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## BRIEF REPORT

# Imprisoned by the past: Unhappy moods lead to a retrospective bias to mind wandering

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Evidence suggests that mind wandering is a frequent accompaniment to an unhappy mood. Building on such work, two laboratory experiments used mood induction to assess whether the greater frequency of mind wandering in a low mood is also accompanied by a shift towards a focus on events from the past. Experiment 1 induced moods via video and induction of an unhappy mood was associated with a greater tendency for past-related mind wandering as measured by a post-task questionnaire. In Experiment 2, negative and positive moods were induced in a group of participants using the Velten mood-induction procedure and the temporal focus of mind wandering was measured using experience sampling probes. Analyses indicated that induction of an unhappy mood led to an increase in past-related mind wandering and the magnitude of this change increased with scores on a measure of depressive symptoms. Together these experiments suggest that when the mind wanders in an unhappy mood it is drawn to events from its past.

**Keywords:** Mood; Task-unrelated thought; Mental time travel; Mind wandering.

Contemporary accounts of consciousness emphasise that *mind wandering* is normal (Smallwood & Schooler, 2006). Experience sampling studies suggest that almost one third of daily life is spent engaged in thoughts unrelated to the here and now (Kane et al., 2007; Klinger, 1999), while cognitive neuroscience has revealed the complex brain systems involved in their generation (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009;

Mason et al., 2007). In many cases, such spontaneous thought entails a form of mental time travel (Tulving, 1985) with the wandering mind generally more likely to be drawn to the impending future than to its past (Bernsten & Jacobsen, 2008; Smallwood, Nind, & O'Connor, 2009).

While common in daily life, evidence suggests that the tendency for the mind to wander is exacerbated by an unhappy mood. Cross-sectional

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studies have associated depression with mind wandering using both objective (e.g., Carriere, Cheyne, & Smilek, 2008; Smallwood, O'Connor, Sudberry, & Obonsawin, 2007) and subjective measures (Smallwood, O'Connor, & Heim, 2005; Watts, MacLeod, & Morris, 1988). The association between unhappiness and mind wandering emerges across a range of situations including sustained attention (Smallwood et al., 2004), encoding (Smallwood et al., 2007) and reading (Watts et al., 1988). Studies using covert measures of cognitive processing have revealed that dysphoric mind wandering entails elevated physiological arousal (Smallwood et al., 2007) while the induction of a negative mood was shown to increase the frequency of mind wandering in a student sample (Smallwood, Fitzgerald, Miles, & Phillips, 2009).

The association between negative affect and enhanced mind wandering leads to the obvious question: *What features of an unhappy mood could underlie the association with increased mind wandering?* One common theme of many theories of negative affect is that cognition is disproportionately influenced by the past. The influential response styles theory (Nolen-Hoeksema, 1991) suggests that individuals who passively ruminate on the reasons for why they feel the way they do are at greater risk for depression. In fact, a key feature of ruminative thought—as opposed to worry—is a focus on the past (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Based on such theory, it is plausible that retrospective focus associated with negative affect could bias the wandering mind to mentally travel to events from the past.

### Current experiments

The current work used two different mood-induction procedures and two different methods of assessing spontaneous thought to examine whether the mind wandering that occurs following an unhappy mood is generally focused on the past. Experiment 1 used emotional videos to manipulate mood and a post-task questionnaire was used to measure mind wandering. Experiment

2 used a variant on the Velten mood procedure and measured the temporal focus of mind wandering online using experience sampling probes. Experiment 2 also employed a measure of depression (the Beck Depression Inventory, BDI; Beck, Steer, & Brown, 1996). In both experiments we hypothesised that the induction of an unhappy mood would lead the mind to wander to events from the past. In Experiment 2 we also expected that the extent of past-focused mind wandering in an unhappy mood would increase with levels of depressive symptoms.

## EXPERIMENT 1

To provide basic information on the relationship between unhappy moods and the temporal focus of mind wandering, Experiment 1 reports a reanalysis of the previously published data study by Smallwood, Fitzgerald, and colleagues (2009) who used emotional videos to induce positive, neutral and negative moods. In this study, task-unrelated thought was measured after completion of a short task in which mind wandering is common (Smallwood et al., 2004). Mind wandering was measured via a post-task questionnaire (Matthews, Joyner, Gilliland, Huggins, & Falconer, 1999) containing eight items relating to the different types of unrelated thoughts that people can experience while performing a simple task. Several of these questions specifically deal with mental time travel during mind wandering: “I thought about something earlier today”, “I thought about something in the distant past”, “I thought about something in the recent past”, “I thought about something in the future”. The remaining four items deal with social interactions and other types of content that are beyond the scope of this paper. The hypothesis was that following the induction of a negative mood participants would endorse greater ratings of retrospective mental time travel during mind wandering than following induction of a positive mood.

