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Cognitive Exertion and Subsequent Intention Execution in Older Adults

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Objectives. Previous studies have demonstrated that increasing the demands of a prospective memory task is detrimental to older adults' performance; however, no studies have investigated how prior cognitive demands influence subsequent prospective memory. The present study sought to address this gap by using a resource depletion paradigm.

Methods. A sample of 107 older adults whose ages ranged from 60 to 85 years (M = 71.91, SD = 7.12) completed an initial task that was either cognitively taxing or relatively easy followed by either an attention-demanding prospective memory task or one that required minimal attentional resources.

Results. Initial cognitive exertion led to decrements in prospective memory performance in the attention-demanding situation, particularly for the old–old participants (age ≥ 72); however, prior cognitive exertion did not influence subsequent prospective memory performance when the prospective memory task required minimal attentional resources.

Discussion. This study extends the negative effects of prior cognitive exertion to prospective memory in older adults. Also, dovetailing with past work, the depletion effects were limited to prospective memory tasks that are thought to require demanding attentional processes. The depletion effects were most pronounced for the old–old, suggesting that increased age may be associated with decline in attentional resources.

Key Words*:* Aging—Cognitive fatigue—Prospective memory—Resource depletion.

PROSPECTIVE memory refers to remembering to carry out intended actions in the future. Crucial real-world behaviors such as remembering to take insulin before a meal require successful prospective memory; therefore, failures in prospective memory can have serious potentially life-threatening consequences. The significance of prospective memory failures underscores the importance of studying prospective memory in older adults, who often face challenging health-related prospective memory demands. In this study, we investigate the extent to which prior cognitive exertion (termed resource depletion) might compromise older adults' prospective memory.

Prospective Memory

The typical laboratory-based prospective memory task engages participants in an ongoing activity, such as decision making, and requires them to remember to perform a separate action when a particular stimulus appears (termed an event-based task). One theoretical analysis of event-based prospective memory suggests that depending on the nature of the prospective memory cue, retrieval of the intention can be relatively spontaneous or can require effortful monitoring processes to support retrieval (McDaniel & Einstein, 2000, 2007). Specifically, when there is overlap in the information processing demands of the ongoing activity and the nature of the information that is relevant for the detection of the prospective memory cue, which we will label a *focal* cue, then retrieval can be relatively spontaneous (see Brewer, Knight, Marsh, & Unsworth, 2010; Einstein et al., 2005; Harrison & Einstein, 2010; Scullin, McDaniel, Shelton, & Lee, 2010 for supporting evidence). For example, during a lexical decision task, which requires processing letter strings to determine whether they are words, a particular word would serve as a focal prospective memory cue.

By contrast, if ongoing task processing does not direct attention to the presence of a prospective memory cue, then this would be labeled a *nonfocal* cue. In these situations, we assume that prospective memory retrieval will require effortful attentional processes recruited to monitor for the nonfocal cue. For instance, during a lexical decision task, a particular target syllable would be considered a nonfocal prospective memory cue. In addition to being characterized as a nonfocal cue, a syllable embedded in a lexical decision task has also been shown to be more difficult to identify relative to a word cue (Scullin, McDaniel, Shelton, et al., 2010). The assumption that nonfocal prospective memory retrieval requires resource-demanding monitoring has been supported by previous research (Brewer et al., 2010; Einstein et al., 2005, McDaniel, Einstein, & Rendell, 2008; Scullin, McDaniel, & Einstein, 2010; Scullin, McDaniel, Shelton, et al., 2010).

For present purposes, the pattern of older adults' performance on focal and nonfocal prospective memory tasks is

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of particular interest. Maylor (1996) argued that the overlap between ongoing task processing and the type of prospective memory cue used could influence not only prospective memory performance but also whether age-related differences were observed (see McDaniel et al., 2008, pp. 143–144, for a discussion of the distinction between cue focality and the task-appropriate processing framework proposed by Maylor, 1996). One general finding is that, for older adults, focal prospective memory performance is significantly higher than nonfocal performance (McDaniel et al., 2008; Rendell, McDaniel, Forbes, & Einstein, 2007). Second, age-related differences are minimal for focal prospective memory tasks (McDaniel et al., 2008; Rendell et al., 2007.). Furthermore, consistent with the idea that spontaneous retrieval can support focal prospective memory performance, older adults tend not to show significant decrements in ongoing task performance as a consequence of having to perform a prospective memory task that uses focal cues (McDaniel et al., 2008).

