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Shifting Moods, Wandering Minds: Negative Moods Lead the Mind to Wander

Jonathan Smallwood, Annamay Fitzgerald, Lynden K. Miles, and Louise H. Phillips
University of Aberdeen

This study examined the effect of mood states on mind wandering. Positive, neutral, and negative moods were induced in participants prior to them completing a sustained attention task. Mind wandering was measured by using the frequencies of both behavioral lapses and retrospective indices of subjective experience. Relative to a positive mood, induction of a negative mood led participants to make more lapses, report a greater frequency of task irrelevant thoughts, and become less inclined to reengage attentional resources following a lapse. Positive mood, by contrast, was associated with a better ability to adjust performance after a lapse. These results provide further support for the notion that a negative mood reduces the amount of attentional commitment to the task in hand and may do so by enhancing the focus on task irrelevant personal concerns.

Keywords: attentional lapses, attentional commitment, mood, mind wandering, task unrelated/stimulus independent thought and self-focus

Since the time of William James, psychology has assumed an inextricable link between emotion and cognition. Such a perspective is supported by neuropsychological studies that suggest that many areas of the brain associated with emotion are also known to be implicated in processes that are distinctly cognitive (Davidson & Irwin, 1999). Indeed, a meta-analysis of 330 functional magnetic resonance imaging (fMRI) studies indicated that although emotional induction resulted in inferior medial prefrontal activation and cognitive tasks tended to activate dorsolateral prefrontal structures, there was nonetheless significant overlap between both activations (Steele & Lawrie, 2004). As a result current perspectives on psychological science often accept that cognition and emotion are inseparable (e.g., Ekman, Davidson, Ricard, & Wallace, 2005).

In daily life, one area in which emotion and cognition could overlap is through their joint contribution to the experience of thoughts unrelated to the here and now—a phenomenon that has been termed “daydreaming” (Singer, 1966), “mind wandering,” (Smallwood & Schooler, 2006; Mason et al., 2007) or “absentmindedness” (Cheyene, Carriere, & Smilek, 2006; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). To explain the occurrence of mind wandering, it is often assumed that the experience entails that attention is withdrawn from current sensory input and instead focused on self-relevant concerns (Klinger, 1999).

Jonathan Smallwood, Annamay Fitzgerald, Lynden K. Miles, and Louise H. Phillips, School of Psychology, University of Aberdeen, United Kingdom.

Jonathan Smallwood is now a research scientist at the University of California, Santa Barbara. Lynden K. Miles and Louise H. Phillips are on the faculty at the University of Aberdeen, United Kingdom. Annamay Fitzgerald completed this study as part of her undergraduate degree.

Correspondence concerning this article should be addressed to Jonathan Smallwood, Department of Psychology, University of California, Santa Barbara, CA 93106-9660. E-mail: smallwood@psych.ucsb.edu

Studies of mind wandering have used both subjective and objective indicators for measuring the experience of off-task thinking (see Smallwood & Schooler, 2006, for a review). Direct methods for studying mind wandering typically use self-reports to gain either online or retrospective measures of the occurrence of task unrelated thought (Antrobus, 1968; Giambra, 1995). A more objective technique for linking affective states to moment-to-moment mind wandering is to use a task in which behavioral performance is sensitive to task-unrelated thought. A common approach to studying mind wandering is to use a simple go/no go sustained attention task, in which participants must inhibit a response to an infrequent target known as the Sustained Attention to Response Task (SART; Robertson et al., 1997). The monotonous nature of the SART gives it strong face validity as a plausible context in which to study mind wandering and because of its reliance on response inhibition, errors on the SART have been associated with absentmindedness (Robertson et al., 1997) or boredom proneness (Cheyene et al., 2006). Recent studies have underscored the overlap between SART errors and subjective markers of mind wandering by documenting that the amplitude of the P3 component of the event related potential was reduced prior to both behavioral and subjective indicators of off-task thinking (Smallwood, Beech, Schooler, & Handy, 2008).

