

Ego Depletion Induces Mental Passivity: Behavioral Effects Beyond Impulse Control

Andrew J. Vonasch

University of North Carolina at Chapel Hill

Kathleen D. Vohs

University of Minnesota

Anastasiya Pocheptsova Ghosh

University of Arizona

Roy F. Baumeister

Florida State University

Three studies supported the hypothesis that people can become mentally and physically passive when resources are depleted by prior acts of self-control. Feeling depleted and recent self-regulatory exertion were associated with preferences for passive behaviors like resting and watching TV. Participants who had to maintain attention in the face of distractions preferred to avoid making consumer decisions as compared with participants who did not. Breaking a habit caused hungry participants to eat more peanuts when doing so was easy (the peanuts lacked shells) and to eat less when eating required minor preparatory action (the peanuts had shells). Mental passivity induced by depletion of self-control causes both passive behavior and impulsive behavior, depending on the situation.

Keywords: self-regulation, passivity, ego depletion

The difference between active and passive responding is one of the most fundamental dimensions among the countless ways that living creatures can respond to environmental events. Active responding means that the creature reacts to the external circumstances by seeking to steer the course of events in one rather than another direction. In contrast, passive responding involves allowing events to unfurl without attempting to control the outcome or alter the

status quo. In other words, passive responding means letting things happen and not intervening to change things.

The view of self-regulation as an effortful activity that depletes an energy resource has stimulated much research (for meta-analysis, see Hagger, Wood, Stiff, & Chatzisarantis, 2010; for recent overview of theoretical disputes and issues, see Baumeister & Vohs, 2016). The underlying assumption has been that a particular resource, akin to the folk notion of willpower, is expended in regulating behavior such as by inhibiting impulses. The present paper tests an extension to this theory. Moving beyond resisting temptation, it tests the idea that the difference between active and passive responding involves the expenditure of this same resource. We reasoned that top-down control takes energy and will decline when regulatory resources are low. This may result in increased inaction insofar as action requires initiative, but it may also produce increased behavior insofar as inhibitions or stopping the behavior requires top-down control.

Passivity

Living things vary widely in their capacity for active response. It is arguable that plants

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Andrew J. Vonasch, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill; Kathleen D. Vohs, Carlson School of Management, University of Minnesota; Anastasiya Pocheptsova Ghosh, Eller College of Management, University of Arizona; Roy F. Baumeister, Department of Psychology, Florida State University.

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Correspondence concerning this article should be addressed to Andrew J. Vonasch, Department of Psychology and Neuroscience, The University of North Carolina at Chapel Hill, 235 East, Cameron Avenue, Chapel Hill, NC 27599. E-mail: avonasch@email.unc.edu

have almost no active responses. As a revealing example, they remain inactive even while other creatures eat them. Animals, in contrast, move to eat and to resist being eaten. Among simple animals, passive responding means physical stillness, and active responding means physical movement.

In humans, the active versus passive distinction occurs at both the physical level (stillness vs. movement) and at the mental level (relying on automatic vs. controlled processes). Mental passivity is the absence of active processing to override one's incipient or automatic responses. Physical passivity is usually a result of mental passivity, such as during rest or sleep. To be sure, physical passivity can stem from active mental processing, such as when someone tries to hold still while being tickled or injected.

Being mentally passive does not necessarily mean one's body is unmoving. A passive person might simply follow orders, such as walking to a specific place. Mental passivity involves letting one's automatic responses to the environment drive one's behavior. Depending on one's automatic impulses, mentally passive behavior can be either physically passive or physically active.

Mentally active versus passive responding seemingly goes to the essence of volition. Many human decisions and experiences depend on the difference between active and passive responding. A health warning may be passively ignored or met with an active change of behavior. People's moral judgments depend greatly on this difference. Most people judge actively killing someone to be much more reprehensible than passively letting someone die, even if the outcome and motive are the same (Rachels, 2007). Indeed, basic linguistic structure attests to the importance of the active-passive dimension: active versus passive verbs can express the same thought often with substantially different meanings (such as "Mistakes were made").

Depletion has often been understood as transfer of control from conscious to unconscious, from central executive to automatic (Hofmann, Friese, & Strack, 2009). One way of summarizing this diverse literature is to suggest that top-down mental control is generally reduced or even abdicated during ego depletion. The view that depletion brings abdication of control fits many findings, such as increased yielding to impulse (Hagger et al., 2010). The resource-

expensive form of control is curtailed, to conserve energy, and this could mean broadly a passive attitude toward life and events. If mental passivity is a central aspect of depletion, then depletion may produce physical passivity, especially when there are no automatic impulses to take action, and when action requires exerting top-down control (e.g., difficult decisions, or initiative).

In sum, our investigation focused on the hypothesis that ego depletion produces mental passivity, which entails an abdication of top-down mental control over responses. This could produce physical passivity and inaction (as in Banker, Ainsworth, Baumeister, Ariely, & Vohs, 2017; Baumeister et al., 1998, Study 4; Giacomantonio, Jordan, Fennis, & Panno, 2014; Job, Bernecker, Miketta, & Friese, 2015)—but under some circumstances could yield increases in physical activity (as in most other depletion studies summarized in Hagger et al., 2010).

Active Versus Passive Mental Processes and Behaviors

Either action or inaction can result from mental passivity. Carver, Johnson, and Joormann (2008) proposed that lack of executive function control leaves the person responding reflexively to environmental cues. That sort of a mentally passive response style can theoretically produce responses ranging from physical lassitude to disinhibited violence.

