Choice and Ego-Depletion: The Moderating Role of Autonomy

Arlen C. Moller
Edward L. Deci
Richard M. Ryan
University of Rochester

The self-regulatory strength model maintains that all acts of self-regulation, self-control, and choice result in a state of fatigue called ego-depletion. Self-determination theory differentiates between autonomous regulation and controlled regulation. Because making decisions represents one instance of self-regulation, the authors also differentiate between autonomous choice and controlled choice. Three experiments support the hypothesis that whereas conditions representing controlled choice would be ego-depleting, conditions that represented autonomous choice would not. In Experiment 3, the authors found significant mediation by perceived self-determination of the relation between the choice condition (autonomous vs. controlled) and ego-depletion as measured by performance.

Keywords: *choice; ego-depletion; self-regulation; self-control; autonomy; self-determination*

Baumeister and colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998) have argued that all acts of volition and self-control are effortful and draw on a limited resource, resulting in a state they refer to as ego-depletion. Ego-depletion is theorized to be "a temporary reduction in the self's capacity or willingness to engage in volitional action (including controlling the environment, controlling oneself, making choices, and initiating action), caused by prior exercise of volition" (Baumeister et al., 1998, p. 1253).

The vast majority of studies supporting this ego- (or self-regulatory) strength model have demonstrated that one act of self-control can impair performance on a subsequent, yet ostensibly unrelated, task that requires self-control (Baumeister et al., 1998; Muraven & Baumeister, 2000; Schmeichel & Baumeister, 2004; Schmeichel, Vohs, & Baumeister, 2003).

For example, emotional self-control often has been associated with ego-depletion. Participants who suppressed reactions to an emotionally evocative film (humorous or sad) performed worse on a subsequent anagram task than did participants who were free to express their emotions and thus did not have to exert self-control (Baumeister et al., 1998, Study 3). In a study by Muraven, Tice, and Baumeister (1998), participants were exposed to a distressing, sad film clip and were instructed either to stifle their emotional response or to amplify it. Participants in both of these emotion-regulation conditions (i.e., either decreasing or increasing their response) persisted for less time on a subsequent handgrip task that required physical stamina, relative to control group participants who were not told to alter their emotional states.

Appetite regulation, another form of self-control, also has been regularly linked to ego-depletion in the literature. For instance, resisting the temptation of chocolate chip cookies caused participants to give up more quickly on a subsequent, unsolvable, geometric, figure-tracing task (Baumeister et al., 1998, Study 1). Vohs and Heatherton (2000) found that dieters asked to sit next to a bowl of candies were more ego-depleted, as indicated later by their eating more ice cream (Study 1) and persisting less on a demanding cognitive task (Study 2)

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than were participants who sat farther from the bowl of candies. There was no such effect among nondieters, presumably because they found the candies less tempting and less demanding of self-regulatory resources.

Several studies also have linked ego-depletion to self-regulation more abstractly defined. In one study (Baumeister et al., 1998, Study 4), participants were asked to search for and cross out each letter *e* in a page of text, unless doing so violated one of several rules (e.g., do not cross off an *e* that is adjacent to another vowel). The rules made this a self-regulation activity because it required participants to override the impulse to simply cross off every letter *e* they found. Participants in a comparison condition performed three-digit multiplication problems, a task designed to be difficult and mentally taxing without requiring self-regulation. In phase two, participants were asked to watch a boring movie for as long as they wanted. Half of the participants were told that pressing a button would stop the movie (i.e., an active response), whereas the other half were told that releasing a button would stop the movie (i.e., a passive response). The results showed that, relative to the multiplication-problem control group, participants in the *e*-hunting condition stopped watching sooner when stopping required a passive response, but they waited longer when stopping required an active, volitional response. Thus, a task requiring active self-control led to the participants being passive and not actively exerting themselves on a subsequent task.

In another study, Wallace and Baumeister (2002) demonstrated that working on the Stroop task, which also requires an abstract form of self-control, impaired performance on a subsequent test of self-control relative to a comparison group that did not work on the Stroop task. These studies also ruled out self-attribution or self-efficacy as an alternative account of ego-depletion effects because success or failure feedback following the initial Stroop task did not influence subsequent performance. Furthermore, several studies have now demonstrated that, in general, the suppression of thoughts can cause ego-depletion (Muraven et al., 1998). For instance, in two studies suppressing the thought of a white bear (Wegner, Schneider, Carter, & White, 1987) led to a tendency to give up more quickly on unsolvable anagrams (Study 2) and impaired efforts to control the expression of amusement and enjoyment (Study 3).

Autonomous Regulation Versus Controlled Regulation

Throughout the ego-depletion literature, the terms self-regulation and self-control are used interchangeably (Baumeister et al., 1998; Muraven & Baumeister, 2000; Muraven et al., 1998; Schmeichel & Baumeister, 2004; Schmeichel et al., 2003). For instance, Muraven and colleagues (1998) made that equation in the statement, "if self-regulation conforms to an energy or strength model, then self-control should be impaired by prior exertion" (p. 774). However, self-determination theory (SDT; Deci & Ryan, 1985, 1987, 1991, 2000; Ryan, 1995) draws an important distinction between autonomous regulation (which is akin to what often is referred to as self-regulation) and controlled regulation (which is akin to what is sometimes called self-control).

Within SDT, autonomy is defined by the phenomenological experience of an internal perceived locus of causality (deCharms, 1968) or the self-endorsement of one's action. Autonomous regulation refers to regulation that is initiated and sustained by one's integrated, or true, self, whereas controlled regulation encompasses regulation by aspects of the person that are less well integrated with the self. For instance, behavior that stems from coercive, rigid, internalized demands (i.e., introjects) is an example of controlled regulation (Ryan & Connell, 1989). In short, controlled regulation involves feeling pressured, coerced, or seduced into action, whereas autonomous regulation involves doing what one finds interesting or important and would be inclined to do more freely.

