Event-based prospective memory in depression: The impact of cue focality

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Abstract

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EVENT-BASED PROSPECTIVE MEMORY IN DEPRESSION: THE IMPACT OF CUE FOCALITY

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Short title: Event-Based Prospective Memory in Depression

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Abstract

This study is the first to compare event-based prospective memory performance in individuals with depression and healthy controls. The degree to which self-initiated processing is required to perform the prospective memory task was varied. Twenty-eight individuals with depression and 32 healthy controls worked on a computerized prospective memory task. Prospective cues were either presented focally or nonfocally to the ongoing activity. Collapsing data across both conditions, controls outperformed individuals with depression in the prospective memory task. Overall, participants showed a poorer prospective memory performance in the nonfocal condition that required self-initiated processing to a higher degree than the focal condition. Importantly, as revealed by a group by task condition interaction, groups did not differ in the focal condition, whereas, controls outperformed individuals with depression in the nonfocal condition. The results are in line with the multiprocess framework of event-based prospective remembering and the cognitive-initiative account of depression-related cognitive deficits.

Word count: 149

Keywords: depression, prospective memory, self-initiated processing, automatic processing, executive functions
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Depression is characterized by a lowered mood, feelings of sadness or anxiety, reduced energy and activity. Moreover, individuals with depression often find it hard to think, concentrate or to make decisions (e.g., APA, 2000). Depressive impairments have also been found in various memory tests with both verbal and visual stimuli (e.g., Austin, Mitchell, & Goodwin, 2001; Fossati, Coyette, Ergis, & Allilaire, 2002; Ilsley, Moffoot, & Ocarroll, 1995). Although depressive deficits have even been observed in recognition tasks (when conscious recollection was required, Hertel & Milan, 1994), individuals with depression seem to have particular problems with free recall tests in which controlled retrieval processes are important (Ilsley et al., 1995; Roybyrne, Weingartner, Bierer, Thompson, & Post, 1986). In general, impairments appear to be most pronounced when tasks demand self-initiated processing (Hertel, 2000) and are rather effortful as compared to automatic (e.g., Austin et al., 2001; Roybyrne et al., 1986). Concordantly, there is anecdotal evidence from our clinical experience that individuals with depression frequently report memory problems when they have to self-initiate actions planned earlier such as buying groceries in a shop or passing a message to a colleague. Surprisingly, this memory function for the delayed realization of intended actions, which is currently studied under the label of prospective memory (PM, Brandimonte, Einstein, & McDaniel, 1996), has received little attention in the clinical neuropsychology of depression (see Hertel, 2000, for a first conceptual outline).

PM is an umbrella term that refers to the task itself as well as to the involved cognitive processes such as executive functions and retrospective memory (Brandimonte et al., 1996; Ellis & Freeman, 2008). Importantly, individuals have to initiate the execution of previously formed intentions on their own account. Taken together, for successful PM performance abilities are needed in which individuals with depression are impaired. Research on PM differentiates between two types of tasks on the basis of the cue that signals the appropriate moment to re-instantiate the planned action. This cue may be an event (event-
based tasks; e.g., when someone enters the room) or a specific time (time-based tasks, e.g., at 11 o'clock or every five minutes, Einstein, McDaniel, Richardson, Guynn, & Cunfer, 1995).

Up to now, only one study has tested prospective remembering in depression (Rude, Hertel, Jarrold, Covich, & Hedlund, 1999). Specifically, Rude and colleagues investigated PM performance in individuals with depression in comparison to healthy controls in a time-based PM task; a task that is assumed to be highly demanding of self-initiated processing (Einstein et al., 1995). The ongoing task was a multiple-choice general knowledge test that was presented on a computer screen. For the PM task, participants were asked to press a defined key every five minutes during the execution of the ongoing activity. When participants wanted to check the time, they could press a different key to request a display of the elapsed time. In this task, individuals with depression showed a reduced performance on the PM task as compared to healthy controls. In addition, participants with depression monitored the time less frequently than controls and showed a different pattern in doing so, i.e., controls increased the frequency of time-monitoring more than clinical participants in the final test block. This observation points to a difference between the groups that resembles the patterns found in studies comparing young and old adults, where the latter performed similarly to individuals with depression (Einstein et al., 1995). However, groups did not only differ in the PM task, but also in the ongoing activity and in a vocabulary test. Hence, group effects in prospective remembering may also be due to differences in terms of general cognitive ability (Kliegel & Jäger, 2006b).

