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Everyday attention lapses and memory failures: The affective consequences of mindlessness

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Abstract

We examined the affective consequences of everyday attention lapses and memory failures. Significant associations were found between self-report measures of attention lapses (MAAS-LO), attention-related cognitive errors (ARCES), and memory failures (MFS), on the one hand, and boredom (BPS) and depression (BDI-II), on the other. Regression analyses confirmed previous findings that the ARCES partially mediates the relation between the MAAS-LO and MFS. Further regression analyses also indicated that the association between the ARCES and BPS was entirely accounted for by the MAAS-LO and MFS, as was that between the ARCES and BDI-II. Structural modeling revealed the associations to be optimally explained by the MAAS-LO and MFS influencing the BPS and BDI-II, contrary to current conceptions of attention and memory problems as consequences of affective dysfunction. A lack of conscious awareness of one's actions, signaled by the propensity to experience brief lapses of attention and related memory failures, is thus seen as having significant consequences in terms of long-term affective well-being.

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Introduction

Lapses of attention and memory failures, commonly known as absent-mindedness, are a familiar occurrence in our daily lives. Generally, these lapses result in only minor inconveniences, such as a brief loss of time while trying in vain to find an object in full view or failing to remember what one needed to pick up at the supermarket. These same lapses can, however, also have dramatic and life-threatening consequences, such as when a pilot fails to lower the plane's landing gear while approaching a runway (e.g., Transportation Safety Board of Canada, 2004) or a surgeon leaves forceps in a patient during surgery (Gawande, Studdert, Orav, Brennan, & Zinner, 2003). From these examples it is apparent that even minor disruptions in the basic cognitive processes of attention and memory can have numerous and potentially far reaching consequences.

The present paper examines some of the potential long-term consequences of momentary everyday attention lapses. In particular, we examine the long-term effects of everyday lapses of attention and memory on two theoretically related affective dysfunctions: boredom and depression.

The relation between mind-wandering and affective dysfunction has been established for some time (e.g., Watts & Sharrock, 1985). Recent research has raised the possibility that relatively small everyday lapses of attention can have important consequences with regard to one's affective state, and may even lead to affective dysfunction. This conclusion is consistent with research conducted by Farrin, Hull, Unwin, Wykes, and David (2003), examining the extent to which cognitive failures are related to depression via a combination of the Sustained Attention to Response Task (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) and the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, fitzGerald, & Parkes, 1982). This research reported a strong correlation between the CFQ and depression, and a significant correlation between performance on the SART and depression. That lapses of attention can have a significant effect on one's affective state is also consistent with research by Smallwood and colleagues showing a positive association between mind-wandering and dysphoria (Smallwood et al., 2003; Smallwood & Schooler, 2006). Finally, additional support for the role of attention in affective dysfunction comes from our previous work on everyday attention lapses (Cheyne, Carriere, & Smilek, 2006), in which we examined the relation between self-report measures of attention lapses, attention-related cognitive errors, and boredom proneness. One of the results of this research was the finding of a robust relation between the propensity to experience attention lapses and boredom proneness, again suggesting attention lapses can play a significant role in one's affective state.

We have hypothesized that attention plays a key role in many of the most common conceptions of boredom (Cheyne et al., 2006). Indeed, an examination of the research on boredom reveals that it is primarily an inability to engage and sustain attention (Berlyne, 1960; Damrad-Frye & Laird, 1989; Hebb, 1966) and is a typical outcome when we are either (a) prevented from taking a desirable action or (b) forced into an undesirable action (Fenichel, 1951). However, we were particularly struck by the subjective experience of boredom in which one is unable to maintain attention on any object, despite being free to do so, and by the possibility of substantial individual differences in boredom proneness as a result of one's tendency to be inattentive. Evidence in support of the idea that attention can have a direct causal influence on affective state comes from a recent study reporting that selective inhibition of distractor stimuli during visual search leads to affective devaluation of those stimuli (Fenske & Raymond, 2006). In this case the visual search task demands that one not pay attention to specific objects, however such research raises the possibility that one's tendency to be inattentive—and one's subsequent inability to maintain attention on any object or experience, despite being free to do so—may play a causal role in the general affective devaluation of one's experiences that is found in boredom. Consistent with this conceptual analysis we (Cheyne et al., 2006) found a significant association between the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986) and a direct measure of the propensity to experience attention lapses, the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). The data were insufficient, however, for developing a causal model of the relation between attention lapses and affective dysfunction as reflected in boredom. Nonetheless, we proposed the hypothesis that a potential consequence of a chronic inability to engage and sustain attention is a lack of interest in everyday events, as is typically experienced in boredom, leading to a loss of meaning in everyday tasks, a lack of motivation, and persistent negative affect (O'Hanlon, 1981; Sommers & Vodanovich, 2000).