The SART also allows the investigator to distil a number of information processing characteristics and so shed light on the nature by which attention is maintained over the course of testing. First, both errors (Robertson et al., 1997) and off-task reports (Smallwood et al., 2004) are generally preceded by rapid careless responding (*pre-error acceleration*) confirming that in both cases participants are not giving the task their undivided attention. Second, errors on task are almost always noticed by participants, at least in neurologically healthy individuals (O’Keefe, Dockree, & Robertson, 2004) and such detection usually leads to a predictable deceleration in response time (*post-error slowing*). This has been dubbed the *Oops phenomenon* and is thought to index the reengagement of task focus (Manly, Robertson, Galloway, & Hawkins, 1999; Robertson et al., 1997).

With respect to the present study, several recent theoretical frameworks predict that negative mood will enhance the likelihood of mind wandering. First, low and high moods may alter the amount of attentional resources that participants commit to a task. Olivers and Nieuwenhuis (2005) demonstrated that the attentional blink—a temporary failure detect a second target that closely follows the first—was reduced when the participant either listened to music or engaged in mild rumination relative to a control condition. According to Olivers and Nieuwenhuis, this counterintuitive result occurred because the control participants overinvested attention in the initial target, leaving insufficient resources to detect the subsequent target. More recently, Jefferies, Smilek, Eich, and Enns (2008) showed that a negative mood led to a reduction in the attentional blink relative to a positive mood, implying that sadness could reduce the commitment of attentional resources to the concurrent task. Unlike the attentional blink, errors on the SART occur because the participant fails to sustain the necessary resources on the task and so the attentional commitment hypothesis predicts that a negative mood will lead to greater errors than a positive mood.

Second, according to Personality Systems Interaction theory (PSI; Kuhl, 2000) negative affective states are aversive and can be reduced by a process of self-affirmation. Following the induction of a negative mood, therefore, participants could be inclined to not only withdraw attentional resources from the task they are performing but also focus on self-relevant information to improve their mood. According to PSI, therefore, higher frequencies of self-focus during the SART (e.g., task-unrelated thoughts) are most likely to be experienced by participants in a negative mood.

Existing empirical evidence supports the contention that a negative mood leads the mind to wander. Pioneering work by Fraser Watts and colleagues showed that depressed patients reported greater frequencies of mind wandering during reading (Watts, MacLeod, & Morris, 1988). More recently, Smallwood, O'Connor, Sudberry, & Obonsawin (2007) demonstrated that task-unrelated thinking (TUT) was both more frequent and accompanied by greater physiological arousal in dysphoric college students. Finally, using a mood induction procedure, Seibert and Ellis (1991) demonstrated that following both positive and negative mood inductions, college students reported greater levels of TUT. To date, the only relevant mood induction study failed to show an increase errors in the SART task for negative compared with neutral moods (Chepekni, Corwen, & Farah, 2004); however, this study failed to include a positive mood condition and the numerous cognitive tasks following the mood induction procedure resulted in a substantial fluctuation of mood intensity across the course of this lengthy testing session.

Current Study

Although the evidence reviewed strongly implies that a negative mood should encourage the mind to wander, no study to date has examined the effect of an induced mood on both subjective and objective indicators of mind wandering. In the current study, we induced positive, neutral, and negative moods before participants performed the SART. Mood was assessed using the Positive Affect and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) both before and after the mood induction procedure to ensure the validity of the induction process and to rule out individual differences in mood levels. In this study we considered the effects of mood on both (a) the number of behavioral lapses made by participants, and (b) the response times before and after correctly and incorrectly detected targets. Upon completing the task, participants retrospectively reported the amount of off-task thinking experienced while completing the task, providing a subjective indicator of the amount of mind wandering. Participants reported the frequency of two types of subjective experience task-unrelated thought (TUT: the experience of thoughts that are unrelated to what one is doing) and task-related interference (TRI: the experience of interfering thoughts regarding how one is performing on the task as a whole). Using this design, it is possible to explore the consequences of positive, negative, and neutral moods on subjective and objective indicators of attentional lapses and so further refine our theoretical understanding of how current mood can influence whether the mind wanders from the constraints of the task.

