimenter also said that the university's

Board of Trustees had agreed to listen to the speeches to see how much impact the messages would have on their decisions about raising tuition.

The experimenter showed the participant two folders, labeled *pro-tuition raise* and *anti-tuition raise*. Participants in the no-choice (counterattitudinal) condition were told that they had been assigned to make the pro-tuition raise speech. The experimenter said that the researchers already had enough people making the speech against the tuition raise and so it would not be possible to give the participant a choice as to which speech to make. In contrast, participants in the high-choice conditions were told that the decision of which speech to make was entirely up to them. The experimenter explained that because there were already enough participants in one of the groups, it would help the study a great deal if they chose to read one folder rather than the other. The experimenter then again stressed that the final decision would remain entirely up to the participant. All participants agreed to make the speech that they had been assigned.

Participants in the no-speech control condition did not do this part of the experiment. The issue of tuition increase was not raised with them.

At this point, all participants completed the same mood measure used in Experiment 1. The experimenter then began explaining the task for the second part of the experiment. She said there was some evidence of a link between problem-solving abilities and persuasiveness. Accordingly, the next part of the experiment would contain a measure of problem-solving ability. For participants in the speech-making conditions, the experimenter said that the problem-solving task would precede the recording of the speech.

The problem-solving task was precisely the same one used in Experiment 1, involving tracing geometric figures without retracing lines or lifting the pen from the paper. As in Experiment 1, the participant's persistence at the frustrating puzzles was the main dependent measure. After signaling the experimenter that they wished to stop working on the task, participants completed a brief questionnaire that included manipulation checks. They were then completely debriefed, thanked, and sent home.

Results

Manipulation check. The final questionnaire asked participants (except in the control condition) how much they felt that it was up to them which speech they chose to make. A one-way ANOVA confirmed that there was significant variation among the conditions, $F(2, 31) = 15.46$, $p < .001$. Participants in the no-choice condition indicated that it was not up to them which speech to make ($M = 27.10$), whereas participants in the counterattitudinal–choice ($M = 10.21$) and proattitudinal–choice conditions ($M = 6.60$) both indicated high degrees of choice. Another item asked how much the participant considered reading an alternative speech to the one suggested by the experimenter, and on this too there was significant variation among the three conditions, $F(2, 31) = 11.53$, $p < .001$, indicating that high-choice participants considered the alternative much more than participants in the no-choice condition.

Persistence. The main dependent measure was the duration of persistence on the unsolvable puzzles. The results are presented in Table 2. A one-way ANOVA on persistence times indicated that there was significant variation among conditions, $F(3, 35) = 8.42$, $p < .001$. Pairwise comparisons confirmed that the counterattitudinal–choice and the proattitudinal–choice conditions each differed significantly from both the control and the counterattitudinal–no-choice conditions. Perhaps surprisingly, the two choice conditions did not differ significantly from each other.

Table 2
Persistence on Unsolvable Puzzles (Experiment 2)

Condition	Time (min)	Attempts
Counterattitudinal speech		
High choice	14.30	26.10
No choice	23.11	42.44
Proattitudinal speech		
High choice	13.80	24.70
No speech control	25.30	35.50

Note. Standard deviations for Column 1, top to bottom, are 6.91, 7.08, 6.49, and 5.06. For Column 2, *SD*s = 14.83, 22.26, 7.13, and 9.14.

Similar results were found using the number of attempts (rather than time) as the dependent measure of persistence. The ANOVA indicated significant variation among the four conditions, $F(3, 35) = 3.24$, $p < .05$. The same pattern of pairwise cell differences was found: Both conditions involving high choice led to a reduction in persistence, as compared with the no-speech control condition and the no-choice counterattitudinal speech condition.[3]

Mood state. One-way ANOVAs were conducted on each of the two subscales of the BMI Scale. There was no evidence of significant variation among the four conditions in reported valence of mood (i.e., pleasant vs. unpleasant), $F(3, 35) < 1$, *ns*. There was also no evidence of variation in arousal, $F(3, 35) < 1$, *ns*. These results suggest that the differences in persistence were not due to differential moods engendered by the manipulations.

Discussion

The results supported the ego depletion hypothesis and suggest that acts of choice draw on the same limited resource used for self-control. Participants who agreed to make a counterattitudinal speech under high choice showed a subsequent drop in their persistence on a difficult, frustrating task, as compared with participants who expected to make the same speech under low choice (and as compared with no-speech control participants). Thus, taking responsibility for a counterattitudinal behavior seems to have consumed a resource of the self, leaving the self with less of that resource available to prolong persistence at the unsolvable puzzles.