The result of a PM deficit in depression is in line with theoretical approaches conceptualizing cognitive deficits in depression. For example, the cognitive-initiative framework of depression (Hertel, 1994; Hertel & Hardin, 1990) predicts that depressive-mood states influence memory task performance. According to this model, depression reduces the initiative to control attentional resources and to use beneficial strategies to approach a task. As a consequence, performance in cognitive tasks decreases, when no
explicit instructions or task constraints are given that structure and thus control the allocation of resources. Overall, it is assumed that memory deficits in depression depend on the degree to which environmental support (e.g., in form of experimental control) is present and the cognitive tasks require self-initiated, controlled processes (for experimental evidence on retrospective memory see e.g., Channon, Baker, & Robertson, 1993; Hertel & Hardin, 1990).

Importantly, PM tasks are typically assumed to be self-initiated tasks that are low in environmental support. Examining age-related changes in memory performance, Craik (1986) has proposed that the extent of age differences in memory can be explained by the degree to which self-initiated processes are necessary to remember the information. In his influential framework, remembering involves the recapitulation of a previous mental state and its effectiveness depends on the degree to which the learning context is given at the time of retrieval. If environmental support in terms of cues and context is low, more self-initiated activities are needed to return the mnemonic system to its previous state and, thus, to ensure successful remembering. With decreasing environmental support, the need for intentional and effortful self-initiated activities increases. From priming tasks, over relearning, recognition, cued recall and free recall tasks to PM tasks self-initiated processing becomes more and more important (Craik, 1986). Consequently, prospective remembering is generally considered to be highly demanding of self-initiative processing. Modifying this conceptual model, McDaniel and Einstein (2000) in their Multiprocess Framework for event-based PM tasks suggested that retrieval of an intended action may be supported by both strategic, self-initiated processing and/or by rather automatic processing. The extent to which strategic, self-initiated processing as opposed to automatic processing are required for successful prospective remembering “varies as a function of the characteristics of the PM task, target cue, ongoing task, and individual” (p. S127). Of great importance in their framework is the relation of the prospective cue to the ongoing activity, namely its focality. The term focality refers to the extent “the ongoing task encourages processing of the target” (Einstein &
McDaniel, 2005, p. 287). That is, focality describes the similarity of the cognitive processes needed for performing the ongoing task and detecting the prospective cue (McDaniel & Einstein, 2000). If the cue is focal to the processes involved in the ongoing activity (e.g., both the ongoing task and the prospective cues demand semantic processing), the cue automatically initiates the retrieval of the planned action. In contrast, nonfocal cues (e.g., a letter-pair embedded in a word when its meaning has to be rated) demand more self-initiated resources or strategic processes to monitor for the cue. The authors suggest that event-based prospective remembering should improve when the cue is part of the information that has to be processed to perform the ongoing task, i.e., focal to the ongoing activity. With regard to age effects and effects of clinical impairments, McDaniel and Einstein (2000; McDaniel, Einstein, & Rendell, 2008) hypothesized that both are more likely to occur in nonfocal tasks where strategic self-initiated processing is required. This is supported by empirical evidence from studies on healthy older adults and first clinical populations of patients with closed head injury (e.g., Einstein et al., 1995; Schmitter-Edgecombe & Wright, 2004).

