Consciousness and Cognition 22 (2013) 931–943

Contents lists available at SciVerse ScienceDirect

Consciousness and Cognition

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

The role of metacognition in prospective memory: Anticipated task demands influence attention allocation strategies

Jan Rummel *, Thorsten Meiser

University of Mannheim, School of Social Sciences, Mannheim, Germany

ARTICLE INFO

Article history:
Received 22 February 2013
Available online 13 July 2013

Keywords:
Prospective memory
Metacognition
Monitoring processes
Attention allocation

ABSTRACT

The present study investigates how individuals distribute their attentional resources between a prospective memory task and an ongoing task. Therefore, metacognitive expectations about the attentional demands of the prospective-memory task were manipulated while the factual demands were held constant. In Experiments 1a and 1b, we found attentional costs from a prospective-memory task with low factual demands to be significantly reduced when information about the low to-be-expected demands were provided, while prospective-memory performance remained largely unaffected. In Experiment 2, attentional monitoring in a more demanding prospective-memory task also varied with information about the to-be-expected demands (high vs. low) and again there were no equivalent changes in prospective-memory performance. These findings suggest that attention–allocation strategies of prospective memory rely on metacognitive expectations about prospective-memory task demands. Furthermore, the results suggest that attentional monitoring is only functional for prospective memory to the extent to which anticipated task demands reflect objective task demands.

1. Introduction

Event-based prospective memory (PM) denotes the ability to remember performing an intended action at the occurrence of a target cue (Kvavilashvili & Ellis, 1996). Typically, the PM cue occurs while one is engaged in other ongoing activities (Ellis & Kvavilashvili, 2000). For example, when remembering to give a colleague a message the next time one sees her, encountering the colleague can cue the intention. When the colleague passes one's office, however, one is usually engaged in answering phone calls, writing emails, or talking to other colleagues and thus one is likely to miss the opportunity to pass the message. Therefore, it might be reasonable to devote some attention to monitor for the occurrence of the colleague to make sure that one will not miss the appropriate moment of intention fulfillment. How individuals distribute their attentional resources between a PM intention and other ongoing tasks, however, is not yet completely understood. Therefore, in the present research, we investigated how metacognitive expectations about the demands of a given PM task influence attention–allocation strategies of PM.

Expectations about cognitive demands have been demonstrated to influence strategies in various memory tasks. For example, such metacognitive expectations have been shown to affect study-time allocation in recognition memory (Dunlosky & Ariel, 2011; Hines, Touron, & Hertzog, 2009; Mazzoni, Cornoldi, & Marchitelli, 1990; but see also Son & Metcalfe, 2000), the illusion of competence in cued-recall tasks (Castel, McCabe, & Roediger, 2007; Koriat & Bjork, 2005), or systematic guessing behavior in recognition and source memory (Förster & Strack, 1998; Meiser, Sattler, & von Hecker, 2007; Strack, Förster, &

* Corresponding author. Address: Department of Psychology, University of Mannheim, D-68131 Mannheim, Germany.
E-mail address: rummel@uni-mannheim.de (J. Rummel).

1053-8100/$ - see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.concog.2013.06.006

Werth, 2005). Two different approaches have been suggested to investigate metacognitive expectations about task-demands. The most prominent one is to ask participants to rate their own performance in a cognitive task either prior to or after performing the task. Such metacognitive judgments have been successfully used to assess individual expectancies about the demands of and the performances in different memory tasks (e.g., Koriat & Bjork, 2005; Nelson & Dunlosky, 1991; Touron, Oransky, Meier, & Hines, 2010). Another less frequently used approach is to manipulate metacognitive expectations experimentally via (bogus) information provided with memory-task instructions. Förster and Strack (1998), for example, investigated the role of task-demands expectations in a recognition task by inducing the beliefs that the music played at encoding would foster (hinder) learning of the words and found that the induced expectancies about the music's impact affected the hit rate and false alarm rate in a subsequent recognition test.