By contrast, age-related differences typically emerge in prospective memory tasks that use nonfocal cues (see Kliegel, Jäger, & Phillips, 2008 for a meta-analysis and McDaniel & Einstein, 2007 for a review), although in some cases there is no significant age-related prospective remembering decrement on nonfocal tasks (McDaniel et al., 2008, Experiments 1 and 2). Especially pertinent for the present study, McDaniel and colleagues (2008, Experiment 2) did not observe age differences in the particular task mentioned above (syllable prospective memory cue in a word decision task), but the equivalent prospective memory performance across age groups resulted in more pronounced ongoing task disruption in older relative to younger adults. That is, older adults can engage in effortful monitoring to support nonfocal prospective memory, but supporting this monitoring is especially demanding for older adults.

Another important point that has been raised in the prospective memory and aging literature is that too few studies examine age-related differences that occur within an older adult sample. Kvavilashvili, Kornbrot, Mash, Cockburn, and Milne (2009) reported that age-related differences in prospective memory might be subtle or nonexistent in the young–old (age range: 61–70 years) but pronounced in old–old (age range: 71–80 years). The authors argued that one reason for the inconsistent findings regarding age-related differences in prospective memory (see McDaniel et al., 2008) is that most studies treat participants in the young–old and old–old range as a single sample (but see Maylor, 1996). Kvavilashvili and colleagues further asserted the importance of future research, investigating the approximate age at which prospective memory shows a precipitous decline. Building upon their work, the present study examined age differences within a broad age range (60–85 years). Combining these observations from the prospective memory and aging literature with the assumption that cognitive demand prior to a prospective memory task may diminish self-control resources, we propose the novel hypothesis that within an older adult sample, nonfocal, but not focal, prospective memory will be negatively impacted by *prior* cognitive demands and these consequences will increase with chronological age.

Resource Depletion

The self-regulatory resource model (Baumeister & Heatherton, 1996) posits that all forms of self-control rely on a common limited resource pool and that acts of self-control temporarily diminish the supply of available resources. In this model, the term "self-control" includes a wide variety of outcomes, including impulse control, emotional regulation, and cognitive control. The primary prediction derived from this model is that any initial act of self-control will lead to a state of resource depletion, which is characterized by impaired performance on subsequent self-control tasks. Strong support for this prediction has been garnered from a two-task paradigm in which self-control demands are manipulated with an initial task and then subsequent self-control capacity is measured with a different task. This basic design has demonstrated that a diverse array of tasks can lead to a host of negative outcomes (see Hagger, Wood, Stiff, & Chatzisarantis, 2010 for a meta-analysis). A classic demonstration of this effect is that resisting the temptation to eat freshly baked cookies later decreased the participants' persistence on frustrating unsolvable puzzles (Baumeister, Bratslavsky, Muraven, & Tice, 1998, Experiment 1).

Depletion does not, however, influence all cognitive tasks equally. Specifically, depletion primarily impairs tasks with high attentional demands while leaving less demanding tasks relatively spared. For example, Schmeichel (2007) demonstrated that participants who were given a demanding writing task later performed worse on an attention-demanding backward digit span task relative to participants who were not constrained while writing; however, the negative effects of the demanding writing task were not observed on subsequent performance in a forward digit span task that required minimal attentional resources. Similarly, Schmeichel, Vohs, and Baumeister (2003) found that depletion compromised cognitive tasks reliant on the online manipulation of information (e.g., Graduate Record Exam analytical items) but not those involving only the retrieval of previously learned information (e.g., recall of nonsense syllables).

