Decision Fatigue Exhausts Self-Regulatory Resources — But So Does Accommodating to Unchosen Alternatives

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Abstract

Effortful choice is costly, but so is accommodating to choices made by others. In five studies, participants who made a series of choices regarding consumer products, college courses, or course materials subsequently showed poorer self-regulation (measured in terms of task persistence, task performance, and pain tolerance), as compared to people who viewed or rated similar options without making choices. In two additional studies, people were better at self-regulation (measured in terms of physical stamina and speed-accuracy trade-offs) after they had performed a task they had chosen, as compared to performing a task chosen by others. A limited resource model can explain why people regard choice-making as stressful yet generally prefer to have choices.

"*The difficulty in life is the choice."* --George Moore, The Bending of the Bough, 1900

The rich complexity of human social life is partly attributable to choice. Each day, millions of people make decisions that will have lasting effects on their lives. Although choices are often described as painful, agonizing, difficult, and by other terms that connote adversity, people who lack choices tend to see their situations as even more aversive. Indeed, the restriction of freedom (through jailing or other confinements) has long been used in human society as a severe form of punishment. Conversely, the worldwide shift toward democracy that has been one great theme of the late 20th century (Fukuyama, 1992) can be seen as a broad-based insistence on having more choices.

There is no denying that choices have proliferated, in terms of the number of decisions one can make in life or even throughout a day. The diversity of product selection has expanded exponentially, such that the average American supermarket in 1976 carried 9,000 different products, whereas fifteen years later that figure had ballooned to 30,000 (Waldman, 1992). The average produce section alone had risen from 65 items to 285 items. The coffee shop chain Starbucks boasted in 2003 that it offered each customer 19,000 "beverage possibilities" at every store, and this was before their new "superheated" option multiplied the number even further. Approximately 50,000 new products are introduced every year in the U.S., whereas the number 30 years ago was only a few thousand.

Has the proliferation of choice uniformly made life easier and better? Iyengar and Lepper (2000) found that people who had more choices were often less willing to decide to buy anything at all, and their subsequent satisfaction was lower when they had been confronted with 24 or 30 options than when they faced six options. Such findings suggest that choice, to the extent that it requires greater decision-making among options, can become burdensome and ultimately counterproductive. Schwartz (2000) denounced the stresses and others costs of increased choice as "the tyranny of freedom."

We thus have a potential paradox. People who lack choices seem to want them and often will fight for them. Then again, people find that making many choices can be aversive. The purpose of the present manuscript was to test two seemingly competing hypotheses about choice, derived from a

limited resource model of psychological functioning. The first hypothesis centers around *decision fatigue*: the notion that making choices can be effortful and can therefore deplete resources. The second hypothesis is that when one does not have choice, even though one might be spared the depleting effect of choosing, one may have to expend resources to adjust oneself to unchosen circumstances. Thus, we propose that choice is a two-sided coin for executive functioning: Making choices is taxing, but so is accommodating to the choices of others.

Choice and Control

By some analyses, human life is full of constant choices, insofar as an alternative is available to nearly every action (Sartre, 1956). We use the term choice in a more limited sense, however, to refer to choices made by a conscious consideration among alternatives. Most of the time people proceed by routine, habit, and automatic processes (Bargh, 1989; Bargh & Thein, 1985). To say that a professor chooses to go to her office each day, because in principle she could stay home or get another job is misleading in our view: Most likely she does not go through a conscious consideration of alternatives each day.

Our point is simply that the contemplation of alternatives and selection among them is a meaningful and effortful psychological act. It is a form of exerting control: One can decide the outcome of a particular situation. Indeed, in some views the capacity to make flexible choices based on new information is one of the driving forces behind the evolution of basic cognitive processes (Tomasello & Call, 1997). That is, simple organisms behaved according to fixed action patterns, by which their biological programming dictates a single and inflexible response. More complex organisms may act on the basis of operant conditioning, so that current behavior is somewhat flexibly shaped by prior consequences of like behavior. The most advanced form of choosing involves weighing information about currently available options to select the option that seems most promising. This response would be the most flexible, and potentially the most adaptive in terms of promoting survival and reproduction, but it requires the most elaborate information-processing apparatus and the most pliant behavior control system — so, in a sense, it is costly.

Strength and Ego Depletion

Recent findings have begun to suggest that many of the self's activities depend on a common resource, akin to energy or strength. The self's executive function is the agent that makes choices and decisions, initiates and controls action, and regulates the self by operating on its inner states (see Baumeister, 1998). All of these important activities seem to draw on this common resource, which may easily become depleted.

We define self-regulation as the self exerting control to change its own responses in an attempt to pursue goals and standards. These responses include changing one's emotional state, regulating thought processes, persisting at a task despite a strong desire to quit, and overriding impulses. The goals and standards include ideals, morals, norms, performance targets, and the expectations of other people. A series of studies has provided evidence that some psychological resource is depleted by acts of regulating the self. Muraven, Tice, and Baumeister (1998) and Baumeister, Bratslavsky, Muraven, and Tice (1998) showed that performing one act of regulating the self impaired performance on a subsequent, seemingly unrelated act of self-control. For example, resisting temptation, stifling emotional distress, or suppressing thoughts caused people to quit earlier on a frustrating task, show less physical stamina, and be unable to refrain from laughing at a humorous scene. Presumably, the first act of self-control depleted some resource that would have been needed to perform better at the second act of self-control. Depletion of the self's resources has been linked to multiple behavioral problems, including overeating by dieters (Vohs & Heatherton, 2000), prejudicial responding (Richeson & Shelton, 2003), inappropriate self-presentation (Vohs, Baumeister, & Ciarocco, in press), and intellectual underachievement (Schmeichel, Vohs, & Baumeister, 2003).

These studies of self-regulation are relevant because they involve the self's executive function, which is to say the inner agency that exerts control and also makes choices. Baumeister et al. (1998) suggested that the resource involved in self-regulation might be the same one needed for other activities of the executive function, such as choice-making. In one study, making a responsible choice to perform a counterattitudinal behavior (as in dissonance research; Linder, Cooper, & Jones, 1967)

depleted the ego resource, as shown by quitting more rapidly on a subsequent figure-tracing task. Although encouraging, those results do not amount to a strong or clear test of the view that making choices depletes the self's resources. The reliance on a dissonance procedure could entail that dissonance-reduction processes were activated, and these could have depleted the self's resources. Dissonance often invokes a sense of responsibility for undesirable consequences (Linder et al., 1967), and this also may have drained the self's inner strength. Hence the focus of the present investigation was to establish the role of the self's resources (specifically self-regulatory strength) in choice.

The strength model of the self's executive function has two aspects relevant to the present discussion. First, this resource is used for a broad variety of regulated activities. The same resource is used for controlling thoughts, modifying emotions, overriding impulses, performance regulation, as well as active choosing. Second, this executive resource is fairly limited, so that even relatively small expenditures translate into an impaired ability to execute executive responses later.

Choice Can Be Depleting

The current work tests the hypothesis that there is a hidden cost to choosing beyond responsibility for outcomes and thinking about options. Specifically, the process of choosing may itself drain some of the self's precious resources, thereby leaving the executive function less capable of carrying out its other activities. Decision fatigue can therefore impair self-regulation.

A thought-provoking review paper by Burger (1989) concluded that the quest for choice and control is in reality somewhat limited. In many situations, people prefer not to have control, such as when someone else can do the job better. Individual differences are also apparent: Burger pointed out that even in conditions in which most people prefer control, there is generally a minority of people who choose not to have control. It seems that for these people, the burden of responsibility that goes with choice is simply too great. Even when the burden seems trivial, some people still want to avoid it.

There are multiple reasons people may seek to avoid choice, not the least of which is reluctance to be held responsible for negative outcomes stemming from one's decision. Another reason, however, may be that the decision process itself is costly, insofar as it consumes valuable resources. In

particular, people may avoid choosing so as not to conserve their powers of self-regulation and other executive functions. This valuable resource is limited, and so conserving it when possible would be prudent. If choosing depletes this resource, it would be adaptive for the self to pass up unnecessary choosing, unless one is certain that there will be no further demands on the self for a while.

There are several reasons to think that choosing would deplete the self's strength. Self-regulation presumably consumes resources because the self must override one response and then substitute a different response, and energy is needed to perform these interrupt and initiate functions. Choosing may also involve an energy-consuming transition. The Rubicon model of action (Gollwitzer, 1996) outlines two mindsets that people move through serially. The deliberative mindset allows the person to consider and weigh various options and the implemental mindset enables the person to pursue the selected course of action. To move from the first mental mode to the second involves a termination of the deliberating process and then an initiation of actions in pursuit of the chosen option.

In that sense, choosing is also not equivalent to the cognitive process of deliberating. The philosopher Searle (2002) has discussed this difference at some length and argues that rationality presupposes some degree of free will (or purposeful control over behavior) because rational analysis is functionally useless unless one can act based on the outcome of the analysis. Searle further emphasized that people can recognize multiple reasons to behave in a certain way but still not perform the behavior, again indicating that contemplating and choosing are separable steps. Converging evidence comes from Damasio (1994), a neuropsychologist who observed that certain brain-damaged patients with emotional deficits can and do engage in sophisticated (and accurate) cognitive deliberations, such as lengthy ruminations about the costs and benefits of several options — but they often cannot bring themselves to finally make a choice.

In sum, we reasoned that making a choice involves a particular intrapsychic act. This step, which in some way commits the person to a course of action, requires an effortful inner process. As such, we hypothesize that it consumes some of the self's limited supply of energy, thereby rendering the resource less available for future self-directed activities. The first series of studies in this

investigation was designed to test the hypothesis that acts of choice would produce a state of ego depletion that would be discernible in impaired self-regulation subsequently.

Lack of Choice Can Also Be Depleting

It is also clear that people like to have choices. Choice and control reduce the stress of outcomes and make life situations more agreeable (e.g., Deci & Ryan, 1995; A. Campbell, 1981; Glass, Singer, & Friedman, 1969). Deprived of choice and control, people exhibit strong negative reactions, ranging from learned helplessness to aggressive reactance (Brehm, 1966; Seligman, 1975). They may also respond to a lack of control by developing illusions of control (Langer, 1975) or by seeking alternative, secondary forms of control (Rothbaum, Weisz, & Snyder, 1982). Most broadly, one trend in world history is an overall increase in choice, including the proliferation of consumer options, the shift from parentally-arranged marriages to self-chosen partners, and the political revolutions and movements in which people vociferously demand more (never less) freedom. Whatever the drawbacks or burdens of choosing, people want to be able to choose, and they express a corresponding dislike of situations where they have no control or no choice.