## Methods

Fifty-nine participants were allocated to watch one of three emotional videos, following which they completed a 10-minute mind-wandering task before finally completing a retrospective measure of mind wandering. Details of the population, mood induction procedure, methods and effects of mood on the performance data are reported in detail elsewhere (Smallwood, Fitzgerald, et al., 2009).

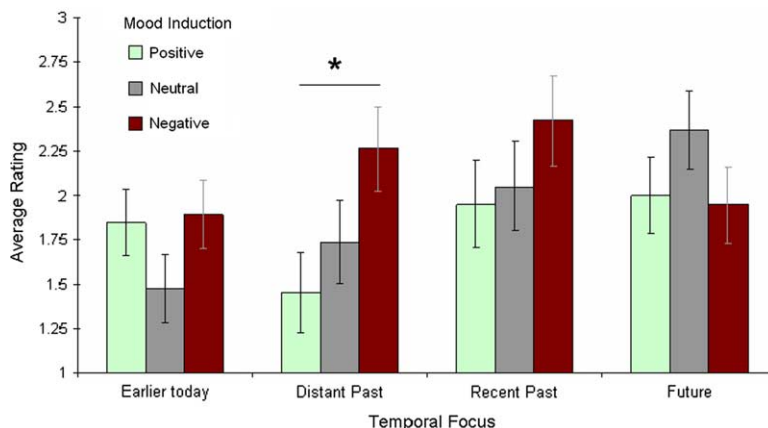
## Results

Figure 1 presents the average ratings of each statement regarding the temporal basis of mind wandering reported following the induction of positive, neutral and negative mood. These data were analysed using a mixed analysis of variance (ANOVA) with a within-participant factor of Item with four levels (one for each type of question) and a between-participant variable of Mood Induction with three levels (positive vs. neutral vs. negative). This analysis revealed an Item  $\times$  Condition interaction,  $F(6, 168) = 2.48$ ,  $p < .05$ , and was followed up by separate univariate ANOVAs examining the effects of mood condition on each item. These analyses

indicated a main effect of Condition for thoughts of the distant past,  $F(2, 56) = 3.68$ ,  $p < .05$ , but not for any other measure (all  $p$ -values  $> .16$ ). Post hoc Bonferroni tests indicated that this effect was due to a greater focus on the past following the negative than the positive mood manipulation ( $p = .04$ ). While the neutral group did not differ from either the positive or the negative groups on this item, uncorrected comparisons suggested a trend for a difference with the negative group ( $p = .09$ ) without any obvious differences from the positive group ( $p = .38$ ).

## EXPERIMENT 2

The results of Experiment 1 indicated that when an unhappy mood was induced by video, participants showed a retrospective bias to mind wandering, especially regarding events from the distant past. Experiment 2 aimed to: (i) replicate this association using an alternative measure of mood (a variant on the Velten procedure); (ii) measure the temporal focus of attention online using experience sampling rather than using a post-task questionnaire; and (iii) explore whether the increase in past-focused mind wandering



**Figure 1.** Experiment 1. Induction of a negative mood via video leads to an increase in focus on thoughts of the distant past. The different bars indicate the nature of mind wandering following the induction of a positive (left bar), neutral (centre bar) and negative mood (right bar). Thoughts of events in the distant past were rated as more frequent following the negative than positive manipulation. The error bars indicate one standard error of the mean.

under conditions of an unhappy mood was positively related to BDI score.

## Methods

### *Participants*

A total of 82 participants (54 females) recruited from a British university (via an experimental management sign-up system) and via convenience sampling from the general population completed Experiment 2. Students received course credit and snowballing techniques (word of mouth, advertisements) were employed to yield a convenience sample from the general population. The mean age of the sample was 23.6 ( $SE = 0.77$ ) years. The sample was equally divided across the positive and negative mood-induction groups and no conditional differences were observed in initial mood, age or BDI score (all  $p$ -values  $> .23$ ).

