



The impact of ruminative and mindful modes of self-focus on prospective memory

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ABSTRACT

There is a substantial body of literature documenting the susceptibility of retrospective memory to negative emotional influences. By contrast, despite the ubiquity of prospective memory (Burgess, Quayle & Frith, 2001), very little is known about how this cognitive ability to execute previously formed intentions interacts with enduring emotional states. The present study set out to investigate the impact of ruminative and mindful modes of self-focus on prospective memory. The Ruminative Response Scale (Nolen-Hoeksema & Morrow, 1991) and the Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006) were opportunistically administered to 165 healthy volunteers. Of these, 16 men and 81 women aged between 18 and 64 years (median age: 18-24 years) completed the questionnaires. Respondents scoring above one standard deviation of the respective scales were invited back for a computer-based prospective memory experiment (mindful group n=9, rumination group n=10) comprising both a time-based task and an event-based task. The results did not reveal any significant differences in prospective memory performance between the two groups. Explanations for the lack of effect are offered with reference to the Resource Allocation Model (Ellis & Ashbrook, 1988), the cognitive-initiative framework of depression (Hertel, 2000) and the Multiprocess Framework (McDaniel and Einstein, 2000).

KEY WORDS:	PROSPECTIVE MEMORY	MINDFULNESS	RUMINATION	RESOURCE ALLOCATION MODEL	MULTIPROCESS FRAMEWORK
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INTRODUCTION

The impetus for this study is derived from the documented interconnectivity between cognition and emotion (Clore & Martin, 2001). The memory system is one of the most extensively researched areas within human cognition. Within this domain, research efforts have primarily focussed on the relationship between retrospective memory and negative emotional states, notably anxiety and depression (e.g. Ellis & Ashbrook, 1988; Eysenck & Calvo, 1992; Hertel & Milan, 1994). By contrast, there is a paucity of studies addressing how prospective memory (PM) is modulated by transient fluctuations in mood, enduring emotional states and clinically relevant affective disorders (Kliegel & Jäger, 2006).

Depressive rumination is a maladaptive and unconstructive form of self-reflection which involves passively and repetitively brooding over one's feelings and problems rather than in terms of the specific thought content (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008). Phenomenologically, it is characterized by a multidimensional configuration of perseverative thinking with a focus on drawing attention to aspects of the self and one's dysphoric symptoms through the repeated analysis of the causes, meanings, consequences and implications of these symptoms (Watkins, Moberly & Moulds, 2008). Depressive rumination is consistently implicated in the maintenance of depression-related deficits such as impoverished problem solving (Lyubomirsky & Nolen-Hoeksema, 1995; Watkins & Moulds, 2005), impaired executive functioning (Kuehner, Huffziger & Liebsch, 2008) and negative cognitive bias (Lavender & Watkins, 2004; Rimes & Watkins, 2005). In fact, rumination has been identified as a core process in the onset and maintenance of depression (Teasdale & Barnard, 1993) and is the form of perseverative cognition most robustly associated with depressive symptoms (Mor and Winquist, 2002). The negative ramifications of rumination have typically been accounted for by the compellingly central role of self-focus on depressive symptoms (Lyubomirsky & Nolen-Hoeksema, 1995); this has come to be known as the *symptom-focus* hypothesis.

An alternative theoretical account proposes that the deleterious effects of rumination may, in part, be determined by the particular mode of information processing espoused during self-focus (McFarland & Buehler, 1998; Teasdale, 1999). Although depressive rumination is predominantly self-focused, it is suggested that it is not the self-focus *per se* that exacerbates depression but rather, the nature of its manifestation (Watkins & Teasdale, 2004). Several researchers have highlighted a distinction between *experiential mindful self-focus* which is a more abstract, analytical and conceptual level of thinking versus *ruminative self-focus*, which refers to rationalisation anchored in direct, concrete and specific experience (Borkovec, Ray & Stöber, 1998; Teasdale, 1999; Stöber & Borkovec, 2002; Philippot, Baeyens, Douilliez & Francart, 2004). It follows then that the 'symptom focus' in the context of depressed mood is a necessary but not sufficient condition for the materialisation of the negative repercussions of rumination; the effect largely depends on the "route" (mindful vs. ruminative) that is adopted.

A mindful mode is a non-evaluative, non-judgemental way of relating to one's experience that involves a present-centred awareness in which each subjective thought, feeling or bodily sensation that arises is acknowledged and accepted

(Kabat-Zinn, 1994). Essentially, it requires taking a “decentred viewpoint” and observing one’s feelings and thoughts as being mere percepts of the mind independent from the self, rather than as accurate and permanent depictions of reality (Safran & Segal, 1990).

Mindful self-focus then can be described as being “distinct, concrete, situationally specific, unequivocal, clear, singular” self-contemplation (Stöber & Borkovec, 2002). Leveraging on this operational definition, a mindful self-focus would summon the recall of a *specific* autobiographical memory (Watkins & Moulds, 2005) that is, a memory depicting the detailed context of a particular event at a particular time (e.g. “I sat next to Sara at the fundraiser brunch last Sunday”). Conversely, ruminative self-focus is construed as being a form of self-reflection that is “indistinct, abstract, cross-situational, equivocal, unclear, aggregated” (Stöber & Borkovec, 2002) and typically entails the recall of an *overgeneral* autobiographical memory (Watkins & Moulds, 2005), represented as a categorical summary of repeated experiences (e.g. “I am a constant failure”). In other words, it is the tendency to recall categories of events when asked to recount specific episodes from one’s life (Gibbs & Rude, 2004).