Feeling a loss of meaning in everyday tasks and a persistent negative affect are characteristic not only of boredom but also of more serious affective dysfunction; most notably, depression (Abramson, Metalsky, & Alloy, 1989). Thus, attention lapses may have implications for cognitive and affective aspects of depression as well. The relation between attention lapses and depression is supported by research conducted by Wagle, Berrios, and Ho (1999) and by Farrin et al. (2003) reporting significant correlations between a questionnaire assessing a variety of everyday cognitive failures (the Cognitive Failures Questionnaire), including attention and memory failures, and a questionnaire designed to assess depression (the Beck Depression Inventory). As well, clinical perspectives on depression often cite attentional problems as one of several cognitive outcomes and assert that they are resolved through treatment of the underlying depressive disorder (e.g., Christopher & MacDonald, 2005; Hasher & Zacks, 1979; Karasu, Gelenberg, Merriam, & Wang, 2000; Watts & Sharrock, 1985). Indeed, the importance of addressing attentional problems early on in Cognitive Behavioural Therapy (CBT) treatments for depression can be seen in the recommendations of Hollon, Haman, and Brown (2002), who note:

". . . a depressed patient often feels overwhelmed and unable to cope with life's demands. In fact, the patient may indeed be facing serious demands in a number of different areas: friction in relationships, financial difficulties, or insufficient work productivity. Such a patient may be encouraged to make a list of what he or she needs to do and then to break large tasks into their smallest constituent steps." (p.385).

Although the authors explain the use of this intervention as motivated by the desire to combat unrealistic beliefs that are thought to play a causal role in depression, in line with the emphasis on dysfunctional beliefs inherent in the CBT perspective, it is important to note that the intervention is clearly to teach coping strategies for dealing with difficulty sustaining attention to specific, normally manageable, tasks. Indeed, though it has received little notice, one recent study (Papageorgiou & Wells, 2000) reported that depression can be treated successfully via an attention training regimen only, suggesting that the failures of basic cognitive mechanisms at play in attention lapses are capable of playing a causal role in modifying depression.

Another basic cognitive process expected to play a role in affective dysfunction is memory, as it is closely associated with both attention (Cowan, 1995) and depression (Christopher & MacDonald, 2005; Moore, Watts, & Williams, 1988). To date few studies have closely examined the specific association between boredom and memory. However, Wallace, Kass, and Stanny

(2002) have recently shown a substantial positive correlation between the BPS and the memory component of the CFQ, indicating a strong association between boredom and memory failures. A follow-up study then demonstrated the BPS to be a significant predictor of the CFQ overall (Wallace, Vodanovich, & Restino, 2003). Together, these findings suggest boredom could have substantial effects on memory performance, though the reverse remains a possibility as well. Similarly, depression is also thought to have pervasive effects on memory processes, ranging from an inability to voluntarily recall specific memories to long-term episodic memory deficits and the involuntary recall of negative memories (Blaney, 1986; Moore et al., 1988; Raes et al., 2006; Watkins, Grimm, Whitney, & Brown, 2005; Watts, 1995;Watts & Sharrock, 1985). As with attention problems, these memory deficits are thought to be resolved when the underlying depressive disorder has been treated (Karasu et al., 2000). However, to date it is unknown whether memory deficits also play a causal role in depression—though given the interconnectedness of attention and memory processes (Cowan, 1995), and the finding that basic attention processes could play a causal role in depression, this remains a distinct possibility.

Given previous research suggesting that depression, boredom, attention, and memory are all theoretically and empirically linked, the present research seeks to examine the relations between one's propensity to experience cognitive errors, such as *attention lapses* and *memory failures*, and one's proneness to experience *boredom* and *depression*. To assess the propensity to experience attention lapses and memory failures we developed a new version of the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the MASS-LO (see Section 2 below), and a revised version of our own Memory Failures Scale (MFS; Cheyne et al., 2006). To address the relations between these attention and memory deficits and affective dysfunction, we measured boredom via the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986) and depression via a scale that closely follows the diagnostic criteria for depression in the Diagnostic and Statistical Manual, version 4 (DSM-IV; American Psychiatric Association, 1994), the Beck Depression Inventory—Second Edition (BDI-II; Beck, Steer, & Brown, 1996). We also included a revision of our Attention-Related Cognitive Errors Scale (ARCES), allowing further examination of the possibility that the occurrence of everyday cognitive failures in both depression and boredom can be explained by disruptions of basic cognitive mechanisms.