There is also some evidence at the neurobiological level that is consistent with the distinction between autonomous and controlled regulation (Kuhl & Fuhrmann, 1998; Ryan, Kuhl, & Deci, 1997; Walton, Devlin, & Rushworth, 2004), and the empirical utility of drawing such a distinction has been well documented in a wide variety of domains, including education (Ryan & Connell, 1989), religion (Ryan, Rigby, & King, 1993), interpersonal relationships (La Guardia, Ryan, Couchman, & Deci, 2000), work organizations (Deci, Connell, & Ryan, 1989), sports (Frederick & Ryan, 1995), and health care (Williams, 2002).

Autonomous Regulation and Energy

In contrast to the ego-depletion prediction, Ryan and colleagues have established a positive link between autonomous or volitional self-regulation and the state of subjective vitality (Ryan & Frederick, 1997), which is a "positive feeling of having energy available to the self" (Nix, Ryan, Manly, & Deci, 1999, p. 266). For example, when patients at a pain clinic felt more autonomous with regard to seeking treatment (i.e., had more internal reasons), they also reported greater subjective vitality (Ryan & Frederick, 1997, Study 4), and when morbidly obese patients reported more internal (autonomous) reasons for entering a weight-loss program, they reported higher levels of vitality at a 2-year follow-up (Study 5). In this later study, self-reported vitality also

was linked to an objective measure of behavioral energization, assessed as decreases in body mass index. In yet another population, Kasser and Ryan (1999) demonstrated that the experience of autonomy versus control among nursing home residents positively related to greater ongoing subjective vitality, as well as to less mortality, at a 1-year follow-up. In contrast, these studies further showed that people who displayed controlled regulation tended to show less vitality and persistence.

The positive relation between autonomous self-regulation and subjective vitality also has been documented experimentally. In three studies, Nix et al. (1999) manipulated autonomous versus controlled motivation and each time found that autonomous motivation led to greater subjective vitality, further suggesting that autonomous self-regulation should not be depleting.

Autonomous regulation has not only been associated with the subjective experience of energization (i.e., subjective vitality) but also with the energization of behavior, both in the lab and in real-world settings. As already mentioned, autonomous regulation has been related not only to vitality but also to weight loss and seeking treatment for pain, and it has consistently been related to increased persistence at various activities. For example, a study of persistence among high school students conducted by Vallerand, Fortier, and Guay (1997) found that autonomous regulation predicted decreased likelihood of students dropping out. Pelletier, Fortier, Vallerand, and Brière (2001) found that elite swimmers' autonomous regulation predicted greater persistence (i.e., less attrition from the team) at 22-month follow-up.

In addition to enhanced persistence, the experience of autonomy has been linked to greater effort and goal attainment. Sheldon and Elliot (1998) found that the autonomy of personal goals predicted goal attainment among college students and that this effect was mediated by improved effort (i.e., greater amounts of time spent working on particular goals).

Choice and Energy

Experiments have suggested that manipulations designed to enhance one's experience of autonomy can boost intrinsic motivation and energize behavior (Simon & McCarthy, 1982; Swann & Pittman, 1977; Zuckerman, Porac, Lathin, Smith, & Deci, 1978). In the study by Zuckerman and colleagues, participants in a choice condition were shown six puzzle configurations and were allowed to select on which three of the six they would work. They also were allowed to apportion a total of 30 min of puzzle-solving time among the three puzzles. Participants in a no-choice comparison condition were yoked to participants in the choice condition, so participants in the two conditions worked on the same puzzles for the same amounts of time. The results of this study demonstrated that choice participants spent more time working on the task during the behavioral free-choice period and reported more intrinsic motivation, relative to comparison participants. In short, offering people an optimal amount of choice enhanced their intrinsic motivation and energy to persist.

The experience of choice also has been associated with facilitating the process of internalization, thereby enhancing autonomous self-regulation and the vitality that accompanies it. In fact, even using language that conveys choice (e.g., can, may, could) rather than control (e.g., should, must, have to) has been found to enhance autonomous motivation for an activity (Deci, Eghrari, Patrick, & Leone, 1994; Ryan, Connell, & Deci, 1985; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Thus, whereas the ego-depletion model suggests that all acts of self-regulation or self-control, including the exercise of choice, will tend to deplete energy for subsequent volition and action, the SDT perspective suggests that if the regulation is autonomous rather than controlled, it will not be depleting.

Choice and Energy: A Paradox

According to the Baumeister et al. (1998) model, because making choices represents one kind of self-regulation, making choices would necessarily result in ego-depletion. To our knowledge, the lone published study directly investigating the influence of choice on ego-depletion was conducted by Baumeister et al. (1998, Study 2). In this study, choice was manipulated in relation to having participants select which side of a debate they would later endorse in a persuasive speech. In the low-choice condition, participants were told that they had been assigned to make one of the two speeches because the researchers already had enough people making the other speech, "so it would not be possible to give the participant a choice as to which speech to make" (p. 1257). In contrast, participants in the condition labeled high choice "were told that the decision of which speech to make was entirely up to them [however] . . . because there were already enough participants in one of the groups, it would help the study a great deal if they chose" the other speech topic (p. 1257). Half were given each of the two sides. It was assumed that all students were against the proposed tuition increase, so those asked to take that side were assumed to be in a proattitudinal condition, and those asked to take the other side were assumed to be in a counterattitudinal condition.