Of particular further interest was the high-choice proattitudinal behavior condition. These people should not have experienced any dissonance, yet they showed significant reductions in persistence on unsolvable problems. Dissonance is marked

[3] The differences between the control condition and the two high-choice conditions failed to reach significance if we used the error term from the ANOVA as the pooled variance estimate. The proattitudinal–choice condition did differ from the control condition in a standard *t* test using only the variance in those two cells, $t(18) = 2.94$, $p < .01$. The counterattitudinal–choice condition differed marginally from the no-speech control using this latter method, $t(18) = 1.71$, $p = .105$. The high variance in the counterattitudinal–no-choice condition entailed that it also differed only marginally from the counterattitudinal–choice condition if the actual variance in those cells was used rather than the error term, $t(17) = 1.90$, $p = .07$.

by an aversive arousal state (Cooper, Zanna, & Taves, 1978; Zanna & Cooper, 1974; Zanna, Higgins, & Taves, 1976), but apparently this arousal or negative affect is not what is responsible for ego depletion, because we found almost identical evidence of ego depletion among people who chose to make the nondissonant, proattitudinal speech.

Thus, it is not the counterattitudinal behavior that depletes the self. Indeed, people who expected to perform the counterattitudinal behavior under low choice persisted just as long as no-speech control participants. Making a speech contrary to one's beliefs does not necessarily deplete the self in any way that our measure detected. Meanwhile, making a speech that supports one's beliefs did deplete the self, provided that the person made the deliberate, free decision to do so.

The implication is that it is the exercise of choice, regardless of the behavior, that depletes the self. Whatever motivational, affective, or volitional resource is needed to force oneself to keep trying in the face of discouraging failure is apparently the same resource that is used to make responsible decisions about one's own behavior, and apparently this resource is fairly limited.

Experiment 3

Experiments 1 and 2 suggested that self-regulation is weakened by prior exercise of volition, either in the form of resisting temptation (Experiment 1) or making a responsible choice (Experiment 2). In both studies, the dependent variable involved persistence on unsolvable problems. It is reasonable to treat such persistence as a challenge for self-regulation, because undoubtedly people would feel inclined to give up when their efforts are met with frustration and discouraging failure, and overcoming that impulse (in order to persist) would require an act of self-control.

An alternative view, however, might suggest that it is adaptive to give up early on unsolvable problems. Persistence is, after all, only adaptive and productive when it leads to eventual success. Squandering time and effort on a lost cause is thus wasteful, and optimal self-management would involve avoiding such waste (e.g., McFarlin, 1985). It is true that such an argument would require one to assume that our participants actually recognized the task as unsolvable, and there was no sign that they did. (In fact, most participants expressed surprise during the debriefing when they were told that the puzzles were in fact unsolvable.) Yet for us to contend that ego depletion has a negative effect, it seemed necessary to show some decrement in task performance. Unsolvable puzzles cannot show such a decrement, because no amount of persistence leads to success. Study 3 therefore was designed to show that ego depletion can impair performance on solvable tasks.

Because broad conclusions about ego depletion are difficult to draw from any single procedure, it seemed desirable to use very different procedures for Study 3. Accordingly, the manipulation of ego depletion involved affect regulation (i.e., controlling one's emotions). Affect regulation is one important sphere of self-regulation (e.g., Baumeister et al., 1994). In this study, some participants were asked to watch an emotionally evocative videotape and stifle any emotional reaction they might have. To ensure that the effects were due to self-regulation rather than the particular emotional response, we used both positive (humorous) and negative (sad and distressing) stimuli.

For the measure of task performance, we selected anagram solving. This is a widely used performance measure that has elements of both skill and effort. More to the point, we suspected that success at anagrams would require some degree of self-regulation. One must keep breaking and altering the tentative combinations of letters one has formed and must make oneself keep trying despite multiple initial failures. In the latter respect, anagram solving resembles the dependent measure used in the first two studies, except that persistence can actually help lead to success. The prediction was that participants who had tried to control their emotional responses to the videotape would suffer from ego depletion and, as a result, would perform more poorly at anagrams.

Method

Participants. Participants were 30 (11 male and 19 female) undergraduates who took part in connection with introductory psychology requirements. They participated in individual sessions and were randomly assigned among the conditions.

Procedure. The experimenter explained that the purpose of the study was to see which personality traits would make people more responsive to experiencing emotions. They were told that the first part of the procedure would involve watching a movie.