The aims of the present study were to explore event-based prospective remembering in people with depression for the first time and to experimentally test the involvement of strategic or self-initiated processing in participants’ PM performance (McDaniel & Einstein, 2000). Prospective cues were presented focally and nonfocally, respectively, to the ongoing activity. As for our hypotheses, given the assumed reduced cognitive initiative of individuals suffering from depression (Hertel, 2000) and the low environmental support of PM tasks (Craik, 1986), first, individuals with depression were expected to show an overall impairment in PM performance in comparison to healthy controls (group effect). Second, as suggested by the multiprocess framework, participants should perform better in the focal condition than in the nonfocal condition (focality effect). Third, and most importantly, according to the cognitive-initiative account external control may substitute for self-initiated control in less-structured situations, whereby performance of individuals with depression should increase
under attention-controlled conditions. Focal tasks may be regarded as rather high and nonfocal tasks as rather low in environmental support (Einstein & McDaniel, 2005) and thus, both tasks provide differential external cognitive control. Consequently, we predicted an interaction of group by condition and expected the depression group to be differentially more impaired in the nonfocal condition than the control group because nonfocal tasks provide low environmental support and put high demands on self-initiated strategy application. In contrast, performance differences between groups should be smaller in the more structured focal condition.

**Methods**

**Participants**

Inclusion criteria were diagnosis of major depression according to criteria from the Diagnostic and Statistical Manual of Mental Disorders (4th ed. [DSM-IV-TR]; APA, 2000) for the clinical group and aged between 20 and 60 years for the entire sample in order to minimize possible additional cognitive effects of normal aging (see Kliegel & Jäger, 2006a; McDaniel et al., 2008). Exclusion criteria were any other history of psychiatric or neurological diseases, or drug or alcohol abuse to exclude possible effects of other neurocognitive conditions. A total of 60 participants were included in the current study: Twenty-eight individuals with unipolar depression and 32 healthy controls. Controls were matched on age (depression group: $M=42.32$, $SD =10.43$; controls: $M=41.03$, $SD = 1.81$; $F(1,58)=.19$, $p>.05$), education (education in years: depression group: $M=12.93$, $SD=2.4$; controls: $M=13.84$, $SD=2.8$; $F(1,58)=1.81$, $p>.05$), and sex. Twelve individuals with depression and 12 controls were men. Patients were recruited from local clinics in Zurich and Berne, Switzerland, and were all inpatients. Diagnoses were provided by the participating clinics. As expected, the clinical group showed more depressive symptoms on Beck’s Depression Inventory (BDI, Beck, Hautzinger, Bailer, Worall, & Keller, 1995, depression group: $M=22.89$, $SD=7.8$, controls: $M=4.34$, $SD=4.4$, $F(1,58)=131.07$, $p<.001$). All
individuals with depression were on antidepressant medication (SSRI, SNRI, tricyclic or tetracyclic antidepressants). Four individuals were also treated with benzodiazepines or neuroleptics as hypnotic or anxiolytic. The study was approved by the State Ethics Committees in Berne and Zurich, Switzerland. Only those participants took part in the study who had given informed consent. Each participant was tested individually. Testing took about 60 minutes with a short break after 30 minutes.

Materials and Procedure

Neuropsychological assessment. As a measurement of participants’ memory span the subtest Digit Span Forward of the Wechsler Adult Intelligence Scale – Revised (WAIS-R, Tewes, Neubauer, & von Aster, 2004) was used. In this task, participants have to repeat increasing numbers of digits (starting with three digits). The number of digits presented increases by one with every other trial. If at least one numerical series of a given number was reproduced correctly, the next longer sequence of numbers is presented (maximally a nine digit sequence). The number of correctly repeated digit series is counted.

To assess participants’ working memory capacity the subtest Digit Span Backward of the WAIS-R (Tewes et al., 2004) was presented. It equals the digit span forward tasks with the difference that participants are required to repeat the digit sequences in reversed order (starting with two digits until maximally eight digits).

Inhibitory efficiency was measured with the Stroop test (Stroop, 1935). In this task, participants are to name the colour of coloured bars (red, blue, green, and yellow) as fast as possible (baseline trial). Thereupon, they are presented with the interference trial. Here, they are to name the mismatched colour of colour name words as fast as possible. Both trials comprise 36 items. Dependent variable is the time difference between the interference trial and the baseline trial, whereby higher scores indicate worse inhibition abilities.