Of interest, all participants in these two high-choice conditions (proattitudinal and counterattitudinal) agreed

to make the speech they had been asked to take. In a fourth, no speech condition, there was no mention of the speech or of a choice about what to do. In the second phase of the experiment, participants were asked to work on an unsolvable, figure-tracing, puzzle activity. The results of the experiment indicated that, relative to the low-choice and no choice conditions, participants given high-choice persisted for less time and made fewer attempts at solving puzzles before quitting, regardless of whether this illusion of choice manipulation had them assigned to a proattitudinal or counterattitudinal position. The researchers concluded that "making a meaningful personal choice" is ego-depleting.

Autonomous Choice Versus Controlled Choice

We suggest that these seemingly contradictory findings result primarily from an undifferentiated conceptualization of self-regulation and choice in the ego-depletion literature. We have argued for the conceptual importance and empirical utility of distinguishing between autonomous and controlled forms of regulation, with the latter being energy depleting but the former not being. We now suggest that the concept of "choice" or "decision" requires a similarly precise or differentiated definition that pays greater attention to participants' phenomenological experience.

In the Zuckerman et al. (1978) study, participants were given an unrestricted choice of three out of six puzzle problems, with no cues about which ones to select. We herein refer to that as autonomous choice. However, in the Baumeister et al. (1998) study, participants were subtly pressured to choose one of the options. We call that controlled choice because people may feel compelled to select that option so they will not appear unhelpful to the experimenter. In fact, a very similar manipulation was found to lead to an external perceived locus of causality by Pittman, Davey, Alafat, Wehterill, and Kramer (1980). Just as the regulation of behavior can be controlled by introjects or external contingencies, so too can people's decisions. One might argue that in such a situation, the people make a behavioral selection or decision, but they may not experience a true sense of autonomy or choice.

Simply stated, the objective presence of multiple options from which to select is not a sufficient condition for the experience of autonomy or choice as defined by SDT. For example, in the Baumeister et al. (1998) experiment, people were told they were free to choose between two options, but at the same time they were being subtly pressured to select one of two. We suggest that this was probably not experienced as a true, or autonomous, choice (i.e., one accompanied by an internal perceived locus of causality). Of course it is possible that a person who did what the experimenter requested would have experienced autonomous choice, but we would argue that the very fact that every participant chose what the experimenter requested indicates that participants probably felt compelled to do what was suggested. This, then, would be considered a controlled choice that would be expected to deplete participants' energy and vitality. The critical difference between this and the choice in the Zuckerman et al. (1978) study was that in the latter there were no requests, suggestions, or pressures to select a particular puzzle. As such, participants would likely have experienced an internal perceived locus of causality with respect to their selection.

There are two other noteworthy differences between the Zuckerman et al. (1978) study and the Baumeister et al. (1998) study. Zuckerman and colleagues considered the effects of choice on intrinsic motivation for the interesting activity about which people were given choice. In contrast, Baumeister and colleagues looked at the effects of choice related to one activity on the energy for a different, uninteresting activity. Thus, the first difference is that the dependent measure in the ego-depletion studies was not intrinsic motivation because the persistence activities were not interesting. The second difference was that the dependent measure assessed energy for a task different from the one about which people had choice.

Present Investigations

Three experiments were conducted in an attempt to reconcile the seeming discrepancies between the SDT and self-regulatory strength model positions on the relation of choice to psychological energy. These experiments follow up on Baumeister et al. (1998, Study 2) using concepts from SDT to moderate the ego-depletion effect. In each of these studies, we used both an autonomous-choice condition and a condition similar to the one used by Baumeister and colleagues, which we refer to as controlled choice. We intended the autonomous-choice condition to facilitate the experience of volition and choice. Our expectation was that the autonomous-choice condition would be vitalizing relative to the controlled-choice condition, which we expect to be depleting. Thus, we hypothesized that we would replicate the ego-depletion effect for the controlled-choice condition but that the autonomous-choice condition would not lead to depletion relative to the no-choice comparison condition and would result in greater energy and persistence than the controlled-choice condition. In Experiment 3, we examined whether the relation between the experimental choice

conditions and ego-depletion would be mediated by self-reported experiences of autonomy or self-determination.

EXPERIMENT 1

The first experiment was virtually a direct replication of Baumeister and colleagues' (1998, Study 2) study on choice and ego-depletion, using the same choice manipulation activity (i.e., a decision relating to speech topics) and the identical dependent measure of ego-depletion (i.e., persistence at an unsolvable puzzle), with the addition of a key autonomous-choice condition. In this study, we contrasted an autonomous-choice condition with the controlled-choice condition used by Baumeister and colleagues (the latter having been labeled "high choice" by them). We expected a significant difference between the two. In addition, we included a no-choice condition comparable to that used by Baumeister and colleagues, which we expected to fall between the other two conditions.[1]

Method

Participants. Data were collected in individual sessions from 37 undergraduate college students (12 men, 25 women) in exchange for extra course credit. The average age of participants was 19.3 years old, with a range of 18 to 22 years. Each participant was randomly assigned among three experimental conditions: autonomous choice, controlled choice, and no choice.

Procedure. Participants signed up for a study on persuasion and problem solving. The experimenter greeted each participant and explained that the purpose of the study was to see how people responded to persuasion. Participants were told that they would be making stimuli that would be played to other people to try to alter the others' attitudes. In particular, they would be making an audiotaped recording of a persuasive speech regarding whether psychology should be taught at the high school level. The following cover story was borrowed directly from the procedures employed by Baumeister and colleagues (1998, Study 2). The topic of the debate was changed from the one used by Baumeister et al. so participants would be likely to vary in terms of which side was consistent with their attitudes.

