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The Impact of Illusory Fatigue on Executive Control: Do Perceptions of Depletion Impair Working Memory Capacity?

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Abstract

The human mind is quite adept at modifying and regulating thoughts, judgments, and behaviors. Recent research has demonstrated that depletion of self-regulatory resources can impair executive function through restriction of working memory capacity. The current work explored whether the mere perception of resource depletion (i.e., illusory fatigue) is sufficient to directly produce these deficits in executive control. To manipulate illusory fatigue, participants were exposed to a depleting or nondepleting task before being presented with false feedback about the effects of the initial task on their state of resource depletion. Participants then completed a well-established index of working memory capacity. Findings revealed that individuals provided with feedback that led to perceptions of low depletion exhibited greater working memory capacity. This effect was independent of individuals' actual state of depletion and was furthermore mediated by their perceived level of depletion. Implications for spontaneous resource replenishment are discussed.

Keywords

self-regulation, executive control, metacognition, resource depletion

Perception can be a powerful force. Indeed, considerable research has studied people's *subjective* sense of numerous phenomena—such as certainty in one's attitudes (Tormala & Rucker, 2007), confidence in one's beliefs (Briñol & Petty, 2004), ease with which one's thoughts come to mind (Alter & Oppenheimer, 2009), even bias in one's beliefs (Wegener & Petty, 1997)—because such perceptions can (and often do) lead to important consequences for judgment and behavior, independent of objective "reality" (see Petty, Briñol, Tormala, & Wegener, 2007, for a review).

Recently, work within the area of self-regulation has shown the power that perceptions have for affecting self-regulation—specifically, that self-regulatory performance can be driven by the mere perception of mental resource availability (i.e., *illusory fatigue*: Clarkson, Hirt, Jia, & Alexander, 2010). Across four studies, Clarkson et al. (2010) demonstrated that the perception of low depletion enhanced self-regulatory performance, whereas the perception of high depletion impaired self-regulatory performance. Notably, these differences in subjective perceptions occurred independently of actual level of depletion. Thus, individuals who should have resources available were unable to successfully self-regulate their behavior (e.g., low-depleted individuals who perceived themselves as depleted), whereas individuals who should not have resources available were able to successfully self-regulate their behavior (e.g., highly depleted individuals who perceived themselves as less depleted). Furthermore, this pattern was demonstrated across a diverse array of regulatory behaviors (e.g., problem solving, attention regulation, information processing).

Although the Clarkson et al. (2010) findings showcase the importance of perceptions on self-control, it remains unclear why the mere perception of depletion is affecting self-regulatory behavior. The present research attempts to offer insight into the mechanism underlying this effect. Specifically, we tested the possibility that people's allocation of their cognitive abilities—defined herein as working memory capacity (Schmeichel, 2007)—varies as a function of their perceived resource depletion.

Executive Control as a Mechanism of Self-Regulation

Considerable research has shown that self-regulatory abilities depend on a limited supply of cognitive resources (see

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Baumeister, Schmeichel, & Vohs, 2007, for a review). Recent work has linked this limited supply of cognitive resources to people's *working memory capacity*—broadly defined as the capacity to temporarily store and manipulate information (Baddeley, 1986; Just & Carpenter, 1992). Specifically, researchers have demonstrated that restrictions in working memory capacity directly impair self-regulatory performance (Schmeichel, 2007; Schmeichel, Volokhov, & Demaree, 2008; Shamosh & Gray, 2007). For instance, individuals depleted (vs. not depleted) of their self-regulatory resources show restricted executive functioning in the form of poorer working memory performance (Schmeichel, 2007), and individuals who score low (vs. high) in working memory capacity display reduced emotion regulation (Schmeichel et al., 2008). Thus, although working memory capacity is primarily an index of executive functioning that may or may not be allocated to subsequent tasks of self-control (see Engle, 2002), recent research suggests that working memory can be allocated to subsequent tasks of self-control and as such can serve as an apt operationalization of people's limited cognitive abilities.

