Consciousness and Cognition 22 (2013) 1223–1230

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Resource depletion does not influence prospective memory in college students

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ARTICLE INFO

Article history:
Received 2 January 2013
Available online 8 September 2013

Keywords:
Prospective memory
Resource depletion
Self-control
Self-regulation
Delay interval
Executive control

ABSTRACT

This paper reports an experiment designed to investigate the potential influence of prior acts of self-control on subsequent prospective memory performance. College undergraduates (n = 146) performed either a cognitively depleting initial task (e.g., mostly incongruent Stroop task) or a less resource-consuming version of that task (e.g., all congruent Stroop task). Subsequently, participants completed a prospective memory task that required attentionally demanding monitoring processes. The results demonstrated that prior acts of self-control do not impair the ability to execute a future intention in college-aged adults. We conceptually replicated these results in three additional depletion and prospective memory experiments. This research extends a growing number of studies demonstrating the boundary conditions of the resource depletion effect in cognitive tasks.

1. Introduction

An impressive body of social psychology research has demonstrated that exertions of self-control, defined as effortful attempts to override one's automatic or habitual response tendencies (Baumeister & Vohs, 2003), negatively impact a wide range of subsequent behaviors and cognitive tests (see Hagger, Wood, Stiff, & Chatzisarantis, 2010, for a meta-analysis). According to the self-regulatory resource model (Baumeister, Bratslavsky, Muraven, & Tice, 1998), such impairment occurs because exertions of self-control expend cognitive resources and lead to a state of *resource depletion.* In a typical resource depletion paradigm participants perform an initial task that is either high or low in self-control demands, and then they complete a second task that measures self-control. Research has demonstrated that high self-control demands during the first task result in subsequent self-control decrements such as decreased task persistence (e.g., Baumeister et al., 1998), impaired emotional regulation (Schmeichel, 2007), increased aggression (DeWall, Baumeister, Stillman, & Galliot, 2007), and greater expression of prejudice (Muraven, 2008). The present study sought to extend this line of research to the domain of a laboratory event-based *prospective memory* test to determine if the execution of a delayed intention (i.e., remembering to do something in the future) is susceptible to the consequences of resource depletion, or alternatively, if prospective memory intentions remain unaffected by depletion manipulations.

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http://dx.doi.org/10.1016/j.concog.2013.08.008

Influential extensions of the self-regulatory resource model (e.g., Schmeichel, 2007; Schmeichel, Vohs, & Baumeister, 2003) have argued that cognitive tasks utilizing the central executive fall within the domain of self-control and are susceptible to depletion effects. Supporting this view, Inzlicht and Gutsell (2007) found that suppressing emotional reactions to disturbing film clips led to higher Stroop interference, relative to a non-suppression group. Similarly, in a series of experiments, Schmeichel et al. (2003) demonstrated that performing an attentional control task (relative to a less-demanding task) impaired subsequent performance on tests measuring reasoning ability, analytical ability, and reading comprehension. Also, Schmeichel (2007) observed working memory deficits in participants who had previously completed a self-control task. Schmeichel et al. interpreted their findings in terms of the self-regulatory resource model (Baumeister et al., 1998), which argues that a domain-general system is responsible for all acts of self-control. From this perspective, all self-regulatory tasks utilize the same pool of resources regardless of the specific features of the task (e.g., inhibiting an emotional response, resisting temptation, solving difficult word problems).

Boundary conditions to depletion effects have also been observed. For example, Schmeichel et al. (2003) found that the same depletion manipulation that led to performance decrements on reasoning tasks had no depletion effect on tests of crystallized knowledge or a nonsense syllable memorization test. Schmeichel et al. explained the boundary conditions they observed based on assumptions of the self-regulatory resource framework that suggest that complex cognitive tasks, such as those requiring strategic reasoning skills, will be compromised by initial acts of self-control, whereas simpler cognitive tasks, such as those requiring rote memorization, will be less susceptible to the negative effects of resource depletion. In a later study that similarly revealed depletion effects in complex cognitive tasks requiring executive control, Schmeichel (2007) stated that "executive control operates like a limited and depletable resource." (p. 251) and further argued that his results "lend support to the view that executive control is a unitary capacity insofar as different executive tasks influenced each other across time..." (p. 253; but see Inzlicht & Schmeichel, 2012 for a more nuanced view). By contrast, others have argued that depletion effects may be domain-specific, and consequently, depletion effects will not necessarily be observed across all executive control tasks (Healey, Hasher, & Danilova, 2011; Persson, Weish, Jonides, & Reuter-Lorenz, 2007).