The strength model of the self's executive function can offer an explanation for some of the negative effects of lacking choice. Rothbaum et al. (1982) distinguished between primary and secondary control, which were aimed at creating harmony between self and environment. Primary control involves altering the environment to suit the self, whereas secondary control involves altering the self to fit the environment. Secondary control therefore depends heavily on self-regulation, insofar as it entails changing the self. When the self lacks choices or control, it must generally accept the environment as it is and consequently its main option for creating harmony with the environment is to alter the self. This strategy requires energy and effort because, by definition, the external world is not aligned with the self's preferences.

In principle, there could be an ideal solution: Someone else would choose for you exactly what you would most like to have, and thus you would be relieved of the burden of choosing while also getting just what you want. Some people may expect their parents or romantic partners to perform that

function (cf. Iyengar & Lepper, 1999), but in practice it is unclear how consistently this solution works. Hence when one does not have choice, one must adjust oneself to accommodate to the dictates of other people or external demands. Consequently, we expect that the self-regulation required for this type of adjustment should be depleting.

Hence, we tested a second hypothesis in this paper related to the depletion resulting from self-chosen versus other-chosen activities. We predicted that when choices are made for oneself by someone else, self resources will become depleted by the attempt to accommodate to the assigned course of action, even though one was spared the regulatory strain of choosing.

Present Investigation

This investigation sought to demonstrate both the costs and benefits of having choice. Experiments 1-5 were conducted to address the first hypothesis, of whether acts of decision-making tax the regulatory system. Experiments 1-4 took place in the laboratory, and in these studies participants in the crucial condition were instructed to make a series of choices. The choices were made meaningful and personally relevant. Afterward, self-regulatory resource depletion was assessed by having participants perform a task that required self-control. We predicted that those who made many choices in the first task would be more depleted and therefore perform worse on the second task, relative to those who had not made frequent choices earlier. Experiment 5 was a naturalistic study in which participants at a shopping mall were asked about the extent to which they had engaged in decision-making throughout their shopping trip that day. Subsequently, shoppers' performance on a self-control task was measured. We predicted that making many personally involving choices would result in subsequent impairments in self-regulation.

Experiments 6-7 were conducted to address the second hypothesis, that performing an act that was chosen by someone else would be more depleting than a self-chosen act. Participants were given the choice to perform a task or were assigned to it; later, self-regulatory resource depletion was assessed by asking them to engage in a self-control task. We predicted that participants who did not choose their earlier task would have poorer regulatory abilities and therefore be less effective during

the subsequent regulatory task, compared to those who had chosen their earlier task.

EXPERIMENT 1

Experiment 1 was a preliminary study designed to justify the assumptions behind the choice procedure that was to be used in Experiments 2-4, and it also validated a self-report measure for in Experiment 5. In Experiment 1, we assigned people either to make a series of binary choices between products or to report their usage of the same products, in order to confirm that people do make more effortful, self-involving choices in the high choice condition than in the no-choice condition.

The choice condition was designed to mimic some aspects of choosing in everyday life. In daily life, most people make a multitude of minor choices. (Of course, people do make major, momentous choices such as whether to marry or divorce, but for ethical and pragmatic reasons we did not include such momentous choices in the present studies.) Some of these choices have consequences, such as the dieter's decision to pass up the fresh fruit and instead devour the fattening dessert, whereas others have few or no consequences, such as deciding to wear the black rather than the gray skirt with the white blouse. In Experiment 1, participants in the high choice condition were asked to make a multitude of choices between products, and at least one of these choices would determine which item they would receive. Thus, participants' choices had potentially real (though relatively minor) outcomes.

Method

Participants

Participants were 34 undergraduate students (20 male) who participated in exchange for partial course credit.

Procedure

Participants were randomly assigned either to make choices or rate products. They were given a list of 60 specific varieties of products, such as colored pens, scented candles, popular magazines, and colored t-shirts. Participants in the *no choice condition* were asked to read and rate the products on the extent to which they had used each product in the past (on a scale from 1-5, from *never* to *very often*).

Participants in the *choice condition* were asked to read the list of products, but they were also instructed to choose between two different versions of each product (e.g., between a white t-shirt and a black t-shirt; a red pen or a purple pen).

Subsequently, participants completed the state version of the Positive and Negative Affectivity Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and also an 8-item questionnaire that served as the manipulation check of the methods. Two items asked participants about the extent to which participants engaged in choice-making during the products task, three items asked about the amount of consideration, deliberation, and thinking that participants put into the task, one item tapped the extent to which responses to the product task were of participants' own choosing, and one final item asked how tired participants felt. The first seven items were designed to tap into the different aspects of choice-making that are important in the depletion of self-resources; the last item on tiredness was included to see if participants reported feeling more tired after making multiple choices. After completing the product task questionnaire, participants were debriefed and thanked.

Results and Discussion

A factor analysis of the eight items showed that one factor accounted for 43% of the variance in the unrotated solution (eigenvalue = 3.46), whereas the second factor (eigenvalue = 1.27) accounted for an additional 16% of variance. Inspection of the varimax-rotated solution showed that 7 items loaded onto one factor at over .55, whereas item 8 (*How tired do you feel?*) loaded onto a second factor (i.e., item 8 loaded at -.001 onto Factor 1 and at .86 on Factor 2). Accordingly, we aggregated the first 7 items into one factor that tapped *involvement of self in choosing* and left the eighth item on its own to represent the second factor of feeling tired. Coefficient alpha for the entire scale was satisfactory, α = .75.

A t-test with condition as predictor and the dependent measure of *involvement of self* (i.e., scale items 1-7) revealed the predicted effect of condition, t (32) = 2.43, p = .02. Participants in the choice condition (M = 43.63, SD = 7.09) reported that they were more involved and made more choices during their task than did participants in the frequency (no choice) condition, (M = 36.06, SD = 10.52).

Reports of feeling tired did not, however, vary with condition, t (32) < 1, $p = ns$ (M = 3.31; SD = 2.44 versus M = 3.22, SD = 2.02).

There was a significant difference in the length of time it took each group to complete their task, t (32) = 3.36, p < .01. The choices task took about a minute longer (M = 210.32 seconds; SD = 65.98) than did the frequency rating task (M = 146.32 seconds; SD = 44.02). Analyses showed, however, that time spent on the task did not predict scores on Factor 1 (items 1-7) of the involvement of self measure, r (34) = .10, ns. Furthermore, an ANCOVA with time spent on the product ratings task as a covariate confirmed that differences in length of time did not account for differences on Factor 1 of the choices measure, F (1, 31) < 1, but rather condition remained a significant predictor in this model, F (1, 31) = 6.01, p = .02.

As mentioned, participants' first charge after completing the product ratings task was to complete the PANAS to determine whether mood differed as a consequence of choosing versus rating products. A t-test showed that condition did not affect positive affect (PA; M choices = M = 24.31, SD = 7.09; M frequency = 25.05, SD = 6.61) or negative affect reports (NA; M choices = 13.19, SD = 4.45; M frequency = 11.89, SD = 2.25), t (32) = .32, *ns*. Thus, we can rule out differences in mood as a function of condition.

In sum, the choice procedure led to higher ratings of psychological involvement than the mere rating task. Participants who made choices among products reported being more self-involved in the task, relative to participants who rated the frequency with which they had used the products, which presumably required only conjuring up past instances of use in memory and making a Likert-scale judgment of usage.

EXPERIMENT 2

Experiment 2 provided the first test of our hypothesis that making choices depletes the self's resources. Experiment 1 confirmed that our procedure of having people make a series of binary choices was perceived by participants as making more demands on the self than the low-choice procedure (of merely rating the same products). Our theory holds that such effortful, involving choices will deplete

the self's resources, and that this depletion could be seen in impaired performance on a self-regulation task. Hence in the following three studies (Experiments 2 – 4), the choice (or no choice) manipulation was followed by a self-regulation task that had no obvious connection with the product-rating task. In the current study, the choice versus ratings task was followed by the cold pressor task, which has been deemed a valid measure of self-control (Litt, 1988).

Experiment 2 also included several features that deserve comment. First, the choice manipulation and the dependent measure were administered by separate experimenters and presented as separate experiments. We used two different experimenters to ameliorate the possibility that participants would try to perform well on the self-control task in order to get a better gift from the experimenter (which was promised as the result of the choice versus rating procedure). Second, the experimenter for the dependent measure was kept blind to condition, which eliminates the possibility of unknowingly biasing the results via demand characteristics. Third, the cold pressor task requires participants to hold their non-dominant hand and most of their lower arm (to the elbow) in frigid water for as long as possible. We understand self-control as overriding one's habitual, normal, or natural response (Baumeister & Heatherton, 1996), and so in this case people had to override their normal tendency to recoil and pull one's arm out of the near-freezing water. Thus, we predicted that people who had made choices among products would not be able to overcome this impulse as well as would no choice (rating) participants.

Method

Participants

Twenty-five (16 female) undergraduates participated in exchange for partial course credit.

Procedure

Participants were randomly assigned to one of two conditions: a choice task or a no choice task. In the choice condition, participants made a long series of choices between products, both within and across categories, much the same as in Experiment 1. For example, 11 colors of t-shirts were displayed on the table in front of the participants, each labeled with a letter code. Participants made similar

choices between items in the following categories: scented candles, t-shirt sizes, shampoo brands, candy, and types of socks. After choosing preferred items within each product category, participants then chose between different categories of products. Participants were encouraged to "think carefully about each choice, because you will be given a free gift at the end of the experiment based in part on the preferences you indicate here."

In the no choice condition, participants recorded their thoughts, feelings, and/or opinions about each of eight advertisements taken from popular magazines. Thus, in both the choice and no choice conditions, people were asked to rate products, but only in the choice condition were people asked to make choice decisions. Participants in the no choice condition were also informed that they would be given the opportunity to select a free gift for themselves at the end of the experiment. They were also told that the same options were presented to all participants.

Following the manipulation (choice task or no choice task), participants were escorted to another room, where a second experimenter administered the cold pressor task. This experimenter was blind to participants' earlier experimental condition. For the cold pressor task, water temperature was maintained at 1 degree Celsius (about 34 degrees Fahrenheit) using a mixture of ice and water. An aquarium pump was used to circulate the water continually to prevent a warm pocket of water from forming around the participant's hand. The room air temperature was also maintained at a constant 72 degrees Fahrenheit (22 degrees Celsius). Participants first held their hand and lower arm in room temperature water for one minute to ensure an equal starting point before putting their arm in the ice water. Using the standard directions that qualify the cold pressor task as a measure of self-control, the experimenter asked the participant to put his or her arm into the water up to the elbow and hold it there for as long as possible. The experimenter used a stopwatch to measure the length of time the participant held his or her arm in the water. This number (in seconds) served as the measure of self-control. After completing the cold pressor task, participants were fully debriefed, given an opportunity to choose a free gift, and thanked.

