Research Article

SELF-REGULATORY FAILURE: A Resource-Depletion Approach

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Abstract—*Three studies were conducted to test the behavioral consequences of effortful self-regulation. Individuals with chronic inhibitions about eating were exposed to situations varying in level of self-regulatory demand. Subsequently, participants' ability to self-regulate was measured. Two studies manipulated self-regulatory demand by exposing participants to good-tasting snack foods, whereas a third study required participants to control their emotional expressions. As hypothesized, exerting self-control during the first task led to decrements in self-control on a subsequent task. Moreover, these effects were not due to changes in affective state and occurred only when self-control was required in the first task. These findings are explained in terms of depletion of self-regulatory resources, which impairs successful volitional control.*

Self-regulation is involved in a multitude of tasks, from getting out of bed in the morning, to maintaining attention during classes or meetings, to running a marathon. However, attempts to self-regulate frequently fail, with significant consequences for both the individual and society (Baumeister, Heatherton, & Tice, 1994). Researchers have recently theorized that self-regulation is governed by a limited resource that allows people to control impulses and desires (Baumeister & Heatherton, 1996; Heatherton & Baumeister, 1996). According to this model, self-regulatory resources can be depleted or fatigued by self-regulatory demands. Hence, the active effort required to control behavior in one domain leads to diminished capacity for self-regulation in other domains. Because people have a limited reservoir of self-regulatory resources, they can be overwhelmed by both self-initiated and situational demands, thereby resulting in self-regulation failure. This article reports on a set of studies that used chronic dieters to examine the applicability of self-regulatory resource theory to understanding self-regulation failure.

Empirical studies (e.g., Gross & Levenson, 1997; Muraven, Tice, & Baumeister, 1998), as well as theoretical postulates (e.g., Baumeister et al., 1994; Mischel, 1996), suggest that resource models are appropriate representations of self-regulatory mechanisms. Recent tests of a resource model have provided initial support. Muraven et al. (1998) found that one route to self-regulatory failure is prior self-regulatory endeavors. In these studies, participants who were asked to engage in a form of self-regulation (e.g., mental control or regulation of emotional expression) were less able to subsequently self-regulate (see also Baumeister, Bratslavsky, Muraven, & Tice, 1998). Although these initial studies provide evidence that self-regulatory resources may be important for understanding self-regulation failure, additional research is necessary to examine whether a self-regulatory resource model can account for patterns of self-regulatory failure related to chronic differences in inhibition (see Heatherton & Vohs, 1998). Because Muraven et al. (1998) and Baumeister et al. (1998) relied on artificial regulatory tasks that were implemented during the experiment (e.g., squeezing a hand grip), it is not yet known how self-motivated, chronic inhibitions affect subsequent self-regulatory endeavors. It is possible that repeated attempts at inhibition (e.g., chronic dieting) render a person especially vulnerable to situational temptations. Accordingly, the current investigations examined self-regulatory failure among chronic dieters, as these people possess extant inhibitions about eating.

Self-regulatory failure among dieters is the ideal context within which to examine the applicability of self-regulatory resource theory. First, dieting is one of the most commonly self-regulated behaviors in contemporary Western society, as exemplified by the $35 billion spent by Americans on dieting programs each year (Brownell, 1991). Second, it is ethical to study this form of self-regulation in the lab. Third, there is substantial evidence that long-term weight loss is extremely difficult to achieve, as most people who try to regulate their eating fail (NIH Technology Assessment Conference Panel, 1993). Finally, dieters must expend effort to override feelings of hunger, perhaps by focusing on long-term weight-loss goals (Heatherton & Vohs, 1998). In sum, it is important to study chronic dieting as it exemplifies the processes and possible consequences of long-term inhibitions.

STUDY 1

Study 1 tested the proposition that situational demands and the existence of a chronic inhibitory state interact to affect self-regulatory resources. We manipulated situational conditions to differ in temptation level by varying whether tempting foods were positioned within participants' reach (high temptation) or across the room (low temptation). Pilot research demonstrated that being seated next to good-tasting snacks is highly tempting for chronic dieters, but does not affect mood or self-esteem.[1] Thus, this manipulation varied only in

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1. Pilot testing supported our contention that exposure to candies placed nearby is tempting. Chronic dieters ($n = 24$) were seated next to or far away from an overflowing bowl of M&M candies while watching a 10-min neutral film. After being moved to a different room, they were asked to use a 7-point Likert scale to report how tempted they felt, how much they thought about the candies, and how much they wondered about the candies, as well as to complete a 24-item mood scale and the State Self-Esteem Scale (Heatherton & Polivy, 1991). These participants were not asked to perform a second self-regulatory task.