In support of the domain-specific view, recent research suggests that depletion effects may not extend to all measures of self-control, particularly when the measure of self-control is characterized as an executive control task (Brewer, Spillers, McMillan, & Unsworth, 2011; Christiansen, Cole, & Field, 2012; Healey et al., 2011). For example, Brewer et al. (2011) demonstrated that performing an initial executive control task (antisaccade task) did not disrupt performance on any of three subsequent executive control tasks (Stroop task, operation span, and Raven's Advanced Progressive Matrices). Similarly, Christiansen et al. (2012) found no evidence of significant depletion-related decrements on three aspects of executive function (inhibitory control, phonemic fluency, and delay discounting). Thus, the findings of Brewer et al. and Christiansen et al. suggest that depletion effects will not necessarily be observed on all measures of executive control.

The focus of the present research was to assess the possible effects of resource depletion on prospective memory. Prospective memory, which refers to remembering to perform intended actions at the appropriate time in the future, can require strategic processes that are assumed to place demands on executive control. Craik (1986) noted that remembering to perform future actions was one form of memory that often relies on self-initiated processing. He further characterized self-initiated processing as an effortful, resource-consuming cognitive process that is used to support memory when the present state of the environment (e.g., contextual cues) or internal state of the organism (e.g., being tired) is not conducive to remembering.

The typical laboratory prospective memory paradigm consists of an encoding phase followed by a short, activity-filled delay interval (used to better simulate real-world prospective memory situations and to avoid it becoming a vigilance task) before the intention execution phase (Einstein & McDaniel, 1990). Prior to the delay interval participants receive the prospective memory instructions to respond (e.g., press the 'Q' key) if a certain target cue (e.g., the syllable *tor*) appears while they are performing an ongoing task (e.g., a lexical decision task). According to the multiprocess framework, resource-consuming monitoring processes are necessary to detect prospective memory cues when the processing demands of the ongoing task do not direct attention to the prospective memory cue (referred to in the literature as *nonfocal* tasks). For example, a lexical decision task directs individuals to process words and so detecting something other than a word (e.g., the syllable *tor*) embedded in this task requires one to effortfully monitor for the cue. In the present study we will focus on these situations in which prospective memory retrieval is supported by effortful monitoring processes.

The importance of executive control to successful execution of nonfocal prospective memory tasks has been demonstrated in several ways. First, increasing the cognitive demands of the ongoing task (via complexity of ongoing processing or divided attention manipulations) leads to lower prospective memory performance (e.g., Einstein, Smith, McDaniel, & Shaw, 1997; Marsh, Hicks, & Watson, 2002; McDaniel, Robinson-Riegler, & Einstein, 1998; McDaniel & Scullin, 2010). Second, adding a nonfocal prospective memory cue to an ongoing task tends to slow down ongoing task performance, indicating that participants are allocating attentional resources away from the ongoing task and toward the prospective memory task (Einstein et al., 2005; Marsh, Hicks, Cook, Hansen, & Pallos, 2003). Third, in the absence of monitoring, nonfocal prospective memory performance has been shown to approach floor levels (Scullin, McDaniel, & Einstein, 2010; Scullin, McDaniel, Shelton, & Lee, 2010). Fourth, although working memory capacity does not predict performance on a focal prospective memory task, it does predict performance on a nonfocal task (Brewer, Knight, Marsh, & Unsworth, 2010). These complementary pieces of evidence converge on the idea that resource-demanding executive control processes are required for successful nonfocal prospective memory performance.