Results and Discussion

Experiment 2 supported the hypothesis that making a series of choices depletes a valuable resource, leaving the self subsequently less effective at self-regulation. The self-regulation measure in this study involved holding one's hand in unpleasantly cold water. Participants who had made a series of choices quit earlier on the task (by pulling their hands out of the water) relative to participants in the no choice condition, F (1, 23) = 5.97, $p < .025$ (see Table 1). The main effect for choice remained significant when relevant controls were entered into an ANCOVA (trait self-control x gender, with time taken on the choice vs no choice task as covariate), F (1, 19) = 5.77, $p < .03$. The resource needed to enable oneself to persist in holding one's hand in frigid water was apparently depleted by the process of making a series of choices.

Persistence on the cold pressor task was not confounded with time spent on the first task. The product rating task did not take any longer than the choosing task, F (1, 23) = 1.76, *ns*. Participants in the no choice condition in fact took slightly more time (M = 26.92 min) than participants in the choice condition (M = 24.39 min). Thus, the results cannot be explained as due to greater elapsed time, hurry to leave, or overall tedium in the choice condition. It was not the length of time that people spent on the task that was depleting. Rather, it was the act of making decisions itself that left people less able to persist.

The design of Experiment 2 bolstered the findings by ruling out several alternative explanations. We used two experimenters in the current study, one to administer the dependent measure and one to administer the product task. Moreover, the experimenter overseeing the dependent measure was blind to condition, thereby eliminating concern that experimenter demand could have contributed to the results. Also, no choice participants in the current study were told they would be able to choose their own gift from a standard set of options, thereby eliminating concern that their performance on the self-control measure was aimed at persuading the experimenter to offer them a better gift or a more appealing set of options.

EXPERIMENT 3

To provide further evidence of the detrimental impact of making choices on subsequent self-regulation, Experiment 3 was designed as a conceptual replication of Experiment 2 but with new procedures for both the choice task manipulation and the dependent measure of self-regulation. Instead of making choices among small household products, participants in this study made choices (or not, in the no choice condition) regarding the courses they would take to satisfy their degree requirements. They were encouraged to take these choices seriously as if they were actually selecting the classes they were to take in future years, so it seems reasonable to assume that they would regard these choices as important and relevant to their lives.

Self-regulation was measured in terms of resisting procrastination. Participants were given 15 minutes to study for an upcoming nonverbal (math) intelligence test that was framed as a predictor of many desirable life outcomes. To practice, participants were given a packet of sample problems. However, as a competing temptation, they were also allowed to read magazines and play a video game. We assumed that self-regulation would be required to override the seductive pull of games and magazines and make oneself practice arithmetic problems. Most likely, this is a self-regulation dilemma that would be familiar to many college students, namely whether to push oneself to study for a test or indulge in more pleasant pastimes.

We hypothesized that choosing one's courses would deplete the self's resources, as compared to merely reading about courses and requirements without choosing. We predicted that participants who made choices would spend more of their time on the time-wasting temptations of magazines and video game and, correspondingly, would spend less time studying for the upcoming test.

Method

Participants

Twenty-six introductory psychology students (17 males) participated in exchange for partial course credit. Data from two participants were not included in analyses (leaving 24). One participant was aware that the intelligence test was not going to be administered and the other was an

acquaintance of the experimenter.

Procedure

Participants arrived at the laboratory individually, where they were informed that the experiment examined whether a person's choice of college major was related to nonverbal intelligence. All participants were shown a list of general education course requirements and also a list of all the classes that satisfy each of these requirements. This information was taken directly from the official undergraduate bulletin at Case Western Reserve University, which stated that a total of 36 credit hours (12 courses) in pre-determined content areas are required of all undergraduates regardless of major area of study. These 12 courses must be selected from a total of over 60 distinct courses offered at the university.

In the *choices condition*, participants were directed to spend 8 min indicating which courses they would choose to take to satisfy each of the general education requirements and to write down their selections on the response sheet they were given. If they finished this task, participants were to consult the undergraduate course bulletin to select and then write down the courses they would take to satisfy their major degree requirements. In the *no choices condition*, participants were instructed to peruse course requirements and then read over the different courses that satisfy these requirements. These participants were also encouraged to review course descriptions of classes in their major and to consider courses in which they might enroll to satisfy their major degree requirements. These participants, unlike choice condition participants, were not asked to make formal choices by writing them down on a response sheet. Rather, they were simply instructed to think about courses in which they may choose to enroll.

After 8 min had elapsed, the experimenter asked participants to complete the PANAS (Watson et al., 1988) as a mood questionnaire. Participants then began the nonverbal intelligence (math) test portion of the experiment. The experimenter explained the format of the test and told participants that the test is highly predictive of skills important for real-word success. Additionally, participants were told of past research showing that performing practice math problems for 15 minutes significantly

improved performance on the test but practicing for more than 15 minutes did not lead to additional increases on performance. The experimenter announced he was going to leave the room for 15 minutes and gave participants a packet of practice math problems. Participants were told they could practice for the upcoming test for as long as they wanted during the next 15 minutes. The experimenter also noted that participants could look at magazines or play a hand-held video game (both of which were located on a stand next to the participants' work area) if they did not want to work on the practice problems for the entire 15 minutes. Once participants indicated that they understood the procedure, the experimenter exited the room.

As the experimenter left the room, a research assistant who was blind to participants' experimental condition entered an adjacent room and observed participants through a two-way mirror. The mirror was covered by closed vertical blinds, except for two slats that were slightly bent at an angle that allowed the observer to clearly view participants' behavior without their knowledge. The observer recorded participants' behavior every 30 sec according to whether the participant was practicing math problems, looking at a magazine, playing the video game, or engaging in some other (unscripted) activity such as sitting quietly.

When 12 min 30 sec had elapsed, the experimenter returned and asked participants if they wanted more time to practice for the intelligence test. All participants declined this offer. Participants then completed a brief questionnaire that asked how difficult the degree requirement activity (choices versus no choices task) had been (1 = *not at all* and 9 = *completely*), how frustrating the degree requirement activity had been (1 = *not at all* and 9 = *completely*), how much they practiced for the upcoming nonverbal intelligence test (1 = *none* and 9 = *a lot*), and how personally important it was to do well on the upcoming nonverbal test (1 = *not at all* and 9 = *very much*). Finally, participants were informed that they would not be taking the nonverbal test, after which they were fully debriefed and thanked.

Results

Our main prediction was that making a series of choices would result in a state of ego

depletion, thereby truncating persistence (or practice) at the math problems and leading to more procrastination. As expected, the choices versus no choices manipulation affected how long participants practiced for the upcoming test, t (22) = 2.43, $p < .05$ (see Table 1). After making a series of choices, participants spent less time practicing for the upcoming IQ test than did participants who did not make choices. This finding also indicates that depleted participants spent more time playing the video game, reading the magazines, and doing nothing than did non-depleted participants.

Although our main focus in the current study was on the amount of time spent on the math problems, we also checked to see whether performance on the math problems differed as a function of choice condition. We counted every problem participants attempted (because sometimes participants did a bit of work on a problem but failed to finish it) and subjected this measure to a t-test with choice condition as a predictor. This measure showed no difference as a function of condition, t (22) < 1, *ns*. The number of problems completed also showed no difference as a function of choice condition, t (22) < 1, $p > .60$. Number of problems correctly answered also showed no differentiation by condition, t (22) < 1, $p > .80$. Last, we conducted an ANCOVA, comparing the choice and no choice conditions on number of problems correct, with time spent practicing as the covariate. The effect of the covariate, time spent, was marginal, F (1, 21) = 4.14, p = .06, but the effect of condition on performance was not significant, F (1, 21) = 0.55, p = .47.

We assessed whether the choices manipulation influenced mood states, which if observed may have affected persistence. Consistent with the results of Experiment 1, the choice manipulation did not differentially affect mood. Reports of PA, t (22) = 1.01, $p = .33$, and NA, t (22) <1. *ns*, were similar in the two groups. Further analyses confirmed that choice and no choice conditions did not differ with regard to self-rated difficulty of their respective degree programs, t (22) = 1.10, *ns*, frustration with the tasks, t<1, *ns*, nor rated importance of performing well on the upcoming intelligence test, t (22) = 1.44, *ns*. Thus, the effects of choice were not due to mood, difficulty, frustration, or perceived importance.

Discussion

Experiment 3 conceptually replicated the finding that making a series of

decisions leads to subsequent impairment of self-regulation. Participants in this study were given instructions either to select courses to fill the remainder of their undergraduate careers or to read and think about course options without having to choose. Subsequently, participants were given the opportunity to practice for an upcoming math test said to be predictive of successful life outcomes, but their studying was compromised by the availability of tempting, fun alternative activities such as video games and magazines. Participants who had made choices about their future coursework, as opposed to those who simply read and considered their options, spent less time studying and practicing for the math test (and spent correspondingly more time indulging in the tempting distractor tasks). Poor or failed self-regulation is an important contributor to procrastination (Tice & Baumeister, 1997), and thus Experiment 3 demonstrates another way in which making a multitude of choices can lead to a breakdown of self-control.

EXPERIMENT 4

One ambiguity about the findings of Experiment 3 was that participants solved the same number of problems in both conditions, despite the difference in duration of persistence. Although null findings are generally not entitled to substantive interpretation, one could read those results as indicating that people who made choices were better at self-regulation (not worse, as we found in Experiment 2), insofar as they solved approximately the same number of problems in less time. Hence we felt the importance of conducting a conceptual replication, and we did so in two different ways. Experiment 4 tested persistence on unsolvable problems and solvable problems after choice or no choice procedures.

To increase the robustness of our conclusions, the choice manipulation was again changed, in this case to decisions about the psychology course in which participants were currently enrolled. Participants in the choices condition made a series of decisions about the course, choices they were told (veridically) would determine the way the instructor taught the course both during the current term and in subsequent terms. It is possible that participants in Experiment 3 did not see their choices as binding because students

can and do change their minds about what courses to take. In contrast, the choices made in Experiment 4 were binding in the sense that once students' choices were communicated to the instructor via this experiment, there was no opportunity to change the selections and the instructor was intending to modify the course on the basis of students' selections.