Participants seated close to the candies reported being more tempted ($M = 3.8$, $SD = 1.4$) than those seated across the room from the candies ($M = 2.6$, $SD = 1.1$), $t(22) = 2.27$, $p = .03$. In addition, participants seated close to the candies reported that they spent more time thinking and wondering about the candies than those seated further away, $t(22) = 2.41$, $p < .03$, and $t(21) = 3.38$, $p < .01$, respectively. No differences were found between conditions on reports of Positive Affect, Anxiety, Dysphoria, or Hostility, all ts < 1.0, or state self-esteem, $t(21) = 0.80$. Thus, proximity of snack foods influences level of temptation and cognitive energy devoted to the presence of the food, but does not affect mood or self-esteem.

temptation level. This point is crucial because dysphoria and threats to self-esteem are associated with disinhibited eating among chronic dieters (Heatherton & Baumeister, 1991). Additional pilot testing revealed that highly tempting conditions deplete self-regulatory resources, as evidenced by increased eating among chronic dieters.[2]

A second manipulation of resource depletion involved the availability of the tempting snacks. Participants either were told that they could help themselves to the snacks or were asked not to touch the snacks. We predicted that only in the "help yourself" conditions, which placed the burden of responsibility on the individual, would subsequent self-regulation be affected by temptation level. Subsequent self-regulation in the "don't touch" conditions, in which the experimenter's instructions—not the self—placed constraints on participants' behavior, was not predicted to vary with temptation level.

Last, we hypothesized that the situational factors of availability and temptation would affect subsequent self-regulation among dieters, but not among nondieters. We based this prediction on the idea that situational factors should have the greatest effect on individuals who are most vulnerable to resource depletion, such as dieters (who regularly face temptation). Thus, we predicted greatest self-regulatory resource depletion among chronic dieters who were seated next to the candies and were told to help themselves.

Method

Participants

Female participants volunteered for the experiment in exchange for extra course credit. They were labeled as either chronic dieters ($n = 36$) or nondieters ($n = 64$) on the basis of scores on the Restraint Scale (Herman & Polivy, 1980). As is standard in research on chronic dieters (Heatherton, Polivy, Herman, & Baumeister, 1993), a score of 16 or higher was used to classify participants as chronic dieters (mean dieters' restraint score = 19.1, $SD = 1.9$; mean nondieters' restraint score = 9.4, $SD = 2.4$). The experimenter was blind to dieting status while conducting the experiment. The data from 6 participants (5 nondieters and 1 dieter) were excluded from analyses because those participants snacked during the manipulation of temptation and availability. Although height did not vary significantly with dieting status, $t(91) = 0.92$, $p = .82$, body weight was marginally predicted by dieting status, $t(91) = 1.54$, $p = .13$.[3] Mean weight of dieters was 135.9 lb ($SD = 16.1$ lb), whereas mean weight of nondieters was 130.2 lb ($SD = 16.4$ lb).

Procedure

To ensure that participants' eating behavior would not be affected by prior intake of food, we asked participants not to eat for the 2 hr before the experiments. Participants arrived individually and were asked to watch a neutral video, *Bighorn* (depicting the daily activities of Bighorn sheep), for 10 min to "neutralize" their moods. It was while the participants watched the video that manipulations of temptation and availability took place. An array of tempting snacks (Doritos, Skittles, M&Ms, and salted peanuts) was used to create a highly tempting situation for both dieters and nondieters, therefore providing a strong test of our hypotheses. The snacks were placed either next to participants (within arm's reach) or across the room (approximately 10 ft), corresponding to the high- and low-temptation conditions.

Before leaving the room, the experimenter acknowledged the snacks and told half of the participants that they could help themselves to the snacks, as the snacks had been used in a study that had just been completed. The rest of the participants were told that the snacks were being used in a different experiment later that day and asked not to touch them.