The hypothesis that ego depletion can produce mental passivity fits some previous findings. For example, judges on parole boards can make an easy, default decision (to keep a prisoner in prison) or a risky, difficult decision (to grant a parole and allow the convict to rejoin society, where he might commit a crime). Danziger, Levav, and Avnaim-Pesso (2011) found that judges granted parole at reasonably high rates when the judges had been rested or fed, but as the day wore on they became increasingly likely to favor the default response of denying parole. Likewise, over the course of making many decisions while buying a car, buyers increasingly tend to select the standard or default option (Levav, Heitmann, Herrmann, & Iyengar, 2010). Polman and Vohs (2016) confirmed that decision fatigue is associated with preference for the status quo option. Banker, Ainsworth, Baumeister, Ariely, and Vohs (2017)

found that even when people's decisions diverge from the status quo, they diverge less when people are depleted. In making decisions, then, depletion increases the tendency to stick close to a safe, default response.

The limited resource model of self-regulation suggests that people conserve resources by reducing top-down control after they have expended some effort in self-control or decision-making (Baumeister, Vohs, & Tice, 2007). Recent evidence has linked prior exertion of self-control to a lessening of deliberate, thoughtful responding. For example, fMRI studies have found that brain areas involved in the implementation of control—but not the detection of a self-control conflict—became less active after depletion (Hedgcock, Vohs, & Rao, 2012). Thus, depletion led to reflexive but not reflective responding, which increases reliance on situational cues (Carver et al., 2008).

When top-down control is reduced, responses depend on automatic processes and external cues (Hofmann, Friese, & Strack, 2009). Depletion should produce that pattern, alongside the impulse to conserve energy (Muraven, Shmueli, & Burkley, 2006). Hence easy access to tempting rewards might cause a depleted person to take disinhibited action, as much work has found (see Hagger et al., 2010). In contrast, depleted people might become inactive if there are few immediate rewards or other external impetus to act—as well as if it would seemingly take active exertion to pursue rewards.

Some existing literature supports the idea that depletion can produce physically passive responding. Experiment 4 from Baumeister et al. (1998) found that depleted people passively sat longer through a boring movie when skipping the movie required them to alter their behavior. More recent studies showed that depletion increases passive resting, and thoughts about resting, among people who implicitly believe that their willpower is limited (Job, Bernecker, Miketta, & Friese, 2015). One study examined depletion's effect on both active and passive behavior, by testing how much risky reward seeking people would do when depleted versus not. Depleted people sought rewards more when they were easy to obtain, but less when seeking rewards involved the effort of pumping a manual bicycle pump (Giacomantonio, Jordan, Fenris, & Panno, 2014). The findings support the idea that depletion can lead to physically pas-

sive responding, in contrast to the more studied effect of depletion increasing disinhibition.

Although many published studies support the claims of the limited resource model, the existence of the ego depletion effect has recently been disputed (Carter, Kofler, Forster, & McCullough, 2015; Hagger et al., 2016). One purpose of the present research was to conceptually replicate depletion's effects of increasing both disinhibited and passive behavior. To improve the replicability of our results, our studies used larger sample sizes to achieve higher statistical power than is common in this literature. Additionally, the present studies tested the hypothesis that the same cause of depletion could produce divergent, disinhibited or passive behavior, depending on the situation.

The idea that depletion can produce either action or inaction is consistent with motivational intensity theory (Brehm & Self, 1989). That theory assumes that people conserve energy and restrict their efforts to the minimum levels required for task success. As tasks become perceived as more difficult, people exert more effort to meet the perceived effort required to succeed. Notably, however, people stop exerting effort when they perceive higher effort costs than likely rewards from the task (Aggarwal, Wright, Mlynski, Hammad, & Blackledge, 2016). Depletion is assumed to increase the perceived effort required for most tasks (Wright, 2014; Richter, Gendolla, & Wright, 2016). Therefore, depletion is expected to increase effortful action (i.e., disinhibition) in most cases. However, whenever the perceived effort becomes so great that the task no longer seems worthwhile, passivity would result.

Hence we predicted that self-regulatory resource depletion could produce either action or inaction, depending on the situation. Depletion in the context of easy and immediate rewards should produce disinhibited activity. In contrast, depletion should produce a reluctance to put forth effort to pursue rewards, either because few rewards are readily available or because claiming them would require high effort.

Present Studies

Three studies tested the hypothesis that participants would become mentally passive following self-regulatory exertion. The basic design was to instruct some participants to use

self-control initially, whereas others not; then all participants were measured on tasks in which they could respond passively or actively. Study 1 tested whether recent self-regulatory exertion and feelings of depletion predicted preferences for passive behavior. Studies 2 and 3 were experiments testing whether self-regulatory exertion caused mental passivity. Study 2 tested whether depletion would produce mental passivity, operationalized as whether participants postponed making a decision. Study 3 offered immediate rewards to some participants and manipulated how easily available they were. Study 3 tested the moderation hypothesis that depletion's effect on mental passivity would produce either physical inactivity or impulsive appetitive action, depending on the opportunity for immediate reward.

Study 1: Self-Reported Depletion Predicts Preferences for Passive Activities and Weaker Feelings of Vitality

Study 1 provided the first evidence linking ego depletion to passive feelings. It relied on correlations among self-report variables (unlike the experiments reported subsequently). Wright and Baumeister (2015) developed brief measures (suitable for experience sampling) of feeling depleted and of having engaged in activities that could deplete regulatory resources. Both measures are imperfect proxies for depletion, each measuring a single aspect of a complex phenomenon. Feeling depleted is presumably often the result of doing depleting things, but it could also result from lack of rest, believing that recent events caused you to be depleted (Job, Dweck, & Walton, 2010), or other causes. In contrast, recent engagement in depleting events presumably causes depleted feelings much of the time, but perhaps not always. Participants filled out those and then expressed their current degree of inclination to perform various activities, which were selected as a diverse assortment that would include some highly active and other passive ones. The active activities were selected as requiring self-initiated responses (initiative), ongoing decision making and action control, physical movement, and/or effort expenditure, whereas the passive ones were chosen based on lacking those features. We also measured vitality, which is the state of feeling alive and alert and having energy available to

the self (Ryan & Frederick, 1997). The main predictions were that high reports of depleting actions and of feeling depleted would be linked to high preferences for passive activities, low preference for active pastimes, and low feelings of vitality.