Moreover, though many view working memory capacity as a stable individual difference variable, recent work highlights the impact of contextual factors on working memory capacity. We know, for instance, that increasing the salience of one's gender or race is sufficient to affect the availability of cognitive abilities in terms of working memory capacity (Rydell, McConnell, & Beilock, 2009; Schmader & Johns, 2003). Similarly, increasing performance expectations can affect working memory capacity (Beilock & Carr, 2005). Thus, salient cues can facilitate changes in working memory capacity. In the present research, we examine the possibility that the mere perception of depletion (over and above differences in actual depletion), like other contextual factors, can alter the accessibility of working memory capacity.

Evidence for a Direct Perception–Ability Link?

In addition to examining whether the mere perception of depletion can directly affect working memory capacity, a second goal of the present work was to explore the mechanism by which perceptions of depletion affect people's self-regulatory performance. Clarkson et al. (2010) argued that perceived depletion most likely affected participants' actual self-regulatory *abilities* and that these differences in ability were responsible for individuals' subsequent self-regulatory performance. Thus, Clarkson et al. posited a direct causal link between perceptions of depletion and self-regulatory performance through impaired access to cognitive abilities.

However, a viable alternative perspective is that these perceptions influence self-regulatory behavior by affecting people's *motivation* to engage in subsequent tasks. Indeed, motivation can have important consequences for self-regulatory success, as heightened motivation can counteract the deleterious effects of depletion (Muraven & Slessareva, 2003; Muraven, Shmueli, & Burkley, 2006). In light of this work, it seems quite plausible that the perception of high (vs. low) depletion decreases the motivation to engage in subsequent self-regulatory behavior, thus resulting in poorer performance.

In the Clarkson et al. (2010) work, however, neither participants' general motivation nor their motivation to conserve resources was affected by their paradigm; only perceptions of resource depletion affected self-regulatory performance, leading them to endorse an ability account. Moreover, in his studies, Schmeichel (2007) ruled out a motivational account for the effects of actual depletion on working memory capacity by illustrating that high and low-depleted individuals showed no difference in the amount of time spent (i.e., effort) on the working memory task. Such null effects cast doubt on the likelihood that the self-regulatory performance effects observed in the Clarkson et al. work were from differences in motivation. Nonetheless, given that several recent studies have found that motivation can affect working memory capacity (cf. Barch, Yodkovik, Sypher-Locke, & Hanewinkel, 2008; Heitz, Schrock, Payne, & Engle, 2008), we sought to empirically evaluate the viability of both a direct (i.e., ability) and an indirect (i.e., motivation → ability) mechanism.

Overview

In this study, we used the misattribution paradigm employed by Clarkson et al. (2010) to manipulate illusory fatigue. Specifically, we varied participants' actual state of depletion before providing situational feedback regarding the replenishing or depleting effects of an aspect of the initial task (i.e., the depletion manipulation). Actual resource depletion was manipulated by presenting participants with a letter-search task of varying levels of difficulty (cf. Baumeister, Bratslavsky, Muraven, & Tice, 1998). Following this task, participants were then informed that a specific aspect unique to the initial task—namely, the color tone of the paper on which they completed the letter-search task—has been shown to either replenish or deplete people's mental abilities. Participants then completed a revised version of a popular index of working memory capacity (Automated Operation Span Task [Aospan]; Unsworth, Heitz, Schrock, & Engle, 2005) as well as measures of their perceived depletion and motivation to engage in the working memory task. We also gathered assessments of participants' mood, given that prior work has shown mood to influence executive functioning (e.g., Spies, Hesse, & Hummitzsch, 1996).

Hypotheses

We anticipated an interaction between people's actual state of depletion and our feedback manipulation on working memory capacity. Consistent with Clarkson et al. (2010), we expected that low-depleted individuals who receive replenished feedback and high-depleted individuals who receive depleted feedback should perceive themselves as less depleted and thus exhibit greater working memory capacity. Thus, we expected participants' *perceptions* of resource availability to be determined by the interplay between participants' actual state of resource depletion and our situational feedback.

This prediction was based on the *resource attribution hypothesis* (Clarkson et al., 2010). According to this hypothesis, high-depleted individuals experience a concrete state of depletion that prompts them to search for information to *explain* their current state. For instance, in Schachter and Singer's (1962) classic studies, participants experienced a tangible state of physiological arousal before seeking situational information (e.g., the alleged side effects of the injection, the confederate's behavior in the waiting room) to explain it. Similarly, high-depleted individuals, when told that the paper is depleting (vs. replenishing), are predicted to misattribute their state of depletion to an aspect of the task (i.e., the color tone of the paper) and—when that aspect of the task (i.e., the paper) is subsequently removed—to base their perceptions on this misattribution (i.e., perceive greater resource availability).