In the suppress-emotion condition, participants were instructed to try not to show and not to feel any emotions during the movie. The experimenter said that the participant would be videotaped while watching the film, and so it was essential to try to conceal and suppress any emotional reaction. Meanwhile, participants in the no-regulation condition were instructed to let their emotions flow while watching the movie, without any attempt to hide or deny these feelings. They were also told that their reactions would be videotaped.

Following these instructions, each participant saw a 10-min videotape. Half of the participants in each condition saw a humorous video featuring the comedian Robin Williams. The others saw an excerpt from the film *Terms of Endearment*, portraying a young mother dying from cancer. At the end of the video clip, participants completed the BMI Scale.

Then the experimenter extended the cover story to say that they would have to wait at least 10 min after the film to allow their sensory memory of the movie to fade. During that time, they were asked to help the experimenter collect some preliminary data for future research by completing an anagram task. Participants received 13 sets of letters that they were to unscramble to make English words during a 6-min period. The participant was left alone to do this task. After 6 min, the experimenter returned and administered a postexperimental questionnaire. After the participant completed that, he or she was debriefed and thanked.

Results

Manipulation check. The final questionnaire asked participants to rate how effortful it had been to comply with the instructions for watching the video clip. Participants in the suppress-emotion condition reported that they found it much more effortful ($M = 13.88$) than participants in the no-regulation condition ($M = 5.64$), $t(28) = 2.88$, $p < .01$. Similar effects were found on an item asking people how difficult it was to follow the instructions while following the video, $t(28) = 4.95$, $p < .001$, and on an item asking how much they had to concentrate in complying with the instructions, $t(28) = 5.42$, $p < .001$. These findings confirm that it required a greater exertion to suppress one's emotional response than to let it happen.

In addition, the films were perceived quite differently. On the item asking participants to rate the movie on a scale ranging from 1 (*sad*) to 25 (*funny*), participants rated the comedy video as much funnier (M = 21.94) than the sad video clip (M = 4.54), $t(29) = 4.62$, $p < .001$. There were no differences as a function of ego depletion condition in how the movie was perceived.

Anagram performance. The main dependent variable was performance on the anagram task. Table 3 shows the results. Participants in the suppress-emotion condition performed significantly worse than participants in the no-regulation condition in terms of number of anagrams correctly solved, $t(28) = 2.12$, $p < .05$. There was no effect for type of movie.

Mood. There was no difference in either mood valence or arousal between participants who tried to suppress their emotional reactions and those who let their emotions go. Hence any differences in performance between these conditions should not be attributed to differential mood or arousal responses.

Discussion

The results confirm the view that ego depletion can be detrimental to subsequent performance. The alternative view, that Experiments 1 and 2 showed improved self-regulation because it is adaptive to give up early on unsolvable tasks, cannot seemingly account for the results of Experiment 3. In this study, an act of self-regulation—stifling one's emotional response to a funny or sad video clip—was followed by poorer performance at solving anagrams. Hence, it seems appropriate to suggest that some valuable resource of the self was actually depleted by the initial act of volition, as opposed to suggesting merely that initial acts of volition alter subsequent decision making.

Experiment 4

The first three experiments provided support for the hypothesis of ego depletion. Experiment 4 was designed to provide converging evidence using quite different procedures. Also, Experiment 4 was designed to complement Experiment 2 by reversing the direction of influence: Experiment 2 showed that an initial act of responsible decision making could undermine subsequent self-regulation, and Experiment 4 was designed to show that an initial act of self-regulation could undermine subsequent decision making.

Experiment 4 used procedures that contrasted active versus passive responding. In many situations, people face a choice between one course of action that requires an active response and another course that will occur automatically if the person does nothing (also called a *default option*). In an important study, Brockner, Shaw, and Rubin (1979) measured persistence in a futile endeavor under two contrasting situations. In one, the person had to make a positive move to continue, but the procedure would stop automatically if he or she did nothing (i.e., continuing was active and quitting was passive). The other situation was the reverse, in which a positive move was required to terminate whereas continuing was automatic unless the person signaled to quit. Brockner et al. found greater persistence when persistence was passive than when it was active.

Table 3
Success at Solvable Puzzles (Experiment 3)

Condition	Solved	*SD*
Suppress	4.94	2.59
No regulation	7.29	3.52

In our view, the findings of Brockner et al. (1979) may reflect a broader pattern that can be called a *passive-option effect.* The passive-option effect can be defined by saying that in any choice situation, the likelihood of any option being chosen is increased if choosing involves a passive rather than an active response. Sales organizations such as music, book, and film clubs, for example, find that their sales are higher if they can make the customer's purchasing response passive rather than active, and so they prefer to operate on the basis that each month's selection will automatically be mailed to the customer and billed unless the customer actively refuses it.