The experimenter then showed the participants two folders, labeled "for psychology in high school" and "against psychology in high school." Participants in the autonomous-choice condition were told that it was entirely up to them which side of the debate they would choose to argue so they could take their time to think about it and then make a choice. Participants in the controlled-choice condition were given a procedure scripted directly from the Baumeister et al. method section for the condition they labeled "high choice." Our participants in this condition, which we called controlled choice, were yoked to the option chosen by the participant in the autonomous-choice condition who immediately preceded them. Again, controlled-choice participants were initially told that the decision was entirely up to them, but then 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 would choose to read one folder rather than the other. The experimenter then stressed again that the final decision remained theirs. As in the original study (Baumeister et al., 1998, Study 2), all participants chose to make the speech they had been assigned. Participants in the no-choice condition also were yoked to the option chosen by the previous participant in the autonomous-choice condition. The experimenter explained that the researchers already had enough people making the speech for (or against) so it would not be possible to give the participant a choice of which speech to make. Participants in each condition expressed their choice (or acceptance of a speech) verbally to the experimenter and were then given the appropriate folder of materials. It took the experimenter 1 to 2 min to convey the cover story to each participant, and participants typically took less than 1 min to make their choice (or articulate consent).

At this point, participants were presented with the task for the second part of the experiment. The experimenter explained that there was some evidence for a link between persuasiveness and problem-solving abilities. Accordingly, the next part of the experiment would contain a measure of problem-solving ability. Participants were told that the problem-solving activity would precede the speech.

The problem-solving task was the same one that had been used by Baumeister et al. (1998, Studies 1 & 2). 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, and participants were instructed to use one slip of paper per attempt. Each participant was initially given a solvable practice figure to learn how the puzzles worked, with the experimenter present to answer any questions. After the practice period, the experimenter gave the participant the test figure with the following 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 take. You will be judged on whether or not

you finish tracing the figure. If you wish to stop before you finish (i.e., before you solve the puzzle), ring the bell on the table.

Unbeknownst to the participant, the test figure 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). Thirty minutes was set as the maximum time, and the 9 participants who were still working at 30 min were stopped by the experimenter at that point.[2] For the rest, when the experimenter heard the bell, he reentered the room and administered the Brief Mood Inspection Scale (BMIS; Mayer & Gaschke, 1988) and the Intrinsic Motivation Inventory (IMI; Ryan, 1982). This was used to ensure that any ego-depletion effects were not a function of changes in affect or intrinsic motivation. When the participants finished, the experimenter debriefed, thanked, and dismissed them.

Measures. The BMIS (Mayer & Gaschke, 1988) is a mood-adjective scale with an item sample of 16 adjectives, 2 selected from each of the following eight mood states: (a) happy, (b) loving, (c) calm, (d) energetic, (e) fearful/anxious, (f) angry, (g) tired, and (h) sad. Participants rated the degree to which they felt the affect in each item on a 4-point scale ranging from 1 (*definitely did not feel*) to 4 (*definitely felt*). Mayer and Gaschke (1988) identified two subscales that emerged as unrotated factors: pleasant-unpleasant ($\alpha = .86$) and arousal-calm ($\alpha = .63$). This measure was included to confirm that any effects on energy resulting from the manipulation were not mediated by mood.

The IMI (Ryan, 1982) measures dimensions related to intrinsic motivation. The interest/enjoyment subscale of the IMI consists of four items that most closely represent the experience of intrinsic motivation and thus were used in the current study to determine whether any effects found were a function of changes in intrinsic motivation for the activity used to measure ego-depletion. Participants rated the degree to which they found the unsolvable problem interesting using a 7-point scale ranging from 1 (*not at all true*) to 7 (*very true*) (α for the current sample = .88).

Results

Persistence. The first dependent measure was the amount of time participants spent on the unsolvable puzzles. A one-way ANOVA indicated significant variation among the three conditions, $F(2, 34) = 3.45$, $p < .05$.[3] The means are presented in Table 1. As predicted, pairwise comparisons among the groups indicated that participants in the autonomous-choice condition persisted for significantly longer than did participants in the controlled-choice condition, $F(1, 35) = 6.69$, $p = .02$. Also as expected, the no-choice condition was midway between the autonomous-choice and controlled-choice conditions. The autonomous-choice condition did not differ significantly from the no-choice condition, $F(1, 35) = .48$, $p = .49$, but the controlled-choice condition was marginally significantly lower than the no-choice condition, $F(1, 35) = 3.12$, $p < .09$, thus nearly replicating the Baumeister et al. (1998, Study 2) finding.

TABLE 1: Means and Standard Deviations for the Two Measures of Persistence on Unsolvable Puzzles in the Three Experimental Conditions (Experiment 1)

Condition	*Time (s)*	*Attempts*
Autonomous choice ($n = 12$)		
M	1440.42	46.83
SD	154.01	5.92
No choice ($n = 12$)		
M	1278.00	35.00
SD	154.01	5.92
Controlled choice ($n = 13$)		
M	896.39	19.15
SD	147.97	5.69

NOTE: Higher numbers indicate greater persistence.

As in the Baumeister et al. (1998) study, we also used a second dependent measure, namely, the number of attempts made before giving up (i.e., the number of pieces of paper used). A one-way ANOVA again revealed significant variation among the three conditions, $F(2, 34) = 5.74$, $p < .01$. The pattern of results was essentially the same as with duration of persistence, as can be seen in Table 1. Pairwise comparisons among the groups indicated that participants in the autonomous-choice condition persisted for significantly longer than did participants in the controlled-choice condition, $F(1, 35) = 11.72$, $p < .01$. The no-choice condition did not differ significantly from the autonomous-choice condition, $F(1, 35) = 1.61$, $p = .21$, but again it was marginally different from the controlled-choice condition, $F(1, 35) = 3.35$, $p = .08$.