Methods

Participants

Fifty-nine undergraduate students (25 males) participated in this experiment for course credit. The mean age of the sample was 21.7 (SD = 2.0; range = 18–25) years. Individuals were allocated to positive (n = 20), negative (n = 20), and neutral (n = 19) mood induction conditions using a counterbalanced design.

Procedure

The first stage in the procedure required participants to complete a baseline measure of mood, after which they underwent the mood induction procedure. Video clips lasting approximately 5 min were used to induce mood. Pilot work had previously established these to be effective and reliable stimuli for eliciting the appropriate mood state. The neutral clip consisted of a segment from a nature documentary, the positive clip was from a sitcom showing a humorous situation, and the negative clip was from a documentary and focused on a dog that was seriously ill. After viewing the clip, participants completed a second mood measure. Next all participants performed the SART before completing a retrospective measure of mind wandering. Finally, participants were debriefed on the purpose of the experiment. Ethical approval was obtained from School of Psychology's ethics committee before testing.

Measures

Mood. To assess mood before and after the mood induction participants completed the PANAS (Watson et al., 1988). This is a 20-item scale that requires participants to rate whether a series of adjectives describes how they feel at the moment (e.g., Positive—Proud, Negative—Afraid). Participants were asked to rate how they felt "right now."

Mind wandering. Behavioral incidences of mind-wandering were measured using a variant on the SART (Robertson et al., 1997). Participants were asked to respond to the nontarget and to inhibit their response when presented with the target. Nontarget stimuli ("O") in the SART were presented on 256 occasions while the target stimulus (" = ") occurred 20 times (approximately 8%). Stimuli were presented at a rate of one every 2,500 ms. Participants responded to the target using the space bar and were asked to give equal weight to both speed and accuracy. Mind wandering is indicated by a high number of errors of commission.

Subjective reports of mind wandering were measured directly after completing the SART using the Thinking Content component of the Dundee Stress State Questionnaire (Matthews, Joyner, Gililand, Campbell, & Faulconner, 1999). This scale is a 16-item questionnaire that assesses the content of thinking during a recently completed task, and it is divided into two 8-item factors: (a) TRI ("I thought about how I should work more carefully" or "I thought about my level of ability"), and (b) TUT ("I thought about personal worries" or "I thought about something that happened earlier today"). This measure has been successfully used in previous studies using the SART (e.g., Smallwood et al., 2004).

Results

Effects of Mood Induction

Participant mood as assessed before and after mood induction procedure is presented in Table 1. Repeated measures analysis of variance (ANOVA) yielded a Mood Group × Time Interaction for both positive, $F(2, 56) = 5{,}2$, $p < .01$, $\eta^2 = .16$, and negative affect dimensions, $F(2, 56) = 3.38$, $p < .05$, $\eta^2 = .11$. Post hoc least-significant difference (LSD) tests confirmed that the individuals in the Negative mood group had more marked negative affect than both Neutral and Positive groups at post ($p < .05$) but not at pre induction intervals ($p > .4$). Furthermore, individuals in the Negative mood condition showed lower ratings of positive affect than individuals in either the Positive or Neutral conditions for the postinduction ($p < .05$) but not the preinduction mood levels ($p > .25$).

Frequency of Behavioral Lapses

Our next analysis examined the effects of the different mood induction procedures on SART errors. ANOVA indicated a reliable effect of condition on the proportion of errors, $F(1, 56) = 3.1$, $p < .05$, $\eta^2 = .10$ (see Figure 1A). Post hoc LSD tests indicated that participants allocated to the Negative condition made more errors than individuals allocated to the Positive condition ($p = .016$). No other differences were statistically significant.