For present purposes, the passive-option effect is an important possible consequence of the limited resources that the self has for volitional response. Our assumption is that active responding requires the self to expend some of its resources, whereas passive responses do not. The notion that the self is more involved and more implicated by active responding than by passive responding helps explain evidence that active responses leave more lasting behavioral consequences. For example, Cioffi and Garner (1996) showed that people were more likely to follow through when they had actively volunteered than passively volunteered for the same act.

The passive-option effect thus provides a valuable forum for examining ego depletion. Active responses differ from passive ones in that they require the expenditure of limited resources. If the self's resources have already been exhausted (i.e., under ego depletion), the self should therefore be all the more inclined to favor the passive option.

To forestall confusion, we hasten to point out that the term *choice* can be used in two different ways, and so a passive option may or may not be understood as involving a choice, depending on which meaning is used. Passive choice is a choice in the sense that the situation presents the person with multiple options and the outcome is contingent on the person's behavior (or nonbehavior). It is, however, not a choice in the volitional sense, because the person may not perform an intrapsychic act of volition. For example, a married couple who sleeps together on a given night may be said to have made a choice that night insofar as they could, in principle, have opted to sleep alone or with other sleeping partners. Most likely, though, they did not go through an active-choice process that evening, but rather they simply did what they always did. The essence of passive options, in our understanding, is that the person does not engage in an inner process of choosing or deciding, even though alternative options are available. Passive choices therefore should not deplete the self's resources.

In Experiment 4, we showed participants a very boring movie and gave them a temptation to stop watching it. For some participants quitting was passive, whereas for others quitting required an active response. The dependent variable was how long people persisted at the movie. According to the passive-option effect, they should persist longer when persisting was passive than when

persisting required active responses. We predicted that ego depletion would intensify this pattern.

Prior ego depletion was manipulated by altering the instructions for a task in a way that varied how much the person had to regulate his or her responses. The basic task involved crossing out all instances of the letter *e* in a text. People can learn to do this easily and quickly; and they become accustomed to scanning for every *e* and then crossing it out. To raise the self-regulatory difficulty, we told people not to cross out the letter *e* if any of several other criteria were met, such as if there was another vowel adjacent to the *e* or one letter removed. These people would presumably then scan for each *e* but would have to override the response of crossing it out whenever any of those criteria were met. Their responses thus had to be regulated according to multiple rules, unlike the others who could simply respond every time they found an *e*. Our assumption was that consulting the complex decision rules and overriding the simple response would deplete the ego, unlike the simpler version of the task.

Method

Participants. Eighty-four undergraduate students (47 males, 37 females) participated for partial fulfillment of a course requirement. Each individual testing session lasted about 30 min.

Procedure. The experimenter told participants that the experiment was designed to look at "whether personality influences how people perceive movies." After signing an informed consent form, participants completed several personality questionnaires to help maintain the cover story. (Except for an item measuring tiredness, the questionnaires are not relevant to the current study and will not be discussed further.)

Participants then completed the regulatory-depletion task. Each was given a typewritten sheet of paper with meaningless text on it (a page from an advanced statistics book with a highly technical style) and told to cross off all instances of the letter *e*. For the participants assigned to the ego-depletion condition, the task was made quite difficult, requiring them to consult multiple rules and monitor their decisions carefully. They were told that they should only cross off an *e* if it was not adjacent to another vowel or one extra letter away from another vowel (thus, one would not cross off the *e* in *vowel*). Also, the photocopy of the stimulus page had been lightened, making it relatively difficult to read and thus further requiring close attention. In contrast, participants in the no-depletion condition were given an easily legible photocopy with good contrast and resolution, and they were told to cross off every single *e* with no further rules or stipulations.

The experimenter then told participants that they were going to watch two movies and that after each movie they would answer a few simple questions about it. He explained that the videos were rather long and the participant did not have time to watch the complete movie. It would be up to the participant when to stop. The participant was however cautioned to "watch the video long enough so that you can understand what happened and answer a few questions about the video."

The experimenter next gave the participant a small box with a button attached. Participants were told to ring the buzzer when they were done watching the movie, at which point the experimenter would reenter the room and give them a few questions to answer. Half of the participants were told to press the button down when they wanted to stop (active quit condition). The others were told to hold down the button as long as they wanted to watch more of the movie; releasing the button would cause the movie to stop (passive quit condition). The buzzer was wired to signal the experimenter when the button was pressed (active quit condition) or released (passive quit condition). In other words, half of the participants stopped the movie by pressing down on a button, whereas the other half of the participants stopped the movie by taking their hand off of a button.