### *Procedure*

*Positive and negative mood manipulations.* Following the design of studies that explored the effects of mood on autobiographical retrieval (e.g., Eich, Macaulay, & Ryan, 1994), Experiment 2 employed the Velten mood procedure to induce positive and negative moods (Velten, 1968). The Velten procedure is as effective as other procedures for engendering a negative mood (Larsen & Sinnett, 1991) and has the advantage of lasting longer than alternative approaches such as failure feedback (Chartier & Ranieri, 1989). Following Moore and Oaksford (2002), participants listened to music with a specific request to participants to try to alter their mood state. In the positive condition, music consisted of Mozart's *Einekleine Nachtmusik*, alongside statements including "I have complete confidence in myself". In the negative condition, statements such as "Just when I think things are going to get better, something else goes wrong" were accompanied by Barber's *Adagio for Strings*. We chose to focus on positive and negative moods because this is known to yield clear differences in mood congruent

memory (Ucross, 1989) and because the previous experiment yielded the clearest difference between positive and negative moods. Mood was measured both prior to the baseline session and following the induction procedure using a Visual Analogue Scale ranging from 1 (*not at all sad*) to 100 (*extremely sad*).

*Beck Depression Inventory (BDI-II; Beck et al., 1996).* The BDI is a well-established 21-item self-report questionnaire, which assesses depressive symptoms over the past two weeks. Cronbach's alpha was high (.9) indicating that the questionnaire was reliable. The mean BDI score of the sample was 7.8 (Range 0–49,  $SD = 6$ ).<sup>1</sup>

*Experimental task.* To measure the temporal focus of mind wandering, participants completed the same choice reaction time task (CRT) as reported elsewhere (Smallwood, Nind, et al., 2009). Participants viewed a stream of black numbers appearing in the centre of the screen waiting for a target identified by colour (green). Stimuli were presented against a white background in 40-point Arial font for 1000 ms and were followed by a 1500 ms fixation cross. Stimuli were presented in five quasi-randomised blocks each containing approximately the same number of targets and non-targets. Block order was randomised within each participant and session. In total, 320 stimuli were presented in each session and 32 of these were targets. Participants were instructed to respond to the target using the mouse button depending on whether the target digit was odd or even. Testing lasted ten minutes per session. Response time (RT) and accuracy were recorded by the computer and median RT was calculated to avoid the influence of outliers.

*Experience sampling.* The temporal focus of mind wandering was measured using experience sampling (see Smallwood, Nind, et al., 2009). Thought probes were presented in yellow on a blue background and participants were asked to determine if immediately prior to the presentation

<sup>1</sup> One individual had a BDI score that was four  $SD$ s greater than the next highest score. To ensure that this outlier did not unduly bias the analysis this score was replaced by a value that was one point greater than the next highest value (27).

of the probe they had been thinking about the present (here and now), the past, the future or none of the above. An additional no temporal time period option was offered to encompass experiences such as humming a tune or considering an abstract mathematical problem. Responses were made using the first letter of the appropriate category on a computer keyboard (F, P, H & N). Participants were asked to reserve the categories of past and future thinking for personal events *outside* of the experimental session and were given an example experience sampling probe prior to beginning the task. Thought probes occurred eight times in each session.

## Results

### *Analysis strategy*

For each dependent measure we first conducted a mixed omnibus analysis of variance (ANOVA) in which the mood-induction Condition (positive, negative) and the Session (pre, post) were included as between-participant categorical variables. In all follow-up tests, the Bonferroni correction was applied to control for the number of comparisons when applicable.

### *Effects of the manipulation on mood*

Our first analysis examined whether the induction procedure successfully altered mood state. Analysis of the Visual Analog Scale data indicated a Session  $\times$  Condition interaction,  $F(1, 78) = 11.9$ ,  $p < .05$ . No conditional differences were observed prior to the induction phase, Negative  $M = 8.4$  ( $SE = 1.4$ ), Positive  $M = 8.77$  ( $SE = 1.4$ ),  $p = .5$ . Following the mood induction, the negative group,  $M = 17.1$  ( $SE = 2.3$ ), was significantly more sad than the positive group,  $M = 7.9$  ( $SE = 1.4$ ),  $t(80) = 3.0$ ,  $p < .005$ . Furthermore, sad mood increased significantly from baseline levels for the negative, baseline  $M = 8.8$  ( $SE = 1.7$ ), post induction  $M = 17.1$  ( $SE = 2.6$ ),  $t(40) = -4.0$ ,  $p < .005$ , but not for the positive group, baseline  $M = 8.7$  ( $SE = 1.05$ ), post induction  $M = 7.9$  ( $SE = 1.41$ ),  $t(40) = 0.54$ ,  $p = .59$ .