After participants watched the video, they completed a 24-item mood questionnaire and were taken to another room to taste and rate ice cream flavors for 10 min. For this task, participants were seated in front of three flavors of ice cream presented in very large containers that ostensibly obscured the amount of ice cream eaten from the experimenter. As the experimenter left the room, she added, "By the way, help yourself to any ice cream you want; we have tons in the freezer." Our measure of self-regulatory ability was the number of grams of ice cream eaten, as assessed by weighing the ice cream containers before and after the ratings task. This ratings paradigm has been an effective means of measuring eating for more than 30 years (Schachter, Goldman, & Gordon, 1968). After the ratings task, participants were debriefed and thanked.

Results

Preliminary analyses

As mentioned, participants were asked not to eat for the 2 hr before the experiment. To ensure that participants followed this request, we asked them to report the number of hours since they last ate and how hungry they currently felt. A 2 (dieting status: dieter vs. nondieter) × 2 (temptation condition: high vs. low) × 2 (availability condition: "help yourself" vs. "don't touch") analysis of variance (ANOVA) revealed no significant differences in number of hours since last eating or reported hunger (all ps > .10).

Mood states after watching the video were assessed using a 24-item mood checklist. The mood checklist consisted of four factors

2. A second pilot study was conducted to test the effects of temptation on ability to self-regulate. Chronic dieters ($n = 38$) were randomly assigned to either sit next to an overflowing bowl of candies (high temptation), sit across the room from the bowl of candies (low temptation), or not be exposed to any candies (control condition) while they watched a 10-min neutral film. Subsequently, their ability to self-regulate was tested by measuring grams of ice cream eaten during a taste-and-rate task identical to that used in Study 1 (see Study 1 Method).

We predicted that participants in the high-temptation condition would eat the most ice cream, because of greater depletion of self-regulatory resources by overriding a desire to eat the nearby candies. A one-way analysis of variance (temptation condition: control, low, and high) conducted on grams of ice cream eaten showed that temptation level affected amount eaten, $F(2, 35) = 3.60$, $p < .04$. Planned contrasts revealed a significant difference between amount of ice cream eaten by control versus high-temptation participants, $t(35) = 2.40$, $p < .02$, and between that eaten by low-temptation versus high-temptation participants, $t(35) = 2.45$, $p < .02$. Participants seated next to the bowl of M&Ms ate significantly more ice cream than did participants seated far from the bowl and more than those not exposed to the candies. Eating among control and low-temptation participants did not differ, $t(35) = 0.05$. Thus, being highly tempted is depleting for dieters, as evidenced by decreased ability to self-regulate during a taste-and-rate ice cream task.

3. Statistically controlling for body weight in analyses of eating behavior did not significantly change the results of Study 1. In fact, the majority of effects became stronger when analyses controlled for body weight.

determined by earlier research in our lab (Heatherton & Vohs, in press): Positive Affect (cheerful, excited, lighthearted, euphoric, happy, peppy, enthusiastic, lively, elated, and content), Anxiety (fearful, apprehensive, jittery, anxious, uncertain, nervous, and confused), Dysphoria (distressed, hopeless, sad, and depressed), and Hostility (annoyed, irritated, and bored). We conducted 2 (dieting status: dieter vs. nondieter) × 2 (temptation condition: high vs. low) × 2 (availability condition: "help yourself" vs. "don't touch") ANOVAs to examine whether mood differed as a result of the independent variables. These analyses revealed no main effects or interactions involving Anxiety, Dysphoria, and Hostility (Fs < 3.0, ps > .05). However, an interaction between dieting status and availability condition was obtained on ratings of Positive Affect, $F(1, 86) = 5.16$, $p < .03$: Dieters in the low-temptation condition and nondieters in the high-temptation condition reported higher levels of Positive Affect.

Eating behavior

We first examined the dependent measure, grams of ice cream eaten, for its skewness and found it to be highly positively skewed, which is typical in studies using dieters and nondieters (Kirschenbaum & Tomarken, 1982). Accordingly, a log transformation was conducted to achieve homogeneity in variance. For clarity, the reported means are not transformed.