Participants were then shown a film that had been deliberately made to be dull and boring. The entire film consisted of an unchanging scene of a blank white wall with a table and a computer junction box in the foreground. The movie is just a picture of a wall and nothing ever happens, although participants were unaware of this fact and were motivated to keep watching to make sure that nothing did actually occur. Participants were told that after they stopped watching this video, they would see another video of highlights from a popular, humorous television program (*Saturday Night Live*). Participants therefore believed that after they finished watching the aversive, boring picture of a wall they would get to watch a pleasant, amusing video. This was done to give participants an added incentive to stop watching the boring video and also to remove the possibility that stopping the movie would immediately allow them to leave the experiment; although, to be sure, terminating the first movie would in fact bring them closer to their presumed goal of completing the experiment and being able to leave.[4]

The experimenter left the room, surreptitiously timing how long participants watched the video. When participants rang the buzzer (either by pressing or releasing the button, depending on the condition), the experimenter noted the time and reentered the room. At this point, participants completed a brief questionnaire about their thoughts while watching the movie and their level of tiredness. Participants were then completely debriefed, thanked, and sent home.

Results

Manipulation check. On a 25-point scale, participants assigned to the difficult-rules condition reported having to concentrate on the task of crossing off the *e*s more than participants assigned to the easy-rules condition, $t(63) = 2.30$, $p < .025$. Participants in the ego-depletion condition needed to concentrate more than participants in the no-depletion condition, which should have resulted in participants in the ego-depletion condition using more ego strength than participants in the no-depletion condition.

Further evidence was supplied by having participants rate their level of tiredness at the beginning of the experiment and at the end of the experiment. Participants in the ego-depletion condition became more tired as the experiment progressed compared with participants in the no-depletion condition, $t(83) = 2.79$, $p < .01$. Changes in level of tiredness can serve as a rough index of changes in effort exerted and therefore regulatory capacity (see Johnson, Saccuzzo, & Larson, 1995), and these results suggest that participants in the ego-depletion condition indeed used more regulatory strength than participants in the no-depletion condition.

Movie watching. The main dependent measure was how long participants watched the boring movie. These results are presented in Table 4. The total time participants spent watching the boring movie was analyzed in a 2 (rules) × 2 (button position) ANOVA. Consistent with the hypothesis, the two-way interaction between depletion task rules (depletion vs. no depletion) and what participants did to quit watching the movie (active quit vs. passive quit) was significant, $F(1, 80) = 5.64$, $p < .025$. A planned comparison confirmed that participants under ego depletion watched more of the movie when quitting required an active response than when quitting involved a passive re-

[4] Of course, participants were informed that they were free to leave at any time. Still, most participants prefered to complete the procedure and leave the experiment having accomplished something, as opposed to leaving in the middle of the procedure.

sponse, $F(1, 80) = 7.21$, $p < .01$. The corresponding contrast in the no-depletion condition found no difference in movie duration as a function of which response was active versus passive, $F(1, 80) = 0.46$, *ns*. Thus, participants who were depleted were more likely to take the passive route compared with participants who were not as depleted.

Additionally, there was a strong trend among participants who had to make an active response in order to quit: They watched the movie longer when they were in the ego-depletion condition than in the no-depletion condition, $F(1, 80) = 3.35$, $p < .07$. In other words, when participants had to initiate an action to quit, they tended to watch the movie longer when they were depleted than when they were not depleted. Participants who had to release the button to quit tended to stop watching the movie sooner when they were depleted than when they were not depleted, although this was not statistically significant, $F(1, 80) = 2.33$, $p < .15$. Participants who had to do less work to quit tended to quit sooner when they were depleted than when they were not depleted.

Discussion

The results of Experiment 4 provide further support for the hypothesis of ego depletion, insofar as ego depletion increased subsequent passivity. We noted that previous studies have found a passive-option effect, according to which a given option is chosen more when it requires a passive response than when it requires an active response. In the present study, ego depletion mediated the passive-option effect.

Experiment 4 manipulated ego depletion by having people complete a complex task that required careful monitoring of multiple rules and frequent altering of one's responses—more specifically, they were instructed to cross out every instance of the letter *e* in a text except when various other conditions were met, in which case they had to override the simple response of crossing out the *e*. These people subsequently showed greater passivity in terms of how long they watched a boring movie. They watched it longer when continuing was passive (and stopping required an active response) than when continuing required active responses (and stopping would be passive). Without ego depletion, we found no evidence of the passive-option effect: People watched the movie for about the same length of time regardless of whether stopping or continuing required the active response.

