

# Violence restrained: Effects of self-regulation and its depletion on aggression <sup>☆</sup>

C. Nathan DeWall <sup>\*</sup>, Roy F. Baumeister, Tyler F. Stillman, Matthew T. Gailliot

*Department of Psychology, Florida State University, Tallahassee, FL 32306-1270, USA*

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## Abstract

Aggressive impulses arise from many factors, but they are usually held in check by social norms for self-control. Thus, the proximal cause of aggression is often failure of self-restraint. In five studies, depleted capacity for self-regulation (caused by prior, even irrelevant acts of self-regulation) increased aggressive responding, especially after an insulting provocation. When participants were insulted and their self-regulatory strength was depleted (i.e., after completing previous tasks that required self-regulation), participants were more likely to aggress. When the urge to aggress was relatively weaker (i.e., when participants were not insulted), self-regulatory depletion did not increase aggressive behavior. This effect was moderated by trait self-control: Participants low in trait self-control were particularly likely to express intentions of behaving aggressively in response to provocation, whereas participants high in trait self-control did not express intentions of responding aggressively. Laboratory, autobiographical memory, and hypothetical responses confirmed the pattern. Published by Elsevier Inc.

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## Introduction

Man's inhumanity to man has vexed and puzzled thinkers for centuries. Violence and oppression have blackened human relations in every corner of the globe. From sibling violence, to street crime, to genocide and warfare, people have inflicted pain, suffering, and sometimes death on each other in terrible numbers. Social scientists have sought the root causes of such aggression and violence and come up with a great many answers, including frustration of goal-directed behavior, innate aggressive urges, threatened egotism, social conflicts and the need to influence the behavior of others, sexual possessiveness, nationalism and other antagonistic world views, sadistic pleasure at inflicting pain, selfish desires for personal gain, economic difficulties

including poverty, negative emotional states, character disorders, and idealistic projects ostensibly aimed at making the world a better place (Anderson & Bushman, 2002; Baumeister, 1997; Berkowitz, 1990; Buss, 2000; Dollard, Doob, Miller, Mowrer, & Sears, 1939; Geen, 1990; Hare, 1999; Staub, 1989; Tedeschi & Felson, 1994).

Those who hope for a less violent world may despair at the long list of root causes, which makes the prospects for eliminating violent impulses seem dauntingly slim. A more optimistic view was, however, introduced by Baron (e.g., Baron, 1976, 1983; Baron & Bell, 1977). That line of research focused on aggression prevention and noted that some inner responses may reduce aggressive feelings and perhaps even prevent aggressive impulses from being translated into violent actions. A more recent formulation building on this approach recognizes that in normal human life most aggressive impulses are restrained so as to stop short of aggressive behavior. Self-regulation (also called self-control) is an important inner faculty that enables people to resist temptation and hold back from acting on their impulses. Hence, though there may be many root causes

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<sup>\*</sup> Corresponding author.

E-mail address: [dewall@darwin.psy.fsu.edu](mailto:dewall@darwin.psy.fsu.edu) (C.N. DeWall).

that give rise to violent impulses, intrapsychic restraints keep aggression from engulfing society. By implication, the proximal cause of violence is often a failure or breakdown of self-control (Baumeister, 1997; Gottfredson & Hirschi, 1990).

The present investigation was concerned with the link between self-control and aggression. The hypothesis was that poor or failing self-control leaves people more likely to act aggressively when aggressive impulses are stimulated. In particular, we build on work suggesting that the capacity for self-control or self-regulation is a limited resource that operates like a strength or energy, and when this capacity has been depleted by prior use, people become less successful at self-regulation—and so they should be more likely to act aggressively if the aggressive impulse arises.

### *Self-control, aggression, crime, and antisocial acts*

Natural selection most likely favored the development of aggressive tendencies in social animals as one means of resolving the disputes and conflicts that arise inevitably in social life. Thus, when two animals want the same food, territory, mate, or other resource, aggression enables the larger and more dominant one to prevail. As social animals, humans undoubtedly inherited certain propensities to resort to aggression at such times. But as humans developed culture, aggression ceased to be the only or perhaps even the primary way of settling such disputes, especially with the development of laws, language and negotiation, morality, norms of fairness, third party intervention and judging, and the like (Baumeister, 2005). One can view much of the history of culture as the escalating attempt to restrain aggression and replace it with peaceful means of conflict resolution.

Most social animals also acquired the beginnings of the capacity to restrain their own aggressiveness. This may have occurred mainly out of self-interest, insofar as an animal who attacked a stronger and more dominant one was courting injury. The capacity to override one's aggressive impulses and refrain from aggressive action is arguably more important in humans than in other species, because (again) aggression is less needed and less desired in a cultural context. More generally, the human capacity to override and restrain socially inappropriate behavior, better known as self-control, allows humans to live and work together in a cooperative cultural system that confers varied and immense benefits on its participants.

Consistent with the view that self-control serves to restrain aggressive action, a growing body of evidence has linked poor self-control to aggression, though most of it has focused on chronic or trait levels of self-control. Gottfredson and Hirschi (1990) proposed that low self-control is the single most important factor in understanding and predicting criminality. Subsequent research has supported the link between deficits in self-control and criminal behaviors (Cherek, Moeller, Dougherty, & Rhoades, 1997; Cochran, Wood, Sellers, Wilkerson, & Chamlin, 1998; Gibbs, Giever,

& Martin, 1998; Longshore & Turner, 1998; McGuire & Broomfield, 1994). By and large, criminal acts provide immediate gratification of desires, supply few long-term benefits, and require little to no planning, all of which suggest an impulsive nature not subject to self-control.

Additional research has linked deficits in self-control to aggressive behavior. Murphy and Eisenberg (1997) showed that children with dispositionally poor self-regulation (as rated by teachers) had more angry conflicts with others and acted out more hostile responses to anger in a role-playing scenario with puppets, as compared to other children. Krueger, Caspi, Moffitt, White, and Stouthamer-Loeber (1996) showed that poor self-control was associated with aggressive and delinquent behavior among preadolescent and early adolescent boys. Other research has shown that young children who exhibited a reduced capacity for exerting self-control were less able to control their anger (Kochanska, Murray, & Harlan, 2000). Tangney, Baumeister, and Boone (2004) found that people low in self-control reported responding to anger-evoking situations with significantly greater outward aggression compared to people high in self-control. Caspi (2000) concluded that individual differences in self-control predict rates of behavioral problems and criminality over long periods of time.

Self-regulation can vary not just between but also within individuals, as the next section will discuss in greater detail. Although there has been little direct research attention to the idea that state fluctuations in self-regulation can influence aggressive behavior, some findings suggest such an interpretation. Alcohol use, for example, has been widely linked to impairments of self-control and self-regulation (e.g., Baumeister, Heatherton, & Tice, 1994; Steele & Southwick, 1985), and alcohol intoxication has consistently been linked to greater aggression (Bushman & Cooper, 1990; National Research Council, 1993). Sleep and negative affect have likewise each been linked to both self-regulation failure and aggression (Averill, 1982; Hindelang, 1976; Hindelang, Gottfredson, & Garofalo, 1978; Parrott, Garnham, Wesnes, & Pincock, 1996; Rand, Klaus, & Taylor, 1983; Tice, Bratslavsky, & Baumeister, 2001).

In sum, dispositionally low self-control has been linked repeatedly to aggression. There is indirect evidence that state differences in self-control may also play an important role.

### *Self-control as limited resource*

Some recent work has begun to suggest that the capacity for self-control waxes and wanes within an individual across time and circumstances, operating like muscular strength or an energy resource that can become depleted after use and is replenished after rest (Muraven & Baumeister, 2000). Engaging in acts of effortful self-control appear to produce a state that has been dubbed ego depletion, characterized by poorer than usual capacity for further self-regulation (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998). People in a depleted state persist less on discouraging or frustrating tasks

(Baumeister et al., 1998), are more prone to indulge excessively in alcoholic beverages, even when anticipating a driving test (Muraven, Collins, & Neinhuis, 2002), perform worse on effortful intellectual tasks though showing no impairments on automatic processes such as rote memorization (Schmeichel, Vohs, & Baumeister, 2003), are more likely to break their diets (Vohs & Heatherton, 2000), and are less able to cope with aversive thoughts (Gailliot, Schmeichel, & Baumeister, *in press*), as compared to people whose self-regulatory resources have not been depleted.