To examine our prediction that temptation level and availability condition would interact to predict amount of ice cream eaten among chronic dieters, we conducted a 2 (temptation condition: high vs. low) × 2 (availability condition: "help yourself" vs. "don't touch") ANOVA on log-transformed grams of ice cream eaten. This analysis revealed a main effect of temptation condition: Dieters in the high-temptation condition ate more ice cream ($M = 164.0$ g, $SD = 88.5$) than those in the low-temptation condition ($M = 112.1$ g, $SD = 89.4$), $F(1, 31) = 5.37$, $p = .03$. This main effect was qualified by a significant interaction between the temptation level and availability condition, $F(1, 31) = 5.12$, $p = .03$. As seen in Figure 1, this interaction revealed that dieters who were seated next to the snacks (high temptation) and who were told they could help themselves to the snacks ate significantly more ice cream in the subsequent taste-and-rate task ($M = 181.7$ g, $SD = 95.4$) than dieters who were seated away from the snacks (low temptation) and were told to help themselves ($M = 71.7$ g, $SD = 57.4$), $t(31) = 2.83$, $p < .01$. It is important to note that eating behavior among dieters was affected by temptation level only in the "help yourself" conditions, $t(31) = 2.70$, $p < .02$, in which desire to eat the snacks was inhibited by self-control, and not in the "don't touch" conditions, $t(31) = 0.05$, $p > .95$, in which desire to eat the snacks was inhibited by the experimenter's instructions.

To test our hypotheses regarding the interaction of individual differences and situational factors, we conducted a 2 (dieting status: dieter vs. nondieter) × 2 (temptation condition: high vs. low) × 2 (availability condition: "help yourself" vs. "don't touch") ANOVA on log-transformed number of grams of ice cream eaten. We found a marginally significant three-way interaction among dieting status, temptation condition, and availability condition on amount of ice cream eaten, $F(1, 86) = 2.70$, $p = .10$.

As noted, the placement of tempting foods and their availability affected amount of ice cream eaten by dieters. Therefore, to test our a priori prediction that the eating behavior of nondieters would be unaffected by situational manipulations, we conducted a 2 (temptation level: high vs. low) × 2 (availability condition: "help yourself" vs. "don't touch") ANOVA on grams of ice cream eaten. This analysis failed to yield a significant difference in eating among nondieters as a function of temptation level, $F(1, 55) = 2.11$, $p = .16$, or availability condition $F(1, 55) = 0.13$, $p = .73$; neither was there an interaction between these factors, $F(1, 55) = 0.81$, $p = .34$ (see Fig. 1).