This result indicates that the negative mood-induction procedure successfully increased sad mood.

### *Effects of mood and depressive symptoms on task performance and mind wandering*

In addition to the between-group factors of Session (pre, post) and Condition (positive, negative) in all subsequent analysis the BDI score was entered as a continuous between participant variable.

*Accuracy.* Comparison of accuracy yielded two effects. First, we observed an effect of Session,  $F(1, 78) = 6.77$ ,  $p < .01$ , indicating that accuracy rose slightly from the first session,  $M = 0.929$  ( $SE = 0.01$ ), to the second,  $M = 0.933$  ( $SE = 0.01$ ). Second a Session  $\times$  BDI interaction was observed,  $F(1, 78) = 8.89$ ,  $p < .005$ . The Session  $\times$  BDI interaction was followed up by conducting separate correlations between BDI and accuracy on each session. The BDI score did not impact on accuracy in the first session,  $r = -.06$ ,  $p = .59$ , although it was negatively associated with accuracy on the second,  $r = -.35$ ,  $p < .005$ .

*Response time (RT).* Analysis of RT yielded a Session  $\times$  BDI  $\times$  Condition interaction,  $F(1, 78) = 5.97$ ,  $p < .05$ . Subsequent analysis focused on the correlation between BDI and RT in each session of each condition. These analyses indicated that for the negative condition RT was unrelated pre-induction,  $r = .02$ ,  $p = .86$ , yet was positively associated with BDI score in the second session following the negative induction,  $r = .40$ ,  $p < .001$ . Furthermore, BDI was not associated with RT either before,  $r = .01$ ,  $p = .95$ , or after the positive manipulation,  $r = .06$ ,  $p = .69$ .

*Experience sampling.* The experience sampling data were analysed using a mixed-model ANOVA. In addition to the variables described above, this analysis included an additional within-participant dependent variable, Temporal Focus, with three levels (past, here and now,

future). All other variables were entered in the same manner as before. This analysis indicated five statistically significant effects.

First, analysis identified a main effect of Temporal Focus,  $F(2, 156) = 45.98$ ,  $p < .001$ . Across the sample, participants were focused on the here and now,  $M = 3.8$  ( $SE = 0.11$ ), more frequently than the future,  $M = 1.7$  ( $SE = 0.15$ ),  $p < .005$ , and thoughts of the past were less frequent than either category,  $M = 0.92$  ( $SE = 0.23$ ),  $p < .005$ , for both comparisons. Consistent with the results of Smallwood, Nind, et al. (2009), a prospective bias to mind wandering was observed with participants generally thinking about the future more than the past.

Second, a Temporal Focus  $\times$  BDI interaction was observed,  $F(2, 156) = 7.09$ ,  $p < .001$ . This interaction was followed up by separate correlations between BDI score and the overall frequency of thoughts focused on the past, future and here and now. Overall higher BDI scores were associated with less frequent thoughts of the here and now,  $r = -.32$ ,  $p < .01$ , replicating previous findings that increasing levels of depressive symptoms is associated with mind wandering (Smallwood et al., 2004, 2007; Watts, 1988). Both past and future thought were not reliably associated with higher BDI scores, future  $r = .21$ ,  $p = .15$ , past  $r = .15$ ,  $p = .18$ .

Third, analysis indicated a Session  $\times$  Temporal Focus interaction,  $F(2, 156) = 4.03$ ,  $p < .05$ . This interaction was followed up by three separate repeated-measures ANOVAs on the different temporal foci to thought. Analysis indicated that thoughts of the here and now decreased from Session 1,  $M = 4.14$  ( $SE = 0.24$ ), to Session 2,  $M = 3.6$  ( $SE = 0.28$ ),  $p < .03$ , replicating previous work that time on task is a primary source of mind wandering (McVay & Kane, 2009; Smallwood, Obonsawin, & Reid, 2003, 2004, 2007). Neither future nor past thought varied systematically across testing session (all  $p$ -values  $> .18$ ).