Another change made for Experiment 4 was to separate the procedures for the independent and dependent variables. When the same experimenter administers both the choice manipulation and the self-regulation measure, it is conceivable that extraneous attitudes toward the experimenter may develop during the choices manipulation that could confound responses to the dependent measure, as we noted in connection with Experiment 2. Hence we used the more elaborate procedure of presenting the tasks as unrelated, including having different experimenters administer the tasks in different rooms.

The main measure of self-regulation in this study was persistence. Persistence requires self-regulation insofar as the repeated failures are discouraging and frustrating, and the participant would soon wish to be doing something else — so one has to override the impulse to quit. Because of the possibility that quitting fast on unsolvable problems signifies exceptionally good self-regulation, however, we ran two versions of this study, one with unsolvable (4A) and the other with solvable (4B) problems. With the solvable problems, we were also able to calculate performance quality by counting correct solutions.

Methods

Procedure 4A

Forty-one undergraduates (26 females) participated in exchange for partial course credit. One participant was unable to complete the study. After arriving and completing consent forms, participants were told that the first part of the study involved reviewing instructors' materials from their psychology class, and the second, unrelated part of the study involved completing a spatial design task. The first experimenter handed out the materials that contained the choices manipulation. All participants were given the same materials, but the instructions that accompanied them were different.

Instructions for participants in the *choices condition* asked them to read the material and, for each section, to choose which option they preferred. Options were always presented as a two-option forced

choice. In one example, participants read descriptions of two possible video clips and chose which film clip they would prefer to see. Another item involved choosing between two different styles of a test question, and another item asked them to choose between two paragraphs of text. Participants in the choices conditions were also told (truthfully) that the choices they made would be reviewed by their instructor and would affect her decisions for future lectures and tests both during this semester while the participants were taking her course as well as for future classes. Thus, the choices were presented as important and consequential. Participants were asked to complete all the choices and return the packet to the experimenter before moving on to the next part of the experiment.

Participants in the *no choices condition* were simply instructed to read the same material that was presented to the participants in the choices condition. They were not asked to make any choices between the options or to rate the material in any way. They were asked to read the material very carefully and return the packet to the experimenter before moving on to the next part of the experiment.

Next, participants moved across the hall to complete the persistence part of the experiment with the second experimenter. The persistence measure involved unsolvable tracing puzzles. This procedure was developed by Feather (1961), was adapted by Glass and colleagues (1969), and has been used in several previous studies as a measure of self-regulation. Participants were given a packet containing several complex figures. Participants were told that performance on these geometric figures was predictive of future life success, due to its links with higher-order cognitive abilities. They were instructed to trace each figure in its entirety without once lifting the pencil from the paper or re-tracing any lines. They were asked to bring their packets back to the experimenter either when they had finished or when they had worked as long as they could on them and wanted to stop. The experimenter recorded how long each participant persisted (to the nearest quarter minute). After finishing, participants were given a manipulation check, debriefed, and thanked.

Procedure 4B

Forty-two undergraduates (28 females) took part in the study. Two participants failed to complete the study. The procedure for Experiment 4B was the same as for Experiment 4A, with two changes.

First, the length of time it took participants to finish the choices or ratings was held constant at 12 min. The choices versus no choices task required going through a lengthy packet. No participant could complete the choices or ratings task in under than 12 min. After the 12 min had elapsed, participants were stopped and informed that they would now complete a separate experiment.

The second change was that the dependent measure was persistence on solvable problems. The second experimenter explained that the next study involved a test of simple mathematical calculations, which long have been known to predict success in later life. She explained that although most people used calculators and computers to perform basic arithmetic, this math test was sensitive to brief amounts of practice and therefore everyone was allowed practice time before taking this test. Participants were moved into new rooms or carrels and given practice sheets of three-digit multiplication problems, which they were told to practice for as long as they could, for a maximum of 30 min. When participants felt they could not practice any longer, they were to return to the first experimental room. At that time, the experimenter recorded the length of time participants had practiced the math problems (to the nearest quarter minute). At this time participants were given a questionnaire of manipulation checks, after which they were debriefed and thanked.

Results

Unsolvable Puzzles (4A)

Participants who did not have to make choices about the material but merely read through it were able to make themselves persist longer on the tracing task (see Table 1) than were participants who were asked to make many choices about the same material, F (1, 38) = 7.12, $p < .05$. Thus, making choices seems to have depleted some resource, thereby reducing persistence on the second task.

Other analyses confirmed that the manipulation was effective. Participants in the choices condition were much more likely to report that they were making choices that would affect their own course than were participants in the no choices condition, F (1, 38) = 585.95, $p < .001$. There were no differences on self-reports of ratings of being happy, sad, depressed, or confident (Fs < 1).

Solvable Puzzles (4B)

Participants who did not make choices about the course material but merely read it and made ratings persisted longer on the practice items than did participants who made many choices about the same material, F (1, 38) = 5.00, $p < .05$ (see Table 1). Participants who did not have to make choices also completed more practice problems than participants who were asked to make many choices, F (1, 38) = 6.23, $p < .05$.

Participants who did not have to make choices got more practice problems correct and marginally fewer wrong than participants who were asked to make many choices, F (1, 38) = 16.56, $p < .001$ and F (1, 38) = 3.81, $p = .06$, respectively. The difference in number of errors was probably weakened by the fact that participants in the choice condition spent less time and attempted fewer problems, which should cause them to make fewer errors than they would otherwise. To correct for this, we computed the error rate by dividing number of errors by number attempted for each participant. ANOVA on error rates confirmed that participants in the choices condition made more errors per attempt than participants in the no choices condition, and this was a significant difference, F (1, 38) = 5.10, $p < .05$.

Participants in the choices condition were much more likely to believe that they were making choices that would affect the rest of their semester in the classroom than were participants in the no-choices condition, F (1, 38) = 224.48, $p < .001$. Thus, again, the manipulation was successful.

Discussion

In Experiment 4, some participants made choices pertaining to their psychology course, whereas other participants examined the same materials but did not make choices. Those who made choices subsequently gave up faster on unsolvable (Experiment 4A) and solvable (Experiment 4B) items, as compared to participants who did not make choices. These findings provide further evidence that making decisions can deplete an important self-regulatory resource, thereby making it more difficult for the person to resist the temptation to quit while performing a wearisome task. In Experiment 4B, making choices about one's psychology course caused people to quit faster and get fewer right while practicing multiplication problems for an upcoming test. Making choices also caused people to make marginally more errors despite spending less time on the problems.

Several design features facilitate interpretation of findings. The choices in Experiment 4 were real and consequential, in the sense that they did influence how the instructor set up the remainder of the course (as opposed, possibly, to what participants thought in Experiment 3). Using two experimenters (one blind) ruled out any likelihood that demand characteristics or desire to impress the (first) experimenter influenced the results. The amount of time spent on the first task was the same for all participants in Experiment 4B, ensuring that persistence on the second task was not affected by how much time had been spent on the first. It was also apparent that less persistence meant poorer performance: Participants who made choices got fewer correct (unlike in Experiment 3) and made more errors than those who did not make choices.

In sum, it appears that making choices depleted some resource that was then unavailable to facilitate performance on unsolvable and solvable tasks. Self-regulation is useful for making oneself persist on a difficult task, for overseeing the calculation process, and for checking and correcting errors, all of which are weakened by previous efforts involved in making choices.

EXPERIMENT 5

To provide a final test of our hypothesis of decision fatigue, Experiment 5 moved outside the laboratory. We approached customers at a shopping mall and assessed the number of decisions they had made during their shopping trip thus far. To measure self-regulation, we then asked them to perform easy but tedious arithmetic problems (adding 3-digit numbers). This task requires self-regulation because most shoppers would probably rather do something else than perform arithmetic, and so the impulse to quit must be overridden if they are to continue. We predicted that shoppers whose resources were depleted by having made a greater number of prior choices would quit faster on the arithmetic problems.

A conceptual replication of the laboratory findings from Experiments 2-4 was desirable for several reasons. First, this study drew its participants from a non-university sample, which increases confidence in the generalizability of the results. Second, this study avoided a potential confound of differential time spent on different experimental tasks (and shoppers would also furnish estimates of

how long they had been shopping, which later could be controlled for when analyzing the impact of prior choices). Third, participation in this study was not affected by a desire to earn a reward, because no reward or gift was offered.

Having shoppers perform math problems also enabled us to check the accuracy of their work. Competing predictions could be made, based on previous findings indicating that ego depletion impairs intellectual performance on complex tasks that require executive control, but it does not affect simple tasks such as rote memory (Schmeichel et al., 2003). On the one hand, addition problems involve applying rote memory (for sums) and following pre-established rules. Insofar as such simple tasks do not require active regulation by the executive self, they should not be impaired by resource depletion. On the other hand, self-regulation could be useful in overseeing the process, such as checking for possible errors and ensuring that rules are followed properly, and depletion might therefore lead to poorer performance.

Method

Participants

Fifty-eight shoppers at an open-air shopping mall in Salt Lake City, Utah participated. They were approached by members of the research team and asked for their time in a volunteer (i.e., no remuneration) experiment. Ninety-six people were approached and 19 women and 39 men agreed to participate (60% response rate). The age of participants ranged from 18 to 59, with 91% of participants listing their ethnicity as White (non-Latino), 4% listing Asian, and 5% listing Latino.

Procedure

Participants were approached by a research assistant in the outdoor corridors of a shopping mall and asked if they would be able to participate in an experiment. Research assistants were instructed not to reveal much about the experiment before participants agreed or declined to participate, so that the details of the task (described next) did not influence who chose to participate. Participants were told the experiment involved answering some questions about their shopping trip and then engaging in a cognitive task.

After a brief demographic questionnaire, participants completed a written version of the *psychological involvement in choices* scale that was used in Experiment 1 (except two redundant items asking about the degree of which choices were required during the task were combined). Participants were asked to respond to questions by thinking about their behaviors during the course of the day, and to give a numeric rating of *1* (*not at all*) to *10* (*very much so*) for the following items: How many choices did you feel you have made on your shopping trip today? How personally important were the choices you made shopping today? How much careful consideration did you put into choices you have made today? How much did you deliberate before making each choice today? How much did you think about your options prior to making each choice today? How active did you feel in making your choices today? How tired do you feel right now? Participants were also asked to list their time spent shopping in hours and minutes. Shopping times ranged from 1 minute (for participants who had just begun shopping) to 4.5 hours.