Mood. As in many studies on ego-depletion, we assessed mood to rule it out as a mediator. The BMIS mood measure contained two subscales (pleasant-unpleasant and arousal-calm). A MANOVA was conducted using condition as the independent variable and the two BMIS subscales as dependent measures. The overall effect was nonsignificant using Wilks's lambda, $F(4, 66) = 0.15$, $p = .96$, and neither of the subscales approached significance, all Fs < 1.0. Thus, affect did not mediate the results on ego strength.

Intrinsic motivation. We also assessed intrinsic motivation (i.e., interest/enjoyment for the activity) to rule it out as a mediator of ego-strength effects. Specifically, this measure was intended to differentiate persistence that reflects self-regulatory strength from persistence that reflects intrinsic motivation. An ANOVA was conducted using condition as the independent variable and interest as the dependent variable. The effect was not significant, $F(2, 34) = 0.71$, $p = .50$, indicating that intrinsic motivation on the persistence activity was not affected by choice on the initial activity.

Discussion

The main hypothesis tested in Experiment 1 was supported. Participants in the autonomous-choice condition persisted longer and made a greater number of attempts relative to those in the controlled-choice condition, with those in the no-choice condition falling in between. The controlled-choice condition was the same as the one that Baumeister et al. (1998, Study 2) had called the high-choice condition. Thus, the fact that participants in the controlled-choice condition persisted for marginally less time and made marginally fewer attempts relative to the no-choice comparison condition essentially replicated the ego-depletion effect reported by Baumeister and colleagues. But the fact that the autonomous-choice condition led to significantly greater persistence than the controlled-choice conditions indicates that some choices are not depleting. Both mood and intrinsic motivation were ruled out as mediators of ego-depletion.

EXPERIMENT 2

In Experiment 2, we extended this work by replicating the autonomous-choice versus controlled-choice results reported in Experiment 1 using a different task to increase generalizability and to show the effect with a physical indicator of energy. Again, the choice manipulation related to an activity that participants believed would take place in a second phase of the experiment. This time, participants made choices related to what activities they would like to engage in later. Again, persistence was used as a dependent measure of ego-depletion. However, to increase generalizability, we made the following changes. First, we used a solvable, yet tedious, persistence activity similar to some that have been used for measuring ego-depletion in the past. Second, we instructed participants to raise their nonwriting hands above their heads while working on the task to make it a physically demanding task similar to the handgrip task used by Muraven et al. (1998). Participants were instructed to drop their hand back onto the desk when they were ready to quit. This hand-raising element effectively changed the decision to quit from an active one (i.e., reaching out to ring a bell) to a passive one (i.e., letting their hand fall) because Baumeister and colleagues (1998, Study 2) found that ego-depletion made people more prone to desist when the termination behavior was passive rather than active. Using the passive termination and the physical-exertion task was intended to increase generalizability of the results and allow an examination of whether autonomous versus controlled choice would affect a physical-exertion behavior.

Method

Participants. Data were collected in individual sessions from 25 undergraduates (9 men, 16 women) who received extra course credit. They averaged 19.3 years old, with a range of 18 to 23. Each participant was randomly assigned to one of two experimental conditions: autonomous choice or controlled choice.

Procedure. Participants signed up for a study on "cognitive exercise." The experimenter greeted each participant and explained that this study was probably different from other studies being run on campus because the participants would be given some choice about what they do in the second phase of the experiment. Participants were then presented with a form inviting them to choose between several potential activities (i.e., either watching a film or listening to music and then either writing about it or talking about it).

Each participant in the controlled-choice condition was yoked to the choices made by the previous participant in the autonomous-choice condition. Again, participants were initially told that the decision was entirely up to them. Then, 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 a particular set of activities. The experimenter then again stressed that the final decision would remain entirely up to them. As in Study 1, participants in each condition expressed their choice verbally to the experimenter, and the timing was about the same as in Study 1. As in the original study (Baumeister et al., 1998, Study 2), all controlled-choice participants selected the activities they were subtly pressured to do.

At this point, participants began the task that contained the dependent measure of ego-depletion. Participants were presented with two sheets of paper, each covered with a relatively dense matrix of letters and symbols, and they were asked to search for differences between the two pages. Participants were instructed to keep their nonwriting hand raised clearly above their head while working on the exercise. They were asked to

TABLE 2: Means and Standard Deviations for the Two Measures of Persistence on the Solvable Difference-Finding Activity in the Two Experimental Conditions (Experiment 2)

Condition	*Time (s)*	*Task score*
Autonomous choice (n = 13)		
M	545.58	27.83
SD	62.33	3.51
Controlled choice (n = 12)		
M	316.08	15.31
SD	59.89	3.38

find as many differences as they could, but they were told that whenever they were ready to quit they could simply drop their hand. The experimenter then covertly started a stopwatch to measure the duration of persistence. Fifteen minutes was set as the maximum time, and the 2 participants who were still working at 15 min were stopped by the experimenter at that point. Following this behavioral measure of ego-depletion, the experimenter administered the BMIS and IMI. When participants finished, the experimenter debriefed, thanked, and dismissed them.

Measures. The BMIS (Mayer & Gaschke, 1988) and the interest/enjoyment subscale of the IMI (Ryan, 1982) were used in this experiment as they had been in Experiment 1 to ascertain whether either mood or intrinsic motivation mediated ego-strength effects.