Previous research has linked depressive rumination to the enhanced preferential retrieval of negatively toned autobiographical memories (Lyubormirsky, Caldwell & Nolen-Hoeksema, 1998), overgeneral autobiographical memories (Watkins & Teasdale, 2004) and reduced autobiographical memory specificity (Crane, Barnhofer, Visser, Nightingale & Williams, 2007). However, little is known about the impact of ruminative and mindful self-focus on PM.

The term “prospective memory” (PM) encapsulates the persuasive cognitive ability to encode, store and execute future intentions. Put another way, PM can be defined as remembering to remember (Winograd, 1988) or remembering to enact a previously formed intention. This memory function for the delayed realisation of [intended](#) actions lies at the heart of everyday competent functioning and one which we tend to take for granted. Without PM, we would have to continuously and actively rehearse the intended action in working memory until the occurrence of the appropriate time or context. Thus PM serves to bind complex goal-directed behavioural sequences and ensure the meaningful fulfilment of plans and wishes (Kliegel & Jäger, 2006).

The implementation of a PM task involves several phases, which embrace distinct cognitive processes (Kliegel & Jäger, 2006). First, an intended action has to be planned and encoded. Next, since PM contexts typically entail a delay between forming an intention and carrying it out, the prospective intention must be accurately maintained in memory throughout the retention interval, the duration of which may vary from minutes to months (Kliegel & Jäger, 2006). During the intervening period, one’s attention would normally be divided between many different events making verbal rehearsal until the retrieval context impractical if not impossible. Finally, when the appropriate opportunity presents itself, the individual has to become aware that an intended action awaits execution, so that the specific intention may be retrieved and performed. Many everyday situations conform to this cognitive sequence such as remembering to buy birthday gifts, to make an important phone call the next day, to pay the bills or to switch off the stove after cooking.

Research on PM has traditionally employed both laboratory-based tasks and naturalistic tasks. Naturalistic PM experiments require the execution of intended actions in everyday settings, such as remembering to send cards to the experimenter (Patton & Meit, 1993), to log the time on an electronic device (Rendell & Thomson, 1993) or to fill out questionnaires and send them back to the experimenter within a given time frame (Kliegel & Jäger, 2006). In laboratory studies, experimental paradigms tapping PM abilities involve both an ongoing task and a PM task. Participants are primarily engaged in a cognitive task (known as the ongoing task) such as a word completion task or an n-back task (Kliegel & Jäger, 2006) and are instructed to concurrently carry out a PM task. The ongoing task is such that it prevents a simple verbal or sub-vocal rehearsal strategy and its demands are often unrelated to the PM intention or retrieval context. Thus, to perform the PM task, attention needs to be intermittently switched from the ongoing task to the intended action and its execution (McDaniel & Einstein, 2000).

The PM literature draws a notable distinction between two types of tasks on the basis of the cue that signals the appropriate retrieval context to re-instantiate the intended action. *Event-based* tasks necessitate the execution of the intended action upon the appearance of a specific externally presented cue (“when x occurs then do y”; e.g. whenever a target word appears during the ongoing task). By contrast, *time-based* tasks require performing the intended action at a particular point in time independent of any event-related cue or after a specific amount of time has elapsed (“at time x do y”; e.g. remembering to press a designated button on the keyboard every 2 minutes). According to Einstein and McDaniel (1990), time-based PM tasks demand the greatest degree of self-initiated processing and cognitive control and hence impinge heavily on cognitive capacity.

The preparatory attentional and memory processes model (PAM) developed by Smith (2003) hypothesises that PM constitutes two components namely, an attentional component and a retrospective component. The attentional component calls for constant vigilance to identify the appropriate time at which to translate the previously formed intention into action; the retrospective component dictates the correct recollection of the content of the intention. The PAM model was derived from an experimental finding that ongoing task performance was adversely affected when participants were subjected to a PM task whilst undertaking an ongoing task compared to a control group who only attempted the ongoing task. It was suggested that the PM task consumed attentional resources which encumbered participants’ ability to attend to the ongoing task.

The view that the attentional component is always effortful and is expressed at the expense of the ongoing task has been challenged by McDaniel and Einstein (2000) in their Multiprocess Framework for event-based PM tasks. It has been argued that retrieval of an intended action may be supported by both strategic, self-initiated processing and by somewhat automatic processing but the extent to which they are needed for successful prospective remembering “varies as a function of the characteristics of the PM task, target cue, ongoing task and individual” (Altgassen, Kliegel & Martin, 2009). A central tenet of the Multiprocess Framework is the relation of the prospective cue to the ongoing task (i.e. focality) which in turn determines the extent to which the ongoing task facilitates the processing of the target (Einstein & McDaniel, 2005). In other words, focality captures the congruency between the

cognitive processes required for performing the ongoing task and those required for detecting the prospective cue (McDaniel & Einstein, 2000). If the cue is focal to the processes involved in the ongoing activity (e.g. both require semantic processing), the cue automatically instigates the retrieval of the intended action. On the other hand, non-focal cues (e.g. first checking if one of the two words is a verb and then deciding which word contains more vowels) are more taxing on cognitive resources because they provide low environmental support and put high demands on self-initiated strategy application, a position consistent with that advocated by Craik (1986) in his seminal account of age-related changes in memory performance.