Method

Participants

Three hundred ten participants (182 female) completed the study. Six participants were excluded for failing an attention check. They were recruited from Amazon's Mechanical Turk and were paid a small amount for participating. Sample size was chosen to have greater than 90% power to find a significant effect if $d = .4$.

Procedure

Participants completed the subjective vitality scale (Ryan & Frederick, 1997; seven items, $\alpha = .91$, e.g., "I feel energized. I feel alive and vital"), and depleted feelings (Wright & Baumeister, 2015; three items, $\alpha = .83$, i.e., "In the past couple of hours, have you felt that: It's hard to make up your mind about even simple things? Things are bothering you more than they usually would? You have less mental and emotional energy than you normally have?") and depleting events scales (Wright & Baumeister, 2015; three items, $\alpha = .67$, i.e., "In the last 60 minutes, have you: Forced yourself to do something that you didn't really want to do? Used self-control to stop yourself from doing something that you wanted to do [e.g., have you resisted desire or temptation]? Exerted mental effort to make decisions?"), all on 7-point Likert scales. Participants next were told that the study concerned what people feel "in the mood" to do at times. They reported the degree to which they would prefer to perform various passive activities (six activities: sleep, sunbathe, watch TV, knit, relax on the couch, listen to music; $\alpha = .52$) and active activities (seven activities: play a sport, cook, dance, write, debate politics, work out, solve a crossword puzzle; $\alpha = .74$), on 7-point Likert scales, presented in a random order. Last, demographic information was collected.

Results and Discussion

As predicted, the more that participants reported depleted feelings, $r(294) = .258, p < .001$, and the presence of recent depleting events, $r(296) = .253, p < .001$, the higher their preferences for passive behaviors, see Table 1.

Although depleted participants desired to be passive, depletion did not produce the expected concomitant desire to avoid being active. Recent depleting events tended to predict stronger preferences for active activities, $r(296) = .113, p = .051$. One possible explanation for this counterintuitive finding is that the relationship between depleting events and preferences for active activities may be a selection effect. People who particularly enjoy active activities may be more likely to have done an active (and depleting) activity recently. Therefore, people who did depleting activities would prefer active activities because of self-selection, not necessarily because depletion makes people prefer active activities. In support of this interpretation, depleted feelings did not predict preferences for active behaviors, $r(294) = -.012, p = .841$. Presumably, if depletion caused people to want to be active, the feeling of depletion would increase activity preferences, but it did not. Overall, the impact of depletion seemed to be an attraction to passivity rather than aversion to activity.

A mediation analysis lent further support to the idea that depletion is associated with a relative preference for passivity rather than activity. We computed a new variable for relative preferences by subtracting participants' preferences for passive behaviors from their prefer-

ences for active ones. We used PROCESS Model 4 (Hayes, 2013) to test for mediation using depleting events as the independent variable, depleted feelings as the mediator, and participants' relative preferences for active versus passive behaviors as the dependent variable. The significant indirect effect ($-.025, SE = .009, 95\% CI [-.04, -.01]$) indicated that depleting events were associated with stronger relative preferences for passive versus active activities because depleting events were associated with concomitant depleted feelings. The remaining direct effect was nonsignificant ($t = -.37, p = .71$), suggesting that depleted feelings fully mediated the relationship between depleting events and behavior preferences.

To compare activity preferences among depleted and nondepleted participants, we conducted a within-participants analysis. For this analysis, depleted feelings and depleting events were combined by averaging their scores ($\alpha = .644$). Type of measure (active vs. passive) was entered as a within-participants variable in a repeated measures ANOVA, with degree of depletion as a predictor. This within-participants analysis revealed that, overall, participants preferred passive ($M = 3.83, SE = 0.055$) to active behaviors ($M = 2.51, SE = 0.061$), $F(1, 301) = 365.89, p < .001$. This difference was influenced by the extent to which participants felt depleted, as evidenced by the significant interaction between the within-participants factor (ratings of passive and active activities) and depletion scores, $F(1, 301) = 11.206, p < .001$ (see Figure 1). Consistent with the correlations reported in Table 1, this additional analysis sup-

Table 1
Correlations Between Depletion, Vitality, and Preferences for Active vs. Passive Behaviors

Variable	1	2	3	4	5	6	7
1. Depleted feelings	—						
2. Depleting events	.475**	—					
3. Depletion combined	.865**	.855**	—				
4. Vitality	-.524**	-.232**	-.444**	—			
5. Active	-.012	.113†	.062	.410**	—		
6. Passive	.258**	.253**	.309**	-.107†	.301**	—	
7. Active – Passive	-.226**	-.109†	-.189**	.444**	.626**	-.556**	—
<i>M</i>	8.78	10.27	3.19	19.99	17.21	22.79	-1.32
<i>SD</i>	4.72	4.57	1.34	9.80	7.23	5.84	1.22

† $p < .10$. ** $p < .01$.