Results

Persistence. The primary dependent measure was the amount of time participants spent on the difference-finding exercise while keeping their hand raised. An independent-samples *t* test indicated that the autonomous-choice condition persisted significantly longer than those in the controlled-choice condition, $t(23) = 7.05$, $p < .05$. The means are presented in Table 2. Performance scores on the search task were calculated by subtracting the number of differences incorrectly identified from the number correctly identified. An independent-samples *t* test indicated that the mean for the autonomous-choice condition was significantly higher than that for the controlled-choice condition, $t(23) = 6.61$, $p < .05$.

Mood. A MANOVA was conducted using condition as the independent variable and the two BMIS subscales as dependent measures. Neither the overall effect nor the individual effects approached significance. The overall effect using Wilks's lambda was nonsignificant, $F(2, 19) = .39$, $p = .68$, and for subscales, all *F*s were less than 1.0, indicating that ego-depletion effects were not a function of mood.

Intrinsic motivation. An independent-samples *t* test was conducted using condition as the independent variable and interest/enjoyment as the dependent variable. The effect was nonsignificant, $t(22) = 0.76$, $p = .46$, indicating that intrinsic motivation on the persistence activity was not affected by choice on the initial activity.

Discussion

Experiment 2 replicated the critical difference observed in Experiment 1 using an alternative manipulation of choice and an alternative measure of ego-depletion that included objective performance and physically demanding persistence. Again, participants in the controlled-choice condition were significantly ego-depleted (i.e., persisted less and performed worse) relative to those in the autonomous-choice condition. The results support our hypothesis that different kinds of choice (autonomous vs. controlled) must be considered with regard to understanding the relation between choice and ego-depletion.

EXPERIMENT 3

In Experiment 3, we extended this work by replicating the results reported in Experiments 1 and 2, with the addition of an important manipulation check and test of mediation. Again, we focused on the autonomous-choice and controlled-choice conditions to further illustrate this conceptual distinction. The choice manipulation was identical to that used in Experiment 2. Participants made two decisions related to which activities they would like to engage in later. Again, performance and persistence were used as the dependent measures of ego-depletion.

One potential critique of the dependent measure used in Experiment 2 is that keeping one's hand raised could have been affected by individual differences in physical strength, so in this experiment, we used a passive response that involved relatively little physical strength. Participants were asked to press the spacebar on a computer keyboard and keep the bar pressed down until they were ready to quit working. This retained a passive response to quit while eliminating the error variance contributed by variation in physical strength. An additional advantage of this approach was that time on task could be measured via the computer.

Second, to increase generalizability, we used a third task for obtaining the dependent measures. It was a search task similar to the one used in Experiment 2, but because the previous search task could be accomplished with an algorithmic strategy, we used one in this experiment that required more complex cognitive activity. Specifically, we adapted a task used by Baumeister and

colleagues (1998, Study 4) that involves searching a page of letters but using more complex problem solving when doing so.

Method

Participants. Data were collected in individual sessions from 33 undergraduates (6 men, 27 women) who received extra course credit. They averaged 19.5 years old, with a range of 18 to 22. Each participant was randomly assigned to autonomous choice or controlled choice.

In this sample, 3 participants in the controlled-choice condition selected activities other than those suggested by the experimenter. We reclassified these 3 as "resisters" and ran an additional 3 "compliant" participants in the controlled-choice condition. All analyses reported were run after dropping these 3 resisters and using a sample of 30 (i.e., 15 per cell).

Procedure. Participants signed up for a study on "cognitive exercise". The experimenter greeted participants individually, obtained consent, and explained that the participants would be given a choice among several activities that they could do in the second phase of the experiment (i.e., either watching a film or listening to music and then either writing about it or talking about it). Participants were then presented with a form and invited to choose.

Participants in the controlled-choice condition were again yoked to the choices made by the previous participant in the autonomous-choice condition. Again, participants were initially told that the decision was entirely up to them. Then, 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 a particular set of activities. The experimenter again stressed that the final decision was entirely up to them.

At this point, participants were presented with the activity that included the dependent measure of ego-depletion (adapted from Baumeister et al., 1998, Study 4). For this task, participants were presented with two sheets of printed text taken from an introductory statistics textbook. They were asked to search for the letter *e* and to cross it out, unless doing so violated any of three rules. The rules were as follows: (a) do not cross out an *e* if it is adjacent to another vowel, (b) do not cross out an *e* if it is the first letter of a word, and (c) do not cross out an *e* if it is followed by two consonants in the same word. Participants were told that although they were not expected to find every *e*, they were to find as many qualifying *e*s as they could before quitting.

On the *e*-hunting exercise, someone could find many qualifying *e*s by simply crossing off every *e* and ignoring the rules. Alternatively, someone could avoid making mistakes by simply circling very few *e*s. For these reasons, performance scores on the *e*-hunting task were calculated by subtracting the number of false alarms (incorrectly crossed off *e*s) from the number of hits (correctly crossed off *e*s).

TABLE 3: Means and Standard Deviations for the Performance and Persistence Measures on the *e*-Hunting Activity in the Two Experimental Conditions (Experiment 3)

Condition	*Time (s)*	*Task Score*
Autonomous choice ($n = 15$)		
M	878.2	210.3
SD	50.2	43.3
Controlled choice ($n = 15$)		
M	685.7	153.47
SD	50.2	69.0

Following the behavioral measure of ego-depletion, the experimenter administered three questionnaires. First, participants completed the BMIS (Mayer & Gaschke, 1988) and the IMI (Ryan, 1982), as in Experiments 1 and 2. Then, we reminded participants of the choices they made earlier in the session and assessed their experience of self-determination with regard to these choices (a variable used as a manipulation check and potential mediator). When participants finished, the experimenter debriefed, thanked, and dismissed them.

Measures. The BMIS (Mayer & Gaschke, 1988) and the interest/enjoyment subscale of the IMI (Ryan, 1982) again were used and are described in Experiment 1.