Ellis and Ashbrook's (1988) Resource Allocation Model (RAM) posits that depressive mood states divert attentional resources to intrusive, task-irrelevant ruminative thoughts thereby resulting in an overall reduction of allocated cognitive capacity required to attend to the task at hand; the adverse effects are more pronounced on cognitive abilities that demand a high degree of controlled and self-initiated processes (Ellis & Ashbrook, 1988; Hertel & Hardin, 1990; Hertel & Milan, 1994). Whereas the conceptualisation has received relatively consistent support from studies investigating the retrieval aspect of retrospective memory, it is not clear if the theoretical assumptions are applicable to PM. Interestingly, time-based PM tasks permit the explicit assessment of attention allocation since participants' clock checking behaviour can be tracked and is assumed to reflect the amount of attentional resources allotted to a PM task. To be sure, previous studies (Rude, Hertel, Jarrold, Covich & Hedlund, 1999; Kliegel & Jäger, 2006) have established clock checking frequency to be a critical mediator for time-based PM performance, particularly in the time block immediately preceding the stipulated target times.

Resonating the view championed by Ellis and Ashbrook's (1988) RAM, the cognitive-initiative framework of depression (Hertel, 1994; Hertel & Hardin, 1990) postulates that depressive mood states have the effect of reducing the initiative to direct attentional resources to a cognitive task in a conducive and strategically beneficial manner. As a consequence, performance decreases especially when no explicit instructions are given or task constraints are imposed that otherwise serve to structure and organize the allocation of limited resources. Thus it is suggested that depression-related memory impairments depend on the degree to which environmental support is conferred and the extent to which cognitive tasks exercise self-initiated controlled processes. In general, PM failures appear to be more severe in tasks that draw on a greater degree of self-initiated processing (Hertel, 2000) and are somewhat effortful as opposed to routinal and automatic (Altgassen et al., 2009).

Even so, performance decrements largely depend on the nature of the task and tend to manifest in tasks that poorly direct attention. In other words, reduced self-initiated control (Hertel, 2000) in less-structured situations can be somewhat compensated for by externally supported mechanisms of attentional control (such as learning or memorising experimental material) so that performance of depressed participants can actually be enhanced even in cognitively challenging tasks (Hertel & Hardin, 1990). Focal tasks may be regarded as being relatively high in environmental support compared to non-focal tasks (Einstein & McDaniel, 2005) hence yielding differential external cognitive control.

Although clinical anecdotes have documented impairments in PM in depressive patients (e.g. missing appointments, forgetting to take medication), there is a dearth of experimental studies in this area (e.g. Altgassen et al., 2009; Kliegel, Jäger, Phillips, Federspiel, Imfeld, Keller & Zimprich, 2005; Rude et al., 1999). Given the pervasiveness of PM in everyday life and the practical implications of deficits in the ability to execute previously formed intentions, it is surprising that the phenomenon has not received much attention in the academic literature.

By the same token, there are virtually no studies investigating the influence of positive emotional states (e.g. mindful self-focus) on PM (Kliegel & Jäger, 2006) in healthy volunteers. This is particularly relevant because the valence of the affect (positive versus negative) has an asymmetrical impact on the way in which cognition operates (Kuhl & Kazén, 1999). Previous studies have shown that positive mood consistently improves planning processes and faculties (Oaksford, Morris, Grainger & Williams, 1996; Phillips, Smith & Gilhooly, 2002) which, in turn, are deemed to be pivotal for successful PM functioning (Kliegel, Martin, McDaniel & Einstein, 2002). Moreover, positive affect appears to disengage the inhibition of the pathway between stored intentions and their output systems thereby facilitating the execution of an intended action (Kuhl & Kazén, 1999). Accordingly, one might anticipate a beneficial effect of adopting a mindful mode of self-focus on PM.

The scant literature documenting the relationship between negative emotional states and PM is supported by a mixed body of evidence. In a clinical study, Rude et al. (1999) investigated whether a community sample of 20 young adults diagnosed with major clinical depression would exhibit time-based PM deficits when compared to non-depressed adults matched in age, educational attainment, ethnicity and gender. The researchers found that the two groups did not differ in tests of retrospective memory, but that the depressed participants scored significantly lower in the time-based PM task, which was partly attributed to a reduced monitoring of the passage of time. Consistent with the pattern observed within the field of retrospective memory (e.g. Hertel & Hardin, 1990; Hertel & Milan, 1994), depression-related impairments tend to manifest in tasks that rely heavily on a high degree of self-initiated controlled processing, as is generally assumed of time-based PM tasks.

Harris and Menzies (1999) sought to disentangle the potential contributions of anxiety and depression on event-based PM performance. The investigators found that heightened levels of anxiety and depression were associated with lower PM performance but anxiety seemed to play a more dominant role than depression. Hence it was concluded that in general, negative emotional mood states might interfere with PM, although the findings are not without inconsistencies. Livner, Berger, Jones and Backman (2005) presented data of a large-scale study that explored the relationship between depressive emotional states and PM performance in a sample of 410 older adults. The event-based PM task required participants to remind the experimenter to make a phonecall upon completion of an extensive cognitive test battery. Surprisingly, the results revealed that PM performance was not disrupted regardless of the severity of depressive symptoms. This could have been due to the fact that the PM task only employed a single trial in which the intended action was to be implemented. However, as Maylor (1993) points out, single-trial observations may culminate in relatively unreliable readings of PM.

Altgassen et al. (2009) compared event-based PM performance in 28 depressed individuals with 32 healthy controls. The degree to which self-initiated processing was required to perform the PM task was varied by presenting prospective cues either focally or non-focally to the ongoing activity. In line with the Multiprocess Framework and the cognitive-initiative account of depression-related deficits, groups did not differ in the focal condition whereas controls outperformed individuals with depression in the non-focal condition presumably because of the higher degree of self-initiated control needed to process non-focal targets.