Based on evidence supporting the assumption that one's propensity to experience attention lapses is an important factor in boredom and depression, and that memory failures also play a role, we predict the MAAS-LO and MFS will explain a significant amount of the variance in the BPS and BDI-II. The ARCES, however, is believed to act only as a mediator between the MAAS-LO and MFS, so the ARCES itself should not explain a significant amount of the variance in the BPS and BDI-II once the MAAS-LO and MFS are accounted for. To examine the hypothesis that failures of basic cognitive mechanisms represent an important contributor to boredom proneness and depression, we conducted a path analysis using structural equation modeling (Arbuckle, 2005) with the MAAS-LO as a common cause of all other variables, and the MFS mediating the associations between the MAAS-LO, BPS and BDI-II. Within the path analysis, several additional hypotheses were also addressed regarding the relations among the MAAS-LO, MFS, BPS and BDI-II. In particular, we assessed an alternative hypothesis in which the MAAS-LO and MFS are modeled as consequences of the BPS and BDI-II. Additionally, the BPS and BDI-II were each modeled separately as common causes of cognitive outcomes.

Method

Participants

Participants were 304 undergraduates enrolled in an Introductory Psychology course at the University of Waterloo who completed all five of the questionnaires below. Included with the scales of interest were several samples of the general on-line assessments associated with Introductory Psychology courses. Participants were not aware of the relatedness of our scales and, while not fully counterbalanced, the questionnaires were presented to participants in one of three random orders, providing a good balance to the distribution of the questionnaires overall. Participants received bonus course credit as compensation for completing the questionnaires.

Questionnaires

The 15-item Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) was selected as a measure of attention lapses. MAAS items ask about mindlessness in everyday situations and, using a Likert scale ranging from *almost never* (1) to *almost always* (6), responses indicating greater frequency indicate less mindfulness. In order to effectively use the MAAS as a measure of attention lapses only several adjustments are required. Two items on the MAAS (items 2 and 6) actually refer to consequences of attention failures and were therefore removed. In addition, one item (item 12) references attention lapses while driving, a situation not commonly experienced for a large proportion of university students, and was removed to increase the general applicability of the scale. Thus, we used a revised version of the MAAS including only the 12 items referring to attention lapses, which we have called the Mindful Attention Awareness Scale-Lapses Only (MAAS-LO). In addition, because we interpret this scale as a measure of attention lapses, we do not reverse score items, as is conventional for the original MAAS (see Cheyne et al., 2006; for a discussion of this issue). The MAAS-LO has a minimum score of 12 (infrequent attentional lapses) and a maximum score of 72 (very frequent attentional lapses).

The 12-item Memory Failures Scale (MFS; Cheyne et al., 2006) was included as a measure of everyday memory failures that are minimally explained by attentional errors. The MFS includes items such as "Even though I put things in a special place I still forget where they are," and follows a Likert scale ranging from *never* (1) to *very often* (5), with a minimum score of 12 and a maximum score of 60. For the present study two questions were replaced from the original MFS (item 1: "I leave important letters/emails unanswered for days"; item 12: "When I go to introduce my friends I forget their names") for being too causally ambiguous and to reduce overlap between items. Items from the revised MFS appear in Appendix Table A.1.

The propensity to become bored was assessed via the 28-item Boredom Proneness Scale (BPS; Farmer &Sundberg, 1986), as it reflects situations in which we are likely to become bored (e.g., "Much of the time I just sit around doing nothing") and related personal characteristics of boredom (e.g., "I would like more challenging things to do in life"). The BPS uses a Likert scale ranging from *strongly disagree* (1) to *strongly agree* (7),with a *neutral* (4) midpoint. The BPS has a minimum score of 28 and a maximum score of 196.

As a measure of depression we included the second edition of the Beck Depression Inventory (BDI-II; Becket al., 1996), a 21-item scale that addresses the diagnostic criteria for depression in the DSM-IV (American Psychiatric Association, 1994). The BDI-II has a minimum score of 0 and a maximum score of 63, requiring participants to select from a list of statements relevant to depression the one that best describes how they have been feeling throughout the last two weeks.

Our own previously developed Attention-Related Cognitive Errors Scale (ARCES; Cheyne et al., 2006),measuring the frequency with which one experiences a variety of everyday cognitive failures for which an attention lapse is the most likely cause, was incorporated as an additional assessment of cognitive impairment. In an effort to continue to improve the ARCES several adjustments were made. One question (item 4: "I have found myself wearing mismatched socks or other apparel") stood out as being substantially less related to the overall scale and was replaced with a question referring to the inability to follow a conversation (see item 3 of Table A.2). As well, two questions (originally items 3 and 5, see Table A.2) received minor wording changes in order to make them more generally applicable. The revised ARCES continues to be a 12-item questionnaire employing a Likert scale of five possible responses, ranging from *never* (1) to *very often* (5), with a minimum score of 12 and a maximum score of 60.