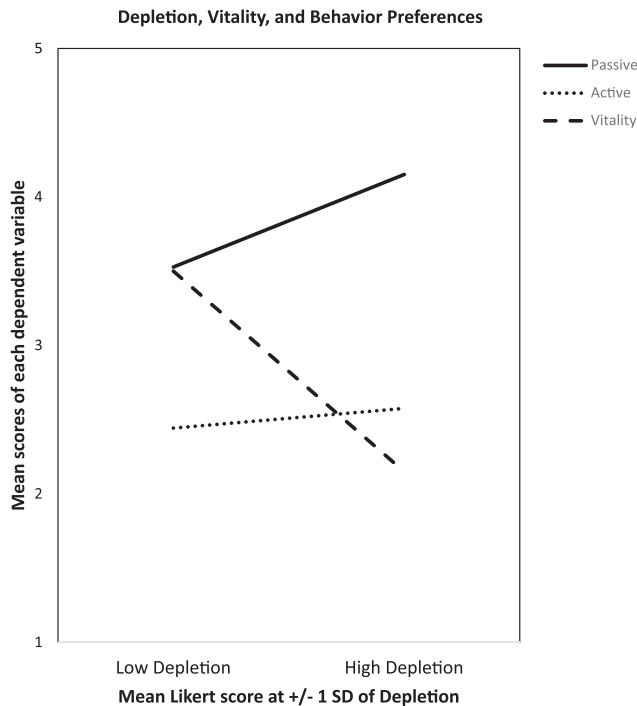


Figure 1. More depleted participants (one standard deviation above the mean of six depletion items) favored more passive activities and felt less vital than less depleted participants (one standard deviation below the mean of the depletion items).

ported the hypothesis that depletion was associated with stronger preferences for passive behaviors.

Because the measure of preferences for passive activities had low internal consistency, we unpacked the scale into its individual items. Depleted feelings were significantly associated with preferences for the four of the six passive activities (sleep, $r = .39$, $p < .001$; sunbathe, $r = .13$, $p = .033$; knit, $r = .16$, $p = .009$; relax on the couch, $r = .13$, $p = .023$; watch TV, $r = -.007$, $p = .90$; listen to music, $r = -.046$, $p = .43$). Meanwhile, depleted feelings were not significantly associated with preferences for any of the active activities (play a sport, $r = -.086$, $p = .14$; cooking, $r = -.05$, $p = .40$; dance, $r = .04$, $p = .53$; write, $r = .07$, $p = .22$; debate politics, $r = -.03$, $p = .65$; work out, $r = -.06$, $p = .30$; solve a crossword puzzle, $r = .02$, $p = .72$). Consistent with the aggregate measures, depleted feelings were associated with preferences for passive, but not active behaviors.

As predicted, more depleted feelings were associated with less vitality, $r(294) = -.524$,

$p < .001$. Recent depleting events also predicted less vitality, $r(296) = -.232$, $p < .001$.

Thus, Study 1 found increased preference for passivity, as well as reduced vitality, among people who reported feeling depleted or who reported having engaged in depleting activities recently. People preferred passive activities to active ones, especially when they were depleted. To be sure, people have many reasons for preferring one activity to another, and depletion may not change an Olympian into a couch potato (as supported by the modest size of correlations found in this study). Nonetheless, despite people's intrinsic preferences for some activities over others, feeling depleted was associated with a shift toward preferences for more passive activities in general. Depletion did not generally alter preferences for active activities. Indeed, the only (marginally significant) finding was that people who had been doing strenuous things expressed a mild preference for further active activities. Because Study 1 used a correlational design, it cannot address

causality. Two subsequent experiments were conducted to test for causality.

Study 2: Postponing Decisions

Study 2 tested the hypothesis that self-control depletion would cause passivity in decision making. Prior work has established that after making decisions, self-control is impaired (Vohs et al., 2008), and after acts of self-control, decision making shifts toward simpler, easier, and more heuristic processes (Pocheptsova et al., 2009). Study 2 sought to carry that line of work further. We predicted that after engaging in self-control (and diminishing their executive resources), participants would postpone making decisions.

Method

Participants

One hundred fifty-nine undergraduates participated in a two-cell (depletion vs. no-depletion) between-participants design. The study was run for a week in the lab and the sample size was determined by the number of students who elected to sign up for a study that week. The resulting sample size had 80% power to detect an effect size of $d = .447$.

Procedure

Participants first were told that the session involved different experiments. Their initial task manipulated attention control and hence self-regulatory resources (Schmeichel, Vohs, & Baumeister, 2003). Participants watched an audioless video of a woman being interviewed. Irrelevant words (e.g., hair, sky) periodically appeared onscreen for 10 s each. In the depletion condition, participants were instructed to focus on the woman and avoid the words. Thus, they had to regulate their attention to curtail the tendency to look at the novel stimuli. In the neutral condition, participants were simply told to watch the film. Next, participants were asked to imagine going shopping for a digital camera. The screen showed two options (which were approximately equally good), along with product names and features. Specifically, participants were told the following:

Imagine that you would like to buy a digital camera. At the store you normally shop, you find the following

two alternatives. You also have the option of not buying either of them and looking for a digital camera at another store.

Participants were further told that the cameras did not differ on price.

The cameras were described using seven attributes (zoom, display size, memory, picture resolution, weight, battery life, and extras) and differed on three of these last attributes. Two models of a real camera brand (Canon) were chosen to enhance the realism of participants' choices. The attributes were presented in a 2×7 matrix using MouselabWeb software (<http://www.mousewelabweb.org>, Willemsen & Johnson, 2010). To view the attributes, participants moved the computer cursor over a box (an action termed "mousein") showing the attribute name. When the cursor hovered over the box, it displayed information about that attribute. If the cursor moved out of the box ("mouseout"), the information was hidden again.

While viewing the page with product descriptions, participants chose whether to continue searching or choose one of the two options. Three buttons at the end of the page represented the following choices: "Prefer to continue searching and decide in the future," "Choose Canon PowerShot SX 210IS," and "Choose Canon PowerShot S90." The main dependent measure was decision deferral, operationalized as whether participants chose either camera versus declined to make a choice (indicating that they would postpone the decision into the indefinite future). MouselabWeb recorded the time of each box opening and closing so we could calculate the length of time participants spent examining the available information about attributes. We also recorded the number of mousein and mouseout actions.