Thus, Experiment 4 found the passive-option effect only under ego depletion. That is, only when people had completed an initial task requiring concentration and careful monitoring of one's own responses in relation to rules did people favor the passive option (regardless of which option was passive). These findings suggest that people are less inclined to make active responses following ego depletion. Instead, depleted people are more prone to continue doing what is easiest, as if carried along by inertia.

Table 4
Boredom Tolerance (Experiment 4)

Condition	No depletion	Depletion
Active quit	88	125
Passive quit	102	71
Difference	−14	54

Note. Numbers are mean durations, in seconds, that participants watched the boring movie. Bottom row (difference) refers to size of passive-option effect (the passive quit mean subtracted from the active quit mean).

Earlier, we suggested that the results of Experiment 2 indicated that choice depleted the ego. It might seem contradictory to suggest that passive choice does not draw on the same resource, but in fact we think the results of the two studies are quite parallel. The procedures of Experiment 2 involved active choice, insofar as the person thought about and consented to a particular behavior. The no-choice condition corresponded to passive choice in an important sense, because people did implicitly have the option of refusing to make the assigned counterattitudinal speech, but they were not prompted by the experimenter to go through an inner debate and decision process. The active choices in Experiment 4 required the self to abandon the path of least resistance and override any inertia that was based on how the situation was set up, and so it required the self to do something. Thus, the high- and low-choice conditions of Experiment 2 correspond to the active and passive options of Experiment 4. Only active choice draws on the self's volitional resource.

General Discussion

The present investigation began with the idea that the self expends some limited resource, akin to energy or strength, when it engages in acts of volition. To explore this possibility, we tested the hypothesis that acts of choice and self-control would cause ego depletion: Specifically, after one initial act of volition, there would be less of this resource available for subsequent ones. The four experiments reported in this article provided support for this view.

Experiment 1 examined self-regulation in two seemingly unrelated spheres. In the key condition, people resisted the impulse to eat tempting chocolates and made themselves eat radishes instead. These people subsequently gave up much faster on a difficult, frustrating puzzle task than did people who had been able to indulge the same impulse to eat chocolate. (They also gave up earlier than people who had not been tempted.) It takes self-control to resist temptation, and it takes self-control to make oneself keep trying at a frustrating task. Apparently both forms of self-control draw on the same limited resource, because doing one interferes with subsequent efforts at the other.

Experiment 2 examined whether an act of personal, responsible choice would have the same effect. It did. People who freely, deliberately consented to make a counterattitudinal speech gave up quickly on the same frustrating task used in Experiment 1. Perhaps surprisingly, people who freely and deliberately consented to make a proattitudinal speech likewise gave up quickly, which is consistent with the pattern of ego depletion. In contrast, people who expected to make the counterattitudinal speech under low-choice conditions showed no drop in persistence, as compared with no-speech controls.

Thus, it was the act of responsible choice, and not the particular behavior chosen, that depleted the self and reduced subsequent persistence. Regardless of whether the speech was consistent with their beliefs (to hold tuition down) or contrary to

them (to raise tuition), what mattered was whether they made a deliberate act of choice to perform the behavior. Making either choice used up some resource and left them subsequently with less of whatever they needed to persist at a difficult, frustrating task. The effects of making a responsible choice were quite similar to the effects of resisting temptation in Experiment 1.

Experiment 3 was designed to address the alternative explanation that ego depletion actually improved subsequent self-regulation, insofar as giving up early on unsolvable problems could be considered as an adaptive response. In Experiment 3, the dependent variable was task performance on solvable puzzles. Ego depletion resulting from an exercise in affect regulation impaired performance on that task.

We had shown (in Experiment 2) that ego-depletion effects carried over from responsible decision making to have an impact on self-regulation. Experiment 4 was designed to show the effect in the opposite direction, namely that prior exertion of self-regulation would have an impact on decision making. To do this, we measured the degree of predominance of the passive option. People were presented with a choice situation in which they could respond either actively or passively. We varied the response format so that the meaning of the passive versus active response was exchanged in a counterbalanced fashion. Prior ego depletion (created by having people do a task that required monitoring their own behavior and multiple, overriding rules) increased people's tendency to use the passive response.

The assumption underlying Experiment 4 was that active responding draws on the same resource that the self uses to make responsible decisions and exert self-control. When that resource is depleted, apparently, people have less of it available to make active responses. Therefore, they become more passive.

Taken together, these four studies point toward a broad pattern of ego depletion. In each of them, an initial act of volition was followed by a decrement in some other sphere of volition. We found that an initial act of self-control impaired subsequent self-control (Study 1), that making a responsible decision impaired subsequent self-control (Study 2), that self-control lowered performance on a task that required self-control (Study 3), and that an initial act of self-control led to increased passivity (Study 4).