Response Time (RT)

Our second analysis examined how mood impacted upon response time both prior to and following presentation of a target that was either correctly or incorrectly responded to. RTs were averaged across the four stimuli before and after target presentation and then binned on the basis of performance on the target. Mixed-model ANOVA was used to examine the effects of induced mood on RT prior to and following presentation of a target binned by accuracy. Mood manipulation was included as a between-participants condition, with repeated measures on both target Accuracy (Failure/Correct) and Epoch (Pre/Pos). This analysis indicated an Epoch × Accuracy × Induced Mood interaction, $F(2, 51) = 4.5$, $p < .05$, $\eta^2 = .15$. To follow up this interaction, we subtracted the RT associated with correct targets from those responded to incorrectly separately for both pre and post target epochs. No differences in pre-error acceleration were associated with mood conditions ($p > .05$), although in all case RT was substantially faster when incorrect, Positive = −76 ms ($SE = 10$), Neutral = −63 ms ($SE = 9$), Negative = −55 ms ($SE = 9$). However, post hoc tests did indicate that inducing a positive mood led to greater post-error slowing than either the negative or neutral conditions (for both comparisons $p < .05$; see Figure 1B). No differences between mood groups were observed following a correct target ($p > .17$ for all comparisons). Finally, we assessed the extent to which participants adjusted their response time according to the accuracy of their performance. This analysis was adjusted for the number of comparisons made ($n = 3$) and revealed that participants in positive and neutral groups adjusted their behavior following a lapse, Positive, $F(1, 18) = 32.7$, $p < .001$, $\eta^2 = .64$, Neutral, $F(1, 18) = 13.37$, $p < .005$, $\eta^2 = .43$. No difference was observed for participants allocated to the negative mood condition, $F(1, 15) = 1.2$, $p > .27$.

Subjective Reports

To examine the effects of mood on subjective reports made in the post task questionnaire, the incidence of off-task thoughts were submitted to a mixed-model ANOVA, with repeated measures on

Table 1
The Effects of Positive, Neutral, and Negative Mood Induction Procedures on Before and After Scores on Positive and Negative Affect Measured Using the Positive Affect and Negative Affect Scale (PANAS)

Measure	Mood induction procedure	Preinduction		Postinduction	
		M	*SE*	*M*	*SE*
PANAS positive affect	Positive	23.35	0.98	23.70#	0.82
	Neutral	22.89	1.00	22.74#	0.84
	Negative	21.75	0.98	19.55	0.82
PANAS negative affect	Positive	10.65	0.17	10.80#	0.26
	Neutral	11.00	0.17	11.26#	0.26
	Negative	10.90	0.17	12.05	0.26