Individual differences in the level of depression were measured with Beck’s Depression Inventory (BDI, Beck et al., 1995). The BDI is a 21-question multiple choice
survey that assesses depressive symptoms such as hopelessness, irritability, feelings of being guilty or of being punished and physical symptoms. Higher scores indicate higher depression.

The PM test. A standard lab PM procedure (Einstein-McDaniel-paradigm) was used in the present study and modified according to the study aims (varying cue focality). It comprises an ongoing task and a PM task component which is embedded in the ongoing task. For the ongoing task participants were presented with noun pairs written in lowercase. They were required to count the number of vowels in both words and to press a green or an orange key, respectively, depending on which word had more vowels (left or right word; e.g., rolle – seife). Participants were told to try to respond to task items correctly and as fast as possible. Items were presented in the centre of a computer screen and presentation lasted until a response was made, but maximally 4000 ms - with an interstimulus interval of 2000 ms between two trials.

For the PM task blocks, participants were to work on two tasks simultaneously, the ongoing task and the PM task. Focality of prospective cues was varied within subjects. For the focal condition, participants were told to press a pink key, whenever one of the two words contained the letter ‘e’ three times (i.e., gerede, seele, gehege, meere). For the nonfocal condition, participants were asked to press the pink key whenever at least one of the two words was a verb (i.e., tanzen, putzen, weinen, lesen). Each of the two test blocks consisted of 92 ongoing task trials and four PM trials. Words were presented in a pseudo-randomized order. Prospective targets appeared between every 12th and 27th trial (M=17.3). Within the focal block no verbs and within the nonfocal block no nouns with three ‘e’ were presented. Accuracy and response times were recorded digitally as dependent variables. The order of the two test blocks was balanced to control for order effects.

After a brief explanation of the task with a print-out depicting two examples of ongoing task trials, participants worked on a practice block consisting of 5 trials. Feedback regarding correctness of participants’ answers was only given during the practice block.
Thereupon, participants completed 20 ongoing task trials (“pure ongoing task block”). Participants were then given instructions for the PM task. They were told that in about 10 minutes after having done other tasks, they were to work on two tasks simultaneously. They were to keep on deciding which of the two nouns contained more vowels and to press the corresponding keys. Additionally, they were to perform a second task of equal importance and were explained the focal or nonfocal prospective task, respectively. Previous research (Brandimonte et al., 1996) has shown that a delay between giving the PM instructions and the actual PM task as well as a ratio of relatively few prospective items to ongoing task items are necessary to make sure that the prospective intention is not continually maintained in working memory and to induce sufficient prospective forgetting. The first delay before the first prospective task block was filled with the Digit Span Forward and Digit Span Backward tests. Afterwards participants had a short break and were then given instructions to the nonfocal or focal prospective task, respectively. The second delay before the second prospective block was filled with the Stroop task.

Results

Individual Difference Variables

Analyses of variance (ANOVAs) revealed no significant group differences with regard to short-term memory, working memory and inhibitory efficiency (see Table 1). That is, no general ability differences emerged between groups.

“Table 1 about here”

PM and ongoing task performance

In a first step, two separate repeated measures ANOVAs were carried out to evaluate participants’ accuracy scores and response times in the PM task (see Table 2 and Figure 1). As expected, regarding accuracy scores significant large-sized main effects for focality ($\eta^2=.52$) and group ($\eta^2=.11$) as well as a significant medium-sized interaction effect ($\eta^2=.08$) emerged. In general, controls outperformed individuals with depression and, overall,
participants performed better in the focal than in the nonfocal condition. However, most importantly, the significant group by focality interaction showed that as compared to controls participants with depression were differentially more impaired in the nonfocal condition than in the focal condition. Post hoc tests revealed that groups did not differ in the focal condition ($F(1,60)=.98, p>.05, \eta^2=.02$), whereas, controls outperformed the depression group in the nonfocal condition ($F(1,60)=10.70, p<.002, \eta^2=.17$).