Thus, when people have already expended some of their resources, their capacity for further self-control is reduced. If an aggressive impulse were to arise at this point of self-regulatory depletion, a person would probably be less able than usual to restrain it. Preliminary support for this view was provided by Stucke and Baumeister (*in press*). In that work, participants first completed either a self-regulation task (e.g., refraining from eating cookies, stifling emotional reactions to a film) or a task that did not require self-control. After this initial task, all participants were insulted by the experimenter and were then given an opportunity to evaluate the experimenter. Participants who had exerted self-control during the initial task evaluated the experimenter more negatively than participants who had not exerted self-control during the initial task. Although those results could indicate that depletion leads to increased aggression, there were no controls to address competing explanations such as that the experimenter's initial task demands (e.g., to refrain from eating the desired foods) constituted frustration or engendered resentment and that the heightened aggression was a direct result of that frustration, in which case self-control might be irrelevant. The purpose of the current studies was to test whether and under what circumstances self-regulatory depletion leads to aggression.

### *Present research*

The present series of studies were designed to test the hypothesis that self-regulatory depletion caused by prior exercise of self-regulation would reduce inner restraints against aggression, leading to more aggressive behavior. To provide converging evidence and increase generality, we used an assortment of methods and measures for operationalizing self-regulatory depletion and aggression. Experiment 1 sought simply to demonstrate that depleted people would behave more aggressively in response to provocation than non-depleted people. Experiments 2 and 3 sought to show that this increase in aggression as a result of depletion occurred only if aggressive impulses were stimulated by a provocation (as opposed to having aggression increase as a direct result of ego depletion). Experiment 4 extended the findings to hypothetical responses in a non-laboratory scenario and also tested whether trait self-control can play a moderating role. Experiment 5 sought to increase external validity by confirming the pattern using autobiographical narratives about personal experiences.

## **Experiment 1**

Experiment 1 provided an initial test of the hypothesis that self-regulatory depletion would reduce inner restraints against aggression, thereby causing people to respond more aggressively to a provocation. The manipulation of self-regulatory strength was adapted from previous work by Baumeister et al. (1998) and consisted of having some participants sit in front of a delicious donut, whereas other participants were sat in front of some rather less appetizing radishes. The assumption was that people would experience desires to eat the donut but would have to override them, thereby depleting their self-regulatory strength. In contrast, participants in the control condition were instructed to spurn a considerably less desirable food than a donut (namely, a radish), which would not require self-regulation. Following this, all participants received an esteem-threatening provocation in the form of a bad and insulting evaluation of an essay they had written.

Aggression was measured with the aversive hot sauce procedure used by several previous investigators (Lieberman, Solomon, Greenberg, & McGregor, 1999; Kirkpatrick, Waugh, Valencia, & Webster, 2002; Webster, 2006). All participants were led to believe that the ostensible other person (who had given them the negative evaluation) had a strong dislike for spicy food, and then the participant was asked to put an unspecified quantity of hot sauce on a cracker for that person to eat. Given the other person's dislike for such spicy tastes, the more hot sauce the participant gave, the more discomfort and frustration the other would likely experience. The prediction was that depleted participants (i.e., those who had had to resist the donut temptation) would dole out significantly more hot sauce than would non-depleted participants.

### *Method*

#### *Participants*

Forty undergraduates (32 women) participated in this study in exchange for partial course credit. Data from seven participants were discarded from all analyses, four due to expressed suspicion about the feedback and three due to participants having eaten the entire donut instead of refraining from eating it (thus there were originally 47 participants). Participants were required not to have eaten at least 3 hours before participating in the experiment, and all participants complied with this requirement. Experimenters were blind to hypotheses.

#### *Materials and procedure*

Participants arrived at the laboratory for a study ostensibly investigating the relationship between food-taste preferences and written expression. After giving informed consent, students were told that they were paired with a same-sex partner in another room. Participants were informed that participation would involve providing a sample of their writing, evaluating their partner's writing, and

preparing food items for their partner “to minimize the time the experiment takes.” Participants were then asked to write a brief essay on their thoughts about abortion. Upon completion of the essay, participants rated their preference for several different flavors and tastes of food (e.g., salty, sweet, creamy, and spicy). This was done to maintain the cover story, as participants later received ratings of flavors and tastes ostensibly from their partner.

The experimenter took the forms from the participant to be assessed by his or her partner. The experimenter then returned with both a blank essay evaluation form and their partner’s essay. Participants received one of four essays designed to match their own gender and attitude on abortion; thus, for example, males received essays written in male handwriting, and those whose essays were pro-choice received pro-choice essays. This was done to ensure that any differences in aggression were due to self-regulatory depletion and not perceptions of partner attitude or similarity. Participants were asked to evaluate their partner’s writing in terms of its organizational structure, content, writing style, and overall quality, using a 7-point scale ranging from 1 (poor) to 7 (excellent). On each evaluation form, there was also a portion where participants could make additional comments about their partner’s essay.

While the participant evaluated the essay, the experimenter left the room and prepared a cheese and cracker snack. The experimenter returned and asked the participant to eat the snack, which participants were led to believe was prepared by his or her partner. Participants also rated the taste of the food sample on several dimensions (e.g., taste, texture, and aroma). Participants were then instructed that they would prepare a food item for their partner. Before participants prepared the food item for their partner, however, participants were exposed to the self-regulatory depletion manipulation. By random assignment, participants were assigned to a depletion or control condition. Participants assigned to the depletion condition were presented with a donut and again asked to rate the taste. As the participant lifted the donut to his or her mouth, the experimenter, feigning confusion, exclaimed, “Wait! I’m sorry; I think I screwed up. This isn’t for you. Please don’t eat the rest of it. Let me go figure out what’s supposed to be next.” Participants in the control condition received the same instructions from the experimenter but were presented with a radish instead of a donut. The experimenter left the participant with either the radish or the donut for 5 min. Thus, participants in the depletion condition were faced with the task of continually restraining their impulses to eat the tempting donut,<sup>1</sup> whereas participant in the no depletion condition had to restrain their presumably weaker impulses to eat a radish.

<sup>1</sup> Indeed, the donut proved so difficult to resist that three participants in the depletion were unable to resist their temptation and ate the donut. No participants in the no depletion condition, in contrast, expressed an inability to refrain from eating the radish.

After 5 min had elapsed, the experimenter returned and removed the food item. The experimenter also returned the participant’s abortion essay and an attached grading sheet ostensibly completed by his or her partner. The comments matched the handwriting of the essay said to have been written by the partner. The evaluation was negative, concluding with the comment “This is one of the worst essays I’ve ever read” (see Bushman & Baumeister, 1998).

After receiving the negative essay evaluation, participants were asked to prepare a snack for their partner. Participants were given chips, an empty bowl, and a commercial container of hot sauce prominently labeled *spicy*. At the same time, participants received the form listing their partner’s taste preferences. *Spicy* was given the lowest rating, one that indicated a strong dislike for spicy foods. Participants were instructed to “Give them 3 chips and adequate sauce.” The amount of sauce used constituted the measurement of aggression. Once the snack was prepared, the experimenter took the snack and removed all of the related supplies. The remaining sauce was weighed and subtracted from the weight before the experiment to determine the amount used. Participants were then given a post-experimental questionnaire, which contained items meant to assess anger-related feelings. Participants were then probed for suspicion, debriefed, thanked for their time, and given a donut.

### *Results and discussion*

As predicted, depleted participants responded to the perceived insult by doling out significantly more hot sauce than non-depleted participants. A one-way ANOVA on the total amount of hot sauce used revealed a significant difference between depleted ( $M = 36.95$ ,  $SD = 25.34$ ) and non-depleted participants ( $M = 22.79$ ,  $SD = 16.50$ ),  $F(1, 38) = 4.29$ ,  $p < .05$ . Thus, participants who refrained from eating a tempting food (donut) showed an inability to refrain from behaving aggressively toward a person who had insulted them compared to participants who had refrained from eating a less tempting food (radish).

To assess anger-related feelings, participants were asked to rate how cruel and threatening they perceived the partner to be, and how angry they felt. Participants made their ratings from 1 (not at all) to 10 (extremely). The three items had good internal reliability (Cronbach’s  $\alpha = .71$ ) and were summed to create an anger-feelings index. A one-way ANOVA was conducted using scores on the 3-item index as the dependent measure. Depleted participants ( $M = 5.24$ ,  $SD = 2.33$ ) did not report significantly greater anger compared to non-depleted participants ( $M = 4.67$ ,  $SD = 2.28$ ),  $F < 1$ , *ns*. Thus, increased aggressiveness among depleted participants was not due to differences in reported anger.

Experiment 1 provided initial evidence that self-regulatory depletion impairs the inhibition of aggression impulses. Participants whose self-regulatory resources were depleted by resisting the temptation to eat a donut responded to an insult with significantly greater aggression

than participants who had not previously exerted self-control. The effect of self-regulatory depletion on aggressive behavior was not due to differences in reported anger.