Almost the entire body of depletion results comes from younger adult samples, so an important but severely understudied issue is the potential consequences of resource depletion for older adults. One possibility is that the existing executive deficits experienced by older adults (Braver & West, 2008) are exacerbated by further reduction of self-control resources, leading to robust depletion effects in older adults. Alternatively, older adults may rely less on resource-demanding strategies and so the reduction of resources through depletion manipulations may have little or no effect on their performance (see Rosen & Engle, 1997 and Kane & Engle, 2000 for conceptually similar findings in the working memory literature). The only study of which we are aware that has examined depletion effects in older adults (Scheibe & Blanchard-Fields, 2009) demonstrated that an emotional suppression task did not lead to performance decrements in a subsequent cognitive task in older adults. This result suggests that depletion effects may not occur in older adults, but caution must be taken as this pattern may reflect age effects specific to emotional processing rather than differences in depletion, per se (see *Discussion* for further elaboration on this point).

Present Study

The present study investigated the interactive effects of type of event-based prospective memory task and prior cognitive demands on prospective memory performance in older adults. We manipulated the prospective memory task by varying cue type, using either focal or nonfocal cues, as in McDaniel and colleagues (2008). The novel manipulation was that of prior cognitive demands, which has never been investigated in prospective memory and has rarely been studied in an older adult sample. Before performing the prospective memory task, participants performed either a challenging Stroop task (mostly incongruent trials) or an easy Stroop task (all congruent trials; Wallace & Baumeister, 2002). Because previous research has revealed depletion effects on demanding but not less effortful cognitive tasks (Schmeichel, 2007; Schmeichel et al., 2003), we predicted that prior cognitive exertion (i.e., a difficult Stroop task) would negatively affect nonfocal prospective memory performance, which requires effortful monitoring, but would not affect focal prospective memory performance, which can be accomplished without monitoring (Einstein et al., 2005; Harrison & Einstein, 2010; McDaniel et al., 2008; Scullin, McDaniel, & Einstein, 2010; Scullin, McDaniel, Shelton, et al., 2010).

Method

Participants and Design

Community-dwelling adults were recruited from Washington University's older adult participant pool, and people who reported hearing or vision difficulty were excluded. The total sample consisted of 107 predominantly Caucasian adults (78 female) between the ages of 60 and 85 (M = 71.91, SD = 7.12). Most of the older adults completed high school (12 years) and some higher education (M = 15.27, SD = 5.63). Participants reported their health as being between fair and excellent (1 = *poor*, 5 = *excellent*; M = 3.91, SD = 0.86). Participation lasted approximately 1 hr, and participants were compensated $10 dollars. The data from 11 participants were excluded due to retrospective memory failure (as is the case for most prospective memory studies, e.g., see Rendell et al., 2007), resulting in 96 participants included in data analysis. Participants were randomly assigned to the conditions (n = 24 per condition) of a 2 (prospective memory task: focal/nonfocal) × 2 (depletion: depleted/nondepleted) between-subjects experimental design. Age, education, perceived health, and sex were comparable among the experimental conditions: nonfocal/nondepleted (age: M = 71.4, education: M = 15.3, health: M = 4, number of females n = 18), nonfocal/depleted (age: M = 72.7, education: M = 15.6, health: M = 4, number of females: n = 14), focal/nondepleted (age: M = 71.8, education: M = 15.4, health: M = 3.8, number of females: n = 19), and focal/depleted (age: M = 71.7, education: M = 14.9, health: M = 3.8, number of females: n = 15). Two participants did not respond to the question regarding sex, 1 did not respond to the perceived health question, and 13 participants wrote ambiguous responses to the years of education question. A comparable number of participants from each experimental condition responded to the education question (n = 20–22).

Procedure

Participants first performed 20 practice trials of a lexical decision task. Letter strings were presented in the center of the screen, and participants were instructed to indicate, by pressing the keys marked Y and N (*1* and *2* on the number keypad, respectively), whether the target was a word or non word. They were instructed to respond as quickly and accurately as possible, and following each practice trial, they received feedback regarding their speed and accuracy on the previous trial (which remained on the screen for 1,500 ms), as well as their cumulative accuracy during the practice block.