Groups did not differ in their reaction times to prospective events either in the focal condition (depression group: $M=2171.6, SD=487.5$; controls: $M=1948.7, SD=421.2$; $F(1,56)=3.5, p>.05$) or in the nonfocal condition (depression group: $M=2200.6, SD=579.6$; controls: $M=1984.1, SD=538.3$; $F(1,53)=2.0, p>.05$).

In a second step, we examined participants’ ongoing task performances. Two separate repeated measures ANOVAs were conducted to analyse participants’ ongoing task performance (accuracy scores and response times) across the three blocks (pure ongoing task block and the two ongoing task plus PM tasks blocks). As can be taken from Table 2, a significant large-sized main effect for focality ($\eta^2=.13$) was observed with respect to accuracy scores, whereas, no statistically reliable group ($\eta^2=.05$) and interaction effects ($\eta^2=.002$) were found. That is, both groups performed better in the focal than in the pure and nonfocal condition. For response times, significant large-sized main effects emerged for group ($\eta^2=.13$) and focality ($\eta^2=.10$), but there was no significant interaction ($\eta^2=.004$). In general participants responded faster to the stimuli in the pure and focal condition than in the nonfocal condition and participants with depression were slower than controls in all three conditions.

“Table 2 about here”

Monitoring costs. To analyse the costs of PM performance on the ongoing task due to PM cue monitoring, we subtracted participants’ mean response times to ongoing task items in
the focal and nonfocal condition, respectively, from their mean response times in the pure condition and then tested whether costs were different from zero. As expected, a significant cost effects did emerge for the nonfocal condition ($M=-121.72, SD=442.56, t(59)=-2.13, p<.05$), but not for the focal condition ($M=59.66, SD=442.45, t(59)=1.04, p>.05$). No differential cost effects were observed for the two groups either for the focal (depression group: $M=90.74, SD=479.27$, controls: $M = 32.46, SD = 413.37; F(1,58) = .26, p > .05$) or for the nonfocal condition (depression group: $M=-88.79, SD=497.38$, controls: $M=150.53, SD=394.28; F(1,58)=.29, p>.05$). Importantly however and in line with their PM performance, the depression group showed a mean level tendency for slightly less cost effects in the nonfocal condition in comparison with controls.

Discussion

The present study is the first to investigate event-based prospective remembering in individuals with depression in comparison to healthy controls. Moreover, it aimed at testing conceptual predictions derived from recent theoretical accounts of event-based prospective remembering (e.g., McDaniel & Einstein, 2000) as well as depression-related cognitive performance (Hertel, 2000). In line with our predictions, the most important finding of the present study was an interaction between depression and type of PM task. Specifically, analyses revealed that groups did not differ in the focal condition, whereas, controls outperformed the depression group in the nonfocal condition.

Qualifying the observed main effects of group and task type, from a conceptual perspective the pattern revealed nicely dovetails with the two models that guided the present study. First, results are in accord with the multiprocess framework of event-based PM (McDaniel & Einstein, 2000), which assumes that tasks in which cues are in the focus of the information being processed for the ongoing activity lead to rather automatic retrieval and result in superior performance in comparison to tasks with rather high demands on self-initiated strategy application. A mechanism that is expected to particularly benefit
populations showing reduced processing resources or low levels of self-initiated monitoring. Second, the cognitive-initiative account postulates that depressive performance decrements emerge in tasks which poorly direct attention, whereas externally supported control of attention (during learning or remembering of the material) can compensate for a reduced self-initiated control (Hertel, 2000). External control may substitute for self-initiated control in less-structured situations, whereby performance of participants with depression should increase under controlled conditions - even in resource-demanding tasks (Channon et al., 1993; Hertel & Hardin, 1990) such as PM tasks. Consistent with these conceptual arguments, groups performed at a similar level in the focal condition, whereas, in sharp contrast, only in the nonfocal condition the depressed group performed significantly worse compared to healthy controls.