Kliegel and colleagues (2005) conducted a study to examine the effects of transient depressive mood states on time-based PM performance by applying an experimental manipulation (a mood induction procedure) to 62 healthy undergraduate students. Participants were randomly assigned to one of two conditions: half of the participants were presented with a film segment that was expected to evoke sadness and depressive feelings while the other half of the participants watched an emotionally neutral film segment. The results revealed that participants who responded to the sad mood induction procedure performed significantly worse relative to the neutral mood group in the five minutes immediately following the depressing movie. The detrimental effect on PM seemed to stem from a substantially decreased timeliness of the PM responses and was accounted for in terms of low clock-checking accuracy and reduced clock-checking frequency especially in the period just before the target times.

In a similar vein, Kliegel & Jäger (2006) found that event-based and time-based PM tasks were differentially sensitive to the impact of negative emotions in a sample of 87 younger, middle-aged and older adults between 18 and 91 years (mean=44.11 years, SD=18.94). Event-based PM performance was more prone to disruption by elevated levels of anxiety but not depression. Conversely, time-based PM performance was subject to the adverse effects of depression but not to anxiety. Contrary to the pattern observed in the laboratory-based PM task, individuals experiencing higher levels of anxiety and depression were more successful in the naturalistic PM task.

The aim of the present study is to investigate the effects of ruminative and mindful modes of self-focus on PM in healthy volunteers. Using the RAM (Ellis and Ashbrook, 1988) and the cognitive-initiative framework of depression (Hertel, 2000) as a point of departure, it can be reasonably hypothesised that since attentional deficits and retrospective memory failures have been implicated in depressive rumination and given that PM encompasses both attentional and retrospective elements (Smith, 2003), that people scoring high on trait rumination would exhibit impairments in PM task performance. Equally, people who have a predisposition to adopt a mindful mode of self-focus would demonstrate superior PM functioning. Further, leveraging on the Multiprocess Framework (McDaniel and Einstein, 2000), it is predicted that the rumination group would be more prone to PM deficits in the time-based task than the mindful group since time-based tasks are generally assumed to lend themselves to a higher degree of self-initiated controlled processing.

METHOD

Data were collected in two phases.

Participants

In Phase 1, the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer & Toney, 2006; Appendix A) and the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991; Appendix B) were opportunistically administered to a non-clinical sample of 165 volunteers. Of these, 97 RRS & 96 FFMQ were completed, with 18 volunteers returning only one of the two questionnaires. Participants were approached during lecture breaks or at various locations around the campus at Oxford Brookes University. Others were recruited through social events and community gatherings. The potential participant pool for Phase 2 consisted of 16 men and 81 women spanning the ages of 18 and 64 years (range: 46 years, median age: 18-24 years). Respondents scoring above one standard deviation of the respective scales were invited back for a computer-based PM experiment. In all, 28 participants fulfilled the criteria but only 19 responded to the invitation.

Materials

Phase 1

The FFMQ (Baer et al., 2006) is a 39-item self-report measure of trait mindfulness. It comprises five subscales measuring five distinct facets of mindfulness: observing, describing, acting with awareness, non-judging and non-reactivity, all of which have been identified as holistically capturing the essence of the mindfulness construct. Adequate to good internal consistency has been reported for each subscale, i.e. non-reactivity $\alpha = 0.75$, observing $\alpha = 0.83$, acting with awareness $\alpha = 0.87$, describing $\alpha = 0.91$ and non-judging $\alpha = 0.87$ (Baer et al., 2006). Items are scored on a five-point scale ranging from 1 (“never or very rarely true”) to 5 (“very often or always true”) and are reversed for statements with negative valence. Scores from the five subscales are summed up to provide a total score of trait mindfulness. The maximum possible score is 195.

The RRS (Nolen-Hoeksema & Morrow, 1991) assesses how individuals respond to low mood by focusing on self, symptoms and on the causes and consequences of their distress. It consists of a 22-item self-report inventory that is part of the larger Response Style Questionnaire (RSQ) and requires respondents to indicate how often they engage in ruminative thoughts or behaviours when they feel sad or blue. These 22 items describe responses to low mood that are self-focused (e.g. I think “why do I always react this way?”), symptom-focused (e.g. “I think about how hard it is to concentrate”) and focused on the possible consequences and causes of one’s mood (e.g. I think “I won’t be able to do my job if I don’t snap out of this”). High internal consistency ($\alpha = 0.90$) and moderate test-retest reliability ($\alpha = 0.67$) have been reported for the RRS (Treyner, Gonzalez & Nolen-Hoeksema, 2003). Each item is scored on a four-point frequency scale ranging from 1 (“almost never”) to 4 (“almost

always”). Scores are summed up to provide a measure of levels of trait rumination. The maximum possible score is 88.

Participants were also asked to provide socio-demographic details in the form of age and highest attained level of education since age (Cutler & Graf, 2007) and academic qualifications may have an impact on cognitive functioning and hence PM task performance.

The question “have you ever been to the GP for depression?” was included at the end of the RRS because there is evidence to suggest that people who have had clinical depression or have been subject to depressive episodes in the past are more likely to score high on trait rumination (Just & Alloy, 1997).

Phase 2

A conceptually standardised PM experimental paradigm devised by Einstein and McDaniel (1990) was employed comprising an ongoing background task (i.e. word completion task) and two concurrent embedded PM tasks. In this dual-task condition, participants were required to sporadically shift attention away from the ongoing task to the PM tasks cued either by an event or by pre-specified target times. The task was programmed using Matlab version 7.0.1.

Design

A quasi-experimental design was adopted since the participants were not randomly assigned to the experimental groups; questionnaire scores were deterministic of group membership. The independent variable was mode of self-focus with two levels, mindful and ruminative. The dependent variable was PM performance on event and time-based tasks.