One important limitation of this study is that all participants received an insulting provocation. Such provocations are strong and reliable predictors of aggression (e.g., Cowie, Naylor, Smith, Rivers, & Pereira, 2002). In fact, Anderson and Bushman (2002, pp. 37) speculated that “the most important single cause of human aggression is interpersonal provocation.” The fact that ego depletion moderated the impact of this common and important kind of provocation on subsequent (retaliatory) aggression attests to the importance of self-regulation in restraining aggression. However, the fact that all participants were insulted leaves room for alternative explanations. In particular, it is conceivable that the ego depletion manipulation itself fueled aggressive impulses, such as by creating frustration among participants who wanted to eat the donuts but had to refrain from doing so. This same question plagued the studies by Stucke and Baumeister (in press). To be sure, one advantage of the present study over those by Stucke and Baumeister is that the aggression was now directed at a new target rather than at the experimenter who had delivered the depletion manipulation. But it is still possible that resentment toward the experimenter over the donut episode could have fueled aggression toward the confederate, whether by excitation transfer (e.g., Zillmann, Katcher, & Milavsky, 1972; Zillmann, 1983), or by aggressive displacement (Marcus-Newhall, Pedersen, Carlson, & Miller, 2000; Pedersen, Gonzales, & Miller, 2000). Hence it was desirable to add a no-provocation control condition to Experiment 2.

## Experiment 2

Our theoretical model held that the provocation (the insult) gave rise to aggressive impulses to retaliate, and that some people restrained these impulses, whereas depleted participants were less able or willing to restrain them. Experiment 1 provided evidence fitting that view but could not rule out the alternative hypothesis that the aggressive impulses arose directly from the ego depletion manipulation itself. To investigate this alternative explanation, Experiment 2 added a no-insult control condition. We reasoned that in the absence of provocation, aggressive impulses would not be stimulated, and so ego depletion would not lead to higher levels of aggression. But if the depletion manipulation itself stimulated aggressive impulses, then aggressive responses would be observed even in the no-insult condition.

Another change for Experiment 2 involved administering measures of mood and frustration directly after the manipulation of self-regulatory depletion, instead of after the aggression measure. This too was designed to explore the possibility that negative affect and frustration were stimulated by the depletion manipulation and contributed to the aggressive responding. In Experiment 1, the measure of anger-related feelings was taken after the aggression

measure, and it is conceivable that the process of doling out the hot sauce counteracted bad feelings arising from the depletion manipulation. Perhaps it was gratifying to think that one’s provoker would have to swallow unpleasant hot sauce, or perhaps the hot sauce procedure came across as enjoyable mischief. Moving the mood measure earlier in the experimental procedure therefore allowed us to test whether negative feelings arose in response to the depletion manipulation, even if they would have been dissipated by subsequent events.

To increase generality, we also used an alternate manipulation of self-regulatory depletion. For this, we adapted a procedure from Gilbert, Krull, and Pelham (1988). Participants watched a videotape (without audio) of a woman being interviewed by an off-camera interviewer. During the interview, a series of neutral words that were irrelevant to the interview were presented at the bottom of the screen for 10 sec each. In the attention-regulate (depletion) condition, participants were instructed to direct their gaze away from the words at the bottom of the screen and to focus exclusively on the woman being interviewed. Other participants were not given any specific video-watching instructions. Gilbert et al. (1988) proposed that most participants focus attention on the woman anyhow, but those given the attention-regulation instructions devote a significant amount of conscious effort to directing their attention away from the words. We predicted that this procedure would cause ego depletion and therefore lead to greater aggression among insulted participants—but not among those who were not provoked.

## Method

### Participants

Fifty-three undergraduates (39 women) participated in this study in exchange for partial course credit. Three additional participants were discarded from all analyses due to suspicion about the essay evaluation feedback.

### Materials and procedure

Participants arrived at the laboratory individually for a study ostensibly investigating impression formation processes. Participants were instructed that they would be paired with a same-sex participant with whom they would play a reaction time game and to whom they would provide a writing sample. After giving informed consent, participants were given a sheet of paper and were instructed to write a short essay regarding their position on abortion.

After approximately 5 min, participants then viewed a 6-min videotape (without audio) that depicted a woman being interviewed by an interviewer located off-camera. In addition to the women being interviewed, a series of common one-syllable words (e.g., tree) appeared at the bottom of the screen for 10 s each (video clip is available for download at the web address: [http://www.psy.fsu.edu/~dewall/attention\\_control.htm](http://www.psy.fsu.edu/~dewall/attention_control.htm)). The words were printed in black ink and were presented on a white background. By random

assignment, half of the participants were assigned to the depletion condition, whereas the other half of participants were assigned to the no depletion condition. For participants assigned to the depletion condition, the experimenter instructed participants “not to read or look at any words that may appear on the screen.” The experimenter reiterated the importance of not looking at the words presented on the bottom of the screen by instructing participants to redirect their gaze immediately if they caught themselves looking at the words instead of the woman’s face. Participants in the no depletion condition, in contrast, were not given any specific instructions for watching the video clip and were not given advance knowledge that there would be words at the bottom of the screen.

After participants had finished watching the video clip, participants completed the PANAS (Watson, Clark, & Tellegen, 1988). Embedded in the PANAS were additional items assessing anger (i.e., *hostile*, *angry*) and frustration (i.e., *frustrated*, *distressed*). These four items had good internal reliability (Cronbach’s  $\alpha = .88$ ) and responses were averaged to create a frustration-anger index. Scores on the frustration-anger index ranged from 1 to 7, with higher scores representing higher levels of frustration and anger.

When participants had finished the mood measure, the experimenter returned with the essay evaluation sheet ostensibly from his or her partner. Half of the participants received negative essay feedback (e.g., “This is one of the worst essays I’ve ever read”), whereas the rest of the participants received a positive essay evaluation (e.g., “Excellent essay! No comments”). Participants then began the computer game, which was described as a competitive reaction game they would play against the partner. Although participants believed they would be playing against their partner, the computer was actually programmed to mimic a person’s responses. The experimenter explained that participants would have to press a button as quickly as possible on a series of trials, and that whoever responded slower on a given trial would hear a blast of white noise. Each participant was asked to assign an appropriate length (determined by the duration the participant held down the mouse button on a particular icon) and volume (a level ranging from 0 to 10) of white noise to be blasted over the headphones of their partner on each trial. Thus, participants were given control of a weapon that could inflict harm on another person by blasting him or her with aversive blasts of white noise if the participant won the competition to react faster.

A Macintosh computer controlled the events in the reaction time task and recorded the duration and volume that participants administered for each of 25 trials. Previous research has shown that the first trial provides the best measure of unprovoked aggression because participants have not yet received aversive blasts of white noise from their opponents (Bushman & Baumeister, 1998; Twenge, Baumeister, Tice, & Stucke, 2001). The noise intensity and duration levels from the first trial were therefore used here as the measure of aggression. The two variables (intensity

and duration) were converted to  $z$ -scores and summed to serve as a composite measure of aggression. After completing the computer game, participants were thanked and debriefed.

## Results and discussion

### Manipulation checks

Participants were asked to rate (a) the degree to which they had to control their attention in order to follow the instructions for watching the video clip and (b) how difficult it was to follow the instructions for watching the video clip. Results indicated that participants in the depletion condition ( $M = 6.15$ ,  $SD = 2.51$ ) reported having controlled their attention to a greater extent than no depletion participants ( $M = 3.33$ ,  $SD = 1.94$ ),  $F(1, 51) = 21.04$ ,  $p < .001$ . Attention-regulation (depletion) participants ( $M = 4.08$ ,  $SD = 2.08$ ) also rated the video-watching task as significantly more difficult than no depletion participants ( $M = 2.85$ ,  $SD = 1.85$ ),  $F(1, 51) = 5.14$ ,  $p < .03$ . These findings suggest that the self-regulatory depletion manipulation was successful in altering the degree to which participants exerted self-control.

### Aggressive behavior

The main prediction of Experiment 2 was that depleted participants would respond aggressively when the urge to aggress was strong (i.e., after being insulted)—but not in the absence of an esteem-threatening provocation. Consistent with that prediction, participants who experienced self-regulatory depletion and received an esteem-threatening insult responded significantly more aggressively than participants in all other conditions. Results from a 2 (depletion: depletion vs. no depletion)  $\times$  2 (provocation: insult vs. praise) ANOVA revealed a main effect of provocation condition,  $F(1, 51) = 5.04$ ,  $p < .03$ , and a significant depletion  $\times$  provocation interaction,  $F(1, 51) = 6.03$ ,  $p < .02$ . The results are shown in Fig. 1.