Results

As predicted by the passivity hypothesis, depleted participants were significantly more likely than nondepleted controls to fail to come to a decision and instead to leave the choice until some unspecified future time (57.9% vs. 42.2%), $\chi^2 = 3.93, p = .047; r = .16$. Thus, the hypothesis that depletion increased passivity was supported in the sphere of decision making.

Exploratory analyses tested the relationship between decision deferral and time spent on various parts of the task. The difference be-

tween the conditions in decision postponement was not due to length of time spent on the web page when they were not looking at the attributes (time between mouseout and mousein actions) nor due to the number of times looking at the attributes (number of mousein and mouseout actions), because neither duration nor number of times looking at the attributes varied by condition ($t_s < 1$). However, duration of time looking at each attribute (time between clicking on an attribute and moving the cursor away from the attribute) did vary by condition. Depleted participants spent more time looking at the attribute information displayed than nondepleted participants ($M_{\text{depletion}} = 11.35$ s, $SD = 5.42$, 95% CI [10.11, 12.59]; $M_{\text{no-depletion}} = 10.26$ s, $SD = 4.60$, 95% CI [9.26, 11.26]), $t(157) = 2.12$, $p = .035$, $d = 0.21$.

One possible explanation for why depleted participants spent more time on the attribute information is that depleted participants were thinking carefully to make their decisions and thus arrived at no decision. However, further exploratory analyses suggested that careful thinking did not explain the found effect of depletion on choice deferral. To test this, we ran a bootstrapping mediation analysis (Model 6, Hayes, 2013) using 10,000 bootstrap samples, with both time spent looking at the attributes and time spent not looking attributes as potential mediators. Although the direct effect of depletion on deferral rate remained significant ($\beta = -.78$, 95% CI [-1.44 to -.12], none of the indirect effects were significant (time looking at the attributes: $b = .09$, 95% CI [-0.01 to .33], time not looking at the attributes: $b = .04$, 95% CI [-0.03 to .25]). Thus, although depleted participants spent more time looking at attribute information, which could imply more thinking, that time spent did not mediate the effect of depletion increasing decision deferral. If depleted participants were thinking more, that thinking did not significantly aid them in ultimately making a decision.

Discussion

When the choice options are both attractive but differ on several attributes, choice among them requires initiative, while avoidance in engaging in attribute trade-offs leads to choice deferral (Dhar, 1997). Consistent with our proposition that depletion leads to more inaction

rather than action, depleted participants who contemplated making a choice between the alternatives were more likely (than nondepleted participants) to postpone making a choice.

Although depleted participants exhibited passivity or lack of action, they did not simply avoid relevant choice information. Depleted persons did not increase their off-task time (as indicated by time spent looking at the website overall). They did, however, spend more time with each piece of relevant information displayed onscreen, and at the end of this process indicated that they had failed to reach a decision and would leave the choice until later. This pattern is consistent with past literature in which depleted people spent equal or more time making decisions and this extra time on the choice tasks did not lead to better choice outcomes (Levav et al., 2010; Pocheptsova et al., 2009, Studies 3 and 4). Moreover, it is consistent with the idea that depletion interferes with active mental processing.

Study 3: Difficult or Easy Eating

Eating is a context that is often studied within self-control paradigms because many people try (with limited success) to control their eating, making it a common but difficult self-control task (Herman & Polivy, 2011). Eating also has the quality of requiring more or less impulse control, depending on the ease of eating. From Schachter and Rodin (1974) to Wansink (2014), research has shown that people who are overweight make it relatively easy to overeat, such as by using utensils as opposed to chopsticks and choosing a seat near the buffet.

Study 3 created a situation wherein eating was either easy or difficult to enact. Prior research has shown that depletion causes increases in many kinds of activity, including eating (Kahan, Polivy, & Herman, 2003; Vohs & Heatherton, 2000). Study 3 aimed to reconcile the fact that prior research has shown that depleted people become behaviorally disinhibited (i.e., show more activity, such as overeating) with our thesis that depletion also can make people passive. Study 3 used a different manipulation of depletion (overriding the habit of crossing out occurrences of the letter *e* on pages of text) and measured initiative versus passivity based on the amount of food consumed. The dependent measure was adapted from early

work by Schachter and Rodin (1974): Participants took an ostensible taste test involving peanuts either with or without shells. Eating peanuts in shells takes more active participation than eating ones without shells.

The hypothesis was that depletion increases mental passivity, thereby reducing top-down control and increasing automatic responses, whether action or inaction. Depletion would reduce eating when eating was relatively effortful (peanuts in shells). In contrast, depletion and the resulting mental passivity would disinhibit eating when it is relatively effortless (no shells)—provided, of course, that there is an impulse to disinhibit. We assessed participants' level of hunger, on the assumption that only hungry participants would have the urge to eat. Among such individuals, we predicted that depletion would decrease eating of peanuts with shells but increase the (easy) eating of peanuts without shells.

Method

Participants

One hundred forty-three undergraduates (95 women) participated. We aimed to collect data from at least 120 participants, and continued data collection through the end of the semester. The study had 80% power to detect an effect of size $f^2 = .10$ for each main effect and interaction. One participant was excluded for ignoring instructions. Two participants were excluded for drinking coffee during the taste test. The design was a 2 (depletion vs. no-depletion) \times 2 (peanuts: with shells vs. without shells) between-participants design, with a continuous individual difference factor of hunger.