# Indicates a difference from negative group in the postinduction phase ($p < .05$).

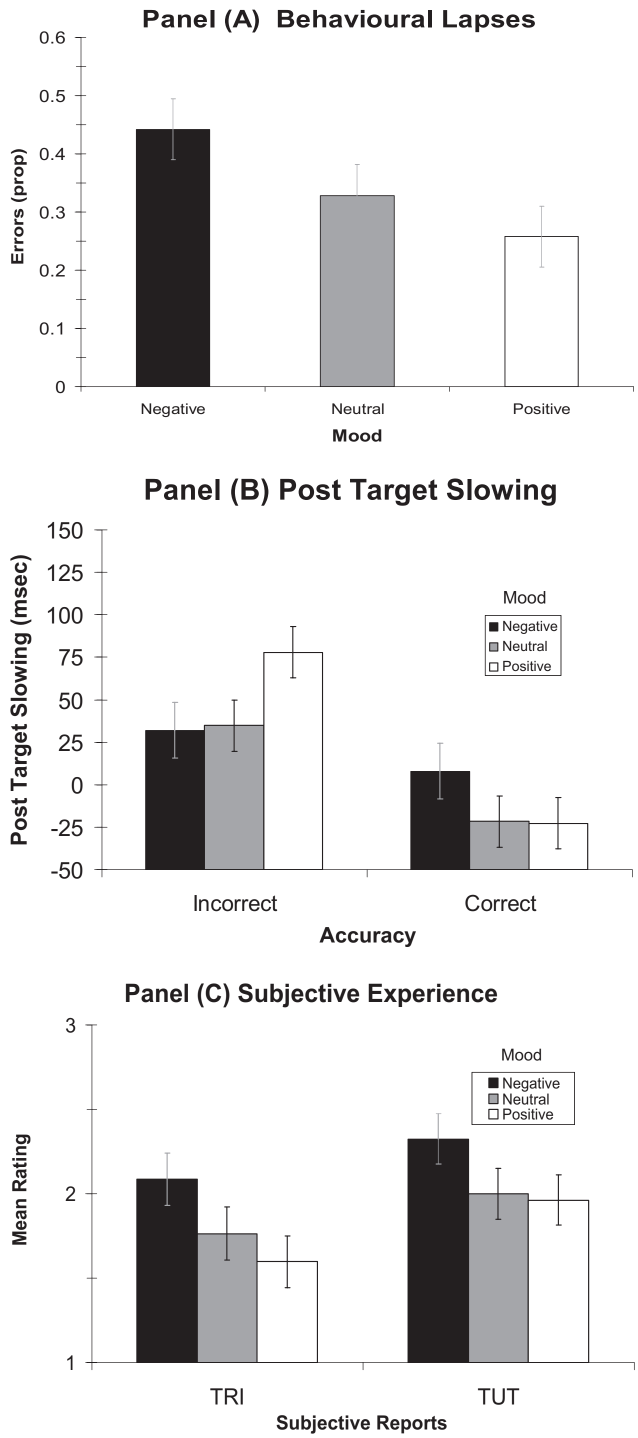

Figure 1. The effects of induced mood on the frequency and response to attentional lapses. A, Frequency of behavioral lapses. Negative mood increased the frequency of behavioral lapses. B, Post target slowing. Positive mood increased the extent to which participants adjust their behavior following a lapse. C, Subjective experience. Negative mood increased reports of both task-unrelated thought (TUT) and task-related interference (TRI).

type of experience (TRI/TUT) and mood induction procedure as a between-participant condition. This analysis indicated that irrespective of condition, participants reported more TUT ($M = 2.0$, $SE = .08$) than TRI ($M = 1.8$, $SE = .08$), $F(1, 56) = 5.9$, $p < .05$, $\eta^2 = .09$. In addition, this analysis yielded a significant effect of mood condition, $F(2, 56) = 3.8$, $p < .05$, $\eta^2 = .12$. Post hoc LSD tests indicated that Negative mood induced greater TUT and TRI than a Positive mood ($p < .05$ for both comparisons). In addition, a clear trend toward greater TUT in the Negative than Neutral condition was revealed ($p = .06$).

Discussion

The results of the current study indicated that inducing a negative mood led participants to make more errors on the SART, prevented them from adjusting their behavior following a lapse, and resulted in greater amounts of preoccupation with self-relevant concerns (TUT) and with how they were performing on the task (TRI) than participants in a positive mood. As such, our results are an important extension of previous studies of mood and mind wandering. Consistent with the only other mood induction study of the SART (Chepekni, Cornen, & Farah, 2006), we observed no difference between negative and neutral conditions. Instead, because we included a positive mood manipulation, our results revealed that attentional lapses were more frequent in a negative than a positive frame of mind. In addition, because we experimentally varied mood our results illuminate the causal role that mood plays in attentional lapses, a finding which correlational studies cannot document (e.g., Carriere et al., 2008; Farrin, Hull, Unwin, Wykes, & David, 2003). Taken together, our behavioral and subjective data converge on the notion that positive and negative mood states have a differential effect on both the commitment of attentional resources to the task and also the likelihood that the mind wanders to self-relevant concerns. A number of interesting conclusions emerge from this data.