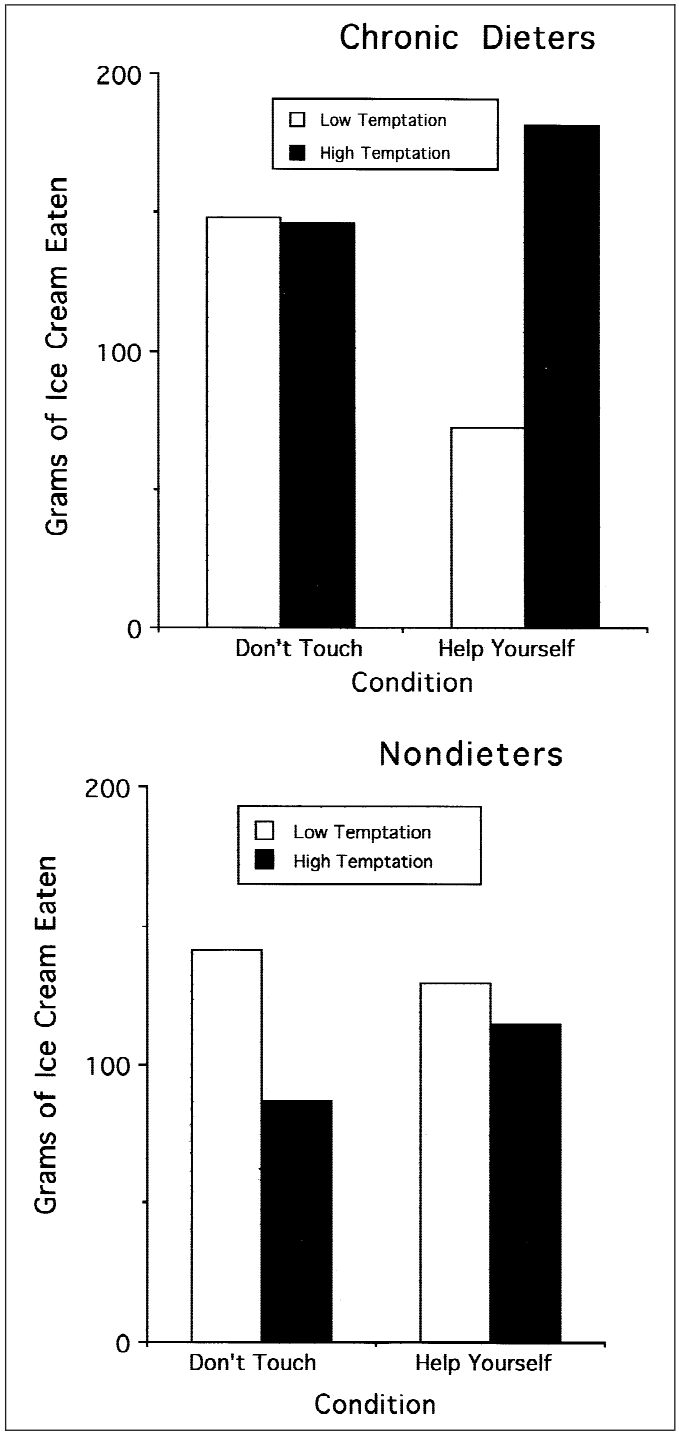

Fig. 1. Effects of dieting status, temptation level, and availability condition on eating behavior (ice cream in grams) in Study 1.

Discussion

Study 1 demonstrated that the manipulation of perceived availability and proximity of tempting snacks undermined subsequent self-control among dieters. It is important to note that only in the "help yourself" conditions, which compelled dieters to exert self-control, was eating behavior significantly affected by temptation level. In the "don't touch" conditions, in which the experimenter restricted the availability of snacks, eating behavior among dieters was not affected by temptation level. This result suggests that for chronic dieters, who actively monitor and inhibit their caloric intake, being told not to eat precluded the need for effortful self-control. The eating behavior of nondieters was not influenced by experimental manipulations. This finding is consistent with our argument that only people who possess inhibitions about engaging in a motivated response become disinhibited as a result of situational demands that deplete self-regulatory resources.

One possible explanation for the results of Study 1 is that being close to the foods and having them available increased the accessibility and availability of eating-related cognitions, thereby priming an eating construct, especially among dieters. To rule out this alternative explanation, we conducted two studies that manipulated and assessed self-regulatory ability in different domains.

STUDY 2

In keeping with our emphasis on the effect of chronic inhibitions, Study 2 exposed chronic dieters to a food-related temptation and subsequently assessed persistence, a behavior unrelated to inhibiting caloric intake. Given that individual differences research (e.g., Mischel, Shoda, & Peake, 1988) and previous tests of resource models of self-regulation (e.g., Baumeister et al., 1998; Muraven et al., 1998) suggest that self-regulatory abilities are global, we predicted that self-regulatory demands in one domain would lead to subsequent decrements in self-regulation in another domain.

Method

Participants

Thirty-one females participated in the experiment in exchange for extra course credit. All participants were chronic dieters who had scored 16 or higher on the Restraint Scale, as assessed at an earlier pretesting session ($M = 19.6$, $SD = 3.6$). The data from 3 participants were not included in the statistical analyses because these participants snacked during the manipulation of temptation.

Procedure

The first phase of the current experiment was similar to the first phase of Study 1. Participants came to the lab individually and were led to a windowless room to watch the *Bighorn* video. In Study 2, self-regulatory resource depletion was manipulated by placing a bowl overflowing with M&M candies either next to (high temptation) or across the room from (low temptation) participants as they watched the video.