Following the practice block, participants received the prospective memory instructions. In addition to making word/nonword decisions, participants were instructed to press *Q* when a specific target appeared. In the *nonfocal* condition, this target was the syllable *tor*, and in the *focal* condition, the target was a single word, either *tortoise* or *dormitory*. Participants were told to press *Q* as soon as they noticed the target. Participants were not allowed to continue until they could correctly repeat the prospective memory instructions to the experimenter. After that, these instructions were not mentioned again.

Next, depletion was manipulated with a Stroop task (see Wallace & Baumeister, 2002). The color words red, green, blue, and yellow were presented on a computer monitor in four font colors (red, green, blue, or yellow), and participants were instructed to place their fingers on the home row of the keyboard, with their index fingers on *F* and *J*, and indicate the font color by pressing designated keys (*J* for yellow, *K* for green, *D* for red, and *F* for blue) as quickly as possible without sacrificing accuracy. Each trial consisted of a 450-ms fixation cross, followed by the stimulus that remained on the screen until the participant responded. Participants completed 10 practice trials that included accuracy and speed feedback (as in the lexical decision practice block) and then performed 7 min of experimental trials. In the *nondepletion* condition, word and font color matched on all trials, and in the *depletion* condition, word and font color matched on only 20% of trials. All 12 combinations of incongruent trial types were randomly distributed across the task.

Finally, participants completed the lexical decision task block containing prospective memory targets. They performed 310 lexical decision task trials, and 6 prospective memory targets were distributed across the trials (trials 51, 102, 153, 204, 255, and 306). The target events in the nonfocal condition were tortoise, haptors, tordering, dormitory, gestorly, and tornado. Finally, participants were again asked to repeat the prospective memory instructions to the experimenter, and those who could not accurately report them were excluded from analyses (n = 11).

Results

Statistical Analyses

A series of hierarchical regression analyses were conducted for the dependent measures of Stroop performance (proportion correct and trimmed mean reaction times across correct congruent and incongruent trials), prospective memory performance (proportion of hits), and lexical decision performance (trimmed mean reaction times on correct trials). Each of these analyses will be discussed in turn. Each of the three hierarchical regression analyses consisted of the following format: All the main effects were entered into the first step of the analysis; all the two-way interactions were entered into the second step of the analysis, and the three-way interaction was entered into the third and final step of the analysis. Alpha was set to .05 unless otherwise noted.

Stroop Performance

The number of Stroop trials completed in 7 min ranged from 161 to 413 (M = 302.49, SD = 49.24). To assess whether the Stroop task used in the depletion condition was more difficult, we first entered proportion of correct Stroop trials into the hierarchical regression model. The only significant effect was the Stroop main effect, t (92) = −2.21, β = −.22 (all other main effects and interactions produced ps < .17); participants made more Stroop errors in the depleted condition (M = 0.22) than the nondepleted condition (M = 0.09). In addition, we noted that there were four participants (n = 2 in depleted condition) who failed to respond correctly on any of the Stroop trials. None of our statistical analyses was significantly altered by whether these participants were included or excluded.

Next, we examined trimmed mean Stroop reaction time on correct trials, and we used a trimming method similar to previous research (Einstein et al., 2005) by excluding trials on the Stroop task that were greater than 2 SDs away from an individual's mean. Consistent with age-related slowing (Salthouse, 1996), there was a main effect of chronological age, t (88) = 3.38, β = .30. There was also a main effect of Stroop condition, t (88) = 4.34, β = .40, such that mean reaction times were slower in the depleted condition (M = 1,055 ms) than the nondepleted condition (M = 833 ms). There were no other significant effects (all other main effects and interactions had ps > .35). These results demonstrated that the Stroop task was, indeed, more demanding in the depleted condition than in the nondepleted condition.

Table 1. The Hierarchical Regression Model and Results for Prospective Memory Performance

	ΔR^2	$^*\Delta R^2$	F value	df	p Value
Step 1: main effects	.62	.62	50.04	3, 92	<.001
Step 2: two-way interactions	.04	.11	3.65	3, 89	.02
Step 3: three-way interaction	.02	.06	5.60	1, 88	.02

Step 1 included the main effects of age, depletion condition, and prospective memory task. Step 2 included the two-way interactions: Age × Depletion, Age × Prospective Memory Task, and Depletion × Prospective Memory Task. Step 3 included the three-way interaction. ΔR^2 refers to additional variance explained by each step, whereas $^*\Delta R^2$ refers to the proportion of remaining variance that was explained by a step.