The nine-item self-report measure of self-determination was adapted from Reeve, Nix, and Hamm (2003). Statements were rated on a 7-point Likert-type scale ranging from 1 (*not at all true*) to 7 (*very true*). The scale includes the following three subscales: perceived locus of causality, volition, and perceived choice, which combine for a total self-determination score ($\alpha = .93$).

Results

Ego-depletion was measured in two ways: (a) time of persistence and (b) performance on the *e*-hunting task. Independent-samples *t* tests indicated that the autonomous-choice participants persisted significantly longer than the controlled-choice participants, $t(28) = 2.71$, $p < .05$ (see Table 3 for the means). On the performance measure, an independent-samples *t* test indicated that the autonomous-choice participants also scored significantly higher than those in the controlled-choice condition at the *e*-hunting activity, $t(28) = 2.70$, $p < .05$.[4]

Mood. A MANOVA using condition as the independent variable and the two BMIS subscales as outcome variables showed that the overall effect was nonsignificant using Wilks's lambda, $F(2, 27) = 0.44$, $p = .65$, and none of the subscales approached significance, Fs < 1.0, again indicating that mood did not explain persistence or performance results.

Intrinsic motivation. An independent-samples t test using condition as the independent variable and interest/enjoyment for the activity as the dependent variable also yielded a nonsignificant effect, $t(28) = 0.73$, $p = .91$. Again, the effects were not a function of changes in intrinsic motivation.

Self-determination. Participants reported their experience of self-determination in relation to the choice manipulation. An independent-samples t test indicated that the mean of the autonomous-choice condition ($M = 50.20$) was significantly higher on self-determination with regard to the choice manipulation than was the mean of the controlled-choice condition ($M = 41.53$), $t(28) = 2.27$, $p < .05$.

Mediation. Next, we tested whether perceived self-determination would mediate the relation between condition and ego-depletion, first done with the *e*-hunt score and then with persistence. Baron and Kenny (1986) presented four steps for establishing mediation. Steps 1 and 2 involve showing that the independent variable (i.e., choice condition) is related to the outcome (i.e., *e*-hunt score) and showing that the independent variable is related to the mediator (i.e., self-determination). These effects were confirmed and reported above. Step 3 requires that the mediator affect the outcome variable, controlling for the independent variable. A regression analysis including both reported self-determination and condition confirmed that self-determination did significantly predict the *e*-hunt score, $\beta = .46$, $t(28) = 2.81$, $p < .01$. The final step for establishing mediation looks at the relation between the initial predictor variable and the outcome, controlling for the mediator. If this effect drops to zero, then there is full mediation; if it drops significantly (Sobel, 1982), then there is partial mediation. The effect of condition on *e*-hunt score dropped from significant ($\beta = .46$) to nonsignificant, $\beta = .27$, $t(28) = 1.66$, $p = .11$. A Sobel test confirmed the significance of this mediation, $z = 2.27$, $p < .05$ (see Figure 1).

With regard to the persistence measure, Steps 1 and 2 held (as reported above). However, when a regression analysis was run including both reported self-determination and condition, self-determination did not significantly predict persistence, $\beta = .25$, $t(28) = 1.36$, $p = .19$.

Figure 1 Mediation of ego-depletion effect by self-determination (Experiment 3).

NOTE: In the figure, numerical values represent standardized beta coefficients resulting from the four-step procedure described by Baron and Kenny (1986) for establishing mediation. The beta value in parentheses refers to the direct effect between choice condition and *e*-hunt performance when self-determination is not being controlled for.

*$p < .05$. **$p < .01$.

GENERAL DISCUSSION

Three studies were designed to test and refute an assertion made by Baumeister and colleagues (1998) that "all acts of volition" (p. 1253) are ego-depleting. Several previous studies had isolated processes that limit or counteract the ego-depletion phenomenon, including positive affect (Baumeister, Dale, & Tice, 1998), self-regulatory practice (Muraven, Baumeister, & Tice, 1999), rest and sleep (Baumeister, Muraven, & Tice, 2000), challenging expectations (Martin, Tenbuelt, Merckelbach, Dreezens, & de Vries, 2002), task motivation (Muraven & Slessareva, 2003), implementation intentions (Webb & Sheeran, 2004), and visualizing an energizing significant other (Knowles & Finkel, 2005). The current studies isolated autonomy as a moderator of ego-depletion.

The current studies also went beyond the previous ones in that they not only specified an antidote to ego-depletion but they suggested that the strength-model conceptualization does not apply to all types of self-regulation. Specifically, SDT emphasizes that there are multiple ways of regulating one's self and that these regulatory approaches have very different relations to psychological energy and vitality. Specifically, controlled regulation (sometimes called self-control) is not equivalent to autonomous self-regulation in terms of its effects. SDT agrees that controlled regulation will be depleting but it maintains that autonomous regulation will not. Indeed, in each of these current studies, and in line with past research, there was a significant difference in the level of energy, vitality, and persistence in the conditions representing autonomous choice (prompting autonomous regulation) versus controlled choice (prompting controlled regulation).

Thus, we maintain that Baumeister et al.'s (1998) claim that *all* acts of self-regulation or choice will deplete

inner resources and energy is insufficiently differentiated. Controlled regulation, which involves inner conflict—with one part of the person pressuring or controlling another part—is indeed depleting. However, we argue that autonomous regulation is a prototypic example of volition that is not depleting. With respect to making decisions or choices, we suggest that the so-called high-choice condition in the Baumeister et al. (1998) research was not an instance of autonomous choice. Although participants were told that the choice was theirs, they were subtly pressured to select one of the options, and indeed, every participant did make that selection. Presumably, the participants in that condition would have felt controlled and perceived an external locus of causality (Pittman et al., 1980). In short, the key to making sense of this apparent contradiction involves an appreciation for the distinction between autonomous choice and controlled choice (Deci & Ryan, 1985). Both involve selecting among options, but autonomous choice is accompanied by the experience of volition, whereas controlled choice, which involves selecting an option under pressure, is accompanied by the experience of control. In other words, choices that are accompanied by demands or obligations involve a very different phenomenological experience from those that simply offer opportunities.