The second phase of the experiment differed from the procedure in Study 1. After watching the video and completing a mood scale, participants were led into another room, where they were asked to work on an embedded-figures task (adapted from Snyder, Smoller, Strenta, & Frankel, 1981). The task consisted of 16 complex geometric shapes, each of which supposedly contained one of five target figures. Participants' goal was to locate the target figure (printed at the top of the page) within each of the 16 test items, but the task was made unsolvable by deleting critical lines in 12 of the test items. Participants were left alone to work on the task. As the experimenter left the room, he told them to knock on the door when they had "solved the puzzles, decided to stop trying to solve them, or given up." Thus, time spent on this task represented our dependent measure, persistence, as participants decided when to terminate this phase of the experiment.

Results

Mood analyses

Participants completed the same 24-item mood scale used in Study 1. Mood ratings after the manipulation of temptation level showed no differences in mood as a function of condition: Positive Affect, $t(25) = 1.19$, $p = .24$; Anxiety, $t(26) = 1.50$, $p = .16$; Dysphoria, $t(26) = 1.49$, $p = .16$; Hostility, $t(26) = 1.37$, $p = .18$.

Persistence behavior

The length of time spent attempting to solve the embedded-figures task served as our measure of persistence. A *t* test conducted on time spent performing this task revealed an effect of temptation condition, $t(26) = 2.04$, $p = .05$. Specifically, participants in the high-temptation condition spent less time persisting at the unsolvable task ($M = 17.0$ min, $SD = 4.5$) than did low-temptation participants ($M = 21.8$ min, $SD = 6.9$). Thus, depleting the self-regulatory abilities of chronic dieters with a food-related cue decreases self-regulatory capacity in other domains.

Discussion

The results from Study 2 provide evidence that self-regulatory resource depletion in one domain affects self-control in other areas. We demonstrated that self-regulatory depletion in the form of nearby tempting foods was detrimental to persistence on an unsolvable task. We also demonstrated that this effect was not due to differences in mood states after the experimental manipulation. These results support our hypothesis that the effect of depleting self-regulatory resources is not domain-specific.

STUDY 3

The goal of Study 3 was to deplete self-regulatory resources in chronic dieters using a manipulation unrelated to food. We manipulated regulation of emotional expression by asking participants to either inhibit their reactions to a sad video or act naturally. We selected emotion regulation as the manipulation of self-regulatory resource depletion because previous research had related purposeful control of emotions to physical and cognitive exertion. Gross and Levenson (1997) asked participants to view a sad, neutral, or amusing film while either suppressing or not suppressing expressive behavior. They found that participants who were asked to inhibit their expressions during the sad and funny films showed increased sympathetic

activation of the cardiovascular system, but that suppression during a neutral film did not elicit increased cardiovascular activity. Hence, we predicted that participants who were asked to suppress their emotional reactions would be more depleted than those who were not asked to suppress their reactions, and therefore would show decreased self-control on a subsequent unrelated task.

Method

Participants

Thirty-nine female participants volunteered for the experiment in exchange for extra course credit. Participants were chronic dieters, as determined by scores of 16 and higher on the Restraint Scale obtained during a preexperimental testing session ($M = 18.7$, $SD = 4.3$). The data from 3 participants were excluded from analyses: Two participants could not eat ice cream for dietary reasons, and 1 failed to follow experimental instructions.

Procedure

As in Study 1, participants were asked not to eat for the 2 hr before the experiment. Participants arrived individually and were led into a windowless room with a television monitor and a video camera, where they were told that they would be watching a short video. Participants were then given instructions about how to regulate their behavior during the video (see Gross & Levenson, 1997). Participants in the suppress-emotion condition were told: "During the movie, your goal is to remain completely neutral on the inside and out. Please try your best not to let any feelings or responses you may have show on your face and, to the best of your ability, try to keep your internal emotional reactions suppressed." Participants in the natural-emotion condition were told: "During the movie, your goal is to remain as natural as possible, both on the inside and out. If you have any feelings or responses to the movie, go ahead and let them flow." To ensure that participants followed the instructions, we videotaped all participants while they watched the movie. The video camera was positioned in plain view, 6 ft from the participant. Participants watched an 11-min segment from *Terms of Endearment,* in which a young, dying woman says good-bye to her friends, sons, husband, and mother.

After the video, participants completed a mood questionnaire and were taken to another room to complete the ice cream taste-and-rate task. Instructions for the ratings task were the same as in Study 1, and again we used amount of ice cream eaten as our measure of self-regulatory ability.