One could argue that the focal condition controls participants’ attention insofar as task instruction lead participants to focus on the words’ vowels in the ongoing and the PM task. Therefore, participants do not have to employ a specific, self-initiated strategy to solve the PM task as they are required to in the nonfocal PM task (e.g., first checking if one of the two words is a verb and then deciding which word contains more vowels, see Smith & Bayen, 2004). Accordingly and in line with Einstein et al. (2005), we only found significant monitoring costs in the nonfocal condition as reflected by increased slowing on the ongoing task relative to the pure condition, but not in the focal condition. These findings suggest high levels of monitoring with a nonfocal task but not with a focal task. Following the reasoning of the multiprocess framework, depressive deficits in nonfocal PM performance may suggest that participants with depression were less likely to maintain a process of monitoring for the target event in the nonfocal condition, and consistently, they showed slightly less monitoring costs in comparison to controls. However, in the present data, this difference did not reach significance. It may well be that the ongoing task chosen was not sensitive enough to detect
this effect properly. Thus, future studies will have to explicitly target the issue of monitoring costs in depressed patients’ PM performance.¹

Importantly, the reduced PM performance in depression cannot be attributed to impairments in retrospective memory, working memory capacity and inhibitory efficiency, as no group differences emerged in the respective tests (Digit Span Forward, Digit Span Backward task, Stroop). The absence of significant group effects in these tests may appear surprising; however, the literature on Stroop effects and digit span performance in depression is rather inconsistent with many studies finding no deficits (e.g., Degl'Innocenti, Agren, & Backman, 1998; Den Hartog, Derix, van Bemmel, Kremer, & Jolles, 2003; Moritz et al., 2002). Moreover, (nonfocal) PM specifically requires self-initiated cue monitoring processing which might not be closely linked to simple span tasks and Stroop performance.

The present results are consistent with the prior study of Rude et al. (1999) on time-based PM in depression extending this impairment to event-based PM with nonfocal cues. Moreover, while we have argued that the interpretation of the effects in Rude et al.’s study may be seen as somewhat limited by impaired performance of the depression group also in ongoing task accuracy, (only) on a first glance, in the present study the ongoing task appeared not to be more difficult for individuals with depression. In fact, groups did not differ with respect to accuracy scores in the ongoing task. Overall participants showed a superior performance in the focal in comparison to the nonfocal ongoing task. This result was mirrored in participants’ response times, where participants needed less time to respond to stimuli in the focal ongoing task block, and corroborates the assumption of more controlled processes being involved in nonfocal PM tasks. However, more importantly, individuals with depression needed significantly more time to perform the ongoing task blocks. This could indicate a speed-accuracy trade off. Participants with depression may have tried to compensate for task difficulty by taking longer to respond, which may suggest that they found the ongoing task more difficult. Following Einstein and McDaniel (2000), this may
have disadvantaged patients’ PM performance, as it may have left them with fewer resources to monitor for the PM cue and may thus have impeded their performance. Hence, if ongoing task difficulty had been functionally equated for participants with depression and controls, group differences in PM performance might have been smaller. Future research needs to directly address this issue and apply an ongoing task that completely equates ongoing task performance across groups.

A possible limitation of the present study may be that in contrast to controls all individuals with depression were on antidepressive medication which may also have affected their PM performance. However, at least regarding the neuropsychological tests applied no group effects emerged. This argues against a mere medication effect of the PM deficit in depression. Moreover, two alternative explanations for depressive impairments in PM performance have to be addressed. Rather than a memory deficit, individuals with depression might have found it harder to concentrate or were less motivated to put effort into the task and may thus have missed prospective cues. However, individuals with depression performed well on neuropsychological tests which argues against a mere concentration or motivation effect.