Participants were required to work on the three tasks simultaneously, specifically, the ongoing task, the time-based task and the event-based task. The cognitive strain imposed by this ‘multi-tasking’ design feature was deliberate and was incorporated into the present experiment to partially simulate real-life PM situations which entail complex cognitive processes requiring self-initiation and control. Previous studies have focused on one task at a time and have acknowledged the inherent simplistic disposition of the laboratory landscape, in part due to the presentation of external cues and the relatively short retention interval (Einstein & McDaniel, 2007) which does not adequately depict or capture everyday PM contexts.

The background task took the form of a word completion task and lasted for the whole experimental session of 5 minutes. It entailed solving word fragments of varying complexities that appeared individually on the screen. The words were selected from the Oxford English Dictionary (2002) and were transformed into fragments by blanking out all occurrences of a single letter (e.g. STRAWBERRY → ST_AWBE__Y). There were a total of 79 word fragments (Appendix C) and these were displayed on the screen as long as the participant needed to solve them. The number of correctly solved word fragments was added and computed as a percentage of the total number of ongoing task trials (i.e. 79).

For the event-based task, participants were instructed to press the right arrow key when the icons for “telephone”, “recycling symbol”, “TESCO” and “books” appeared on the bottom right-hand corner of the screen. Each target icon cued the participant into reporting an intended action, thus tapping into the retrospective component of PM. Participants were prompted by the question “What do you need to do?” to which they were expected to verbally articulate to the experimenter the following four corresponding actions:

Telephone = Call mum to wish her happy birthday
TESCO = Pick up a pint of milk on the way home
Books = Return books to the library
Recycling symbol = Put out recycling bin

Participants were briefed as to the action that each icon represented prior to the experiment. The target icons were randomised and were not tagged to any particular word fragment. Additionally, four distractor icons appeared in the line-up but were not meant to be responded to. The event-based PM cues were selected to be non-focal to the ongoing task in order to reap maximum PM effects (McDaniel & Einstein, 2000).

The participants’ verbal responses were scored manually. The accuracy of their responses could only be objectively measured in one way. Participants either correctly pressed the right arrow key in response to the target stimulus or they did not. If all four event-based actions were correctly reported, participants scored 4 points, i.e. 100%.

In the time-based task block, participants were instructed to press the left arrow key at designated 1-minute intervals as accurately as possible. Again, participants were prompted by the question “What do you need to do?” to which they were expected to verbally report the relevant action to be executed as follows:

1 min - Check on pizza in the oven
2 min - Take medication
3 min - Record favourite show on TV
4 min - Go for hairdresser’s appointment

These actions were specified in advance of the session. The target times were stipulated as minutes elapsed from the start of the experiment and were synchronised with the occurrence of the event-based cues so as to prevent overlap. If all four time-based actions were correctly reported, participants scored 4 points, i.e. 100%.

To monitor the time, participants could press the upward arrow key on the keyboard as and when required. This activated a digital time clock counter {00:00} on the top left-hand corner of the screen which was displayed as long as the target key was held down; it did not obscure or alter the progression of the ongoing task. Participants were instructed to remove their wrist watches and to only avail the on-screen stopwatch; no external aid was allowed.

The number of times the clock counter was viewed was logged to keep track of each participant's time-checking activity. Time-based accuracy scores were coded and computed by assigning a score of 1 to 6 on each of the four target times, depending on whether the response occurred within ± 2.5 seconds (1 point), ± 5 seconds (2 points), ± 10 seconds (3 points), ± 15 seconds (4 points), ± 20 seconds (5 points) of the target time or 6 points if the action was completely missed. Participants were not informed of these time windows in advance. The sub-scores were added to provide an overall time-based accuracy score, where a lower cumulative score was indicative of a relatively accurate performance on the time-based task.

This slight modification of the traditional time-based tasks (which typically require participants to press a particular key at specified time intervals) was intended to introduce a certain degree of experimental realism and to make the task psychologically meaningful.

The experiment was piloted to ensure that all word fragments in the ongoing task were solvable by native English speakers. For both task blocks, the chosen actions were identified through interviews with 10 people and were deemed to be an accurate representation of typical daily chores and errands.

Procedure

Participants were tested individually in a quiet room at the Psychology Department to mitigate the effects of background noise and interference on their performance. After they had read the participant information sheet and signed the consent form, they were handed standardised written instructions (Appendix D) for the PM task. They were requested to reiterate the instructions in order to check for understanding so as to be able to rule out any potential comprehension-related retrospective memory failures in the final analysis. They were also reminded that instructions would not be repeated during the experiment. Finally, they completed the computer-based experiment.

The entire testing period lasted 10 minutes. The study was approved by the Research Ethics Committee of the Department of Psychology, Oxford Brookes University.

RESULTS

Phase 1

The mean rumination score ($n=96$) was 43.97 with a standard deviation of 11.80. The mean mindfulness score ($n=95$) was 123.32 with a standard deviation of 13.98. Respondents scoring above one standard deviation from the mean (i.e. RRS score > 55.77 and FFMQ score > 137.30) of the respective scales were invited back for a computer-based PM experiment. One participant was excluded from Phase 2 because of an extreme rumination score of 88 ($>3SD$). The final mindful group ($n=9$) consisted of 3 males and 6 females with a median age of 18-30 years, all possessing a higher level of education. The rumination group ($n=10$) was homogeneously made up of females with a median age of 18-24 years and like the mindful group, were all

currently in higher education. 80% of the participants in the rumination group had been to the GP for depression compared to 12.5% in the mindful group.