Subsequently participants were presented with 64 three-digit plus three-digit addition problems printed across two sheets of paper. They were asked to do as many as they could, with the understanding that they could stop anytime they "quit, finished, or decided to give up." These instructions come from past depletion research (Vohs & Heatherton, 2000) in which self-control was measured as persistence on a cognitive task. Unbeknownst to participants, there was a second research assistant standing approximately five feet away who surreptitiously recorded the amount of time that participants spent on the addition problems. She started recording when the participant turned the page to begin the math problems and stopped recording when the participant stopped completing the problems. Afterwards, participants were debriefed and thanked for their cooperation.

Results

Choices Scale

First, we conducted a factor analysis on the seven items from the choice scale to test whether they revealed patterns similar to that seen in Experiment 1. The data were subjected to a varimax rotation, and a two-factor structure emerged. Factor 1 accounted for 39% of the variance observed and

Factor 2 accounted for an additional 27%. The items loaded onto factors similarly as in Experiment 1. That is, scale items asking about number of choices, importance of the choices, degree of consideration, deliberation, and thought put into the choices, and degree of activity involved in making those choices all loaded onto the first factor at > .36. In contrast, the item asking about tiredness loaded weakly and negatively onto Factor 1 (-.17), but strongly and positively on Factor 2 (.71). Therefore, we aggregated the first six items into one factor and referred to them (similar to Experiment 1) as *psychological involvement of the self* and left the item tapping respondents' tiredness on its own. We used these factors as predictors in the subsequent analyses.

Persistence on the Math Problems

Participants' persistence on the math problems was the primary indication of good self-control. Persistence was operationalized both in terms of number of problems completed and amount of time spent on the math problems. Using the *psychological involvement* factor (items 1-6 from the choices scale), the tiredness item, and shopping duration as predictors, we ran two regression models to predict time spent on the math problems and number of problems completed (which were highly correlated, r (58) = .71). The overall models were significant, F (3, 52) = 3.71, $p < .02$ for math time, and F (3, 52) = 4.77, $p < .01$, for number of problems completed. Moreover, we found the expected (negative) effect of psychological involvement in predicting number of problems completed, $\beta = -.44$, t (52) = 3.43, $p < .01$, and math time, $\beta = -.31$, t (52) = 2.38, $p < .02$. In other words, the more that people had made frequent and deliberate choices, the less able they were to persist on our math task (see Table 1). In these models, participants' tiredness was not a significant factor in number of problems completed, $\beta = .07$, t (52) = .51, *ns*, or for time spent on the math problems, $\beta = .20$, t (52) = 1.53, $p > .13$. Shopping duration was also not a significant predictor for either measure, ts (52) < 1, *ns*. Thus, we found support from outside the laboratory for the hypothesis that extensive decision-making impairs subsequent self-regulation.

In a second set of models we sought to test the robustness of the choices effect in models where other possible predictors would vie for variance. In these subsidiary models, we included the three

predictors as before (time spent shopping, tiredness, and psychological involvement in choices), as well as ethnicity, age, and gender in order to predict time spent on the math problems and number of problems completed. The overall models were significant, F (6, 49) = 3.99, $p < .01$, for number completed and F (6, 49) = 2.64, $p < .03$, for math time. More notably, the predicted effect of psychological involvement in making choices remained significant despite the additional controls, showing no decrease (and in fact a slight increase in strength) from the previous three-predictor models, $\beta = -.48$, t (49) = 3.72, $p = .001$, for number of problems completed, and $\beta = -.35$, t (49) = 2.65, $p < .02$, for time spent on the math problems.

Self-reported tiredness was not a significant predictor of persistence at math problems, t (49) < 1, *ns*, for number of problems completed, and t (49) = 1.09, $p > .28$, for time spent on the problems. Time spent shopping and age likewise failed to yield a significant effect on either measure of persistence, all ts (49) < 1.01, *ns*. Gender showed a trend toward predicting number of math problems completed, t (49) = 1.61, $p = .11$, with men completing more problems than women, but gender did not predict time spent on the math problems, t (49) = 1.15, $p > .25$. Last, ethnicity predicted both measures, t (49) = 2.42, $p < .02$, and t (49) = 1.90, $p = .06$.

Number of problems correct

As an ancillary test of our hypothesis that making choices leaves people in a state of potential regulatory failure, we computed the number of problems correctly completed as a measure of self-control ability. As mentioned, past research has shown that one consequence of self-regulatory resource depletion is a reduction in cognitive abilities and consequently poorer intellectual performance (Schmeichel et al., 2003). Accordingly, we examined whether participants who had made more choices would perform more poorly on the computation involved in the three-digit plus three-digit math task.

Using the more sophisticated model that included the psychological involvement factor, tiredness, time spent shopping, age, gender, and ethnicity as predictors, we found that, similar to the other measures of self-regulation in this study, number of problems completed correctly was also

predicted by the psychological involvement factor, $\beta = -.51$, t (49) = 4.12, $p < .01$. In this model, again, the predictive contributions of tiredness, time spent shopping, gender and age were all nonsignificant, ts < 1.4, ps >.17, whereas ethnicity was a significant predictor, t (49) = 2.67, $p = .01$.

Discussion

Experiment 5 provided converging support for the hypothesis that choice-making interferes with subsequent self-regulation. Shoppers at a local mall reported how much psychological involvement they had put into making shopping decisions that day and then were asked to solve arithmetic problems. Self-regulation was measured by persistence on math problems. We found that the more choices the shoppers had made, the more quickly they gave up on the math problems, as measured by both time spent and number of problems attempted. Moreover, the negative impact of prior decisions on math persistence remained significant even after controlling for how long they had been shopping, how tired they were, and for several demographic categories including gender, age, race, and ethnicity.

Making more shopping choices was also associated with poorer performance on the math test, measured in terms of number of problems solved correctly. The correlational design of this field study, however, renders it less supportive of causal conclusions than the previous laboratory experiments. The temporal sequence rules out the possibility that math persistence caused the (prior) shopping decision-making, but third variable explanations are still plausible, such as that people who enjoy making effortful decisions while shopping simultaneously dislike expending effort on math problems. (That said, on an *a priori* basis one would likely predict the opposite, such that people with high need for cognition would put more thought into both shopping decisions and math problems.) In that respect, these findings are less conclusive than those of the prior studies, but they also add valuable convergence. The decisions in this study were not mandated by the experimenter but instead were naturally occurring decisions made by people in the course of their daily lives. The sample was also much more diverse (e.g., in age, education, and income) than the university populations sampled in the preceding studies. Also, as noted in the Introduction to this study, some of the potential confounds of

the laboratory studies were ruled out by the design of this investigation.

In sum, we think that the convergence across multiple studies with different procedures and measures is more convincing than the results of any single study. The experiments reported thus far have consistently found that effortful decision-making leads to subsequent decrements in self-regulation. This pattern was found in laboratory, classroom, and shopping mall. This pattern was found with assigned choices and spontaneously made choices. This pattern was found with inconsequential and more consequential choices. And this pattern was found using a variety of self-regulation measures. We therefore turned to testing our second hypothesis, which is the idea that resource depletion can also occur as a result of performing actions that one did not choose for oneself.

EXPERIMENT 6

The next two experiments tested the idea that choice-making can be beneficial to the self-regulatory system, insofar as carrying out a course of action that has been chosen by oneself, rather than by someone else, is psychologically less taxing. That is, it should be easier to perform actions of one's own choosing as opposed to carrying out actions that someone else chose for you.

The following experiments tested this idea by varying or measuring the degree to which participants chose a behavior that they would later have to execute: Some participants had a choice over the goal they were to attempt to achieve, whereas others had less of a say. After performing goal-directed behaviors, we asked participants to perform a second task that served as a measure of self-regulation. Differences in the second, regulatory task as a function of degree of choice regarding the first task suggest that the operations of the first task taxed the regulatory system to varying degrees in accordance with perceptions of choice over whether to perform it. Put more plainly, we expected that when participants were allowed to choose the task that they would later be performing, as opposed to having it chosen for them, the ensuing behaviors aimed at completing that task would be less psychologically depleting, thereby allowing for better self-control subsequently.

Experiment 6 tested the hypothesis by borrowing a paradigm from the dissonance literature. In the current study, participants in the high choice condition were reminded of their decision freedom

regarding their participation in an upcoming task, which leads to the well-known effect of making behavior appear to be a reflection of one's own choosing and to be something for which one is responsible (e.g., Linder et al., 1967). Participants in the low choice condition were simply given a task to perform. Before and then after the numeric task that served as the context for manipulating perceptions of choice, participants squeezed a handgrip as a measure of self-control. Prior research has demonstrated that the ability to hold the handgrip steady is not merely an indicator of physical strength but also depends on self-regulation (Rethlingshafer, 1942). We predicted that participants who performed the numeric task under high choice would demonstrate better self-regulation subsequently than would participants who were instead directed to perform the same task.

Method

Participants

Participants were 16 female and 13 male undergraduates who participated in exchange for partial course credit.

Procedure

Participants came to the lab individually and were met by an experimenter who informed them that the current experiment would involve some exploratory measures as well as some cognitive tasks. Participants were told, "the first thing you are going to do is help us with a measure we are pilot testing for future experiments. We are interested in getting measurements of physical strength in people of college-age. I would like you to grip this handgrip as long as you can as part of this pilot testing." The experimenter then started a stopwatch at the same time that participants squeezed the handgrip strengthener, which is an exercise device used by bodybuilders and others to increase handgrip force. The handgrip device consists of two handles and a spring that forces the two handles apart. One's goal when gripping the exerciser is to squeeze the handles together for as long as possible. For the purposes of this experiment, a piece of paper was inserted into the handgrip exerciser to measure the point at which participants stopped holding together the two handles: once the paper dropped out from the middle of the device, the experimenter stopped the stopwatch to signal that the participant's grip had

gone slack. This procedure has been used in past studies of self-regulatory resources (e.g., Muraven et al., 1998;Vohs et al., in press). This first measure provided the baseline against which to compare later handgrip performance as a test for possible change in self-regulation.

Next, participants were presented with the manipulation of high versus low choice, which pertained to a numeric puzzle. Participants in the *low choice condition* were told that different participants did different tasks at this point in the experiment, and that by random assignment they were assigned to the numeric puzzle task. Their job would be to locate each of 33 target strings in the grid of numbers above. Participants in the *high choice condition* were given similar instructions, except that after they were shown the puzzle and given their charge, they were told, "…the rules of the experimental procedures at this university are such that participants may opt to stop the experiment or not to do any tasks that they do not want to do." The experimenter then directly asked the participant, "Are you sure you want to do this? You don't have to do it if you don't want." Consistent with other studies on dissonance, all participants in the high choice condition agreed to continue with the task. Because low choice condition participants were simply told that they had been assigned to the numeric puzzle task, these participants were not reminded of their ability to choose whether to perform the task.