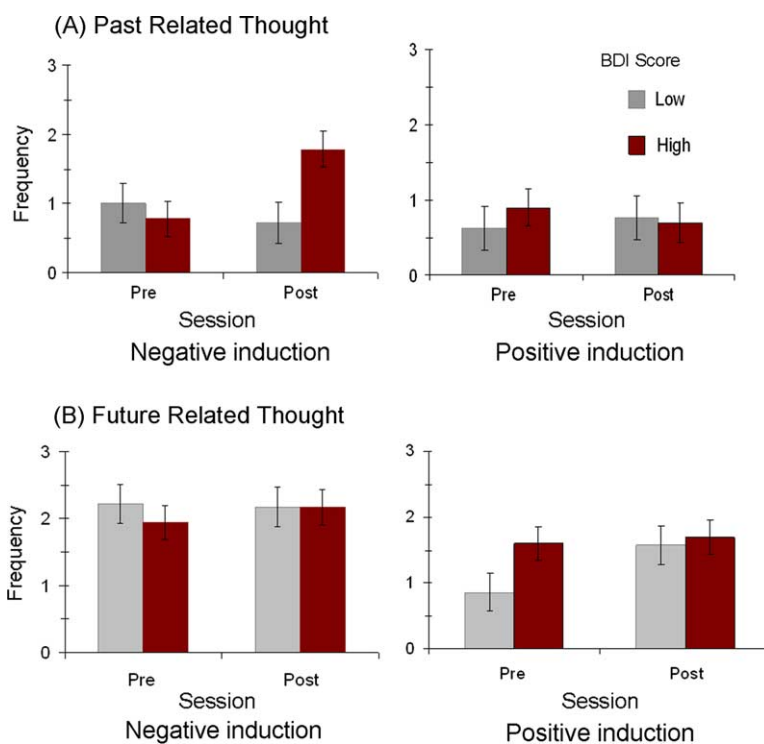
Fourth, both a Session  $\times$  Temporal Focus  $\times$  Condition interaction,  $F(2, 156) = 3.43$ ,  $p < .05$ , and a higher order Session  $\times$  Temporal Focus  $\times$  BDI  $\times$  Condition interaction was observed,  $F(2, 152) = 5.54$ ,  $p < .005$ . These

interactions were followed up by separate mixed ANOVAs comparing the effect of session and condition on the frequency of past- and future-related thought. Comparisons of past-related thought yielded both a Session  $\times$  Condition interaction,  $F(1, 77) = 4.13$ ,  $p < .05$ , and a Session  $\times$  Condition  $\times$  BDI interaction,  $F(1, 77) = 11.68$ ,  $p < .001$ . Prior to the mood induction there were no differences in past-related thought, negative,  $M = 0.9$  ( $SE = 0.20$ ), positive  $M = 0.75$  ( $SE = 0.17$ ),  $t(79) = 0.53$ ,  $p = .59$ , however, greater past thought was reported in the post session following negative than positive induction, negative  $M = 1.3$  ( $SE = 0.24$ ), positive  $M = 0.7$  ( $SE = 0.16$ ),  $t(79) = 2.13$ ,  $p = .03$ .

For the purposes of illustration, Figure 2A uses median splits to display how this increase in past thought in the negative mood condition was related to BDI score. To analyse whether the increase in past thought in unhappy mood interacted with BDI score we conducted separate correlations between BDI score and the frequency of past thought in the pre and post sessions for each mood condition. In the negative mood condition the amount of past thinking post induction was positively associated with BDI score in the post,  $r = .47$ ,  $p < .01$ , but not in the pre session,  $r = -.02$ ,  $p = .90$ . In the positive condition, BDI was not associated with past thinking in either the pre-,  $r = .10$ ,  $p = .53$ , or post-induction sessions,  $r = -.23$ ,  $p = .15$ . Consistent with Experiment 1, past thought was elevated by the induction of negative mood. Moreover, the magnitude of this increase was related to scores on the BDI. Figure 2B illustrates the relationship between future thought, mood and BDI score. Unlike past-related thought, mixed ANOVAs limited to future thought indicated that neither the Session  $\times$  Condition, nor the Session  $\times$  Condition  $\times$  BDI interaction were significant (all  $p$ -values  $> .1$ ).