Prospective Memory Performance

We conducted a three-step hierarchical regression to investigate which factors influenced prospective memory performance (see Table 1). Correct prospective memory responses were operationalized as Q presses occurring on the prospective memory target trial or the following two trials (i.e., target + 1 or target + 2). The variables of chronological age (centered), prospective memory task (nonfocal and focal, dummy coded as 1 and 2, respectively), and depletion condition (nondepleted and depleted, dummy coded as 1 and 2, respectively) were entered into the first step of the regression equation. As predicted, there was a main effect of prospective memory task, t (92) = 12.13, β = .78, such that performance in the focal condition (M = 0.91) was greater than performance in the nonfocal condition (M = 0.25). Next, we predicted that both the Age × Prospective Memory Task and the Prospective Memory Task × Depletion interaction to be reliable, and the former interaction was observed, t (89) = 3.23, which revealed age-related decrements in nonfocal, but not focal, prospective memory. It should be noted that performance in the focal condition was near ceiling, which could reduce the opportunity to observe age differences in this condition. The observation of no age-related decrements in the less challenging condition is, however, consistent with our theoretical orientation and with previous research (Kvavilashvili et al., 2009). Importantly, a three-way interaction between age, prospective memory task,

Table 2. The Association Between Chronological Age and Mean Proportion Correct (standard deviations in parentheses) on the Prospective Memory Task Is Illustrated Across Depletion and Prospective Memory Task Conditions

Depletion condition	Young–old		Old–old	
	Focal	Nonfocal	Focal	Nonfocal
Nondepleted	0.95 (0.11)	0.32 (0.37)	0.86 (0.23)	0.21 (0.24)
N	11	11	13	13
Depleted	0.86 (0.29)	0.44 (0.42)	0.97 (0.06)	0.06 (0.11)
N	12	11	12	13

Regression analyses were used to account for age as a continuous variable (see *Results* section), but for purposes of clarity, we present the results as split into old–old (>72 years old) and young–old (<72 years old) groups. We chose 72 as a cutoff point because it was the mean age of our sample.

and depletion condition was observed, t (88) = 2.37. As seen in Table 2, a large age-related difference in prospective memory performance was observed only in the nonfocal–depleted condition, r (22) = −.61, $p < .01$ ($r_{\text{nonfocal-nondepleted}} = -.21$, $p = .34$; $r_{\text{focal-nondepleted}} = .01$, $p = .96$; $r_{\text{focal-depleted}} = .34$, $p = .11$). The importance of this finding is that it suggests, at least for the present experimental conditions, depleting cognitive resources prior to an attention-demanding prospective memory task did not lead to widespread performance decrements (which would have led to a two-way interaction between prospective memory task and depletion condition). Rather, the negative consequences associated with resource depletion were moderated by age.

Depletion Effects on Lexical Decision Task Performance

Finally, we examined lexical decision task performance to determine if the depletion manipulation influenced older adults' ability to perform the ongoing task while also maintaining the prospective memory intention. We trimmed lexical decision trials in the same way as the Stroop trial reaction time analysis. The results of the lexical decision reaction time analysis revealed a main effect of chronological age, t (92) = 2.07, β = .21, demonstrating slower responding with increasing age (Salthouse, 1996). More importantly, we observed significantly faster responding on the lexical decision task in the depletion group (M = 947 ms) relative to the control group (M = 1,027 ms), t (92) = 2.22, β = −.22. This result suggests that depleted participants were engaging strategic monitoring processes less during the lexical decision task, which is predicted to hinder prospective memory retrieval only when it requires an attention-demanding monitoring process (nonfocal cue). Mean reaction time on the ongoing task has been used in previous studies (Marsh, Hicks, Cook, Hansen, & Pallos, 2003; McDaniel et al., 2008; Scullin, McDaniel, & Einstein, 2010; Scullin, McDaniel, Shelton, et al., 2010; Smith, 2003) to reflect strategic monitoring processes; however, in these studies, participants also completed a control block of the lexical decision task with no prospective memory component embedded in order to control for baseline responding rates. In the present study, a control block was not included because it was unclear whether or not this would deplete cognitive resources if performed prior to the prospective memory task or if it would be susceptible to exaggerated depletion effects if it were performed after the prospective memory task. Thus, in the present study, the average response latencies on the lexical decision task can, at best, only be used as a rough estimate of strategic monitoring.