The numeric task that all participants were given was similar to 'search-a-word' puzzles that are common in children's books. In the current version, however, participants were required to find specific strings of numbers in a larger block of numbers. The fact that this puzzle uses numbers instead of letters makes it particularly difficult (because letters form recognizable words, whereas specific number sequences are much harder to detect); additionally, the grid of numbers in which participants were to find the target number strings was quite large, measuring 25 x 16, thus totaling 400 numbers.

Participants in both conditions were told that they would be performing a cognitive task and that their goal was to find each of 33 target strings of numbers (which ranged from three-digit numbers to 10-digit numbers) within the larger grid of 400 numbers. We created the puzzle such that six of the 33 target strings were solvable but the remainder were unsolvable. The solvable items were included to minimize suspicion that the task was impossible.

Participants then were left to complete the numeric puzzle for 4 min. Participants then completed a version of the Intrinsic Motivation Scale (IM; Ryan, 1982) that contained subscales tapping choice, effort, enjoyment, and value, which were chosen for their relevance to the goals of the current study. Participants also completed the PANAS (Watson et al., 1988).

The next task involved gathering a second measure of handgrip control to see whether the choice manipulation affected self-control. Participants once again squeezed the handgrip exerciser for as long as they could. They were told that the second measurement was needed because multiple assessments provide the most accurate measure. After the second handgrip, participants completed a post-experimental questionnaire. Then participants were debriefed and thanked.

Results

Manipulation Check

Participants' reports on the choice subscale of the IM formed the manipulation check of choice condition. Ratings on this subscale confirmed that participants in the high choice condition felt they had chosen to engage in the task more than participants in the low choice condition, t (27) = 2.74, $p <$ .02 (M low choice = 37.56, SD = 10.39; M high choice = 45.92, SD = 3.88).

Handgrip Performance

The main prediction was that performing the number search task under low (rather than high) choice would deplete the self's resources as indicated by decrements in handgrip performance. To test this, we computed a regression model with two steps. With Handgrip 2 (post-manipulation) as the predicted variable, we first entered gender and Handgrip 1 (pre-manipulation) as predictors in Step 1; next, we entered in the choice condition variable as Step 2. The model revealed that gender and Handgrip 1 had significant effects, and the predicted effect of choice condition was also a significant factor: choice condition, β = .23, t (28) = 2.34, $p <$ .03; gender: β = -.34 (such that men had more handgrip ability than women), t (28) = 2.85, $p <$ .01; Handgrip 1: β = .63, t (28) = 5.34, $p <$ .001 (indicating that those who held on longer the first time also held on longer the second time).

Although all participants showed a decrement in handgrip ability from Assessment 1 (pre-

manipulation) to Assessment 2 (post-manipulation), participants who felt that they freely chose to perform the numeric search task showed smaller decrements (*M* decrement = -.11.69, *SD* = 31.50; Assessment 1 *M* = 70.23, *SD* = 62.85; Assessment 2 *M* = 58.54 *SD* = 46.33) than participants who had little choice in whether to perform the numeric task (*M* decrement = -.31.50, *SD* = 31.37; Assessment 1 *M* = 80.63, *SD* = 45.09; Assessment 2 *M* = 49.13 *SD* = 32.99).

Intrinsic Motivation

Participants completed four subscales from the Intrinsic Motivation Scale (Ryan, 1982). The analyses on the perceived choice subscale were presented earlier as a manipulation check. Subscales pertaining to value/usefulness, interest/enjoyment, and effort/importance were included to investigate whether perceptions of the task on these dimensions was influenced by high or low choice conditions. Three t-tests using choice condition as a predictor revealed that only the value subscale was affected, t (27) = 2.01, $p < .055$, *M* low choice = 22.69, *SD* = 10.03; *M* high choice = 29.54, *SD* = 7.89. Participants in the high choice condition agreed more with statements such as, "I believe doing this activity could be beneficial to me," and "I would be willing to do this again because it has some value to me." Ancillary analyses showed no mediation on the part of value scores in predicting self-control (handgrip performance) from choice condition. Results of the t-tests on effort and enjoyment showed no differences as a function of condition, *t*s (27) < 1, *ns*. Thus, being in the high choice condition led participants to perceive the numeric task as more valuable — in addition to affecting perceived choice — but it did not bring about changes in effort or enjoyment of the task.

Mood and Difficulty

We next checked to see that positive and negative affect (as measured by the PANAS) also showed no difference as a function of choice condition. As in previous studies, mood did not vary as a function of condition *t*s < 1.1, *p*s > .30. Hence, participants' perception that the numeric task was more chosen by them than for them had no significant effect on their affective states.

Post-experimental questions asked participants to rate the difficulty of the numeric puzzle task and both handgrip measures. Ratings on these measures did not differ by choice condition, all *t*s < 1, *p*s

>.35. Thus, participants did not experience the numeric puzzle task as more or less difficult because of having greater or lesser control over participating in it, nor did they perceive any differences as a function of condition in the difficulty of the handgrip tasks.

Discussion

Experiment 6 turned from examining the costs to the benefits of choice. Whereas Experiments 2-5 showed that making choices led to subsequent decrements in self-regulation, Experiment 6 found that self-regulation could be improved among people who had made a prior choice. In this study, participants all performed an unpleasant and difficult initial task, either by their own choice or by being assigned to it. (In actuality, all participants were assigned the same task but some were induced to feel as if the choice had been theirs.) Making oneself perform the difficult task appears to have depleted regulatory resources for all participants, as indicated by poorer performance on a physical stamina (handgrip) task. But the decline in stamina was mitigated among people who felt they had freely chosen to perform the difficult initial task. Apparently, aversive tasks are most depleting when one does not feel one has had any choice about whether to do them. Perceived choice makes the bad task less depleting.

Participants in the high choice condition rated the difficult task as more valuable and more personally beneficial than participants in the no choice condition, but these benefits of choice were unrelated to the depletion effect, according to our mediation analyses. We also found no difference in rated enjoyment of the task, nor in subjective perceptions of effort expended on the task. Thus, the depleting effect of performing a difficult, unchosen task does not seem to be mediated by the subjective experience of performing the task. Instead, the self apparently expends more of its resources in making itself perform an unchosen task than in making itself perform a task it has chosen.

EXPERIMENT 7

Experiment 7 approached the question of freedom of choice and self-regulation from another angle. The independent variable of choice involved students preparing to take one of the standardized examinations generally required of applicants to graduate, law, medical, and business schools. We

assumed that some students are internally motivated by their own goals and ambitions to take those examinations, whereas others take them under pressure from parents, partners, professors, or other external sources. If choice does indeed make onerous tasks less depleting, then taking such an exam should consume fewer resources if students regard the it as reflecting their own choice rather than someone else's. As a consequence, these students should be more successful at a second task requiring self-regulation, relative to students who feel externally pressured to take the exam.

Hence Experiment 7 (like Experiment 5, but unlike the other studies in this report) relied on measuring actual personal choice instead of manipulating it. As we have said, there are interpretive questions that attend either measured or manipulated choice, and so we have looked for convergence of results to make our case.

The quest for multimethod convergence also led to a new dependent measure of self-regulation for Experiment 7. Participants performed a task that involved a speed-accuracy trade-off. Participants were asked to play a commercially-available game called Operation that is won by moving one's hand slowly and carefully across the board so as not to make mistakes. In the present study, the participants' goal was to make as few errors as possible while completing the task in the shortest possible length of time. Some of the more challenging control tasks that humans perform (e.g., shooting a moving animal, hitting a fastball, buying a stock at the best price) rely on the ability to achieve the right balance between speed and accuracy. Measures of speed-accuracy tradeoff have also been used in past studies of self-regulatory resource depletion (e.g., Schmeichel et al. 2003). In the current study, the combination of number of errors and the length of time it took to complete the game was the dependent measure.

We predicted that students who worked on sample items from graduate examination tests would be depleted afterwards, and consequently would perform poorly on the speed-accuracy trade-off task — but only if they perceived themselves to have low choice about taking the actual standardized test. In contrast, the sense of having chosen the graduate examination themselves would make doing practice problems less depleting, and so better subsequent self-regulation would be reflected in better

performance on the speed-accuracy tradeoff task.

Method

Participants

Participants were 37 undergraduate students (22 male, 14 female, and 1 unknown) who participated in exchange for $5. One participant's data were not analyzed because of failure to complete the study. On the measure of speed and the combined speed-accuracy measure, another participant's data were not analyzed due to scores over 4 standard deviations above the mean.

Procedure

Participants were recruited for the experiment by advertisements aimed at students who were intending to take any one of the standardized tests for entrance to graduate or professional school. These tests are the Graduate Record Examination (GRE), the Medical College Admission Test (MCAT), Graduate Management Admission Test (GMAT), and the Law School Admission Test (LSAT). Participants came to the lab individually. An experimenter told them the experiment involved performing several different types of cognitive tasks. First, participants completed the perceived choice, value/usefulness, interest/enjoyment, effort/importance subscales of the IM Scale (Ryan, 1982), which was modified to refer to the graduate exam that the participant was intending to take. The instructions read (underlined parts denote words added for the purposes of the current study, but were not emphasized in participants' instructions), "For each of the following statements, please indicate how true it is for you <u>with regard to the standardized test you are taking</u>, using the following scale. <u>Think about studying for and taking the exam while answering the questions</u>." The only other modification to the IM Scale was changing the phrases "this activity" or "this task" in each sentence to "the test." A sample sentence is, "I believe I have some choice about taking the test."

Next participants were given a packet that contained 16 questions taken from various practice methods for standardized tests. We included items from all four types of tests that students would be taking (MCAT, LSAT, GMAT, and GRE) as well as some items from the Miller Analogies Test, a test that is no longer commonly used. There was one item for each to test logical reasoning, analytical

reasoning, quantitative comparisons, data sufficiency, critical reasoning, sentence completion, and one antonym. Additionally, there were two algebraic items, two reading comprehension items, and four analogies. We included a variety of question types to guard against the possibility that participants who were studying for certain tests (e.g., the GRE) would be more familiar with certain types of items. The experimenter instructed them to complete as many items as possible, while also trying to get as many correct as possible. They were told that the experimenter would stop them in 15 minutes or that they could ring a bell if they finished sooner. The experimenter timed how long participants took to complete the sample items and stopped them if they reached the ceiling of 15 minutes.