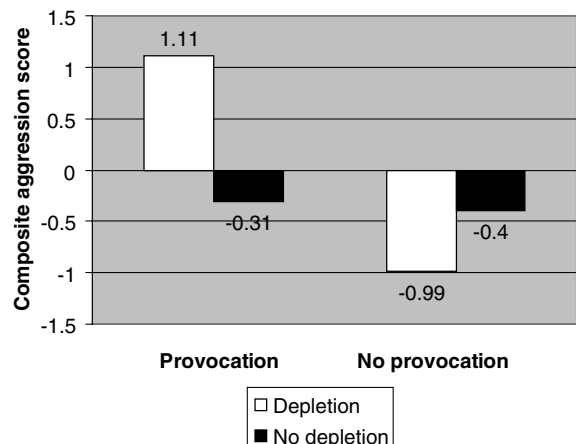


Fig. 1. Interactive effect of self-regulatory depletion and provocation on aggression. Experiment 2. Note. Values represent mean composite aggression scores. Higher values indicate more aggressive responses.

The results from the insult/provocation condition replicated the findings of Experiment 1, indicating that depleted participants (i.e., those who had performed the task under attention-regulate instructions) were more aggressive than those who had not engaged in self-regulation,  $F(1,51) = 5.87, p = .02$ . This replication is noteworthy because this study used a different manipulation of depletion and a different measure of aggression.

The main effect for depletion condition was not significant,  $F < 1, ns$ . Clearly, in this study, the depletion manipulation did not directly lead to any increase in aggression. Furthermore, the higher aggression among depleted participants was not found in the absence of provocation. Participants who received praise rather than criticism showed a nonsignificant trend in the opposite direction (i.e., toward lower aggression among depleted participants),  $F(1,51) = 2.91, p < .11$ . This speaks strongly against the alternative explanation that the manipulation of ego depletion directly increased aggression, such as by engendering frustration or resentment. Instead, the results fit the view that the insult provokes an aggressive impulse, and depleted self-regulatory strength permits the impulse to result in aggressive behavior.

#### *Mood and frustration*

To ensure that increases in aggression were not due to fluctuations in emotion, frustration, or anger, we conducted three one-way ANOVAs using the positive affect (PA) and negative affect (NA) subscales of the PANAS (Watson et al., 1988) and scores on the frustration-anger index as dependent measures. In terms of negative affect, depleted participants ( $M = 1.40, SD = .46$ ) did not differ significantly from non-depleted participants ( $M = 1.32, SD = .46$ ),  $F < 1, ns$ . For positive affect, the difference between depleted participants ( $M = 2.19, SD = .68$ ) and non-depleted participants ( $M = 2.62, SD = .94$ ) was also not significant, although it approached that level,  $F(1,51) = 3.56, p = .07$ . Most important, the frustration-anger index did not yield any difference between depleted ( $M = 1.24, SD = .56$ ) and non-depleted participants ( $M = 1.26, SD = .54$ ),  $F < 1, ns$ . Taken together, these findings speak against any interpretation that the depletion manipulation itself led to angry, frustrated, or negative mood states that could have directly caused (or even indirectly fueled) an increase in aggression.

### **Experiment 3**

Our general hypothesis was that people have a limited ability to refrain from aggressive behaviors, and the first two studies provided support for it. Experiment 3 sought to replicate and extend the findings of Experiments 1 and 2 using different measures and procedures. Experiment 1 manipulated self-regulatory depletion by having some participants refrain from eating a tempting food. In Experiment 2, the depletion manipulation involved having some participants control their attention while watching a video clip. In Experiment 3, participants completed the Stroop task (Stroop, 1935). The Stroop task requires participants to override their

natural inclination to read a word, so that they can say the color of ink in which the word is printed (e.g., the word *green* printed in red ink). In Experiment 3, participants in the depletion condition were required to read aloud the color of ink that was incongruent to the semantic meaning of the word. Participants in the no depletion condition, in contrast, simply read aloud the names of words printed in black ink.

An additional methodological variation in Experiment 3 was the use of an alternate measure of aggression. Participants were given the opportunity to thwart another person's opportunity for obtaining a competitive research assistantship by providing a negative candidate evaluation. Several previous studies have used job-relevant evaluations to measure aggression (Kulik & Brown, 1979; Ohbuchi, Kameda, & Agarie, 1989; O'Neal & Taylor, 1989; Twenge et al., 2001). If self-regulatory depletion causes aggression in the wake of provocation, then participants who exert self-control and are exposed to a provocation should give the most negative job candidate evaluations.

#### *Method*

##### *Participants*

Fifty-one undergraduates (31 women) participated in this study in exchange for partial course credit or extra credit. Four participants were excluded from all analyses, three due to suspicion about the existence of a discussion partner and one due to prior knowledge of the experimental hypotheses.

##### *Materials and procedure*

Participants arrived at the laboratory individually for a study ostensibly concerning the processes involved in impressions formation. Participants were led to believe that they would be interacting with a same-sex participant and would communicate with this partner before they met. This initial separation of the two alleged discussion partners would ostensibly aid the researchers in understanding how initial limitations on first-meeting situations might influence impression formation processes. The experimenter informed participants that the partner had arrived early and was working with another experimenter down the hallway. Because the partner had arrived early, she or he had already completed the initial video message for his or her partner. Participants were then given a videotape ostensibly made by the partner and the questions that the partner was asked during the brief videotaped interview. The experimenter explained that the participant would watch the partner's video message and then make a video response to the partner. Participants were told that their partner had been instructed to look directly into the camera as though he or she was speaking directly to the participant. The experimenter left the room while the participant viewed the videotaped message.

After approximately 5 min, the experimenter returned and informed the participant that he or she would now make a video response to the partner. To become

accustomed to talking comfortably while being videotaped, participants were allowed to make a brief warm-up recording in which they stated their hometown and major area of study. Participants were then informed that their video response would involve them responding to the same set of questions that their partner had been asked on the videotaped message they had just watched. The experimenter then recorded the participant's responses to those questions (e.g., "What personal qualities are important to how you see yourself?"). After completing the interview, the experimenter left the participant's room ostensibly to take the participant's video for his or her partner to watch. The experimenter explained that it would take a few minutes for the partner to watch the videotape response, and so the participant would complete a brief reading task while their partner watched the videotape.

Participants were then exposed to the self-regulatory depletion manipulation. By random assignment, half of the participants were assigned to the depletion condition, whereas the other half of the participants were assigned to the no depletion condition. All participants received a sheet of paper on which a series of words ("yellow," "red," "green," and "blue") were printed. For participants assigned to the depletion condition, the words were printed in a color of ink that was incongruent to their semantic meaning. These participants were instructed to read aloud the color of ink in which each word was printed as quickly and with as little error possible. For participants assigned to no depletion condition, the words were printed in black ink and they were instructed to read aloud the name of the words as quickly and accurately as possible. Thus, participants in the depletion condition were required to inhibit the incipient tendency to read a color word and to replace this response by naming the font-color in which the word was printed. All participants performed the reading task for 5 min.

After participants had completed the reading task, the experimenter left the room to obtain the interview evaluation sheet the partner had filled out. Participants were told that they would be given the opportunity to complete the same interview evaluation sheet for their partner later in the experiment. The experimenter then returned and handed participants the interview evaluation sheet ostensibly completed by the partner. By random assignment, half of the participants were given a positive interview evaluation in which they received positive ratings on items such as "positive demeanor during interview," "friendly," and "seems comfortable on camera." There was also a handwritten comment stating, "No comments. Excellent interview!" The other half of the participants, in contrast, received a negative interview evaluation in which they received negative ratings on the same set of items and a handwritten comment stating, "This is one of the worst interviews I've ever seen!" The experimenter left the room to allow participants to read the interview evaluation sheet and retrieve materials from the partner.

When the experimenter returned, the experimenter explained that the partner had applied for a research assis-

tantship position in the Department of Psychology. Because the research assistant position was competitive, the partner was trying to obtain evaluations from people who had come into contact with him or her. Participants were then given a candidate evaluation form that contained the Department of Psychology letterhead and an envelope that contained the Department of Psychology address. Participants rated the candidate from 1 (strongly disagree) to 10 (strongly agree) on 12 separate statements (e.g., "The applicant would be a dependable employee"). The internal reliability of the 12 statements was excellent (Cronbach's  $\alpha = .97$ ) and so responses were summed to create an index of aggressive responding. As each item was phrased in a positive manner, higher scores indicated a positive evaluation of the job candidate and a low expression of aggression. A low score, in contrast, indicated a negative evaluation of the job candidate and a high expression of aggression. When participants had completed the evaluation form, they placed it in an envelope that had the Department of Psychology letterhead, sealed it, and gave it to the experimenter.

Participants were then told that there would not be an interaction with the partner and were fully debriefed. After the participant understood the true nature of the study, participants were dismissed.

## *Results and discussion*

### *Aggressive responding*

Does self-regulatory depletion lead to aggressive responses to provocation? As predicted, depleted participants who had been insulted behaved more aggressively than participants in the other conditions. Results from a 2 (depletion vs. no depletion)  $\times$  2 (provocation vs. no provocation) ANOVA revealed significant main effects for depletion condition,  $F(1,47) = 7.27$ ,  $p = .01$ , and provocation condition on aggression,  $F(1,47) = 39.32$ ,  $p < .001$ , indicating greater aggression among provoked and depleted participants, respectively. These main effects were qualified, however, by the predicted depletion  $\times$  provocation interaction,  $F(1,47) = 5.06$ ,  $p < .03$  (see Fig. 2).