Conversely, low-depleted individuals experience an ambiguous state of resource depletion that prompts them to search for information to *define and interpret* their current state. The hypothesis testing literature is replete with examples of confirmatory biases in hypothesis testing, such that individuals are likely to search for and obtain evidence consistent with their current hypothesis (Kunda, 1990). As such, low-depleted individuals, when told that the paper is depleting (vs. replenishing), are argued to treat this feedback as a viable hypothesis to test (e.g., "Am I tired and fatigued?"), engage in a hypothesis-consistent information search, and thus base their perceptions on this information search (e.g., perceive less resource availability).

In support of this hypothesis, Clarkson et al. (2010) found that high-depleted individuals perceived themselves as less depleted following the "depleted" feedback, presumably because the depleted feedback provided an apt *explanation* for their concrete state of high depletion. Conversely, low-depleted individuals perceived themselves as less depleted following the "replenished" feedback, presumably because the feedback served to *define* their ambiguous state of low depletion.[1] Thus, if the mere perception of depletion is directly affecting participants' *ability* to self-regulate, then we would expect to observe a similar interaction on working memory capacity.

Method

Participants

In partial fulfillment of a requirement for their introductory psychology courses, 91 Indiana University undergraduates participated. Participants were randomly assigned to conditions in a 2 (depletion: high vs. low) $\times$ 2 (feedback: depleted vs. replenished) between-participants design.

Procedure

Participants were informed at the outset that they would be participating in two unrelated tasks in the same experimental session. They were then randomly assigned to receive the depletion manipulation, ostensibly presented as a perceptual accuracy task. Immediately following the depletion manipulation, participants were randomly assigned to one of two feedback conditions. After the feedback manipulation, participants were presented with brief assessments of their current mood, perceived mental depletion, and motivation to engage in the remainder of the session before completing the working memory index. Participants were then debriefed and thanked for their time.

Independent Variables

Depletion manipulation. Participants were informed they would first complete a perceptual accuracy task consisting of two phases (adapted from Baumeister et al., 1998). In the first phase, participants were given 5 minutes to cross out every letter *e* they came across in a passage as quickly and accurately as possible. In the second phase, participants were given an additional 5 minutes to cross out the letter *e* in another passage in a way that either replicated the first phase (low depletion condition) or required participants to inhibit the previously trained response established in the first phase (high depletion condition). Specifically, participants in the high depletion condition were told to cross out every *e* except when another vowel follows the *e* in the same word (e.g., *read*) or when a vowel is one letter removed from the *e* in either direction (e.g., *vowel*). Important for our feedback manipulation, the texts used in both phases were printed onto yellow paper.

Feedback manipulation. After completing the perceptual accuracy task, a message appeared on the computer screen informing participants of the purported effect of the yellow paper on people's mental abilities. In the *depleted feedback* condition, participants were informed that recent research shows that this specific color exhausts people's mental abilities. In the *replenished feedback* condition, participants were informed that recent research shows that this specific color replenishes people's mental abilities. Importantly, the color yellow was not used in other aspects of the study.[2]

Dependent Measures

Mood. After the feedback manipulation, participants reported their current mood on Mayer and Gaschke's (1988) Brief Mood Introspection Scale. This scale gauges the extent to which participants currently feel each of 16 emotion-laden adjectives (e.g., sad, calm). Participants' responded to each adjective on 7-point scales anchored at *definitely do not feel* and *definitely feel*, and responses were averaged to form a composite index of mood ($\alpha = .83$).

Perceived depletion. Following the mood assessment, participants completed the four-item Mental Fatigue subscale of the Multidimensional Fatigue Inventory (Smets, Garssen, Bonke, & De Haes, 1995), a scale that focuses on one's ability to engage in mental activity (e.g., "It takes a lot of effort to concentrate on things right now"). Responses were obtained on 5-point scales anchored at 1 = *not true at all*, 3 = *somewhat true*, and 5 = *very true.* Responses were summed ($\alpha = .76$), such that higher scores indicated greater perceptions of mental fatigue.