Following the test questions, participants completed the PANAS (Watson et al., 1988). Next, the experimenter brought in the game Operation, a commercial board game targeted at children that involves taking fake plastic body parts (e.g., liver, spleen, heart) from a cartoon patient using pincers. The game is one of accuracy, because the body parts sit in a shallow pit that is surrounded on all sides by metal edges that buzz loudly if the metal pincers touch them. Thus, one's goal is to take the body part out carefully so as not to set off the annoying buzz. Participants were shown the game and shown how to remove the body parts and then told that their goal was to remove all the body parts without touching the sides of the compartments (which would then emit a buzz) while also going as quickly as they can. Participants were allowed one practice trial each and then the game began. The experimenter stood behind and to the side of the participant for observation. She recorded the number of buzzes, which formed the measure of inaccuracy in this study. The length of time it took each participant to get all the pieces out was recorded as a measure of speed. After the Operation game was complete, participants completed a post-experimental questionnaire. Then they were debriefed and thanked.

Results

Preliminary results

We first computed scores on the choice, value, enjoyment, and importance subscales of the Intrinsic Motivation Scale (Ryan, 1982)[1] and then centered them for entry into the regression models. Next we used the four subscales on the IM scale to test whether participants differed in terms of their

perceptions of the difficulty of the sample test questions or the difficulty of the Operation game, as measured by a post-experimental questionnaire. Our analytical strategy for this measure and subsequent measures was as follows: we used all four Intrinsic Motivation subscales as simultaneous predictors (along with gender) to test for significant effects of perceived choice. We included all four subscales to ensure that any potential effects of perceived choice were above and beyond effects of other aspects of intrinsic motivation.

Speed-Accuracy Results

The main purpose of this experiment was to test the hypothesis that higher perceived choice on the graduate admission test would lead to better performance on the speed-accuracy (Operation) task. Number of errors (buzzes) and amount of time it took to complete the game served as measures of accuracy and speed, respectively. We first standardized speed and accuracy measures and then, as a method of combining the two measures into one index of the speed-accuracy tradeoff, we added the two z-scores together. Lower numbers on this measure indicate fewer errors and faster completion of the Operation task (i.e., overall better performance). In the analyses that follow, we used gender and the four subscales of the IM scale (centered) to predict the combined speed-accuracy measure.

The results of this analysis supported our prediction that perceived choice would determine performance on a speed-accuracy trade-off task, $\beta = -.54$, $t\ (28) = 3.26$, $p < .01$. The direction of the beta weight signals that high scores on the perceived choice measure (i.e., feeling that the upcoming graduate/professional exam is freely chosen) were related to better performance (i.e., fewer errors and faster completion) during the Operation game, which was played after participants completed a task directly related to the upcoming test (see predicted values in Figure 1). All other ts < 1.61, ps > .12.

A breakdown of the two constituents of this measure showed that perceived choice was a significant predictor of errors committed, $\beta = -.53$, $t\ (28) = 2.93$, $p < .01$, and of time spent on the task, $\beta = -.45$, $t\ (28) = 2.53$, $p < .02$. No other variable was significant in predicting these two components, ts < 1, except gender marginally predicted time spent on the task, $\beta = .28$, $t\ (28) = 1.88$ $p = .07$, such that women took longer than men. Another method of assessing whether there was a speed-accuracy

trade-off in performance on the Operation game is to compute the correlation between speed and errors (see Patterson, Kosson, & Newman, 1987). A speed-accuracy tradeoff would be suggested by an inverse association, which is the opposite of what measures in the current study showed, r (34) = .66, p < .01.

Analyses on Sample Test Items

We conducted subsidiary analyses to see if perceived choice affected performance on the sample standardized test questions. A regression model with the four IM scores and gender revealed that number of questions answered correctly was also predicted by the choice measure, β = .39, t (28) = 2.50, p < .02, as well as by value scores, β = .43, t (28) = 2.25, p < .04, such that greater feelings of choice and higher value scores related to more correct answers. Additionally, number of problems attempted was predicted by perceived choice, β = .35, t (28) = 1.99, p = .056, such that higher feelings of choice related to more problems attempted. Value scores, β = .39, t (28) = 1.81, p = .08, were also marginally predictive. All other effects of gender, interest scores, and enjoyment scores were nonsignificant, ts < 1.2 ps >.23.

In sum, participants who viewed a forthcoming standardized exam as a task they freely chose were shown to be faster at completing sample test items than participants who felt obliged to take the forthcoming exam. Moreover, these participants who felt they chose the direction of their test-taking future also managed to commit fewer errors on the sample questions than did their low-choice counterparts, thereby better succeeding at their goals. Despite this, they still performed better than their counterparts with lower perceived choice scores by making fewer errors in less overall time on the speed-accuracy trade-off game.

Tests of Mood Effects

Participants completed the PANAS (Watson et al., 1988) as a measure of temporary affect after attempting the sample test questions. A regression with the predictors of perceived choice, value, enjoyment, and importance from the IM Scale was computed to predict both positive and negative affect scores. The results of this model showed that perceived choice was not a predictor of positive

affect, β = .29, t (28) = 1.53, p = .14, nor of negative affect, β = -.06, t (28) < 1, p > .77.

Supplementary Analyses

Perceived choice was not predictive of difficulty ratings in regard to sample standardized test items, β = -.01, t (29) < 1, p > .98, nor were the value subscale, importance subscale, enjoyment subscale, or gender, ts < 1.70, ps > .10. Ratings of the difficulty of the game were not predicted by the choice subscale, β = .09, t (29) < 1, p > .67, but were predicted by value subscores, β = .72, t (29) = 2.86, p < .01, and by importance subscores, β = -.56, t(29) = 2.22, p < .03, but not gender or enjoyment subscores, ts (29) < 1.45, ps > .16. In sum, the variable of interest — perceived choice — did not relate to perceptions of difficulty of the sample standardized test items or of the Operation game.

As mentioned, participants were allowed to spend up to 15 minutes on the sample test questions. The length of time it took participants to complete the items was recorded and then used as the criterion variable in a regression with these following five predictors: the four subscales of the IM (choice, value, enjoyment, and importance) and gender. A regression predicting time spent completing the test questions showed that perceived choice did not relate to time, t (29) = 1.46, p > .16. Descriptively, 83% of participants (30 of 35) went to the limit of 15 minutes, and of those who did not, four participants took over 14 minutes

Discussion

Experiment 7 showed that participants who would be taking an upcoming graduate/professional school examination test performed a speed-accuracy tradeoff task better if they felt they were taking the graduate test by their own choosing. As an intermediary step in this experiment, participants answered questions that closely approximated those they would be completing in their forthcoming exam, a task that served to activate the influence of perceived choice on regulated behavior. Apparently, working on those sample items was challenging and depleted the self's resources, but the depletion (as indicated by performance on the subsequent Operation game) was less among people who felt the graduate exam corresponded to their own choice. Put another way, doing sample items for a test that was not perceived as one's own choice was especially detrimental to one's subsequent self-

regulation, as compared to those who perceived the test as their own choice.

How did participants with higher choice scores achieve better performance on the second regulated task? It was not by lackadaisically muddling through the earlier (test taking) task. On the contrary, the participants whose test-taking reflected their own choices (instead of someone else's) worked harder on the practice test, as indicated by attempting and solving more problems. One might have expected them to be more tired and hence to perform worse on the Operation task, but instead they did better. The implication is that forcing oneself to work on tasks that are not of one's own choosing requires some degree of effortful self-regulation, whereas working on self-chosen tasks is less depleting.

GENERAL DISCUSSION

Ambivalence about choice presents one of the great seeming paradoxes of modern life. On the one hand, the desire for choice seems ubiquitous. People clamor for freedom in their private and political lives. In the economic marketplace, consumers reward companies that provide them with ever more fine-grained choices. In psychological data, people exhibit patterns such as reactance (Brehm, 1966) and illusions of control (Langer, 1975) that indicate deeply rooted motives to maintain a feeling of having choices. On the other hand, people tire of the endless demands for choice and the stress of decision-making. In psychological research, there are signs that having too much choice can be detrimental to satisfaction and that people resist having to face up to the tradeoffs that many choices involve (Iyengar & Lepper, 2000; Luce, Bettman, & Payne, 1997; Schwartz, 2001; 2004).

The present investigation sought to shed light on both the costs and benefits of choice. Both costs and benefits can be seen in terms of the impact on subsequent self-regulation. Making choices can be difficult and effortful, and there is an intrapsychic cost to choosing that is seen in decrements in subsequent self-regulation. But having to perform tasks chosen by others also carries an intrapsychic cost that likewise can impair subsequent self-regulation.

The costs of decision-making were the focus of Experiments 1-5. These were based on the hypothesis that deliberate, effortful choice consumes a limited resource needed for a broad range of

executive functions, including self-regulation. Participants made a series of choices about consumer products, college courses, or course materials — or, in the no-choice conditions they studied and rated those materials without choosing among them. Making choices apparently depleted a precious self-resource, because subsequent self-regulation was poorer among those who had made choices than among those who had not.

Having five experiments permitted us to employ a diversity of measures and manipulations, so that possible ambiguities regarding one procedure could be remedied in another. We had participants make binding and non-binding choices. In some studies we assigned them to make choices or not, and in others we measured how many choices they had spontaneously made. We allowed them unlimited time to choose, or we cut them off prematurely. We measured self-regulation in terms of how long they could hold a hand in ice water, how much they procrastinated while studying, how long they persisted on unsolvable puzzles, and how long they tried and how well they performed on solvable problems. We also employed a range of supplementary measures, including measures of emotion and mood, self-ratings of fatigue, and perceived difficulty of the tasks.

The most parsimonious explanation for all these findings is that making choices depletes some important psychological resource, indeed the same resource that is needed for self-regulation. But to conclude that choice is costly or otherwise aversive would be unfairly one-sided — not to mention disturbingly counterintuitive, insofar as people generally seem to want to have freedom to choose (e.g., Brehm, 1966). If choice is as costly as Experiments 1-5 suggested, but is also as widely desired as many observations indicate, then it must offer some powerful benefits or consolations.

The benefits of choice were the focus of Experiments 6-7. These studies indicated that the perception of having choice can mitigate the difficulty of performing unpleasant or onerous tasks. Put another way, a lack of choice can take the form of having to perform tasks chosen by others, which may require effortful self-regulation in order to accommodate oneself to these external dictates. In Studies 6-7, people who performed tasks chosen by others subsequently showed poorer self-regulation, as compared to people who did comparable tasks they had chosen themselves.