Results from the insult/provocation condition replicated the findings from Experiments 1 and 2, showing that depleted participants (i.e., those who had completed the incongruent color version of the Stroop task) were more aggressive than participants who had not previously exerted self-control,  $F(1,47) = 10.90$ ,  $p = .003$ . These findings replicate the findings of Experiments 1 and 2, using a different manipulation of self-regulatory depletion and an alternate measure of aggression.

As in Experiment 3, the higher level of aggression among depleted participants was not found in the absence of provocation. Depleted participants who received a positive interview evaluation did not differ in their candidate evaluations from no depletion participants who also received a positive evaluation,  $F < 1$ , *ns*. This finding further contradicts the alternative explanation that the depletion manipulation itself caused aggression by means of producing



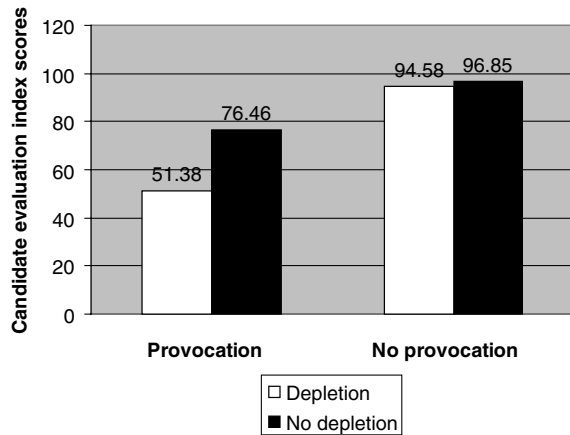


Fig. 2. Interactive effect of self-regulatory depletion and provocation on aggressive responding. Experiment 3. *Note.* Values represent mean scores on the candidate evaluation index. Lower values indicate more aggressive responses.

frustration or resentment, despite the main effect of depletion on aggression. Apparently, the main effect of depletion was due almost entirely to the provocation condition.

The results suggest that the provocation manipulation incited an aggressive impulse that required self-regulatory strength to be restrained. When self-regulatory strength had been depleted, participants were less likely to resist the aggressive impulse and hence more likely to behave in an aggressive manner.

#### Mood and frustration

To test whether the increases in aggression were the result of mood and frustration on the part of depleted participants, we conducted three one-way ANOVAs using scores on the positive affect (PA), negative affect (NA), and frustration-anger index as dependent measures. Results indicated that depleted participants did not differ from no depletion participants in terms of their positive or negative affect, both  $F_s < 1$ , *ns*. In addition, depleted participants ( $M = 5.08$ ,  $SD = 1.47$ ) did not report more frustration-anger than no depletion participants ( $M = 4.69$ ,  $SD = .88$ ),  $F(1,49) = 1.32$ ,  $p = .26$ . These findings speak strongly against the alternative explanation that the depletion manipulation led to increases in negative affect and frustration, which in turn caused depleted participants to behave aggressively. Thus, depletion caused participants who had been insulted to behave more aggressively compared to participants in the other three conditions and this increased aggression was not due to differences in reported negative affect, frustration, or anger.

#### Experiment 4

Experiment 4 sought to strengthen the conclusions of the first three studies in several ways. First, instead of measuring aggression using the artificial behavior paradigms of the laboratory, we sought to assess aggressive intentions using a hypothetical scenario that more closely resembles

some settings that elicit violence in everyday life. In particular, we used a scenario involving romantic jealousy and physical provocation in a bar setting.

A second refinement was the inclusion of an individual difference measure of trait self-control. People who habitually have and exercise good self-control should seemingly have greater inner resources of whatever strength is necessary, so that they do not necessarily yield to all impulses and temptations as soon as their resources have been slightly depleted. Hence we predicted that the effects of self-regulatory depletion should be stronger on people with low trait self-control than on those with high trait self-control. More precisely, we predicted higher levels of aggression among depleted participants with low self-control scores, as compared to other groups.

To increase methodological pluralism and rule out alternative explanations, Experiment 4 used a different manipulation of self-regulatory depletion than those used in Experiments 1–3. For this, we had participants complete an exercise in which some of them had to break a habitual behavioral pattern (borrowed from Baumeister et al., 1998). All participants were presented with a text and were instructed to cross out all instances of the letter *e* until they had identified each instance. Such a task can be learned easily, and people become quickly accustomed to scanning the text for all instances of the letter *e*. This was intended to create a strong behavioral habit of marking every “e” as soon as one spotted it. Participants were then presented with a second text and, depending on condition, were given revised or identical instructions for completing the task. In the control condition, the second task had exactly the same instructions as the first (so people could just continue with their now-habitual response pattern), whereas in the depletion condition the second task added the further rules involving not marking the “e” if there were other vowels nearby (so they often would have to override their habitual tendency to mark every *e*). Thus, the depletion condition required participants first to form a habit and then to break it. Breaking habits by overriding incipient responses is one common and important form of self-regulation.

#### Method

##### Participants

Ninety-seven undergraduates (78 women) participated in this study in exchange for partial course credit. Prior to participation, participants completed brief version of the Trait Self-Control Scale-short version (Tangney et al., 2004) as part of a battery of tests administered in mass-testing sessions at the beginning of the semester.

##### Materials and procedure

Participants arrived at a large classroom in groups of 10–20 for an experiment ostensibly investigating attitudes, behaviors, and task performance. After giving informed consent, participants were given a questionnaire packet that contained the independent and dependent variables.

Participants first completed questionnaires as part of another experiment and then were given instructions for the experimental task, which involved crossing out all instances of the letter *e* on a piece of printed text. The text was taken from an article on neuropsychological assessment and was used to minimize participants' inherent engagement in the content of the text itself; rather, we wanted participants to be concentrating fully on completing the task.

Participants were first asked to cross out all instances of the letter *e* on the piece of paper. There were 337 instances of the letter *e* that appeared on this page, and thus participants' behaviors regarding crossing out "e"s were well-ingrained at the end of the practice task. Following the practice task, participants in the no depletion condition were given a new sheet of paper with text from the same neuropsychological article and were told to continue with the task of crossing out all instances of the letter *e*. Participants in the depletion condition, however, were given new instructions. Faced with the same sheet of text as was used in the no-depletion control condition, participants in the depletion condition were asked to change their behaviors in accordance with new rules. Participants were now asked to cross out all instances of the letter *e* except for "e"s that were followed by a vowel or "e"s that appeared in a word with a vowel appearing two letters before the "e." Depletion participants were then given examples of the new rules, in which the word "take," for example, would *not* have the *e* crossed out (because the "a" appeared two letters before it), whereas the word "behavior" would have the *e* crossed out because it conformed to the general rule.

Participants then responded to a series of scenarios intended to assess how people behave under various circumstances. Participants were instructed to imagine that they were actually present in the scenario and to respond with how they felt they would respond at that very moment to the situation depicted in the scenario. The scenario relevant to the current investigation described an event that involved a threat to relationship security and an opportunity to physically aggress toward the issuer of the perceived insult. The scenario read (in part):

You are at a bar with your boyfriend/girlfriend. You are absolutely in love with your boyfriend/girlfriend and you get very excited every time you see him/her or even think about him/her. At the bar, the two of you are talking, having a couple drinks, and really enjoying yourselves, as usual. You notice another person (of the same sex) eyeing up your boyfriend/girlfriend. To your surprise, this person walks up to the two of you and starts flirting with your boyfriend/girlfriend. Obviously, this gets you very upset, but even more upsetting is that your boyfriend/girlfriend is flirting back and really seems to be enjoying it.

Not knowing what you to, you stand up and confront the person. Shockingly, the person doesn't even respond but instead shoves you violently into the bar. Even

worse, your boyfriend/girlfriend doesn't even try to help you. You are extremely angry and feel extreme hatred toward this other person. As a quick thought, you see a beer bottle on the counter and think about smashing it over the person's head.

Participants then responded to the question "How likely would you be to smash the bottle on the person's head?" Participants rated the extent to which they would smash the bottle on the person's head from -100 (not at all likely) to 100 (extremely likely), with 0 (neither likely nor unlikely) at the midpoint. Higher scores therefore indicated greater intention to aggress toward the issuer of the insult.

After reading and responding to each of the scenarios, participants were fully debriefed, given partial course credit, thanked for their time, and dismissed.