Relative to a positive mood, participants in a negative mood were both more likely to lapse and impaired in their ability to recover from the lapse. Because previous work has shown that positive moods can elevate off-task thinking without the continuous demands of the SART (Seibert & Ellis, 1991), it is unlikely that mind wandering is the exclusive domain of a negative mood; in fact, it seems likely that positive affective states (such as love) could easily prompt the mind to wander in circumstances in which the task allows such unconstrained thinking. Rather, the effects of positive and negative mood are consistent with the attentional commitment hypothesis (Jefferies et al., 2008; Olivers & Nieuwenhuis, 2005). Participants in the positive mood condition sustained attentional resources to the SART across the testing session—as revealed by the smaller number of errors, and showed greater inclination to reengage attentional resources after a lapse—as demonstrated by the slower responding after an error. By contrast, the increase in TRI resultant from a negative mood suggested that these participants not only committed fewer cognitive resources to the task, but they also tended to dwell on their own failures. Within the psychological literature a tendency to dwell on past events has been described as a state orientation because it prevents the engagement of effective problem solving behavior (i.e., an action orientation; Kuhl, 1981) and is suggested to be detrimental to psychological well-being (Carriere et al., 2008; Nolen-Hoeksema, 1991). It is possible that by examining the detailed cognitive and neuropsychological changes that follow attentional lapses, we may be able to examine how individuals prone to a "state orientation" respond to failure under laboratory conditions.

Finally, when in a negative mood, participants not only failed to pay sufficient attention to the task, they also reported greater amounts of TUT. Greater amounts of TUT while in a negative mood is consistent with studies that have linked mind wandering to naturally occurring states of negative mood (Farrin et al., 2003; Smallwood et al., 2007; Watts et al., 1988) and more generally with the concentration problems associated with depression across the life span (Sachs-Ericsson, Joiner, & Blazer, 2008). Theoretically, the link between negative mood and TUT demonstrated in this study is consistent with predictions of PSI theory (Kuhl, 2000) which argues that self-processing often occurs in response to a negative mood. Intriguingly, the need for self-relevant processing in response to a negative mood could provide an explanation for why affective states and arousal interact with respect to their effects on attention. Jefferies et al. (2008) showed a smaller attentional blink effect for individuals in a negative mood that those in a positive mood despite equivalent arousal in both conditions. This finding raised an important question: What is special about a negative mood that leads to the reduction in attentional commitment? In conjunction with PSI, the results of the current study suggest that while both positive and negative moods can entail equal levels of arousal, in a negative mood arousal is related to the processing of self-relevant information in attention leading to a reduction in the availability of resources for the task in hand. The contention that in a negative mood arousal is indicative of the commitment of attentional resources away from the task is supported by the observation that dysphoric individuals showed greater heart rate when their mind wandered than did controls (Smallwood et al., 2007).

A number of limitations should be borne in mind when considering the results of this study. First, the estimation of TUT/TRI was made retrospectively and so it is possible that participants used their behavioral performance to estimate the amount of time spent engaged in TUT. Future work should consider using online thought probes. Second, it is possible that the mood manipulations could have changed more dimensions than simply affect, or that these manipulations may have differed in intensity, hence it is important to replicate the present results using a variety of alternative mood induction techniques. Finally, while a strength of our design is that it measured mood both before and after induction, this approach could have unduly drawn participants' attention to the purpose of the study and so future work could employ a more implicit measure of mood to resolve this issue. These minor limitations notwithstanding, the current study confirms that an increased incidence for mind wandering in circumstances requiring our undivided attention does accompany a negative mood and so is one of the many ways in which "(t)he world of the happy man is a different one from that of the unhappy man" (Wittgenstein, 1922, p. 27).

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