Specifically, participants who chose their own task suffered less ego depletion than participants who performed the same task without choosing it, in Experiment 6. Specifically, they subsequently showed better physical stamina on a handgrip task. In Experiment 7, studying and doing practice problems for an upcoming (and real) standardized test later made students who were externally motivated perform poorly on a game that requires self-regulation of a speed-accuracy tradeoff. In contrast, those who were intrinsically motivated to practice for the upcoming test, which means that they felt the decision to take the upcoming test experiment, participants who were made to feel that they were performing a number-search task by their own free choice, as was their own, performed much better on the speed-accuracy tradeoff task.

Important previous work by Iyengar and Lepper (1999) provided evidence for the advantages of choice. Their research showed that white American children were most motivated on tasks they chose for themselves, whereas Asian Americans were most motivated on tasks chosen for them by someone close them (e.g., their mother). However, they too showed low motivation on tasks chosen by someone else when the other was outside of the self. The present findings extend those findings in several ways. First, we used adults rather than children. Second, and more notably, we showed that motivational effects went beyond the specifically chosen (or unchosen) task to affect performance on other, unrelated tasks. Third, our studies measured performance quality and persistence (both of which were affected by choice on the previous, unrelated task) rather than subsequent choice to perform the task again. Taken together, the findings of Iyengar and Lepper and of the present investigation thus show that having to make oneself perform tasks chosen by non-intimate others produces a broad range of subsequent deficits, including not wanting to do the same task again (Iyengar & Lepper, 1999) and performing worse on a different task (Experiments 6-7).

Alternative Explanations

The present investigation needed multiple experiments, partly because there is no single, unambiguous measure of the constructs. There was no direct self-report measure of decision fatigue. Likewise, there is no single gold standard measure of self-regulatory resource depletion, and so we

measured self-regulation in many different behavioral spheres. The diversity of measures was especially important and helpful because of the theoretical assumption that the same resource is used for many diverse self-regulation activities as well as for effortful decision-making.

In any case, the use of many different procedures and measures should help to counteract possible alternative explanations and increase confidence in the general conclusions about decision fatigue and the costs and benefits of choice. Replication is generally regarded as boosting confidence in research findings, and replication with different measures is important for providing converging evidence.

In Experiment 4A, the experimenter had the informal impression that the choice procedure seemed to take longer than the no-choice procedure, raising the possibility that the effects on self-regulation were caused by the longer duration of the initial task (and hence a greater sense of having discharged one's obligation as research participant, or perhaps more urgent desire to finish and be on one's way). In the remaining studies, however, the time for the two tasks was kept rigidly equal, and the results were the same. Experiments 2 and 4 used two different experimenters and blind testing procedures. The results remained strong, and so the effects cannot be explained away in terms of seeking to gain favor for the sake of getting a better gift. The two-experimenter system also permitted blind testing, which can largely rule out explanations based on experimenter bias or demand characteristics. Some of the procedures, such as evaluating psychology course materials or studying for a standardized graduate school admissions test, pertain mainly to student life. However, we did include field studies with non-university samples, and the results are the same. Thus it seems fair to generalize these results beyond psychology students.

Some studies used persistence on unsolvable problems as the measure of self-regulation, on the assumption that making oneself persist in the face of failure is aversive and difficult. A contrary view might argue that persisting on unsolvable puzzles is a waste of time and therefore quitting is an indication of good self-regulation. Against that view, however, we found that ego depletion caused by decision making made people also quit faster and/or perform worse on solvable problems. In one study

(Experiment 3) there was no difference between the choice and no-choice conditions on one measure of performance quality, but the studies that systematically measured performance (especially Experiments 4B and 5) confirmed poorer performance following choice.

It is conceivable that differences in mood and emotion could perhaps account for some of the patterns we observed, especially insofar as the decision-making tasks might be regarded as inherently more likely to generate aversive emotional states than the no-choice tasks. But many of our studies contained (various) mood and emotion measures and the null results on these measures counteract the view that mood or emotion mediated our results.

Finally it was important for us to empirically confirm that the experimental manipulations about choice were effective. Experiment 1 showed that high-choice procedures made people feel more that they were indeed engaging in decision-making, as well as putting more deliberate thought into the task, than the low-choice procedures. The self was more involved in the high-choice than the no-choice procedure, which is why we think that it expended more of its ego resources.

In short, although some findings may seem open to alternative explanations, we attempted to provide evidence against these alternatives with other studies in the current investigation. The most parsimonious explanation for these findings is that making choices depletes some valuable resource that is needed for self-regulation, and thus self-regulation is impaired in the aftermath of decision-making.

Concluding Speculative Remarks

The line of evolutionary development that led from simple, one-celled creatures to human beings is marked by steadily increasing complexity and sophistication of cognitive processing. Why? One view is that cognitive information processing essentially serves the process of choice, and so those cognitive improvements improve creatures' ability to adapt their behavior to multiple, complex, and changing environments (Tomasello & Call, 1997). Put more simply, cognition evolved to serve choice. By that view, human psychological processes represent an important leap forward in that same direction. People can use logical reasoning, cost-benefit analyses, and other highly sophisticated

decision-making procedures that may be difficult and costly but that open up possibilities for choosing among multiple options in novel, unforeseen, and changing circumstances.

Why has evolution not conferred similar decision-making capabilities on many other species? One answer, suggested by the present research, is that such sophisticated choosing is costly. It consumes a notable quality of an important psychic resource, thereby leaving the individual less able to self-regulate or make other decisions.

The present findings suggest that self-regulation and effortful choosing draw on the same psychological resource, such that making choices impairs self-regulation. We speculate that the capacity for effortful self-regulation evolved first, as social animals adapted to the need to override their impulses and bring their behavior into line with external pressures, and that a later evolutionary step exploited this capability for the sake of enabling complex human decision-making. The present findings confirm that effortful choice is costly — and that the cost is paid in the same coin that pays for effortful self-regulation. Given the huge adaptive benefits of self-regulation, it is reasonable to assume that nature would only reluctantly add new functions that may sap self-regulatory resources and cause impairments in people's capacity for self-regulation.

The findings from our final two experiments also suggest, however, why that price was worth paying (and paying with the precious resource used for self-regulation). Had nature designed human beings to be mostly submissive automatons who bow to external authority, instead of actively making their own choices, the demands on self-regulation would potentially have been even greater. Accommodating oneself to external demands (including decisions made for the self by others) can require self-regulation, including the substantial expenditure of regulatory resources. By making choices for themselves, human beings can spare themselves some of the cost of accommodating to external demands. As the present findings suggest, both the costs and the benefits of effortful choice are registered in the same resource.

Footnotes

1. The range of scores on the choice IM subscale was from 7-49 (M = 28.83, SD = 10.04); the range of scores on the value/usefulness IM subscale was 13-49 (M = 28.00, SD = 11.17); the range for the enjoyment/interest IM subscale was 8-50 (M = 25.33, SD = 8.25); and the range for the importance/effort IM subscale was 14-35 (M = 23.50; SD = 5.44). We computed correlations between the four subscales and found that the highest two correlations were between value and importance, r (36) = .68, $p < .01$, and perceived choice and enjoyment, r (36) = .62, $p < .01$. Value and perceived choice correlated at r (36) = .40, $p < .02$, and importance and perceived choice correlated at r (36) = .16, *ns*.

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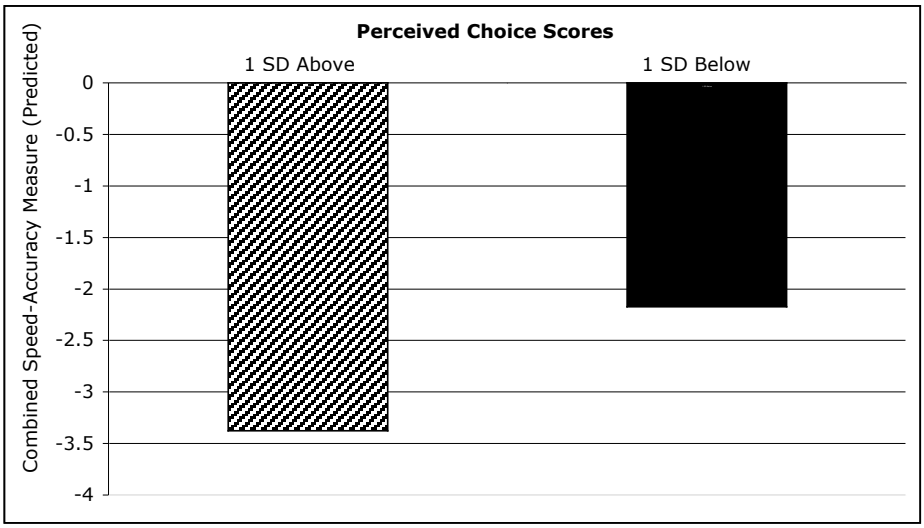
Table 1: Self-regulatory ability as a function of choice condition; Experiments 2-8

	Choice Condition	**No Choice Condition**	**Dependent Variable**
Experiment 2	27.70 (15.81)	67.42 (56.35)	Time Held Arm in Freezing Water (secs)
Experiment 3	8.39 (3.64)	11.40 (1.66)	Time Spent Practicing (minutes)
Experiment 4A	9.11 (3.00)	12.25 (4.31)	Persistence (minutes): Unsolvable Puzzles
Experiment 4B	14.70 (4.05)	17.80 (4.66)	Persistence (minutes): Solvable Puzzles
Experiment 5	3.04 (2.28)	4.54 (3.29)	Persistence (minutes): Math Problems

Note: The data in this table are means and standard deviations (inside parentheses) relating to the effect of choice condition on self-regulation ability. Higher numbers indicate better self-control. Rows denote the experiment number from which the means were drawn. The first two columns are the conditions representing Choice and No Choice, and the Dependent Variable column specifies the operationalizations of self-regulation in each experiment. For Experiment 5, a median split on scores from the *psychological involvement in choices* factor (see Experiment 1) was used to create the groups of Choice and No Choice.

Figure 1: Predicted performance (errors and speed) for Operation game at 1 standard deviation above and below perceived choice scores; Experiment 7



Note: The measure of "combined speed-accuracy" pertains to predicted performance values on the game Operation, in which participants were instructed to make as few errors as possible while completing the game in the least amount of time. Length of time to complete the task and number of errors made were each standardized and aggregated; hence, lower scores indicate better performance. "Perceived choice scores" refers to scores on the Intrinsic Motivation subscale (Ryan, 1982) and pertains to perceptions of choice regarding an upcoming graduate entrance examination. Higher perceptions of choice were predicted to lead to less self-regulatory depletion and therefore better performance (i.e., more negative scores) on the speed-accuracy game.