Phase 2

An examination of the frequency histograms and the Shapiro-Wilk test statistic revealed that the distributions of FFMQ ($M=131.63$, $SD=21.71$) and RRS ($M=50.74$, $SD=16.04$) scores were approximately normal. The data set displayed similar levels of variability as indicated by the SDs and confirmed by a non-significant Levene's test. The means, standard deviations and corresponding 95% confidence intervals of FFMQ and RRS scores for both groups are presented in Table 1.

Table 1
Means and standard deviations of FFMQ and RRS scores for the mindful group (N=9) and rumination group (N=10)

Measure	Condition	Mean	SD	95% CI
RRS Score	Mindful	36.78	10.43	28.76 - 44.79
	Rumination	63.30	6.91	58.35 - 68.25
FFMQ Score	Mindful	151.33	9.06	144.37 - 158.29
	Rumination	113.90	11.50	105.67 - 122.13

An independent samples t-test found that the rumination group ($M=63.30$, $SD=6.91$) scored significantly higher on the RRS than the mindful group ($M=36.78$, $SD=10.43$), $t(17)=-6.60$, $p<0.001$. An independent samples t-test also reported that the mindful group ($M=151.33$, $SD=9.06$) scored significantly higher on the FFMQ than the rumination group ($M=113.90$, $SD=11.50$), $t(17)=7.82$, $p<0.001$. The 19 FFMQ-RRS pairings were subjected to a correlational analysis and indicated a significant inverse and strong relationship between RRS and FFMQ scores ($r=-0.766$, $df=17$, $p<0.001$) implying that the higher participants scored on the rumination dimension, the lower they scored on the mindful dimension. On this basis, it was deemed appropriate to conduct further analyses on the two groups' scores on various objective PM measures.

An initial examination of the frequency histograms and the relevant Shapiro-Wilk test statistics revealed that the respective test distributions (with the exception of 'time-based accuracy' which is reported separately) were not normal and did not meet parametric assumptions. This was confirmed by a significant Levene's test. For this reason, it was deemed preferable to use non-parametric tests for the remaining analyses. The median and range (Table 2) have been reported as measures of central tendency as they are considered to be more representative of the data.

Table 2
Descriptive statistics for the objective measures of prospective memory

Test Variable	Median		Range	
	Mindful	Rumination	Mindful	Rumination
Total RT (s)	267.09	223.13	155.20 - 482.50	154.50 - 305.30
Task Duration (s)	334	243	216 - 515	212 - 354
Correct Word Fragments (%)	92	92	67 - 100	80 - 99
Time-Based Failures (%)	0	25	0 - 100	0 - 50
Event-Based Failures (%)	0	0	0 - 50	0 - 100
Time Monitoring Frequency	18	13.5	9 - 30	8 - 40

A Mann-Whitney independent test was applied to the variables in Table 2. Although the mindful group (median=334 seconds) took longer to complete the experiment compared to the rumination group (median=243 seconds), this difference was not significant, $U=32$, $n=19$, $p=0.288$. Similarly, a Mann-Whitney test demonstrated that the observed difference in total reaction time (RT) between the mindful group (median=267.09) and the rumination group (median=223.13) was not significant, $U=35$, $n=19$, $p=0.414$. There was no difference in the performance on the ongoing task as corroborated by the equal percentage (92%) of correct word fragments across both groups. Likewise, both groups performed equally well on the event-based task (failure rate = 0%).

The time-checking frequency was also logged during the experiment and as Table 2 illustrates, the mindful group (median=18) monitored the clock counter more often than the rumination group (median=13.5); however this difference was not significant, $U=34$, $n=19$, $p=0.368$. As a corollary to a higher time-checking frequency, the mindful group (median=0) had a lower rate of time-based PM failures compared to the rumination group (median=25); however this difference was not significant, $U=42.5$, $n=19$, $p=0.842$.

The timeliness with which the time-based actions were reported differed between the groups such that the rumination group (mean=11.40, $SD=6.24$) were marginally more accurate than the mindful group (mean=11.89, $SD=6.53$); however an independent samples t test found that the documented difference was not significant, $t(17)=0.17$, $p=0.869$.

The mean reaction times (RT) for the ongoing task, the time-based task and the event-based task were computed to determine switching costs between PM events and non-PM events. An examination of the relevant frequency histograms and the Shapiro-Wilk test statistic revealed that the distributions (with the exception of 'mean

RT for ongoing task') were approximately normal. The means, standard deviations and corresponding 95% confidence intervals of the respective mean RTs and switching costs for both groups are presented in Table 3.

Table 3
Means and standard deviations of mean RTs and switching costs for the mindful group (N=9) and rumination group (N=10)

Measure	Condition	Mean	SD	95% CI
Mean RT Event-Based Task (s)	Mindful	12.46	5.72	8.06 - 16.86
	Rumination	8.91	4.41	5.75 - 12.07
Mean RT Time-Based Task (s)	Mindful	10.4	5.24	6.37 - 14.42
	Rumination	12.09	2.64	10.20 - 13.98
Mean RT Ongoing Task (s)	Mindful	2.87	1.45	1.76 - 3.99
	Rumination	2.2	0.42	1.90 - 2.49
Event-Based Switching Cost	Mindful	4.52	1.59	3.30 - 5.75
	Rumination	3.95	1.84	2.63 - 5.27
Time-Based Switching Cost	Mindful	4.3	2.09	2.70 - 5.90
	Rumination	5.62	1.3	4.69 - 5.54

A correlational analysis was conducted to discern the relationships between the mean RTs for the event-based task, time-based task and the ongoing task. The results indicated a significant positive and moderately strong relationship between mean RT for the event-based task and mean RT for the ongoing task, $r=0.684$, $df=17$, $p=0.001$. There were no significant correlations between the mean RTs for the time-based task and the event-based task ($r=0.166$, $df=17$, $p=0.497$) or between the mean RTs for the time-based task and the ongoing task ($r=-0.13$, $df=17$, $p=0.595$). Given that the variable 'mean RT for ongoing task' was not normally distributed, the RT data was also subjected to a Spearman's correlational test. The trend was confirmed with the only significant relationship emerging between mean RT for the ongoing task and mean RT for the event-based task, $\rho=0.79$, $df=17$, $p<0.001$.