The procedures used in these four studies were deliberately made to be quite different. We have no way of directly measuring the internal resource that the self uses for making decisions or regulating itself. Hence, it seemed important to demonstrate ego depletion in circumstances as diverse as possible, in order to rule out the possibility that results could be artifacts of a particular method or a particular sphere of volition. Our view is that the convergence of findings across the four studies is more persuasive evidence than any of the individual findings.

Alternative Explanations

It must be acknowledged that the present studies provided no direct measures of the limited resource and hence no direct evidence that some inner quantity is diminished by acts of volition. The view that the active self involves some limited resource is thus an inference based on behavioral observations. It is therefore especially necessary to consider possible alternative interpretations of the effects we have shown.

One alternative view is that some form of negative affect caused participants in this research to give up early on the frustrating task. The task was, after all, designed to be frustrating or discouraging, insofar as it was unsolvable. It seems plausible that depression or other negative emotions might cause people to stop working at a task.

Although negative affect can undoubtedly affect persistence, the present pattern of results does not seem susceptible to an explanation on the basis of negative affect, for several reasons. We measured negative affect repeatedly and did not find it to differ significantly among the conditions in the various experiments. Moreover, in Experiment 3, we found identical effects regardless of whether the person was trying to stifle a positive or a negative emotion. Our work converges with other evidence that mood effects cannot explain aftereffects of stress (Cohen, 1980).

A second alternative explanation would be that the results were due to cognitive dissonance, especially insofar as several of the procedures required counterattitudinal behavior such as eating radishes instead of chocolate or refusing to laugh at a funny movie. Indeed, Experiment 2 included a condition that used a dissonance procedure, namely having people consent (under high choice) to record a speech in favor of a big tuition increase, contrary to the private beliefs of nearly all participants. Still, dissonance does not seem to provide a full explanation of the present effects. There is no apparent reason that dissonance should reduce persistence on an unrelated, subsequent task. Moreover, Experiment 2 found nearly identical effects of choosing a proattitudinal behavior as for choosing a counterattitudinal behavior, whereas dissonance should only arise in the latter condition.

A variation on the first two alternate explanations is that arousal might have mediated the results. For example, cognitive dissonance has been shown to be arousing (Zanna & Cooper, 1974), and possibly some participants simply felt too aroused to sit there and keep struggling with the unsolvable problems. Given the variations and nonlinearities as to how arousal affects task performance, the decrement in anagram performance in Experiment 3 might also be attributed to arousal. Our data do, however, contradict the arousal explanation in two ways. First, self-report measures of arousal repeatedly failed to show any effects. Second, high arousal should presumably produce more activity rather than passivity, but the effects of ego depletion in Experiment 4 indicated an increase in passivity. If participants were more aroused, they should not have also become more passive as a result.

As already noted, the first two experiments were susceptible to a third alternative explanation that quitting the unsolvable problems was actually an adaptive, rational act of good self-regulation instead of a sign of self-regulation failure. This interpretation assumes that participants recognized that the problems were unsolvable and so chose rationally not to waste any more time on them. This conclusion was contradicted by the evidence from the debriefing sessions, in which participants consistently expressed surprise when they learned that the problems had been unsolvable. More important, Experiment 3 countered that alternative explanation by showing that ego depletion produced decrements in performance of solvable problems.

Another explanation, based on equity considerations, would suggest that experimental participants arrive with an implicit sense of the degree of obligation they owe to the researchers

and are unwilling to do more. In this view, for example, a person might feel that she has done enough by making herself eat radishes instead of chocolates and therefore feels that she does not owe the experimenter maximal exertion on subsequent tasks. Although there is no evidence for such a view, it could reasonably cover Experiments 1 and 3. It has more difficulty with Experiment 4, because someone who felt he had already done enough during the highly difficult version of the initial task would presumably be less willing to sit longer during a boring movie, which is the opposite of what happened in the active-quit condition. Experiment 2 also is difficult to reconcile with this alternative explanation, because the participants did not actually complete any initial task. (They merely agreed to one.) Moreover, in that study, the effects of agreeing to make a proattitudinal speech were the same as the effects of agreeing to make a counterattitudinal speech, whereas an equity calculation would almost surely assume that agreeing to make the counterattitudinal speech would be a much greater sacrifice.