Motivation. Participants then reported their degree of motivation to expend effort on the remainder of the study on two items adapted from prior research (Muraven & Slessareva, 2003). Participants responded to these items (e.g., ‘‘How much effort can you expend on the next task?’’) on 7-point scales anchored at *none at all* and *very much.* Responses were significantly correlated ($r = .53$, $p < .001$) and thus combined to create a composite index of motivation, such that higher scores indicated greater motivation to engage in the subsequent working memory task.

Working memory capacity. Finally, participants proceeded to our index of working memory capacity—Aospan (Unsworth, Heitz, Schrock, & Engle, 2005). This computerized task requires participants to remember sequences of letters while simultaneously answering basic math problems (e.g., $(2 \times 1) + 1 = ?$) within a certain response deadline window. Specific response windows for the math problems are set based on participants' personal performance in practice trials, thus controlling for individual differences in math ability. The test phase of the Aospan consists of 75 trials in which participants recall the content and position of letters individually presented on each trial while maintaining a satisfactory level of math performance (in terms of speed and accuracy). Aospan scores are calculated by summing the total number of trials from blocks in which the participant performed perfectly. Scores can range from 75 (correctly recalling all letters in correct sequence for all blocks) to 0 (making at least one mistake in all blocks). For a more complete description of the task, see Unsworth, Heitz, Schrock, & Engle, (2005).

We chose this task as our index of working memory capacity for three reasons. First, the Aospan task is shown to be a reliable and valid measure of *cognitive ability* (see Unsworth, Heitz, & Engle, 2005). Individuals high (vs. low) in working memory capacity perform significantly better on a variety of cognitive tasks (e.g., reading comprehension; Daneman & Carpenter, 1980), and working memory capacity is significantly impaired by variables known to affect cognitive ability (e.g., cognitive load; Lavie, Hirst, de Fockert, & Viding, 2004). Second, as noted, the Aospan controls for individual differences in math ability. Third, we thought it prudent to explore the effects of *perceived* depletion on working memory capacity by using the same task Schmeichel (2007) used to successfully demonstrate the effects of *actual* depletion on working memory capacity.

Results

Preliminary Analyses

Mood. We submitted the mood index to a two-way analysis of variance (ANOVA), with depletion and feedback conditions as the independent variables. Consistent with previous work (Clarkson et al., 2010), this analysis revealed no effects of the manipulations (all *p*s > .23).

Perceived depletion. The perceived depletion data were submitted to the same two-way ANOVA. This analysis revealed a significant main effect of depletion, $F(1, 87) = 4.23$, $p < .05$, which was qualified by a significant depletion $\times$ feedback interaction, $F(1, 87) = 31.54$, $p < .001$. In the low depletion condition, participants reported less mental fatigue in the replenished ($M = 8.95$, $SD = 2.57$), relative to the depleted ($M = 12.93$, $SD = 1.62$), feedback condition, $F(1, 87) = 20.63$, $p < .001$. In the high depletion condition, participants reported less mental fatigue in the depleted ($M = 10.92$, $SD = 2.21$), relative to the replenished ($M = 13.29$, $SD = 3.32$), feedback condition, $F(1, 87) = 10.99$, $p = .001$. This pattern of results is consistent with the illusory fatigue pattern reported by Clarkson et al. (2010).

Motivation. Finally, we submitted the motivation index to the same analysis, and, similar to the mood data, no differences were observed across conditions for either individual item or the composite (all *p*s > .23). Thus, participants' motivation to engage in the working memory task was not affected by the manipulations.[3]

Main Analysis: Working Memory

The primary purpose of the current research was to provide a direct test of the effect of our manipulations on participants' working memory capacity. Aospan scores were thus submitted to a depletion $\times$ feedback ANOVA. Neither of the main effects was significant (*p*s > .26). Consistent with perceived depletion data, however, a significant depletion $\times$ feedback interaction emerged, $F(1, 87) = 9.69$, $p < .01$. In the low depletion condition, participants demonstrated greater working memory capacity in the replenished ($M = 50.68$, $SD = 11.68$), relative to the depleted ($M = 40.33$, $SD = 12.35$), feedback condition, $F(1, 87) = 3.99$, $p < .05$. In the high depletion condition, however, participants demonstrated greater working memory capacity in the depleted ($M = 54.42$, $SD = 16.46$), relative to the replenished ($M = 44.00$, $SD = 18.29$), feedback condition, $F(1, 87) = 6.13$, $p < .02$.