Procedure

Participants' first task manipulated self-control resource depletion. All participants practiced crossing out instances of the letter *e* that appeared on a piece of text. Then participants were given a second page with instructions that varied by condition. No-depletion condition participants continued their habit of crossing out every *e*. Depletion condition participants were instructed to cross out every *e* except if it was followed by a vowel or a vowel appeared two letters before the *e*. The purpose

of this manipulation is that participants in the depletion condition must repeatedly and effortfully override their automatic response to cross out every *e* (Baumeister, Bratslavsky, Muraven, & Tice, 1998).

Next, participants began a taste test. They rated their current hunger level on a 10-point Likert scale ranging from *not at all hungry* to *very hungry* before being given bowls of unsalted dry roasted peanuts (115g \pm 1), saltine crackers (36.2g), and ratings sheets. Saltines were included with the peanuts to reduce possible suspicion about a taste test with only a single type of food, but the a priori predictions were about peanut consumption. Items on the taste test form were constructed to appear like legitimate 5-point Likert style taste test questions: for example, "How appealing are these peanuts to you? How much do you like the taste/flavor of this food? How do you like the texture of this food? How salty is this food to you? How likely would you be to buy this food in the store? How do you like the feel of the food in your mouth?" The experimenter instructed participants to rate the foods and, as exiting, casually mentioned that they could eat as much as they liked. After 6 min, the food was cleared and participants completed a six-item measure of mental tiredness, the Multidimensional Fatigue Symptom Inventory Mental Fatigue Subscale (Smets, Garssen, Bonke, & De Haes, 1995). Unbeknownst to participants, a research assistant weighed the bowl of peanuts before and after the taste test, and subtracted the post- from the preweight to determine the amount eaten.

Results and Discussion

We regressed grams of peanuts eaten on centered participants' hunger ratings, depletion condition, shells condition, and all interactions ($R^2 = .17$). As predicted, there was a significant interaction among the three predictor variables ($B = -4.28$), $t(133) = 2.96$, $p = .004$. Controlling for the three variable interaction, there also was a significant hunger by depletion interaction ($B = 3.09$), $t(133) = 3.44$, $p < .001$, indicating that depletion had different effects on consumption for hungry versus unhungry participants. The other two interactions and main effects were not significant (i.e., the hunger by shells interaction, $B = 1.32$, $t[133] = 1.33$, $p =$

.185; the depletion by shells interaction, $B = -2.98$, $t[133] = 0.996$, $p = .32$; the main effect of hunger, $B = -.46$, $t[133] = 0.67$, $p = .51$; the main effect of depletion, $B = .32$, $t[133] = .16$, $p = .88$; the main effect of shells, $B = -1.02$, $t[133] = .47$, $p = .64$). Analyses of the simple effects (with high and low hunger levels at ± 1 standard deviation beyond the mean) revealed support for the hypotheses (see Figure 2). For descriptive statistics, see Table 2.

Hungry Participants

Figure 2 shows the results for hungry participants (one standard deviation above the hunger mean). When depleted, they ate significantly more when the peanuts were easy to eat than when difficult ($B = -10.45$), 95% CI $[-16.71, -4.18]$, $t(133) = 3.30$, $p < .001$. This supports the main hypothesis that depletion induces mental passivity, causing inaction: Even when they were hungry, depleted participants were less willing to open peanut shells in order to get to some food. It is not that depletion reduced hunger, as indicated by the high consumption by depleted participants in the easy-to-eat condition, and by the lack of difference in hunger ratings between depletion ($M = 4.39$, $SE = .25$, 95% CI $[3.89, 4.89]$) and no depletion ($M = 4.67$, $SE = .27$, 95% CI $[4.15, 5.20]$) conditions, $F(1, 134) = .60$, $p = .44$. When hungry participants were not depleted, they ate about the same amount regardless of ease of eating ($t < 1$, ns). Thus, active versus passive responding was only relevant to the eating of depleted persons.

We also examined comparisons within the peanut condition. Hungry participants ate more of the easy-to-eat peanuts when depleted than when not depleted, consistent with the usual depletion effect of disinhibition ($B = 7.06$), 95% CI $[1.60, 12.52]$, $t(133) = 2.56$, $p = .012$. This effect was however eliminated, indeed almost reversed, when the peanuts were difficult to eat, as hungry participants ate nonsignificantly fewer difficult-to-eat peanuts when depleted than when nondepleted ($B = -5.25$), 95% CI $[-11.86, 1.36]$, $t(133) = 1.57$, $p = .12$.

These findings support the hypothesis that depletion reduces top-down control. These participants were motivated to eat (i.e., were hungry). Depletion disinhibited them, so they ate more if eating was easy. But depletion also produced passivity in the face of external demands for effort. When eating required effort to break the shells, depletion failed to increase eating among hungry participants, and indeed the trend suggested it made them eat less.

Not Hungry Participants

Eating amounts did not vary much among not hungry participants. The only significant effect was that participants tasting peanuts without the shell ate significantly less when depleted than when not depleted ($B = -6.41$), 95% CI $[-12.20, -.62]$, $t(133) = 2.19$, $p = .030$. All other contrasts ($ts < 1.23$). Thus, when motivation to consume was low, depletion and difficulty were irrelevant (see Figure 2).

Overall, the results were also consistent with motivational intensity theory (Brehm & Self,

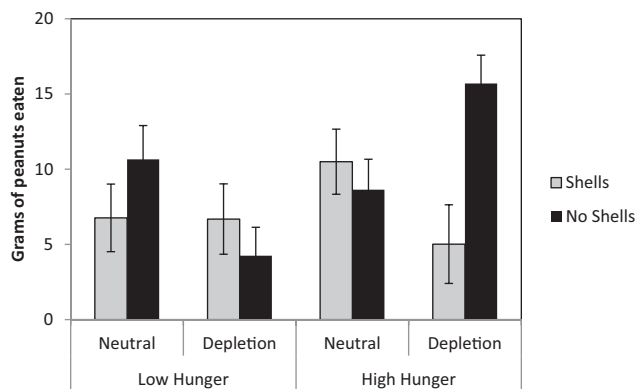


Figure 2. Consumption of peanuts by condition, among hungry and unhungry participants (one standard deviation above and below the mean of hunger).