Discussion

The present study is the first to offer insight into the impact of performing a cognitively demanding task on older adults' ability to carry out future intentions. The results revealed that in the present experimental context prior cognitive exertion did not produce general prospective memory deficits in older adults. Only using the more demanding nonfocal (syllable) prospective memory cue revealed any effect of depletion, and even then, in the present study, chronological age moderated this effect such that depletion had the largest effect on the older end (age ≥ 72) of our sample (see Table 2). This pattern provides support for Kvavilashvili and colleagues' (2009) emphasis on the importance of examining potential differences between young–old and old–old adults in different prospective memory situations. Additionally, these data are consistent with the prediction that the presence of focal cues in the less demanding prospective memory task allows even the old–old adults to rely on preserved spontaneous retrieval processes that utilize minimal cognitive resources (McDaniel & Einstein, 2000, 2007).

Possible Cognitive Mechanisms

The efficiency of the effortful monitoring process required by the more demanding nonfocal prospective memory task is assumed to decline with increasing age (McDaniel et al., 2008). Although older adults might be able to support such monitoring processes under optimal conditions, when cognitive or neural resources have been drained, performance now suffers with age. When performing a nonfocal prospective memory task, individuals must decide how to distribute attentional resources across the ongoing and prospective memory tasks. The findings from McDaniel and colleagues (2008) suggest that under optimal conditions older adults can adopt an attention allocation policy that serves to boost prospective memory performance (i.e., engaging strategic monitoring processes), which leaves less attentional resources available for meeting ongoing task demands. Under nonoptimal conditions (e.g., when attentional resources are drained), however, older adults may adopt an alternative attention allocation policy that sacrifices prospective memory performance in favor of meeting ongoing task demands. The finding of faster lexical decision reaction times following the depletion manipulation provides some initial support for the claim that depleted participants engaged fewer resource-demanding strategies during the ongoing task; existing research suggests that this will negatively affect prospective memory performance in the nonfocal, but not the focal, cue condition (Einstein et al., 2005; McDaniel et al., 2008; Scullin, McDaniel, Shelton, et al., 2010). Admittedly, we do not have a precise index of strategic monitoring (because of the absence of a control block); therefore, it is unclear whether disruptions in strategic monitoring mediated the age-related nonfocal prospective memory deficits observed following depletion.

An alternative possibility is that the depletion manipulation disrupted the retrospective memory component of prospective remembering (i.e., recognizing a cue as a target event; Smith & Bayen, 2004) rather than the strategic monitoring process. If this was the case then one would expect participants in the depletion condition to be more likely to have problems (retrospectively) reporting the prospective memory target and response at the end of the experiment. Contrary to this expectation, all the participants who were retained in the present sample were able to recall the prospective memory target and response at the end of the experiment. These data suggest that it is unlikely that retrospective memory failures can account for the negative consequences of resource depletion observed in the present study. Furthermore, existing theories and previous research have argued for the strategic monitoring process to be the most costly resource-demanding component of prospective memory. Taken together, although the present paradigm did not include an optimal measure of strategic monitoring, we suggest that the nonfocal prospective memory performance decrement associated with the depletion of cognitive resources was triggered by a disruption in strategic monitoring processes. However, future research is needed to better elucidate this possibility.