Results

Preliminary analyses

To ensure that participants followed the request that they not eat for the 2 hr before the experiment, we asked them to report the number of hours since their last meal. Participants assigned to the suppress-emotion and natural-emotion conditions did not differ significantly on this measure, $t(34) = 0.62$. Participants in the two conditions differed somewhat on degree of hunger prior to the experiment, $t(33) = 1.7$, $p = .10$. Specifically, participants in the natural-emotion condition reported slightly more hunger ($M = 3.6$, $SD = 3.3$) than those in the suppress-emotion condition ($M = 2.7$, $SD = 1.6$), a trend that runs contrary to the predicted results.[4]

After the video, participants completed the 24-item mood-state questionnaire. The mood factors of Positive Affect, Anxiety, Hostility, and Dysphoria were subjected to *t* tests to see if mood varied as a result of instructions. There were no significant differences in ratings of Positive Affect, $t(33) = 1.06$; Anxiety, $t(32) = 1.17$; or Hostility, $t(34) = 0.46$. Ratings of Dysphoria, the factor of interest, showed only a slight and nonsignificant difference by condition, $t(33) = 1.59$, $p > .10$: Participants who watched the movie under instructions to suppress their emotions were somewhat less dysphoric ($M = 16.0$, $SD = 5.6$) than those who were asked to be natural ($M = 18.5$, $SD = 3.3$).

As a manipulation check, participants' facial expressions while watching the movie were rated by a judge blind to the experimental hypothesis (see Baumeister et al., 1998). The judge rated the degree of expressiveness shown 1, 5, and 10 min into the movie using a 7-point scale (1 = *no expression*, 7 = *very expressive*). The three ratings were averaged to form a composite measure of facial expressiveness. Analyses on emotional-expression ratings revealed a significant effect of condition, with participants who were asked to inhibit their emotions being less expressive ($M = 1.7$, $SD = 0.66$) than those who were asked to act naturally ($M = 2.5$, $SD = 0.57$), $t(33) = 3.08$, $p < .01$.

Eating behavior

Our test of self-regulatory resource depletion was assessed by grams of ice cream eaten in the second phase of the experiment, the taste-and-rate task. A *t* test conducted on amount of ice cream eaten as a function of emotion-regulation condition revealed that participants who were asked to inhibit their emotional reactions ate significantly more ice cream ($M = 211.2$ g, $SD = 123.8$) than those who were allowed to let their responses occur naturally ($M = 135.6$ g, $SD = 71.7$), $t(34) = 2.27$, $p < .03$. Thus, chronic dieters who exerted control over their facial expressions and emotional reactions were less able to inhibit their intake of ice cream at a later point.

Discussion

Asking dieters to suppress their emotional reactions depleted self-regulatory resources, as evidenced by greater consumption of ice cream. Analyses of mood states after the movie refute the possibility that increased distress caused dieters to eat more (see Heatherton & Baumeister, 1991). In fact, participants who were allowed to react naturally to the video were slightly more dysphoric than participants asked to suppress their feelings and expressions. However, increased dysphoria did not translate to increased eating, as the natural-emotion participants ate significantly less than the suppress-emotion participants. Because this study focused on self-regulatory depletion by varying only instructions to self-regulate, but not the content or valence of the video, all participants experienced increased distress. Yet, eating varied as a function of instructions to self-regulate. Thus, our findings cannot be explained in terms of eating to comfort a distressed state.

4. Statistically controlling for level of reported hunger between conditions marginally changed the effect of emotion-regulation condition on subsequent eating; the effects became stronger in analyses controlling for reported hunger.

GENERAL DISCUSSION

These three studies tested the hypothesis that the ability to engage in successful self-regulation is limited by an underlying resource. The studies examined whether tasks requiring self-regulation (e.g., self-stopping in the face of tempting snacks or suppressing emotions) would affect the ability to self-regulate at a later point. Results from these experiments support a resource model of self-regulation. The findings demonstrate that the existence of chronic inhibitions, when combined with situational conditions requiring effortful self-regulation, can decrease ability to self-regulate. Moreover, our results indicate that inhibition in one domain exerts a generalized effect on behaviors in other domains. Taken together, these studies advance knowledge of the processes that govern self-regulation.