Building on this second approach in the present research, we experimentally manipulated the expectations about the cognitive demands of a PM task to investigate whether, among other factors, metacognitive expectations would influence the strategies of how attentional resources are distributed between a PM intention and an ongoing task. Current theories of PM assume that holding a PM intention as well as performing an ongoing task usually draw on limited attentional resources (McDaniel & Einstein, 2007; Smith, 2003). In line with this idea, adding a PM intention to an ongoing task has been found to slow down performance in the latter task (Marsh, Cook, & Hicks, 2006; Marsh, Hicks, & Cook, 2005, 2006; Marsh, Hicks, Cook, Hansen, & Pallos, 2003; Smith, 2003). The level of these PM-induced costs to the ongoing task, and thus supposedly the level of attentional cue-monitoring, seems to depend on the cognitive demands of the PM intention and the ongoing task. When there are *fewer* different PM cues (Cohen, Jaudas, & Gollwitzer, 2008), when the PM cues become more *salient* (Einstein, McDaniel, Manzi, Cochran, & Baker, 2000; Graf, Uttl, & Dixon, 2002), or when there is a strong *overlap* between the processes engaged to perform the ongoing task and to identify the PM cue (Einstein et al., 2005; McBride & Abney, 2012; Meier & Graf, 2000; Rummel, Boywitt, & Meiser, 2011; see also Einstein & McDaniel, 2005, for a review) PM-induced costs are significantly reduced, sometimes even to non-significant levels. These findings suggest that the level of cue-monitoring is adapted to the reduced PM-task demands. On the other hand, PM performance also varies with the demands of the ongoing task (Marsh, Hancock, & Hicks, 2002). Therefore, Hicks and colleagues (Hicks, Marsh, & Cook, 2005) argue that during intention formation individuals adopt a resource-allocation strategy of how they distribute their attention between the ongoing task and the PM task in accordance with the cognitive demands of both tasks.

The engagement in attentional cue-monitoring, however, is not completely determined by objective task demands. For example, Einstein et al. (2005) showed that additionally stressing the importance of the PM task relative to the ongoing task results in higher PM-induced costs and improved PM performance (see also Marsh et al., 2005). Similarly, individuals become more cautious in their ongoing task responding when they think it is very likely that the PM cue will occur (Boywitt & Rummel, 2012). In line with findings that cue-monitoring can be willingly controlled, Einstein and McDaniel (2008) recently theorized that individuals are aware of the PM-task demands and calibrate their cue-monitoring accordingly. With non-habitual PM tasks, however, individuals supposedly have little prior knowledge about the factual PM-task demands while forming an intention, because they have not yet experienced the PM task (and their own performance in the task) at this point. Therefore, the question arises what a potential awareness of PM-task demands is based on.

We argue that resource-allocation strategies of PM are not only calibrated to objective PM-task demands but also in accordance with idiosyncratic beliefs about these demands, that is, expectations about the cognitive effort necessary for fulfilling the intention. Importantly, such metacognitive expectations about task demands can differ from factual task demands. Research asking participants to predict their PM performance has found, for instance, that participants tend to underestimate their PM performance (Meeks, Hicks, & Marsh, 2007; Schnitzspahn, Zeintl, Jäger, & Kliegel, 2011), especially when objective PM-task demands are low (Rummel, Kuhlmann, & Touron, 2013). Although PM-prediction accuracy has to be interpreted with caution because predictions can reactively change PM performance (Meier, von Wartburg, Matter, Rothen, & Reber, 2011) as well as the engagement in attentional cue-monitoring (Rummel et al., 2013), these results suggest that knowledge about PM-task demands might be rather inaccurate, especially before task experience.

If attention–allocation strategies build on biased expectations about PM-task demands, however, attention allocation will be biased as well. In particular, if the actual PM-performance is underestimated, individuals might allocate additional attention to the PM task exceeding the objective PM-task demands. This would result in additional PM-induced costs, which are not functional for PM. Importantly, the observed PM-induced costs, in terms of slowed ongoing-task performance, would contain both functional and non-functional cost-components. Evidence that PM-induced costs are not always functionally related with PM-performance comes from Meiser and Schult (2008), who found significant correlations between PM-performance and PM-induced costs only when objective PM-task demands were high and ongoing-task accuracy was additionally stressed. Furthermore, Scullin, McDaniel, and Einstein (2010) found increased PM-induced costs with a reminder of the PM task several trials prior to a PM cue, but this increase in costs was not accompanied by an increase in PM performance when factual PM-task demands were low. Thus, in these studies, the PM-induced costs were not always entirely functional for PM.

2. The current study

The aims of the present study were twofold. The major goal was to show that attention–allocation strategies of PM are calibrated to metacognitive expectations about PM-task demands. Others have reasoned that metacognitive expectations about one's own PM performance should play a critical role for the engagement in attentional cue-monitoring (Einstein &