Although the mindful group (mean=4.52, SD=1.59) exhibited a higher event-based switching cost compared to the rumination group (mean=3.95, SD=1.84), an independent samples t test found this difference to be insignificant, $t(17)=0.72$, $p=0.481$. Equally, the rumination group (mean=5.62, SD=1.30) demonstrated a higher time-based switching cost compared to the mindful group (mean=4.30, SD=2.09); however this difference did not reach statistical significance, $t(17)=-1.67$, $p=0.112$.

DISCUSSION

The present study is the first to investigate the impact of ruminative and mindful modes of self-focus on PM. As such, the findings are accounted for by theoretical accounts that essentially conceptualise depression-related cognitive deficits. These paradigms have been chosen as suitable proxies because rumination appears to have a unique relationship to depression which transcends its relationship to several other negative cognitive styles such as neuroticism, pessimism and perfectionism (Nolen-Hoeksema et al., 2008).

Based on previous findings and predictions derived from the RAM (Ellis and Ashbrook, 1988), the cognitive-initiative framework of depression (Hertel, 2000) and the PAM model (Smith, 2003), it was hypothesised that people who engage in ruminative self-focus will demonstrate more PM failures than people who embrace a more mindful mode of self-focus. Moreover, based on the assumptions of the Multiprocess Framework (McDaniel and Einstein, 2000), it was expected that the rumination group would be more susceptible to PM deficits in the time-based task compared to the mindful group. Correlational analysis indicated that RRS and FFMQ scores were significantly negatively associated, thereby confirming that the constructs of rumination and mindfulness do not co-occur and do in fact lie at opposite ends of the continuum. This implies that these two styles of self-reflection are distinct and therefore would reasonably be expected to produce differing effects on PM performance.

The initial analysis revealed that the time taken to complete the ongoing task and the percentage of correct word fragments was not significantly different between the two groups, suggesting that rumination and mindfulness did not have a bearing on ongoing task performance. However, in light of the high performance on the word completion task (i.e. 92%), the lack of potentially deleterious effects of the variables might have been due to the relatively low difficulty of the cognitive task. The only way to establish suspected ceiling effects would be to have a control group perform the ongoing task without the embedded PM task blocks.

With regards to the performance on the event-based and time-based PM tasks, a surprisingly similar pattern of results emerged. Consistent with the experimental findings of Livner et al. (2005), there was no significant difference in the number of event-based PM task failures between the two groups. However, the results are at variance with the Multiprocess Framework (McDaniel and Einstein, 2000) which explicitly predicts that non-focal tasks are most conducive for abstracting and detecting PM decrements because they afford low environmental support and impose high demands on self-initiated strategy application. Given that in the present experiment, the ongoing task and the event-based task necessitated different forms of cognitive processing (specifically self-initiated cue monitoring) and therefore could be considered non-focal, PM deficits should have transpired.

However, in accordance with Einstein and McDaniel (1990), it can be argued that event-based tasks do not deploy self-initiated processes to the same extent as time-based tasks which engender relatively automatic retrieval. In fact, self-initiated effortful processes but not automatic processes have been shown to be selectively disrupted by depression (Hartlage, Alloy, Vazquez & Dykman, 1993). Furthermore, the findings to date bear testimony to the trend that event-based PM tasks were applied in studies that found an absence of or only weak effects of depression on PM performance (Harris & Menzies, 1999; Livner et al., 2005) whereas time-based PM paradigms were administered in studies which reported detrimental effects of depressive emotional states (Kliegel et al., 2005; Rude et al., 1999). Yet, Altgassen et al. (2009) were able to isolate event-based PM deficits in depressed individuals versus healthy controls in the non-focal condition suggesting that depression-related impairments may be unmasked only when the task at hand requires high levels of concentration and conscious deliberate control of attentional resources within the confines of a complex cognitive framework. A plausible elucidation for the discrepant

result could be that the level of task complexity and non-focality did not reach the required threshold to produce the expected effect, a boundary which in itself is ambiguous.

Contrary to the position advocated by Einstein and McDaniel (1990) of time-based tasks being generally more sensitive at picking up PM disturbances, there was no significant difference in performance on the time-based task between the two groups. This was surprising given that according to the RAM (Ellis & Ashbrook, 1988), negative emotional states deflect attentional resources to task-irrelevant thoughts and therefore detract from the main task. While this diminishment in attentional resources was not evident in the ongoing task, it was predicted that since the time-based task presumably required a high degree of self-initiated effortful processing that it would therefore be susceptible to the adverse effects of rumination.

This lack of shortfall in time-based PM performance could have been due to the PM task not being sensitive enough to detect the effect fully, resulting in ceiling effects. It is possible that participants' cognitive resources might not have been overstretched or challenged by the ongoing task as originally intended. Indeed, Eysenck and Calvo (1992) predict that the anticipated adverse effects of negative emotional states on PM performance will not manifest if tasks are not sufficiently taxing of cognitive wherewithal. Moreover, a distracter task was not incorporated into the present experiment which could inevitably have been a limitation because it may not have induced sufficient prospect of forgetting. Previous research (Brandimonte, Einstein & McDaniel, 1996) has shown that in order to ensure that the prospective intention is not continuously rehearsed and maintained in working memory, it is imperative to introduce a delay between giving the PM instructions and commencing the ongoing task.

