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Performance predictions affect attentional processes of event-based prospective memory

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ABSTRACT

To investigate whether making performance predictions affects prospective memory (PM) processing, we asked one group of participants to predict their performance in a PM task embedded in an ongoing task and compared their performance with a control group that made no predictions. A third group gave not only PM predictions but also ongoing-task predictions. Exclusive PM predictions resulted in slower ongoing-task responding both in a nonfocal (Experiment 1) and in a focal (Experiment 2) PM task. Only in the nonfocal task was the additional slowing accompanied by improved PM performance. Even in the nonfocal task, however, was the correlation between ongoing-task speed and PM performance reduced after predictions, suggesting that the slowing was not completely functional for PM. Prediction-induced changes could be avoided by asking participants to additionally predict their performance in the ongoing task. In sum, the present findings substantiate a role of metamemory for attention-allocation strategies of PM.

1. Introduction

Event-based prospective memory (PM) refers to the ability to remember to perform an intended action in response to a target event such as remembering to buy medicine on the way home (Einstein & McDaniel, 1990). Current theorizing suggests two different cognitive routes to successful intention fulfillment: resource-demanding attentional monitoring for the appropriate moment of intention fulfillment and rather automatic (i.e., spontaneous) retrieval of the intention (Einstein & McDaniel, 2010; McDaniel & Einstein, 2007). Research has yielded mixed findings regarding people's engagement of attentional resources for PM intentions (Einstein & McDaniel, 2010; Smith, 2010). In the present research, we examined metamemory influences on attentional monitoring by examining how making performance predictions within PM task settings may alter the allocation of attention to a PM intention as well as its functionality for intention fulfillment.

1.1. Assessing attentional monitoring of prospective memory

In the Einstein–McDaniel paradigm of PM (1990), participants have to perform an ongoing experimental task and, additionally, to prospectively remember to respond to specific PM-target stimuli within the ongoing task with a special key. This task setting mimics the common PM situation of remembering to do something at a future moment while performing other ongoing activities. To the extent that PM performance (i.e., pressing the special key in response to the PM targets) relies on

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attentional monitoring and thus requires cognitive resources, the PM intention should interfere with the ongoing task (Smith, 2003; 2010). Indeed, the addition of a PM intention has been shown to slow ongoing task performance (Hicks, Marsh, & Cook, 2005; Marsh, Hicks, Cook, Hansen, & Pallos, 2003; Scullin, McDaniel, & Einstein, 2010; Smith, 2003). Furthermore, PM performance has been shown to vary with the demands of the ongoing task (Marsh, Hancock, & Hicks, 2002), demonstrating that both tasks draw on the same limited attentional resources. The interrelation between the PM task and the ongoing task is quite strong for *nonfocal* PM targets, whose processing imposes attentional demands in addition to the ongoing task demands. The interrelation is weaker, however, for *focal* PM targets, which require little attentional monitoring (Scullin, McDaniel, Shelton, & Lee, 2010; see also Einstein & McDaniel, 2005, for a review of focality effects). A target can be considered focal when the processing of the ongoing task encourages processing (1) of the PM target, usually referred to as task- or transfer-appropriate processing (cf. Marsh, Hicks, & Hancock, 2000; Maylor, 1996; Meier & Graf, 2000; Meiser & Schult, 2008), and, especially, (2) of those features of the PM target that were encoded as relevant for the PM intention during intention formation (McDaniel & Einstein, 2007; see also McBride & Abney, 2012, for a comparison of task-appropriate and focal processing of PM). To illustrate, when driving home, the pharmacy sign we encounter on our usual way home can serve as a focal target because the sign has probably been encoded as relevant to the intention to buy medicine at the pharmacy. Further, there is a processing overlap between the ongoing activity of driving the car and encountering the sign, because while driving we must attend to road signs anyways. If the pharmacy requires a detour or is inside a mall, however, one would not spontaneously encounter the intention-relevant sign. Thus, attention has to be devoted to not miss the correct turn (i.e., a nonfocal cue; see Einstein & McDaniel, 2008, for similar everyday examples).