For comparative purposes, we ran two external control conditions ($N = 26$) in which participants were exposed to the depletion manipulation but received no feedback regarding the effects of the yellow paper prior to completing the working memory task. Analysis of the control conditions revealed that individuals in the low depletion condition ($M = 53.50$, $SD = 8.23$) demonstrated greater working memory capacity than did individuals in the high depletion condition ($M = 42.30$, $SD = 12.67$), $t(24) = 2.74$, $p < .02$, replicating Schmeichel's (2007) findings regarding the effects of actual depletion on working memory capacity.

We then inserted the control conditions into the analysis and submitted Aospan scores to a revised depletion $\times$ feedback ANOVA. Again, neither of the main effects was significant (*F*s < 1). However, the depletion $\times$ feedback interaction was significant, $F(2, 111) = 7.63$, $p = .001$ (see Figure 1).[4] For individuals in the low depletion condition, orthogonal contrasts revealed that the depleted feedback condition showed significantly less working memory capacity than the replenished feedback or no feedback conditions, $F(2, 50) = 12.26$, $p = .001$, which did not differ from each other, $F < 1$. For individuals in the high depletion condition, orthogonal contrasts

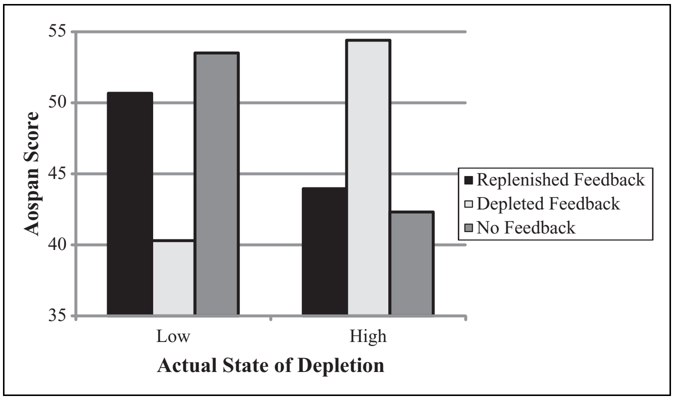

Figure 1. Aospan scores as a function of depletion and feedback
Higher scores indicate greater working memory capacity.

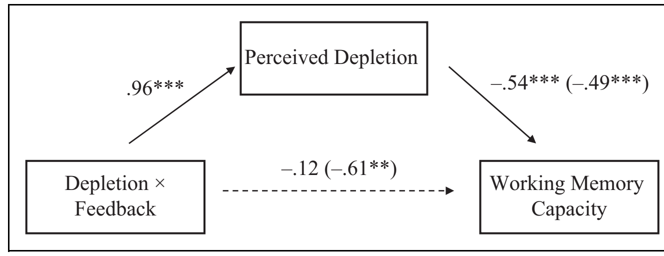

Figure 2. Significant path analysis of perceived depletion
Values in parentheses indicate standardized beta coefficients before controlling for other variables in the model. *$p < .05$. **$p < .01$. ***$p < .001$.

revealed that the depleted feedback condition showed significantly greater working memory capacity than the replenished feedback or no feedback conditions, $F(2, 61) = 6.21$, $p < .02$, which did not differ from each other, $F < 1$.[5]

Mediational Analysis

Finally, if the mere perception of depletion is indeed affecting working memory capacity, then we would expect participants' reported level of mental fatigue to mediate their results on the Aospan task. Furthermore, we included both the mood and motivation indices in all analyses to test the extent to which any effects of our manipulations on mental fatigue or working memory capacity, as well as any mediational impact of mental fatigue on working memory, were independent of any residual impact of mood or motivation. To test this hypothesis, we conducted a series of regression analyses, following the recommendation of Baron and Kenny (1986), treating the Depletion × Feedback interaction (controlling for the main effect terms as well as both mood and motivation) as the primary predictor variable. Consistent with the earlier analyses, there was a significant Depletion × Feedback interaction on both Aospan scores, $\beta = -.61$, $t(84) = -3.11$, $p < .01$, and perceived depletion, $\beta = .96$, $t(84) = 5.58$, $p < .001$. In addition, perceived depletion predicted Aospan scores, $\beta = -.49$, $t(89) = -5.27$, $p < .001$. When the Depletion × Feedback interaction (along with the main effect terms, the mood index, and the motivation index) and perceived depletion were entered into a simultaneous regression model predicting Aospan scores, perceived depletion continued to predict Aospan scores, $\beta = -.54$, $t(85) = -5.69$, $p < .001$, whereas the Depletion × Feedback interaction did not, $\beta = -.12$, $t < 1$ (see Figure 2). This mediational pathway from the Depletion × Feedback interaction to working memory capacity through perceived depletion was significant ($z = -3.95$, $p < .001$).[6]