In three experiments, we illustrated the importance of this distinction for understanding the relation between making choices and ego-depletion. For the first experiment, we duplicated two conditions that had been used by Baumeister and colleagues (1998) in the one published experiment suggesting that making a choice would be depleting. The effect reported by Baumeister and colleagues was essentially replicated, but the study also demonstrated that conditions representing autonomous choice are quite different from those representing controlled choice, which Baumeister and colleagues had labeled "high choice." In our first study, participants in the autonomous-choice condition persisted longer and made more attempts at puzzle solving than did those in the controlled-choice condition, and there was no evidence of ego-depletion for the autonomous-choice condition relative to a no-choice comparison condition. Experiment 2 focused on the key distinction (viz., autonomous choice vs. controlled choice) using a new choice situation that provided more options and a new measure of ego-depletion involving physical exertion. Again, those in the autonomous-choice condition persisted longer at a difficult activity relative to those in the controlled-choice condition. In addition, in Experiment 2, participants in the autonomous-choice condition scored higher on an objective measure of performance (i.e., number of differences found minus number of nondifferences incorrectly identified as differences). Experiment 3 further extended this research by replicating the general effect using yet another dependent measure of ego-depletion. The general effect was again replicated, such that those in the autonomous-choice condition were less ego-depleted than those in the controlled-choice condition, persisting longer and performing better on the *e*-hunting task. Collectively, these studies provide strong support for recognizing the distinction between autonomous and controlled choice and their differential relations with ego-depletion.

In all three experiments, we ruled out affect and intrinsic motivation as possible mediators. Then, in Experiment 3, self-reported self-determination was examined as a potential mediator and was found to mediate the effect of autonomous versus controlled choice on performance on the *e*-hunting task. Self-determination failed to significantly mediate the effect of choice on persistence, perhaps because persistence is not as precise a measure of focused engagement with the task (of ego-energy) as is quality of performance. Specifically, persistence does not distinguish whether people are seriously engaged with the task or are casually engaged with it while daydreaming. An alternative possibility for the lack of significant mediation of the choice-persistence relations is that self-determination is not sufficiently proximal to persistence. For example, perhaps people who experience self-determination would feel greater vitality (Ryan & Frederick, 1997), which would then be more strongly related to persistence. Additional studies of mediation will be required to elucidate this issue further.

The current studies demonstrated that making choices is not always ego-depleting. When people experienced a sense of autonomy with regard to the choice, their energy for subsequent tasks was not diminished. An important question that deserved empirical attention concerns the potential for autonomous choice to vitalize or enhance self-regulatory strength for subsequent tasks. What, for example, are the conditions that will lead autonomous choice to enhance people's motivation for new tasks? We suggest that among the factors that are likely to affect whether choice will be vitalizing is the nature of the options being provided to the person. If a person is offered choice among options that he or she does not value, that are trivial or irrelevant, the choice is unlikely to be vitalizing and may be depleting, even if there is no subtle pressure toward a particular option. On the other hand, having autonomous choice among options that do have personal value may indeed be quite energizing.

We have framed this article in terms of understanding choice as both a phenomenological aspect of autonomous self-regulation and as a description of situations that

involve selecting among options that can vary in whether there are pressures toward one of the options.[5] We used the terms "autonomous choice" and "controlled choice" to covey the absence versus presence of pressure toward an option, and we maintained that only autonomous choice will allow the person to experience a sense of choice. The evidence from the three studies supported our contention that controlled choice is likely to be ego-depleting but that autonomous choice is not. One implication of this work is that researchers would do well to avoid making sweeping statements about the effects of choice. The concept of choice has multiple meanings, and effects of choice will depend on precisely how the term is defined. As the current studies showed, it is important to distinguish between autonomous and controlled forms of choice.

Furthermore, because autonomous choice and controlled choice are instances of the general concept of self-regulation, the implications of the present research can be extended to our understanding of self-regulation more generally. Whereas the ego-depletion literature has to date focused on what we refer to as controlled forms of regulation, we maintain that autonomous self-regulation is very different and that it is important to consider types of regulation when examining vitalizing versus ego-depleting effects in general.

NOTES

1. Because the no-speech condition turned out to be equivalent to the no-choice condition in the original study by Baumeister, Bratslavsky, Muraven, and Tice (1998, Study 2), we did not run the no-speech condition in the current experiment.

2. Because some participants persisted for the full time, we did a test for skewness and found the skewness to be –.44, which is far below the cutoff score suggested by Kline (1998) of an absolute value of 3.0. In Experiments 2 and 3, we also found skewness to be below the cutoff.

3. We also did a 2 × 3 ANOVA with condition crossed by gender. Neither the main effect for gender nor the interaction approached significance. Furthermore, in Experiments 2 and 3, we also analyzed for gender and found no effects, so gender will not be considered further.

4. We repeated the *t* tests with data from the 3 resisters included and the effects were still significant.

5. The concept of choice has received considerable attention in social psychology recently and, in contrast to our approach, many authors have defined choice exclusively in terms of selection among options while ignoring the subjective experience of choice (Carmon, Wertenbroch, & Zeelenberg, 2003; Iyengar & Lepper, 2000; Mick, Broniarczyk, & Haidt, 2004; Schwartz, 2000, 2004).

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