Although it is well demonstrated that the engagement in monitoring for PM targets depends on the PM task demands, like the cues' focality for example, there is evidence that other factors can also influence attention allocation. If the importance of the PM intention relative to the ongoing task is stressed/de-stressed, for instance, monitoring increases/decreases (Marsh, Hicks, & Cook, 2005; Smith & Bayen, 2004). On the other hand, if participants imagine themselves performing the PM task during intention formation (i.e., mental simulation of the PM-task, Brewer & Marsh, 2010), PM performance increases while attentional monitoring remains unaffected or even decreases (Brewer, Knight, Meeks, & Marsh, 2011; McFarland & Glisky, 2012; Meiser & Rummel, 2012; Rummel, Einstein, & Rampey, 2012).

1.2. Prospective memory predictions and attentional monitoring

Recently, PM researchers have started to investigate people's insight into their own PM abilities by asking them to predict their PM performance (e.g., Meeks, Hicks, & Marsh, 2007). Performance predictions have been used in various memory domains to assess people's metamemory (Hertzog & Hultsch, 2000). Memory-performance predictions allow direct investigation of how accurately individuals anticipate their memory performance (e.g., Nelson & Dunlosky, 1991) and have been found to relate to memory strategies (cf. Hertzog, Touron, & Hines, 2007; Kuhlmann & Touron, 2011). More globally, making performance predictions improves retrospective memory performance (Kelemen & Weaver, 1997; Spellman & Bjork, 1992).

Regarding the accuracy of PM predictions, people generally underestimate their PM performance (Knight, Harnett, & Titov, 2005; Meeks et al., 2007; Schnitzspahn, Zeintl, Jäger, & Kliegel, 2011; but see Devolder, Brigham, & Pressley, 1990). Meeks et al. (2007), however, found moderate but significant correlations between PM predictions and actual PM performance, implying that participants had at least some insight in their own PM performance (see also Schnitzspahn et al., 2011). Surprisingly, Meeks et al. (2007) did not find significant correlations between ongoing-task response speed and PM performance, although PM performance in this study should have depended on attentional monitoring as the PM targets were nonfocal.[1] That is, requiring participants to make PM performance predictions appears to have altered attentional monitoring processes, which are usually related to nonfocal PM performance in studies not assessing predictions.

Despite its repeated use, prior research has not sufficiently considered global effects of making PM predictions on the allocation of attention to a PM task by comparing a condition making PM predictions to an appropriate no-prediction control condition. Given that performance predictions have reactive effects on RM performance, we argue that making PM predictions can also reactively affect PM performance and the processes engaged in favor of the PM task (see Meier, von Wartburg, Matter, Rothen, & Reber, 2011, for a similar argument). Such *reactive effects* from PM predictions would not only complicate the interpretation of PM prediction accuracy but also imply that metamemory plays a critical role for attention allocation strategies in PM (cf. Einstein & McDaniel, 2008).

The present study thus aims first to demonstrate that making PM predictions can reactively affect attentional PM processing. Additionally, we suggest a design-based modification of prediction assessment that controls for attentional changes and thus for at least some of the reactive effects of PM predictions. Finally, we argue that examining reactive effects may help to clarify the puzzling null-correlations between PM and ongoing-task performances after predictions (cf. Meeks et al., 2007), as reactive additional monitoring may not be completely functional for PM performance and as such predictions may incite a strategic approach which is not maximally efficient.

To our knowledge, the only previous investigation of reactive effects from PM predictions is a study by Meier et al. (2011). These authors argued that making PM predictions might facilitate processing of the PM target. In particular, they suggested

[1] Meeks et al. (2007) examined two different kinds of PM-target conditions. That is, participants were asked to respond to members of the animal category or to the syllable "tor" with the PM key. Both making category inferences and engaging a perceptual search for a syllable should not rely on the same processes as making lexical decisions. Thus both kinds of PM-targets can be considered as nonfocal (cf. Einstein & McDaniel, 2005).