Table 2
Descriptive Statistics for Study 3

Variable	<i>M</i>	<i>SD</i>
Peanuts eaten (grams)	8.60	9.51
Crackers eaten (grams)	10.91	7.82
Mental Fatigue Index	2.23	.81
Hunger before taste test (1 to 10 scale)	4.84	2.18
Hunger after taste test (1 to 10 scale)	4.52	2.13

1989). According to this theory, motivation increases with perceived effort until the perceived effort becomes so high that the task is insufficiently rewarding to merit further effort. Depletion is assumed to increase perceived effort (Wright, 2014). Thus, depletion would make participants more motivated to eat peanuts, as long as they were hungry and the effort required to eat the peanuts was relatively low. However, in the shells condition, participants were hungry, but the perceived effort required to eat the peanuts was higher, because of the shells. One way of interpreting the results is that participants might have perceived that the reward of eating peanuts was lower than the potential effort costs of opening the shells. However, we measured eating, which does not necessarily track effort. Therefore, although the results are consistent with the motivational intensity theory, this experiment more directly tested the limited resource model.

General Discussion

The central conclusion is that ego depletion produces a state of mental passivity. This does not necessarily mean that the person physically does nothing. Rather, either physical stillness or impulsive hyperactivity can both flow from mental passivity, depending on the situation. The depleted person seems not to exercise top-down mental control over behavioral responses, as compared with other persons. Lacking initiative, the person may sometimes indeed sit still. But an impulsive depleted person may act vigorously on those impulses, without the restraining influence of inhibitory executive control.

Depletion made people less selective in what they chose to do. Although depleted people's strongest preferences were to do passive, energy-saving activities, in their passive state, they could also be compelled to do energy-intensive

activities. In Study 2, depleted people devoted plenty of time to reading information about cameras—but without ultimately completing the task of choosing which camera they preferred. This is consistent with past research showing that depletion undermines people's ability to select tasks appropriate for their depleted mental state (DeWall, Baumeister, Mead, & Vohs, 2011). Indeed, it fits much evidence that making decisions requires effort expenditure (e.g., Vohs et al., 2008).

Study 3 revealed that the same activity (eating) either can increase or decrease in the depleted state, depending on whether the activity requires active effort and on whether the person is motivated to eat. This corroborates and builds on Carver et al.'s (2008) dual process model, which states that behavior can be predicted by the degree of reflection versus impulsivity along with the reward value of the stimulus. After following challenging rules requiring them to first form and then break a habit, hungry participants showed two different patterns in two different conditions, such that one pattern showed depleted persons to increase eating while the other showed decreased eating. (Meanwhile, participants who were not hungry ate about the same amount regardless of ease and depletion.) What determined whether depleted, hungry participants ate much or little was how difficult it was to get access to the food. Even the small requirement of having to crack the shells in order to get at the peanuts was enough to discourage depleted participants from getting the food they wanted. But when no shelling was required, hungry, depleted persons ate more than nondepleted ones. These findings confirm the effects in the Carver et al. (2008) theory, both more passive and more impulsive.

These findings also corroborate and extend upon the results of Giacomantonio, Jordan, Fennis, and Panno (2014). Their study involved either pushing a button or pumping a bicycle pump in order to fill virtual balloons worth rewards. The balloons would sometimes pop if pumped too full. Hence, pumping involved some risk. They found that depletion made people take greater risks in the pursuit of reward when doing so was physically easy (pushing a button). Like participants in our peanut study (3), depletion increased reward pursuit when rewards were immediate and easy to attain. In these situations, depletion led to action, presum-

ably because action was the default and automatic response. In the shells condition of the peanut study, eating involved more effortful override of the default passive response. Depletion again increased the default response, to be passive and not open the shells. Similarly, depletion in the bicycle pump condition led to the tendency to be passive and pump the balloons less. In some ways, the peanut study was a more direct test of the passivity hypothesis. Passive behavior in the balloons study could result from a propensity to be passive, but it could also result from a propensity to avoid risk. However, there is little risk to avoid in eating peanuts. Thus, one benefit of the present studies was their varied methods in demonstrating the effect of depletion on passive behavior. Across multiple methods, the present studies provide further evidence that depletion increases passive behavior when immediate rewards are not present or are difficult to obtain.

Ego depletion leads to mental passivity, which can impair self-control in two ways, depending on the default response: increase passive responding or increase impulsive responding. In contrast, counteractive self-control is a set of strategies people engage in to aid themselves in pursuing long term goals, especially in the face of short term temptations (Trope & Fishbach, 2000). For example, people can impose fines on themselves if they fail to adhere to a three day fast as part of a medical procedure, thereby increasing the likelihood that they will successfully complete the fast (Trope & Fishbach, 2000). Presumably, one reason why self-imposed fines are helpful is they change the automatic response people have when they actually have to make the decision—the fine makes the otherwise tempting option much less appealing. For another example of counteractive self-control, health conscious exercisers devalue the appeal of chocolates compared to healthy foods when making health-related decisions (Myrseth, Fishbach, & Trope, 2009). This strategy might also work because it shifts the automatic response to the chocolate; chocolate is less tempting if it is less appealing. Ego depletion leads to increased reliance on default responses, and counteractive self-control proactively changes those responses to be better aligned with one's long term goals. Therefore, counteractive self-control strategies may be particularly important when people are depleted,

though to our knowledge this prediction has not yet been tested.