## *Results and discussion*

### *Manipulation checks*

As a manipulation check to ensure that depleted participants perceived the second crossing out the "e"s task as more difficult than no depletion participants, we compared participants' ratings of how difficult the second crossing out the "e"s task was. Participants in the depletion condition (i.e., the ones who had to break the habit of marking every "e") reported that the second task was significantly more difficult compared to no depletion participants,  $t(1,95) = 5.68, p < .001$ . Thus, the manipulation was successful in exposing depletion participants to a task that was significantly more difficult and resource-depleting than the task in the no depletion condition.

### *Aggressive intention*

The main dependent measure was to what degree participants expressed an intention to respond aggressively in response to an ego threatening insult. As predicted, participants in the depletion condition expressed greater intentions of responding aggressively toward the issuer of the insult, as compared to no-depletion control condition. Results revealed a significant main effect for depletion, such that depleted participants expressed greater intentions of smashing the bottle over the head of the issuer of the insult compared to no-depletion participants,  $t(95) = 2.54, p = .01$ . This effect replicates the pattern shown in the first three studies. It adds that the effect can be found not only in measured laboratory responses but in consciously imagined hypothetical responses to a non-laboratory scenario of the sort that lead to aggressive activity in everyday life.

### *Moderating effect of trait self-control*

A further important goal of Experiment 4 was to test for possible moderation by trait self-control. A regression analysis was conducted to predict willingness to aggress from depletion condition, trait self-control scores, and their

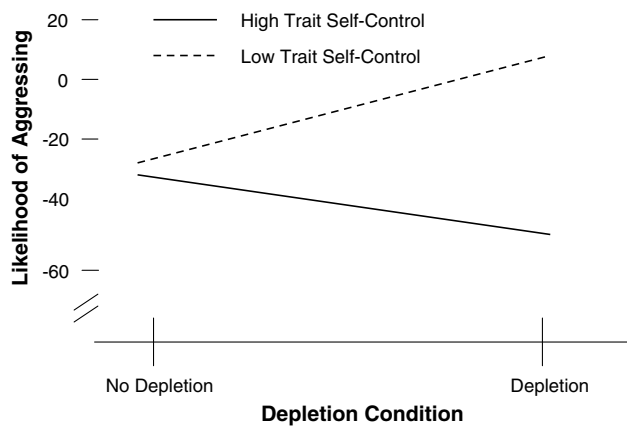


Fig. 3. Interactive effect of trait self-control and self-regulatory depletion on aggressive intention. Experiment 4.

interaction. Results indicated a significant depletion condition  $\times$  trait self-control interaction,  $\beta = -1.42$ ,  $p = .02$ . To explore this interaction, we tested the simple effect of depletion among participants who scored relatively high and low in trait self-control (1 *SD* above and below the mean; Aiken & West, 1991). Results indicated that among participants who were relatively low in trait self-control, self-regulatory depletion led to an increased level of intention to aggress,  $b = 44.81$ ,  $p = .01$ . Among participants who were relatively high in trait self-control, in contrast, self-regulatory depletion did not lead to an increased level of intentions to inflict physical harm toward the issuer of the perceived insult,  $b = -16.75$ ,  $p = .37$ . The findings are presented in Fig. 3. Thus, self-regulatory depletion led participants to express greater intentions of behaving aggressively, and this effect occurred primarily among participants low in trait self-control.

## Experiment 5

The fifth and final experiment was intended to provide another form of converging evidence, using autobiographical narratives. We asked participants to describe incidents from their own lives in which they had versus had not succeeded at restraining their aggressive impulses. They were then asked to describe their mental state at the time, using a state measure designed to assess self-regulatory depletion (Twenge, Muraven, & Tice, 2004). The scale has been shown to correlate significantly with health problems, sleep deprivation, and conflicts in personal relationships. Laboratory manipulations designed to deplete self-control capacity result in significant reductions in scores on the state measure providing some evidence of the scale's validity (Twenge et al., 2004). If a state of depleted self-regulatory resources does indeed increase the likelihood of uncontrolled aggressive outbursts, then people should report that they were in such a state more consistently when describing their failures to restrain aggression than when describing their successful acts of restraint.

## Method

### Participants

One hundred thirty-seven undergraduates (87 women) participated in this study in exchange for partial course credit.

### Materials and procedure

Participants came to a large classroom in groups of 10–20 for a study investigating factors that contribute to aggressive restraint. After giving informed consent, participants were instructed that they would write about two experiences that they had and complete a few questions aimed at measuring how they responded to the situations. Participants described one instance when they were able to control their aggressive urges and one instance when they were unable to control their aggressive urges. To be certain that participants understood what we meant by controlling aggressive urges, additional instructions were included that included a definition of aggressive restraint. For the successful aggressive restraint essay, participants were instructed to “write about a time you wanted to or knew that you should refrain from acting aggressively and you successfully controlled your urges so that you did not act aggressively.” The instructions for the unsuccessful aggressive restraint essay were identical except participants were instructed to write about a time when “you wanted to or knew that you should refrain from acting aggressively but did not.” To prevent any possible ordering effects, the sequence in which participants recalled successful and unsuccessful attempts at restraining their aggression was counterbalanced.

After completing each essay, participants completed a modified version of the State Depletion Scale (Twenge et al., 2004) that assessed self-regulatory depletion. They were instructed to fill it out as to their feelings and circumstances immediately before the incident about which they had written. High scores on this state measure indicate that the self's executive function is not felt to be up to its normal capacity. Sample items include “I felt mentally exhausted,” “I had been exerting a lot of ‘willpower’ in my life,” “I had been dieting,” and “My mental energy was running low.” Participants responded to each of the 10 items using a scale that ranged from 1 (strongly disagree) to 11 (strongly agree). The scale was internally reliable (Cronbach's  $\alpha = .89$ ) and responses were summed to create a state depletion index. After participants had described both incidents and completed all additional information, participants were debriefed, given partial course credit, thanked, and dismissed.

### Results and discussion

#### Self-regulatory depletion and aggressive responding

To test the hypothesis that people tend to be more depleted immediately preceding unsuccessful attempts at aggressive restraint compared to successful attempts at aggressive restraint, we conducted a paired samples *t* test

on state depletion index scores for each incident. As predicted, participants reported significant greater self-regulatory depletion preceding an unsuccessful attempt at restraining aggressive behavior compared to a successful attempt at restraining aggressive behavior,  $t(136)=2.73$ ,  $p=.007$ . Thus, participants reported feeling that the self's executive function was not at its full capacity directly preceding an unsuccessful attempt at restraining aggressive behavior significantly more than before a successful attempt at restraining aggressive behavior.

Autobiographical narrative accounts have both benefits and drawbacks as research tools. It would be rash to conclude from this study alone that self-regulatory depletion leads to increased aggression (which is why we presented it last). It is possible that participants viewed the State Depletion scale as an opportunity to make excuses for their past failure to control their aggressive impulses. It is also possible that people assimilated their memories to a priori theories linking depleted self-regulatory resources to failure to control aggressive outbursts. Ross (1989) has documented that people's memories are often assimilated to such theories. Both of these could have contributed to the present results, although we would have thought that if participants simply used the scale as an exercise in excuse-making, the results would have been much stronger and more dramatic. Still, these possible sources of memory bias mean that these results do not unambiguously support our hypothesis about ego depletion and aggression.

In fact, one might have expected the opposite based on a simple consistency or priming process. That is, describing successful self-control might have prompted people to describe other, recent episodes of successful self-control, and in the same vein they might have responded to the failed self-control story by thinking of other recent incidents of lacking self-control. The fact that we found results opposite to these well-replicated patterns of consistency and concept activation lends confidence to the interpretation that failures to restrain aggression really do stem from depletion caused by prior self-regulation.

Moreover, even if the results were partly or even wholly produced by such sources of memory and narrative bias as a priori theories or excuse-making, they would still be relevant to the present investigation. Both the excuse-making and the a priori theory explanations assume that people have a basic belief that depletion of self-regulatory resources contributes to increased aggressive responding, and this belief itself would be valuable converging evidence (at least when combined with Experiments 1–4) that the depleted state is a risk factor for aggression.

Thus, the results of Experiment 5 confirm that the link between ego depletion and unrestrained aggression exists in people's everyday lives, or at least insofar as those lives are revealed by their accounts of personal experiences.

## General discussion

Aggression remains a major problem for humankind. It also has been a challenge of perennial interest to social psy-

chologists, whose largely benign view of people as information-seeking and approval-seeking individuals who mainly need to belong and want to maintain self-esteem sometimes clashes with the ugly reality of interpersonal violence. Decades of thought and experimentation by leading social psychologists have shed light into root causes and processes that produce aggression (e.g., Anderson & Bushman, 2002; Baumeister, 1997; Berkowitz, 1990; Geen, 1990; Staub, 1989; Sternberg, 2005).