Resource Depletion in Older Adults

The current study makes an important contribution to the depletion literature by providing the first evidence of a cognitive depletion effect in prospective memory and with older adults. To our knowledge, the only previous study to use a depletion manipulation with an older adult sample (Scheibe & Blanchard-Fields, 2009) demonstrated that regulating the emotion of disgust did not negatively impact subsequent cognitive performance. However, Scheibe and Blanchard-Fields' (2009) results may be completely attributable to the use of an emotion regulation task as the depletion manipulation, as older adults generally regulate negative emotions more effectively than younger adults (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). In contrast, the Stroop task in the current study produced a depletion effect within the old–old of our sample, demonstrating that, at least under certain conditions, older adults are susceptible to depletion. An interesting aspect of the current results is the lack of evidence of a depletion effect in the young–old of our sample. Not surprisingly, the old–old, relative to young–old, participants were more susceptible to depletion, possibly due to increasing cognitive and neural declines (Bäckman, Nyberg, Lindenberger, Li, & Farde, 2006), but a complete lack of depletion effects in the young–old participants was surprising due to the robustness of depletion effects in college-aged samples (see Hagger et al., 2010 for a meta-analysis).

Although our results (and those of Scheibe & Blanchard-Fields, 2009) hint that young–old adults may be relatively unaffected by depletion manipulations, we find this simplistic interpretation unlikely. Rather, depletion effects in older adults likely depend critically on the interaction of numerous factors, including chronological age, characteristics of the depletion manipulation, and the subsequent self-control task. For example, one might expect resource depletion to negatively impact prospective memory performance in the young–old if a more difficult ongoing task were used. It is possible that the lexical decision task used in the present study was simple enough for the young–old to direct their attention to the prospective memory task demands without sacrificing performance on the ongoing task.

Another possibility is that the set of resources being drained by the Stroop task are not the same set of resources being used in the nonfocal cue condition of the prospective memory task. Whereas the self-regulatory model (Baumeister & Heatherton, 1996) posits that the same pool of resources is used for all acts of self-control, others hold a more domain-specific view. For example, research has demonstrated that the overlap between the cognitive and neural mechanisms used to perform the depletion task and subsequent task will determine whether or not depletion effects are observed (Persson, Welsh, Jonides, & Reuter-Lorenz, 2007). This latter explanation cannot easily account for why resource depletion led to performance declines in the old–old but not in the young–old in the present study; however, if there is, indeed, a domain-specific nature to resource depletion effects, it is possible that this would be modulated by the reduced neural specialization associated with aging (Park et al., 2004). Gaining a clear picture of depletion effects in aging samples will require careful examination of these factors. The current study provides an important initial building block by demonstrating that depletion effects can be observed in older adults.

Implications

In addition to the theoretical implications of the present findings, these data also point to important methodological considerations. The depletion effects observed in this study arose after participants had completed only 7 min of a cognitively taxing activity. In many individual difference studies, older adults are asked to complete a long battery of cognitively demanding tasks. Furthermore, as noted by Kvavilashvili and colleagues (2009), studies often make age-related comparisons using an older adult sample with a wide age range. The findings from the present study suggest that, under some conditions, prior cognitive exertion may differentially impact the subsequent cognitive performance of older adults depending on their chronological age. In the present study, the differential age effects of resource depletion were only observed in a nonfocal prospective memory task; however, the relationship observed between nonfocal prospective memory tasks and frontal lobe functioning (see Burgess et al., 2008 for a review) suggests that other cognitive control (frontal) tasks would be associated with the same outcome.

Finally, it is important to consider the practical implications of the present findings. Imagine that a 75-year-old woman decides to run a few errands, including going to the bank and picking up her insulin prescription from the pharmacy. The woman first stops by the bank to discuss a complicated financial decision. After leaving the bank, the woman heads to the pharmacy but the draining conversation she just had causes her to forget to monitor for the street that would take her to the pharmacy, so she drives to the house, failing to pick up her insulin. This example illustrates one possible instance of a real-life situation where brief cognitive exertion can lead to potentially dire consequences. Accordingly, future studies might extend the current laboratory finding to a more naturalistic prospective memory task. Older adults may organize their daily schedules to allow for the execution of plans before they become cognitively depleted (cf. Rendell & Craik, 2000). However, older adults sometimes may be forced to execute their plans after a series of cognitively demanding activities and with increasing age, under these circumstances, one's ability to execute a challenging future intention is likely to be compromised.

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