Implications

The present results could potentially have implications for self-theory. The pattern of ego depletion suggests that some internal resource is used by the self to make decisions, respond actively, and exert self-control. It appears, moreover, that the same resource is used for all of these, as indicated by the carry-over patterns we found (i.e., exertion in one sphere leads to decrements in others). Given the pervasive importance of choice, responsibility, and self-control, this resource might well be an important aspect of the self. Most recent research on the self has featured cognitive representations and interpersonal roles, and the present research does not in any way question the value of that work, but it does suggest augmenting the cognitive and interpersonal aspects of self with an appreciation of this volitional resource. The operation of the volitional, agentic, controlling aspect of the self may require an energy model.

Moreover, this resource appears to be quite surprisingly limited. In Study 1, for example, a mere 5 min of resisting temptation in the form of chocolate caused a reduction by half in how long people made themselves keep trying at unsolvable puzzles. It seems surprising to suggest that a few minutes of a laboratory task, especially one that was not described as excessively noxious or strenuous, would seriously deplete some important aspect of the self. Thus, these studies suggest that whatever is involved in choice and self-control is both an important and very limited resource. The activities of the self should perhaps be understood in general as having to make the most of a scarce and precious resource.

The limited nature of this resource might conceivably help explain several surprising phenomena that have been studied in recent years. A classic article by Burger (1989) documented a broad range of exceptions to the familiar, intuitively appealing notion that people generally seek and desire control. Under many circumstances, Burger found, people relinquish or avoid control, and moreover, even under ordinary circumstances, there is often a substantial minority of people who do not want control. The ego-depletion findings of the present investigation suggest that exerting control uses a scarce and precious resource, and the self may learn early on to conserve that resource. Avoiding control under some circumstances may be a strategy for conservation.

Bargh (1997) has recently shown that the scope of automatic responses is far wider than many theories have assumed and, indeed, that even when people seem to be consciously making controlled responses, they may in fact be responding automatically to subtle cues (see also Bargh, 1982, 1994). Assuming that the self is the controller of controlled processes, it is not surprising that controlled processes should be confined to a relatively small part of everyday functioning, because they are costly. Responding in a controlled (as opposed to automatic) fashion would cause ego depletion and leave the self potentially unable to respond to a subsequent emergency or to regulate itself. Hence, staying in the automatic realm would help conserve this resource.

It is also conceivable that ego depletion is central to various patterns of psychological difficulties that people experience, especially ones that require unusual exertions of affect regulation, choice, or other volition. Burnout, learned helplessness, and similar patterns of pathological passivity might have some element of ego depletion. Coping with trauma may be difficult precisely because the self's volitional resources were depleted by the trauma but are needed for recovery. Indeed, it is well established that social support helps people recover from trauma, and it could be that the value of social support lies partly in the way other people take over the victim's volitional tasks (ranging from affect regulation to making dinner), thus conserving the victim's resources or allowing them time to replenish. On the darker side, it may be that highly controlled people who seem to snap and abruptly perpetrate acts of violence or outrage may be suffering from some abrupt depletion that has undermined the control they have maintained, possibly for years, over these destructive impulses. These possible implications lie far beyond the present data, however.

We acknowledge that we do not have a clear understanding of the nature of this resource. We can say this much: The resource functions to connect abstract principles, standards, and intentions to overt behavior. It has some link to physical tiredness but is not the same as it. The resource seems to have a quantitative continuum, like a strength. We find it implausible that ego depletion would have no physiological aspect or correlates at all, but we are reluctant to speculate about what physiological changes would be involved. The ease with which we have been able to produce ego depletion using small laboratory manipulations suggests that the extent of the resource is quite limited, which implies that it would be seriously inadequate for directing all of a person's behavior, so conscious, free choice must remain at best restricted to a very small proportion of human behavior. (By the same token, most behavior would have to be automatic instead of controlled, assuming that controlled processes depend on this limited resource.) Still, as we noted at the outset, even a small amount of this resource would be extremely adaptive in enabling human behavior to become flexible, varied, and able to transcend the pattern of simply responding to immediate stimuli.

Concluding Remarks

Our results suggest that a broad assortment of actions make use of the same resource. Acts of self-control, responsible deci-

sion making, and active choice seem to interfere with other such acts that follow soon after. The implication is that some vital resource of the self becomes depleted by such acts of volition. To be sure, we assume that this resource is commonly replenished, although the factors that might hasten or delay the replenishment remain unknown, along with the precise nature of this resource. If further work can answer such questions, it promises to shed considerable light on human agency and the mechanisms of control over self and world.

For now, however, two final implications of the present evidence about ego depletion patterns deserve reiterating. On the negative side, these results point to a potentially serious constraint on the human capacity for control (including self-control) and deliberate decision making. On the positive side, they point toward a valuable and powerful feature of human selfhood.

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