Discussion

These findings provide compelling evidence of the impact of illusory fatigue on executive control. Consistent with the resource attribution hypothesis, low-depleted individuals given the replenished (vs. depleted) feedback and high-depleted individuals given the depleted (vs. replenished) feedback perceived themselves as less depleted, and this perception consequently led to greater working memory capacity, as demonstrated by mediational analyses. Thus, despite replicating Schmeichel's (2007) results in our control conditions (i.e., high—relative to low—*actual* depletion led to decreased working memory capacity), the mere *perception* of depletion was sufficient to overcome any difference in working memory stemming from actual depletion.

Moreover, these results occurred in spite of no differences in participants' motivation (or mood), further suggesting that the mere perception of resource availability can directly affect individuals' access to their cognitive abilities. Thus, although a considerable amount of work has focused on individual differences in working memory capacity (e.g., Barrett, Tugade, & Engle, 2004; Just & Carpenter, 1992), these findings coincide with other research suggesting that working memory capacity can be quite amenable to situational factors. Indeed, a growing literature suggests that working memory is susceptible to incentives (Heitz et al., 2008), cognitive demand (Lavie et al., 2004), and resource depletion (Schmeichel, 2007). This research demonstrates that the mere *perception* of resource depletion (independent of actual resource depletion) is sufficient to modulate the allocation of working memory resources.

That said, we acknowledge that the resource attribution hypothesis assumes at least some availability of self-regulatory resources following the completion of a depleting task. Specifically, the perception of low depletion should improve subsequent self-regulation only when resources still exist to be allocated. Thus, we would expect such perceptions to influence working memory only when individuals are not fully exhausted of their cognitive resources.

Furthermore, these findings support Clarkson et al.'s (2010) contention that inducing the perception of low resource depletion in high-depleted individuals *affords* access to mental resources that are otherwise unavailable, whereas the perception of high depletion in low-depleted individuals *restricts* access to mental resources that are otherwise available. In a similar vein, Martijn, Tenbült, Merckelbach, Dreezens, and de Vries (2002) showed that inducing the expectancy in depleted individuals that mental capacities do not need a break to replenish decreased subjective reports of fatigue and *afforded access* to mental resources that were otherwise unavailable. Of course, we acknowledge an important distinction between the *availability* and the *use* of executive resources, such that individuals who have resources available may or may not use those resources on subsequent tasks of effortful self-regulation (cf. Engle, 2002). Indeed Muraven et al.'s (2006) conservation paradigm illustrates individuals consciously not *using* their self-regulatory resources in spite of their *availability*. That said, the pattern of results in the current research suggests that access to cognitive ability—defined as working memory capacity—may account for the counterintuitive differences in self-regulatory performance observed in the Clarkson et al. and Martijn et al. studies. Specifically, these results suggest that the capacity to modify and regulate one's thoughts, judgments, and behaviors expands or contracts as perceptions of one's available resources increase or decrease, respectively. Similar to increasing performance expectations (Beilock & Carr, 2005) or the salience of one's social identity (Rydell et al., 2009), then, perceptions of resource depletion appear to serve as a contextual cue that alters self-regulatory performance by affecting the allocation of working memory.

Admittedly, the absence of effects on the motivational items does leave open the question as to the role that motivation plays in these processes. In spite of our efforts to use well-validated (cf. Muraven & Slessareva, 2003) and subtle indices of motivation,[7] our manipulations had no effect on motivation. Some might question the sensitivity of our motivation measures. The fact that motivation—when collapsed across conditions—was predictive of working memory capacity provides suggestive evidence against this argument.[8] Nonetheless, we recognize that a more sensitive (implicit) measure of motivation could potentially reveal less conscious motivational influences that our current measures could not.