A final issue to be discussed in this context is the general slowing of individuals with depression. Participants with depression needed longer to perform the ongoing tasks at the same level as healthy controls and showed slightly prolonged response times in the PM task. Reduced psychomotor speed is a central depressive symptom (APA, 2000) that influences the individual’s mobility, cognitive activity and speech (Dantchev & Widlocher, 1998). Fossati and colleagues (2002) found deficits in free recall in individuals with depression to be related to psychomotor retardation. They postulated that a prolonged speed of processing might reduce cognitive initiation and cue generation during retrieval which may result in deficits in free recall. Future research should explore the potential role of psychomotor retardation in the reduced efficiency of event-based PM of individuals with depression. The understanding of
cognitive processes involved in prospective remembering and related neural correlates may help to understand the processes underlying certain disorders and may enable conceptualizing specific interventions and possibly the improvement of assessment, therapy and rehabilitation of individuals with depression.

In summary, the current study provides experimental evidence that even demanding tasks such as PM tasks do not necessarily show depression-related impairment. Only when the PM task requirements include high levels of intentional control of attentional resources within a complex cognitive task as in the nonfocal condition of our event-based PM task, performance deficits of individuals with depression versus healthy controls can be observed. From a clinical perspective, our findings have important implications for the design of everyday PM tasks: External structure may help to control attentional resources and strategic processing within PM tasks (Rendell, Jensen, & Henry, 2007). Thus, PM tasks should be incorporated in individuals’ daily routines and should always be presented in their focus of attention. For instance, individuals could be asked to place their medicine on their breakfast table instead of a drawer. Future research should extend these laboratory-based findings to naturalistic settings to investigate whether external cues supporting the intentional control of attentional resources within PM tasks may improve everyday PM performance in participants with depression.
Footnote

1 Alternatively, increasing fatigue might also account for the observed group difference in PM performance. If individuals with depression are less likely to engage in self-initiated processing mainly due to fatigue, they should be even less likely to do so in the second block. However, additional analyses showed that the order of PM tasks did not affect patients’ performance. We thank Gil Einstein for this suggestion.
References


Table 1. Individual Difference Variables

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Controls</th>
<th>Group effect</th>
<th>η²</th>
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<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>F (df)</td>
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<tr>
<td>digit span forward</td>
<td>6.14 (1.8)</td>
<td>6.97 (1.7)</td>
<td>3.35 (1,58)</td>
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<td>digit span backward</td>
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<td>6.09 (1.7)</td>
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<td>.001</td>
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<td>Stroop test</td>
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<td>12.81 (4.8)</td>
<td>1.75 (1,58)</td>
<td>.03</td>
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Table 2.

Prospective memory and ongoing task performance: repeated measures ANOVAs of accuracy and response times

<table>
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<tr>
<th></th>
<th>Patients M (SD)</th>
<th>Controls M (SD)</th>
<th>Focality effect</th>
<th>Group effect</th>
<th>Interaction effect</th>
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<tr>
<td><strong>Accuracy (proportions)</strong></td>
<td></td>
<td></td>
<td>63.25 (1,58)</td>
<td>6.88 (1,58) **</td>
<td>4.96 (1,58) *</td>
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<td>focal condition</td>
<td>.81 (.30)</td>
<td>.88 (.18)</td>
<td>***</td>
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<td>nonfocal condition</td>
<td>.44 (.28)</td>
<td>.66 (.26)</td>
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<td><strong>Ongoing Task</strong></td>
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<tr>
<td><strong>Accuracy (proportions)</strong></td>
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<td>8.7 (2,116)</td>
<td>3.32 (1,58)</td>
<td>.13 (2,116)</td>
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<td>.84 (.15)</td>
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<tr>
<td><strong>Response times (ms)</strong></td>
<td></td>
<td></td>
<td>6.3 (2,116)</td>
<td>8.3 (1,58) **</td>
<td>.22 (2,116)</td>
</tr>
<tr>
<td>pure condition</td>
<td>2590.63</td>
<td>2224.88</td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(530.8)</td>
<td>(666.8)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>focal condition</td>
<td>2499.89</td>
<td>2192.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(437.5)</td>
<td>(431.5)</td>
<td></td>
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</tr>
<tr>
<td>nonfocal condition</td>
<td>2679.42</td>
<td>2375.40</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(337.6)</td>
<td>(476.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01, *** p < .001