Both the limited resource model (Baumeister et al., 1998) and motivational intensity theory (Brehm & Self, 1989) assume that people conserve energy or effort, and this affects how they regulate their behaviors. Motivational intensity theory is primarily concerned with how situations affect effort and is often tested using physiological measures (e.g., Agtarap, Wright, Mlynski, Hammad, & Blackledge, 2016). The limited resource model, by contrast, has mostly been tested in terms of depletion's behavioral consequences. The present research suggests that the two models, while distinct, are largely compatible in that they make similar predictions about the effects of depletion on effort. However, the scope of the motivational intensity model is broader, explaining why effort is sometimes low even when people having plentiful self-regulatory resources. Additionally, the motivational intensity model assumes that depletion's effects on effort result from it increasing people's perceptions of task difficulty, such that their motivations change. This motivational explanation is more consistent with the process model (Inzlicht & Schmeichel, 2012, discussed below) than the limited resource model. Future research testing predictions that differ between motivational intensity theory and the limited resource model could provide valuable information about the mechanism behind ego depletion, which remains an unsettled research question (see Baumeister & Vohs, 2016; Inzlicht & Schmeichel, 2012; Job, Dweck, & Walton, 2010).

Although the present article is framed from the theoretical perspective of the limited resources model (Baumeister, Vohs, & Tice, 2007), it is worth discussing how the results pertain to alternative models of ego depletion (i.e., Inzlicht & Schmeichel, 2012; Job, Dweck, & Walton, 2010).

Process Model

The process model (Inzlicht & Schmeichel, 2012) holds that ego depletion results from shifting motivational processes. As a person engages in self-control to perform a "have to" task, over time one's motivation gradually shifts to a "want to" task. Simultaneously, one's attention begins to shift away from task-oriented demands to cues of reward and gratification that

are often associated with other “want to” tasks. In many situations, the process model and the limited resource model make similar predictions. For example, the process model would also predict that depletion might cause passivity. Many passive activities are enjoyable “want to” kinds of tasks. Indeed, in one experience-sampling study, the most intense desire people had was to sleep (Hofmann, Vohs, & Baumeister, 2012). The process model might also explain the appeal of active activities such as sports in the wake of depleting events, as sports are often “want to” tasks. The process model is also consistent with the peanut study’s findings that depleted people ate more easy to eat peanuts, but fewer difficult to eat peanuts, because eating peanuts is presumably a “want to” task, whereas opening shells is not. It is less clear how the process model would predict the results of Study 2, in which people postponed final decision-making about products despite spending the time to review information about the products. It is unlikely that people thought that gathering information about products was a “want,” but deciding on a product was a “need.”

Implicit Theories of Willpower

Another theoretical perspective on ego depletion is the idea that people’s implicit theories about whether willpower is limited or unlimited affect their behavior in response to depletion (Job, Dweck, & Walton, 2010; Job, Walton, Bernecker, & Dweck, 2015). According to this model, people who believe their willpower can be depleted by short tasks behave as though it has been depleted. One limitation of the present research is that because it did not measure implicit willpower theories, it cannot test the predictions of this model. Past research suggests that believing in limited willpower can increase passive resting (Job, Bernecker, Miketta, & Friese, 2015) and impulsivity (Job, Dweck, & Walton, 2010). Future research should test whether these effects are also moderated by the presence of immediate reward.

We noted earlier that some writers have questioned the existence of ego depletion effects, based in part on a single failure to replicate (Hagger et al., 2016). Such questions make it imperative to report further evidence. The present findings provide further evidence of the reality of ego depletion, as they yielded signif-

icant differences in the direction predicted by the theory. We stipulate that we also conducted additional studies, not reported here, and they too found significant effects consistent with the theory. The continuing accumulation of significant findings consistent with ego depletion is increasingly difficult to reconcile with the hypothesis that there is no such phenomenon.

Limitations and Future Directions

The surprising finding of Study 1 was that people who recently did depleting things preferred active (as well as passive) activities. We argued that the most likely explanation for this pattern is a selection effect—that people who prefer active activities are more likely to have recently done something depleting. Future longitudinal examinations of depletion might provide causal evidence in support of this idea that individual differences might account for people’s preferences.

Study 2 showed that depleted people spent more time evaluating decisions, only to fail to come to a final decision. This finding is consistent with past findings that depleted people spend equal or more time making decisions as nondepleted people, but that this extra time on the choice tasks does not lead to better choice outcomes (Levav et al., 2010; Pocheptsova et al., 2009). Contrarily, shorter rather than longer decision times often leads to simplified decision strategies (Dhar & Nowlis, 1999; Dhar, Nowlis, & Sherman, 2000). One intriguing possibility is that the mental passivity brought about by depletion may impair people’s ability to monitor the strategies they use to make decisions (Carver & Scheier, 2001). Although usually longer decision times lead to more complex and better decisions, depletion appears to degrade the decision-making process in two ways—making it both slower and less effective. If people were strategically approaching the task, one would expect them to realize that they were unlikely to make a decision in their passive state of mind, and therefore not spend so much time contemplating their decision. But in the depleted state, the mind may be too passive to notice its own impairment. Future research should investigate why depleted people seem to lack the appropriate strategic response to decision making.

Conclusion

The present findings extend the concept of volition beyond self-regulation and choice, to encompass active responding. Taking the initiative to choose effortful activities, to make a decision rather than postpone it, and even to satisfy one's hunger when eating requires effort, is apparently difficult for and unappealing to people whose self-regulatory resources are low.

Volition is a key aspect of the human self (e.g., Baumeister, 1998). Decision making and self-regulation have long been recognized as key aspects of volition. Apparently, taking initiative to respond actively is another important aspect. Much prior work has shown that when the self's energy is low, it ceases to regulate behavior effectively and makes decisions based on simple, easy processes. The present findings extend that work to suggest yet another consequence of depleted resources: The self starts to favor doing nothing.

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