The present research focused away from basic root causes of aggression and on to what may be one of the last inner events in the chain of causation. Our view is that many factors give rise to aggressive impulses but that most such impulses are blocked by strong inner restraints, and that indeed the operation of these restraints against aggression is one key to civilized human life. Failure of these inner restraints may therefore be a common proximal cause of aggression, (almost) regardless of the root causes. Such restraints, in the form of self-regulation, are however not costless, and in fact they may require an expenditure of psychological energy powerful enough to stop an angry person from an act of violence (such as smashing a beer bottle over the head of an offensive romantic rival, as in Experiment 4). Our reasoning was that these restraints depend on a common resource that can sometimes be found to be lacking, especially when prior events have depleted the person's supply. Under such circumstances, the aggressive impulses may result in more violent action than they would otherwise. In other words, the same person having the same aggressive impulse in response to the same provocation may or may not behave aggressively, as a function of prior, seemingly irrelevant acts of self-regulation.

The present series of studies used a variety of procedures to test the hypothesis that ego depletion, caused by prior efforts at self-regulation, would weaken inner restraints and thereby increase the chances that aggressive impulses would lead to aggressive behavior. All five studies found higher levels of aggression among people who had previously engaged in self-regulation than in those who had not had prior demands for self-regulation.

Crucially, however, Experiments 2 and 3 rejected the alternative view that ego depletion itself leads to increased aggression, because those studies also varied the instigation for aggressive impulses. When no aggressive impulses were stimulated—because the other person praised rather than criticized the participant's performance—depletion did not produce any hint of increase in aggression. (Indeed, that condition yielded a nonsignificant trend in the opposite direction in Experiment 2.) These differences support the view that depletion merely removes restraints against aggression, rather than itself giving rise to aggressive impulses. The aggressive impulse has to arise from something else other than the depleted state or its attendant circumstances.

This investigation took seriously the goal of providing multimethod converging evidence. Because there is no single, unambiguous indication of ego depletion, we used a

variety of procedures to provide converging evidence. Experiments 1–4 used four different manipulations of ego depletion, and the fifth relied on a self-report state measure. The relevance of self-regulation is also indicated by the fact that trait differences in self-control moderated the effect (in Experiment 4). Likewise, we used different measures of aggression, including the noise blasting paradigm, making someone eat unwanted hot sauce, thwarting another person's opportunity for a competitive position by providing a negative candidate evaluation, hypothetically being willing to smash a beer bottle on someone's head, and, in the narrative study, any pair of aggressive inclinations the person recalled from his or her life. The present series of studies supported the hypothesis in widely different contexts, including carefully controlled laboratory situations, hypothetical responses to a vividly imagined scenario, and autobiographical narratives remembered from personal experiences. The convergence across multiple methods is intended to be more illuminating than any single study can be.

#### *Limitations and alternative explanations*

Several alternative explanations for certain of our findings warrant consideration. A first alternative explanation, which was anticipated at the outset of the current studies, is that exerting self-control is an inherently difficult and occasionally frustrating activity, which might lead depleted participants to behave aggressively. This view is certainly plausible, and much previous research has shown that both frustration and negative affect exert a strong influence in shaping aggressive behavior (Berkowitz, 1990; Dill & Anderson, 1995; Geen, 1968). The results of Experiments 2 and 3, however, speak against it. The depletion manipulation alone did not lead to higher aggression in the absence of some external provocation, namely an insulting evaluation. Moreover, self-report data in multiple studies failed to link anger, frustration, or other negative affective responses to the depletion manipulation.

A second, and related, explanation for the current results is that depleted participants behaved aggressively out of a need to improve their mood. Previous research has shown that people behave aggressively when they believe such behavior will improve their current emotional states (Bushman, Baumeister, & Phillips, 2001), though those beliefs and expectations may be wrong. If aggression in the present studies were motivated by mood repair goals, depleted participants should behave aggressively to the extent that they believe such action will improve their mood. The results of Experiments 1–3 contradict this explanation. In those studies, depleted participants behaved aggressively but did not report moods or levels of frustration and anger that differed from non-depleted participants. If depleted participants had reported moods that were more negative than non-depleted participants, it would have been plausible that their aggression could be attributed to affect regulation goals. But their moods did not show signs of negativity or

frustration, and so it seems unlikely that they sought to repair them.

One might also question whether restraining aggression involves self-regulation. Some readers might think that violent action is sometimes appropriate and desirable, so people would not seek to restrain it. In our view, the present results cannot easily be interpreted without accepting the highly plausible assumption that most participants believed they should generally restrain their aggressive impulses. People are taught from an early age to restrain their aggressive impulses, and indeed socialization processes exhibit an almost linear trend toward ever greater restraint of aggression, as indicated by the rather startling observations that the most aggressive human beings (as judged by the frequency of resorting to physical aggression) are two-year-old (Tremblay, 2002). Aggression is rarely perceived as the most adaptive response to an insult. In Experiment 4, depleted participants expressed stronger intentions of smashing a bottle of beer over the head of the issuer of a perceived insult compared to participants who had not previously exerted self-control. Responding aggressively may have ensured that the offending person would refrain from making any more sexual advances toward one's significant other, but such behavior would also likely have severe long-term repercussions (e.g., arrest and possible conviction for a violent criminal offense). Moreover, many acts of aggression bring short-term success but long-term costs (Hindelang et al., 1978; McGarrell & Flanagan, 1985; Rand et al., 1983; Reiss, 1976; Suttles, 1968; Turner, 1969), and that sort of intertemporal tradeoff is one important prototypical case of inadequate self-control (dating back to research on delay of gratification; see Mischel, 1974). Hence we think it reasonable to view aggressive responding as generally, though not invariably, reflecting a failure of self-restraint.

#### *Concluding remarks*

The present investigation sought to extend research on self-regulation into the realm of aggression. Self-regulation appears to depend on a limited resource that is depleted when it is used. In such a state, aggression becomes more likely when external events stimulate aggressive impulses.

In our view, the broader implication of the current findings is that people have a limited ability to refrain from aggressive and other antisocial behaviors (as well as a broad assortment of other problematic behaviors). Virtue stems from effort, and such efforts can be costly and are therefore in limited supply. People are normally willing and able to exert control over their aggressive impulses, as doing so is often rewarded with social approbation and the comforts of personal freedom. Self-regulatory depletion hampers this capacity for aggressive restraint, however, and people are rendered temporarily less able to exert control over their aggressive impulses. People who are chronically low in self-control may be particularly vulnerable to

aggressive responding following self-regulatory depletion, whereas people high in self-control appear more resistant to the effects of self-regulatory depletion.

Most research on aggression has investigated what causes or increases it, and social psychologists have identified a great many causes. Their very multiplicity (after all, who has not experienced frustration, media violence, wounded pride, deprivation of comfort, hot temperatures, and more?) indicates the importance of inner restraints, for otherwise frequent aggressive impulses would make violent acts an inevitable, everyday occurrence for most people. There is, however, a positive implication that comes from appreciating the power and importance of self-regulatory restraints in preventing aggression. Even if the root causes of aggression may be difficult to eradicate, aggression can be reduced if we can learn to strengthen people's ability to override aggressive impulses. Although the roots of violence are many, the restraints against them are also often strong and effective.