## GENERAL DISCUSSION

The current experiments sought to elucidate whether unhappy moods lead the mind's natural



**Figure 2.** Experiment 2. The effects of mood induction and BDI score on the experience of past- (A) and future-related thought (B). Median splits were used for display purposes, although in all analyses the BDI was treated in a continuous fashion. The magnitude of the increase in past thinking following a negative mood was associated with symptoms on the BDI. The error bars indicate one standard error of the mean.

wandering to be drawn to events from the past. Experiment 1 demonstrated that when mood was manipulated by emotionally toned videos, an unhappy mood increased reports of retrospective mental time travel in a post-task questionnaire. In Experiment 2 the induction of an unhappy mood using the Velten mood-induction procedure led to an increase in thoughts regarding the past at experience sampling probes, the magnitude of which showed a reliable positive association with increasing BDI score. Together these experiments used different methods of mood manipulation (the Velten procedure and emotional videos) and different measures of mind wandering (experience sampling and post-task questionnaires) and so in combination support the claim that unhappy moods lead the mind to wander to the past.

The association between an unhappy mood and a retrospective focus to mind wandering has several important implications for understanding of how unpleasant moods impact on cognition. First, because mind wandering in the laboratory generalises to measures recorded in daily life (Klinger & Cox, 1987; McVay & Kane, 2009) our data provide important ecological confirmation that the day-to-day thoughts of unhappy individuals are likely to be focused on the past (Nolen-Hoeksema et al., 2008). Second, while other studies have examined how negative mood biases instructed thought (such as the retrieval of emotionally congruent information; Blaney, 1986) the current data indicates that unhappy moods also lead to the spontaneous generation of mental contents that are related to events from the past. Third, the same conditions that promoted



past thought also resulted in worse task performance demonstrating that in negative states task-unrelated cognitions compete with the attentional resources needed to perform the task in hand, a finding with relevance to contemporary theories of depressive cognition (e.g., Watkins, 2008). Finally, although the mild levels of unhappiness in our sample mean that generalisations to clinical populations should be made cautiously, the current data suggest that investigating the temporal focus of mind wandering in clinically depressed populations could be worthwhile.

Perhaps the most important question regarding the association between retrospective mental time travel following an unhappy mood is whether such a focus is adaptive. Tulving (1985) argued that the primary purpose of mental time travel is to link past, present and future selves together and by so doing provide a coherent sense of identity. Assuming that negative mood acts a signal of personal problems (Watkins & Mason, 2002) the association between retrospective mental time travel and unhappy mood could reflect attempts to reframe self-discrepant information such that it can be integrated into the current self. The extent to which this cognitive effort is adaptive may depend on the whether the self-discrepant information can be reconciled with the current view of self, or on the strategy that the individual employs in the service of this goal (Watkins, 2008; Watkins & Mason, 2002). Future work examining the temporal focus of mind wandering under situations of self-discrepancy could provide important insight into this question.

More generally, the evidence of a link between mood state and the temporal nature of mind wandering raises questions on how cognition and emotion interact through the process of mind wandering. For example, does the content of spontaneous thought exert an influence on affective tone? The observation that negative mood encourages retrospective mental time travel, suggests that the reciprocal relationship could also be true, namely that the content of mind wandering exerts an influence on an individual's affective state. Based on theories of depressive cognition (e.g., Beck, 1979) especially negatively toned or

self-focused mind wandering could create a vicious circle in which self-critical cognition has a dampening impact on subsequent mood. Likewise, perhaps there are adaptive forms of mind wandering (such as optimistic or empathic thoughts) that stabilise the cognitive/affective system of the individual and act as a buffer against the stresses of daily life.

Similarly, what role does positive affect play in how mind wandering unfolds? While the current study has focused on the influence of unhappy mood, this does not mean that states of positive affect will not impact on the manner with which mind wandering unfolds. A small increase in future thought was observed via the induction of a positive mood in Experiment 2 in individuals low on BDI scores (see Figure 2), supporting the notion that positive moods may exert an important influence on the content of mind wandering. For example, given that states of mania often lead individuals to entertain especially lofty goals (Johnson, 2005); the experience of strong positive emotion could lead to mind wandering of a grandiose or abstract nature. As mind wandering occupies so much of daily life and yet is still relatively poorly understood, future work exploring its relation to factors such as the mood or the health of an individual will doubtless have important implications for our understanding of many different facets of mental life. A recent study by Killingsworth and Gilbert (2010) documented an association between mind wandering and subsequent unhappiness in daily life in a large sample of North American adults, making understanding the links between mind wandering and mood an important question for the future.

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