Future research should elucidate more precisely the mechanisms that underlie self-regulatory strength. For instance, research could examine ideas related to delay of gratification, such as Metcalfe and Mischel's (1999) hot-cold theory of self-regulation. Research could also investigate brain mechanisms that may underlie self-regulatory strength, such as frontal lobe functioning (see Damasio, 1994) or the metabolic cost of processing novel information (see Roland, Eriksson, Stone-Elander, & Widen, 1987). We believe that studying self-regulation in terms of a resource model advances understanding of the processes governing effective—and ineffective—self-regulation. The ability to self-regulate is a crucial facet of selfhood, in its ability to bring about changes to improve one's fit with the environment. Our research documents the importance of self-regulatory resources in understanding when, how, and why people fail at self-regulation.

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REFERENCES

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*, 1252–1265.

Baumeister, R.F., & Heatherton, T.F. (1996). Self-regulation failure: An overview. *Psychological Inquiry, 7*, 1–15.

Baumeister, R.F., Heatherton, T.F., & Tice, D.M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego: Academic Press.

Brownell, K.D. (1991). Dieting and the search for the perfect body: Where physiology and culture collide. *Behavior Therapy, 22*, 1–12.

Damasio, A.R. (1994). *Descartes' error*. New York: Avon.

Gross, J.J., & Levenson, R.W. (1997). Emotional suppression: Physiology, self-report, and expressive behavior. *Journal of Abnormal Psychology, 64*, 970–986.

Heatherton, T.F., & Baumeister, R.F. (1991). Binge eating as escape from self-awareness. *Psychological Bulletin, 110*, 86–108.

Heatherton, T.F., & Baumeister, R.F. (1996). Self-regulation failure: Past, present, and future. *Psychological Inquiry, 7*, 90–98.

Heatherton, T.F., & Polivy, J. (1991). Development and validation of a scale for measuring state self-esteem. *Journal of Personality and Social Psychology, 60*, 895–910.

Heatherton, T.F., Polivy, J., Herman, C.P., & Baumeister, R.F. (1993). Self-awareness, task failure and disinhibition: How attentional focus affects eating. *Journal of Personality, 61*, 49–61.

Heatherton, T.F., & Vohs, K.D. (1998). Why is it so difficult to inhibit behavior? *Psychological Inquiry, 9*, 212–215.

Heatherton, T.F., & Vohs, K.D. (in press). Interpersonal evaluations following threats to self: Role of self-esteem. *Journal of Personality and Social Psychology*.

Herman, C.P., & Polivy, J. (1980). Restrained eating. In A. Stunkard (Ed.), *Obesity* (pp. 208–255). Philadelphia: Saunders.

Kirschenbaum, D.S., & Tomarken, A.J. (1982). Some antecedents of regulatory eating by restrained and unrestrained eaters. *Journal of Abnormal Psychology, 91*, 326–336.

Metcalfe, J., & Mischel, W. (1999). A two-system analysis of delay of gratification. *Psychological Review, 106*, 3–19.

Mischel, W. (1996). From good intentions to willpower. In P.M. Gollwitzer & J.A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 197–218). New York: Guilford Press.

Mischel, W., Shoda, Y., & Peake, P.K. (1988). The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of Personality and Social Psychology, 54*, 687–696.

Muraven, M., Tice, D.M., & Baumeister, R.F. (1998). Self-control as limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology, 74*, 774–789.

NIH Technology Assessment Conference Panel. (1993). Methods for voluntary weight loss and control. *Annals of Internal Medicine, 199*, 764–770.

Roland, P.E., Eriksson, L., Stone-Elander, S., & Widen, L. (1987). Does mental activity change the oxidative metabolism of the brain? *Journal of Neuroscience, 7*, 2372–2389.

Schachter, S., Goldman, R., & Gordon, A. (1968). Effects of fear, food deprivation, and obesity on eating. *Journal of Personality and Social Psychology, 10*, 91–97.

Snyder, M.L., Smoller, B., Strenta, A., & Frankel, A. (1981). A comparison of egotism, negativity, and learned helplessness as explanations for poor performance after unsolvable problems. *Journal of Personality and Social Psychology, 40*, 24–30.

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