## References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interaction*. Newburg Park: Sage.
- Anderson, C. A., & Bushman, B. J. (2002). Human aggression. *Annual Review of Psychology*, 53, 27–51.
- Averill, J. (1982). *Anger and aggression: An essay on emotion*. New York: Springer-Verlag.
- Baron, R. A. (1976). The reduction of human aggression: A field study of the influence of incompatible reactions. *Journal of Applied Social Psychology*, 6, 260–274.
- Baron, R. A. (1983). The control of human aggression: An optimistic perspective. *Journal of Social and Clinical Psychology*, 1, 97–119.
- Baron, R. A., & Bell, P. A. (1977). Sexual arousal and aggression by males: Effects of type of erotic stimuli and prior provocation. *Journal of Personality and Social Psychology*, 35, 79–87.
- Baumeister, R. F. (2005). *The cultural animal: Human nature, meaning, and social life*. New York: Oxford University Press.
- Baumeister, R. F. (1997). *Evil: Inside human violence and cruelty*. New York: W.H. Freeman.
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, 74, 1152–1265.
- Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.
- Berkowitz, L. (1990). On the formation and regulation of anger and aggression: A cognitive-neoassociationistic analysis. *American Psychologist*, 45, 494–503.
- Bushman, B. J., & Baumeister, R. F. (1998). Threatened egotism, narcissism, self-esteem, and direct and displaced aggression: Does self-love or self-hate lead to violence? *Journal of Personality and Social Psychology*, 75, 219–229.
- Bushman, B. J., Baumeister, R. F., & Phillips, C. M. (2001). Do people aggress to improve their mood? Catharsis beliefs, affect regulation opportunity, and aggressive responding. *Journal of Personality and Social Psychology*, 81, 17–32.
- Bushman, B. J., & Cooper, H. M. (1990). Alcohol and human aggression: An integrative research review. *Psychological Bulletin*, 107, 341–354.
- Buss, D. M. (2000). *The dangerous passion: Why jealousy is as necessary as love and sex*. New York: The Free Press.
- Caspi, A. (2000). The child is father of the man: Personality continuities from childhood to adulthood. *Journal of Personality and Social Psychology*, 78, 158–172.
- Cherek, D. R., Moeller, F. G., Dougherty, D. M., & Rhoades, H. (1997). Studies of violent and nonviolent male parolees: II. Laboratory and psychometric measurements of impulsivity. *Biological Psychiatry*, 41, 523–529.
- Cochran, J. K., Wood, P. B., Sellers, C. S., Wilkerson, W., & Chamlin, M. B. (1998). Academic dishonesty and low self-control: An empirical test of a general theory of crime. *Deviant Behavior*, 19, 227–255.
- Cowie, H., Naylor, P., Smith, P. K., Rivers, I., & Pereira, B. (2002). Measuring workplace bullying. *Aggression and Violent Behavior*, 7, 35–51.
- Dill, J., & Anderson, C. A. (1995). Effects of justified and unjustified frustration on aggression. *Aggressive Behavior*, 21, 359–369.
- Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression*. New Haven: Yale University Press.
- Gailliot, M. T., Schmeichel, B. J., & Baumeister, R. F. (in press). Self-regulatory processes defend against the threat of death: Effects of self-control depletion and trait self-control on thoughts and fears of dying. *Journal of Personality and Social Psychology*.
- Geen, R. G. (1968). Effects of frustration, attack, and prior training in aggressiveness upon aggressive behavior. *Journal of Personality and Social Psychology*, 9, 316–321.
- Geen, R. G. (1990). *Human aggression*. Pacific Grove, CA: Brooks/Cole.
- Gibbs, J. J., Giever, D., & Martin, J. S. (1998). Parental management and self-control: An empirical test of Gottfredson and Hirschi's general theory. *Journal of Research in Crime & Delinquency*, 35, 40–70.
- Gilbert, D. T., Krull, D. S., & Pelham, B. W. (1988). Of thoughts unspoken: Social inference and the self-regulation of behavior. *Journal of Personality and Social Psychology*, 55, 685–694.
- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford, CA: Stanford University Press.
- Hare, R. D. (1999). *Without conscience: The disturbing world of the psychopaths among us*. New York: Guilford.
- Hindelang, M. J. (1976). *Criminal victimization in eight American cities*. Cambridge, MA: Ballinger.
- Hindelang, M. J., Gottfredson, M. R., & Garofalo, J. (1978). *Victims of personal crime*. Cambridge, MA: Ballinger.
- Kirkpatrick, L. A., Waugh, C. E., Valencia, A., & Webster, G. D. (2002). The functional domain-specificity of self-esteem and the differential prediction of aggression. *Journal of Personality and Social Psychology*, 82, 756–767.
- Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36, 220–232.
- Krueger, R. F., Caspi, A., Moffitt, T. E., White, J., & Stouthamer-Loeber, M. (1996). Delay of gratification, psychopathology, and personality: Is low self-control specific to externalizing problems? *Journal of Personality*, 64, 107–129.
- Kulik, J. A., & Brown, R. (1979). Frustration, attribution of blame, and aggression. *Journal of Experimental Social Psychology*, 15, 183–194.
- Lieberman, J. D., Solomon, S., Greenberg, J., & McGregor, H. A. (1999). A hot new way to measure aggression: Hot sauce allocation. *Aggressive Behavior*, 25, 331–348.
- Longshore, D., & Turner, S. (1998). Self-control and criminal opportunity: Cross-sectional test of the general theory of crime. *Criminal Justice & Behavior*, 25, 81–98.
- Marcus-Newhall, A., Pedersen, W. C., Carlson, M., & Miller, N. (2000). Displaced aggression is alive and well: A meta-analytic review. *Journal of Personality and Social Psychology*, 78, 670–689.
- McGarrell, E. F., & Flanagan, T. J. (Eds.). (1985). *Sourcebook of criminal justice statistics—1984*. Washington, DC: USGPO.
- McGuire, J., & Broomfield, D. (1994). Violent offences and capacity for self-control. *Psychology Crime & Law*, 2, 117–123.
- Mischel, W. (1974). Processes in delay of gratification. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 7, pp. 249–292). New York: Academic Press.
- Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, 126, 247–259.
- Muraven, M., Collins, R. L., & Neinhans, K. (2002). Self-control and alcohol restraint: An initial application of the Self-Control Strength Model. *Psychology of Addictive Behaviors*, 16, 113–120.

- Murphy, B. C., & Eisenberg, N. (1997). Young children's emotionality, regulation and social functioning and their responses when they are a target of a peer's anger. *Social Development*, 6, 18–36.
- National Research Council (1993). *Understanding and preventing violence*. Washington, DC: National Academy Press.
- Ohbuchi, K., Kameda, M., & Agarie, N. (1989). Apology as aggression control: Its role in mediating appraisal of and response to harm. *Journal of Personality and Social Psychology*, 56, 219–227.
- O'Neal, E. C., & Taylor, S. L. (1989). Status of the provoker, opportunity to retaliate, and interest in video game violence. *Aggressive Behavior*, 15, 171–180.
- Parrott, A. C., Garnham, N. J., Wesnes, K., & Pincock, C. (1996). Cigarette smoking and abstinence: Comparative effects upon cognitive task performance and mood state over 24 hours. *Human Psychopharmacology Clinical and Experimental*, 11, 391–400.
- Pedersen, W. C., Gonzales, C., & Miller, N. (2000). The moderating effect of trivial triggering provocation on displaced aggression. *Journal of Personality and Social Psychology*, 78, 913–927.
- Rand, M., Klaus, P., & Taylor, B. (1983). The criminal event. In *Report to the nation on crime and justice* (pp. 1–16). Washington, DC: U.S. Department of Justice.
- Reiss, A. J. (1976). Settling the frontiers of a pioneer in American Criminology: Henry McKay. In J. F. Short (Ed.), *Delinquency, crime, and society* (pp. 64–88). Chicago: University of Chicago Press.
- Ross, M. (1989). The relation of implicit theories to the construction of personal histories. *Psychological Review*, 96, 341–357.
- Schmeichel, B. J., Vohs, K. D., & Baumeister, R. F. (2003). Ego depletion and intelligent performance: Role of the self in logical reasoning and other information processing. *Journal of Personality and Social Psychology*, 85, 33–46.
- Suttles, G. D. (1968). *The social order of the slum*. Chicago: University of Chicago Press.
- Staub, E. (1989). *The roots of evil: The origins of genocide and other group violence*. New York: Cambridge.
- Steele, C. M., & Southwick, L. (1985). Alcohol and social behavior I: The mediating role of inhibitory conflict. *Journal of Personality and Social Psychology*, 48, 18–34.
- Sternberg, R. J. (Ed.). (2005). *The psychology of hate*. Washington, DC: APA.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.
- Stucke, T. J., & Baumeister, R. F. (in press). Ego depletion and aggressive behavior: Is the inhibition of aggression a limited resource? *European Journal of Social Psychology*.
- Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, 72, 271–322.
- Tedeschi, J. T., & Felson, R. B. (1994). *Violence, aggression, & coercive actions*. Washington, DC: APA.
- Tice, D. M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it!. *Journal of Personality and Social Psychology*, 80, 53–67.
- Tremblay, R. E. (2002). Development of physical aggression from early childhood to adulthood. Unpublished manuscript.
- Turner, S. (1969). Delinquency and distance. In T. Selling & M. Wolfgang (Eds.), *Delinquency: Selected studies* (pp. 11–27). New York: Wiley.
- Twenge, J. M., Baumeister, R. F., Tice, D. M., & Stucke, T. S. (2001). If you can't join them, beat them: Effects of social exclusion on aggressive behavior. *Journal of Personality and Social Psychology*, 81, 1058–1069.
- Twenge, J. M., Muraven, M., & Tice, D. M. (2004). Measuring state self-control: Reliability, validity, and correlations with physical and psychological stress. Unpublished manuscript. San Diego State University.
- Vohs, K. D., & Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. *Psychological Science*, 11, 249–254.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063–1070.
- Webster, G. D. (2006). Behavioral and self-reported aggression as a function of domain-specific self-esteem. *Aggressive Behavior*, 32, 17–27.
- Zillmann, D. (1983). Arousal and aggression. In R. G. Geen & E. Donnerstein (Eds.), *Aggression: Theoretical and empirical reviews* (Vol. 1, pp. 75–102). New York: Academic.
- Zillmann, D., Katcher, A. H., & Milavsky, B. (1972). Excitation transfer from physical exercise to subsequent aggressive behavior. *Journal of Experimental Social Psychology*, 8, 247–259.