However, it is not our argument that perceptions of depletion do not affect motivation. In contrast, we contend only that under certain circumstances perceptions can *directly* influence participants' cognitive abilities to successfully self-regulate. In fact, we readily expect that, under other circumstances, perceptions should affect individuals' motivation to use their resources to engage in self-regulation, such as when people are aware they will be completing multiple tasks and thus need to conserve their resources (Muraven et al., 2006).

Last, although these results offer insight into the process by which illusory fatigue affects self-regulatory behavior, we also believe this connection between resource perceptions and working memory capacity offers a potential mechanism for recently documented instances of *spontaneous resource replenishment*. That is, recent research has shown that the induction of a positive mood (Tice, Baumeister, Shmueli, & Muraven, 2007) as well as the act of self-affirmation (Schmeichel & Vohs, 2009) counteracts the adverse effects of regulatory depletion. Specifically, depleted individuals who are immediately put into a positive mood or self-affirmed are spontaneously able to self-regulate their behavior. Based on the current findings, we wonder if the experience of a positive mood or the act of self-affirmation induces the perception of low depletion and thus increases access to resources that would otherwise not be available (i.e., expanded working memory capacity). If so, then not just positive mood or self-affirmation but any variable that induces the perception of resource availability following an act of self-regulation should facilitate spontaneous resource replenishment and thus counteract the notoriously adverse aftereffects of successful self-regulation. For now, such speculation awaits future research.

Notes

1. In support of this claim, Hirt and Clarkson (2010) provide direct evidence that nondepleted individuals view their mental state as more ambiguous than depleted individuals. Following the e-search task, participants reported the degree to which they would describe their current mental state as ambiguous, vague, and unclear. Consistent with the resource attribution hypothesis, nondepleted participants reported higher overall state ambiguity than depleted participants, $t(31) = 2.25$, $p = .03$.
2. To test the believability of our feedback, a pilot study was conducted ($N = 36$) in which participants were presented with the same experimental manipulations described here before rating how convincing, credible, authentic, and believable they found the feedback ($\alpha = .93$). Two findings are worth noting. First, we observed no effects of our manipulations on participants' believability of the feedback (all Fs < 1). Second, the grand mean of believability ($M = 5.77$, $SD = 1.51$) was significantly greater than the scalar midpoint (5), $t(35) = 3.05$, $p < .01$, suggesting the feedback was viewed as equally believable across all conditions.
3. Given that motivation has been shown to directly affect working memory capacity (Barch, Yodkovik, Sypher-Locke, & Hanewinkel, 2008), we assessed the extent to which our motivation index predicted Aospan performance *across conditions*. Results revealed a marginal main effect of people's motivation on working memory capacity, $\beta = .17$, $t(114) = 1.84$, $p < .07$, such that participants' Aospan scores increased with their motivation. Although it is not significant, we believe the marginal correlation supports the veracity of the motivation index.
4. We also examined the time participants spent on the working memory task as an alternative, behavioral index of motivation (see Schmeichel, 2007). This analysis revealed only a trending main effect of depletion on time spent on the task ($p < .14$), such that participants in the high (vs. low) depletion condition tended to spend more time on the Aospan. Interestingly, these data run counter to the Aospan performance results, providing further support that participants' motivation does not account for changes in working memory capacity.
5. It is interesting to note that, in the low depletion condition, participants in the replenished feedback condition did not report greater working memory capacity than did the nondepleted control participants. Although such augmentation effects are notoriously difficult to observe (Feick & Rhodewalt, 1997), we believe this lack of augmentation may also be from the nature of our feedback, as the term *replenish* implies a return to one's baseline level of mental capacities. Perhaps a different term that more clearly implies the availability of resources beyond baseline (e.g., *energizes*, *bolsters*)

would have led to augmented working memory capacity relative to the nondepleted controls.

6. For interested readers, we tested the possibility that the Depletion × Feedback interaction influenced people's perceptions of depletion through their responses on the Aospan task. This alternative pathway, however, was not significant ($z = .71$, $p > .47$), further supporting the causal model presented.
7. See Note 4.
8. See Note 3.

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