The absence of time-based PM effects could also be interpreted within the cognitive-initiative framework of depression (Hertel, 2000) which claims that reduced self-initiated control can be supplemented through external support that facilitates the regulation of attention so that performance can actually be improved, even in cognitively demanding tasks. It can be argued that the experimenter-led laboratory environment is fairly structured and guided insofar as participants are given explicit instructions that have to be committed to memory in order to perform the task; in principle, this serves to channel and focus attention to the task and can therefore be regarded as a form of external support. Additionally, laboratory tasks are typically completed within a short span, in this case, 10 minutes. A drawback of experimental settings is that they can only test PM intentions to be executed in the relatively short term (Kvavilashvili, 1992) because it is impractical to keep participants in the laboratory for more than an hour, thus limiting the possibility to examine long-term PM under controlled conditions. Any PM deficits that might potentially exist in the real world may not be tapped on in that short passage of time. This further raises the issue of ecological validity and generalisation. In everyday life, people have the benefit of access to external memory aids (e.g. lists, reminder notes) to support the timely and accurate remembering of intended actions. Indeed, Kliegel & Jäger (2006) demonstrated that individuals experiencing higher levels of anxiety and depression were actually more successful in the naturalistic PM task compared to the laboratory-based PM task, providing evidence that the association might be reversed in everyday settings. Thus, factors other than pure cognitive abilities may play an

important role for PM processes in daily life, which are also of relevance when evaluating the repercussions of negative emotional states on PM.

Contrary to previous studies (Rude et al., 1999; Kliegel et al., 2005; Kliegel & Jäger, 2006), there was no significant difference in the clock checking accuracy and frequency between the two groups although the mindful group was more vigilant. Given that time monitoring behaviour is assumed to reflect the amount of attentional resources devoted to a PM task (Ellis and Ashbrook, 1988), the results bear out the trend observed in the time-based task, further reinforcing that there was in fact no dissipation of attentional resources.

Correlational analysis revealed a significant positive and moderately strong relationship between mean RT for the event-based task and mean RT for the ongoing task, implying a trade-off between the average RT to solve word fragments and the average RT to respond to event-based prompts. However, there were no significant associations between mean RTs for the time-based task and event-based task or between the time-based task and ongoing task. The observation can be qualified with reference to the PAM model (Smith, 2003) which asserts that the attentional component of PM is resource-consuming and is achieved at the expense of the ongoing task. Conversely, following the reasoning of the Multiprocess Framework, event-based tasks utilise relatively less attentional resources compared to time-based tasks so the trade-off between mean RT for the time-based task and mean RT for the ongoing task should have been significantly higher, more so for the rumination group as predicted by the RAM (Ellis & Ashbrook, 1988). By the same token, groups did not differ with respect to event-based and time-based switching costs.

The deviation from expected results could be due to the different kinds of encoding processes and mechanisms that are involved in the time-based versus event-based tasks. Encoding actions that need to be reported at specified target times might be relatively more focal to the ongoing word fragment task compared to encoding actions cued by pictorial icons which have to be translated into words first. The extra step might expectedly incur cognitive costs in terms of longer RT at retrieval.

Crucially, a plausible explanation for the overall lack of discernible effects might be the small sample size which could have undermined the statistical power of the study and hence its potential to exact material PM differences between the two groups. The research would benefit from replication with a larger sample size which would allow the possibility of recruiting people who are further along the extreme ends of the respective scales (>2 SD); this would provide a sample with a greater contrast in modes of self-focus and hence more conclusive evidence of the impact on PM performance. It is possible that in the current study, the differences in modes of self-focus were of moderate intensity and thus did not exert strong significant effects on PM performance.

The inherent weakness of the various theoretical accounts notably, the RAM (Ellis and Ashbrook, 1988) and the Multiprocess Framework (McDaniel and Einstein, 2000) is that they do not clearly define the threshold for what constitutes a task that is “sufficiently taxing of cognitive resources” and leave it largely to speculation and intuition. Given that the relationship between emotive variables and PM performance

is modulated by specific task characteristics, it would be desirable for future studies to vary the degree of external support and to introduce manipulations pertaining to the complexity/difficulty of the ongoing/PM tasks in order to more tangibly establish not only the “threshold” but also the role of self-initiated processing, cognitive capacity and attentional resources in PM deficits. Further, the approach would help unravel differences in the underlying processes that mediate negative and positive emotions, thereby pinpointing the exact nature of the mechanisms at play.

It should be acknowledged that ultimately the explanations that are offered are based on predictions derived from models relating to depression-related cognitive deficits which may be far-fetched; the ‘symptom focus’ hypothesis asserts that rumination is a necessary but not a sufficient condition for the precipitation of depression. Rumination is merely a precursor to depression so due caution is warranted in delivering the interpretations by making direct correspondences between rumination and depression. It would also be worth noting that by and large, the theoretical accounts detailed relate to depressive mood *states* whereas the FFMQ and RRS measure and assess the relatively more enduring *traits* of rumination and mindfulness; again, drawing casual comparisons between states and traits might lead to flawed assumptions which would arguably have different implications for PM performance.

Despite its limitations, the present study represents an initial foray into how different modes of self-focus might impact PM. There were no apparent differences in PM performance between the mindful group and the rumination group *prima facie* but this conclusion is necessarily tentative; it would merit verification using a larger cohort in order to ascertain if the negligible effects are merely an artefact of the experiment or if there truly are no differences in PM performance.

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