Results

Consistent with our earlier findings (Cheyne et al., 2006), the revised ARCES and MFS were found to have good distributional and psychometric properties. There was a good range of scores, no significant deviations from normality in skewness and kurtosis, and there was a very satisfactory internal consistency (Table 1). The items of the revised ARCES and MFS all had good item-total correlations (see Appendix Tables A.1 and A.2). The MAAS-LO also had good distributional and psychometric properties, with a good range of scores, no deviations from normality in skewness and kurtosis, and very satisfactory internal consistency (Table 1). The BPS was characterized by some minor skewness and kurtosis, a good range of scores, and good internal consistency. The BDI-II alone was characterized by more significant skewness and kurtosis, although still well within reasonable levels of tolerance.

Pearson Product-Moment correlation coefficients are presented in Table 2. All coefficients are moderate to large. As predicted, the ARCES, MAAS-LO, and the MFS were positively correlated. Furthermore, as predicted, both attention measures and the MFS were associated with the BPS and BDI-II, which were also positively associated.

Table 1
Means, standard deviations, ranges, skewness & kurtosis (with standard errors), and alpha coefficients for all questionnaires ($N = 304$)

	Mean	*SD*	Range	Skew[a]	Kurtosis[b]	Alpha
Mindful Attention Awareness Scale-Lapses Only	38.75	8.83	10–67	−.11	.01	.83
Attention-Related Cognitive Errors Scale	36.61	7.81	12–59	.09	.31	.88
Memory Failures Scale	31.23	7.10	13–55	.58	.60	.85
Boredom Proneness Scale	98.64	18.84	40–144	−.22	−.11	.83
Beck Depression-II	11.65	9.18	0–48	1.63	3.20	.91

[a] $SE = .14$.
[b] $SE = .28$.

Table 2
Pearson Product-Moment Correlations of Mindful Awareness of Attention (MAAS-LO), Attention-Related Errors (ARCES), Memory Failures (MFS), Boredom Proneness (BPS) and Beck Depression (BDI-II) Measures ($N = 304$)

	ARCES	MFS	BPS	BDI-II
Mindful Awareness of Attention-Lapses Only	0.46	0.45	0.44	0.39
Attention-Related Cognitive Errors		0.59	0.32	0.28
Memory Failures			0.41	0.38
Boredom Proneness				0.44
Beck Depression-II				

For all coefficients, $p < .001$.

To further assess our previous finding (Cheyne et al., 2006) that the ARCES mediates the association between the MAAS-LO and MFS, a step-wise multiple regression analysis was conducted (Table 3). At step two, when the ARCES was added, the beta weight for the MAAS-LO was substantially reduced, but remained significant, indicating a substantial, though partial, mediation of the relation between the MAAS-LO and MFS via the ARCES. Thus, we again find attention lapses are strongly associated with memory failures, though a substantial portion of this relation is due to the attention-related cognitive errors also resulting from attention lapses. The corroboration of our previous finding in our current results plays an important role in our subsequent structural equation models because the finding that the ARCES mediates the relation between the MAAS-LO and MFS substantially constrains the number of potential models to be examined. Accordingly, all of the hypotheses to be tested were developed as an extension of our previous finding and were designed to assess what role boredom proneness and depression are likely to play when added to our model.

Table 3
Step-wise multiple regression testing for Mediation of Memory Failures (MFS) by Mindful Awareness of Attention (MAAS-LO) and Attention-Related Cognitive Errors (ARCES)

	β	t	p
Dependent variable: MFS			
Step 1			
MAAS-LO	.45	8.74	.001
Step 2			
MAAS-LO	.23	4.44	.001
ARCES	.49	9.68	.001
Final model	$R = .63$, $F(2,301) = 96.74$, $p < .001$		

To assess the hypothesis that the association of boredom proneness with attention-related cognitive errors is mediated by basic attention and memory failures, a step-wise multiple regression analysis (Table 4) was conducted. In this analysis, with the BPS as the dependent variable, the ARCES was significantly associated with the BPS in step one. In step two, when the MAAS-LO was added, the beta weight for the ARCES was reduced but remained significant. In step three the MFS was added. Although both the MFS and MAAS-LO remained significant, the beta for the ARCES was very small and no longer significant. This regression analysis was repeated for each of the three random questionnaire orders, each showing a reduction in the association between the ARCES and BPS, suggesting the order of the questionnaires did not play a significant role in this association. Thus, the present analysis indicates the bivariate association between the ARCES and BPS is almost entirely accounted for by the MAAS-LO and MFS, suggesting that attention-related cognitive errors and boredom proneness are related only to the extent that they are both closely related to lapses of attention and memory failures.

A parallel analysis was conducted with the BDI-II as the dependent variable, with very similar results(Table 5). Once again, the MAAS-LO and MFS substantially reduced the contribution of the ARCES, effectively eliminating the association between the ARCES and BDI-II. This analysis was again repeated for each of the three random questionnaire orders, with each showing a reduction in the association between the ARCES and BDI-II, again suggesting questionnaire order had little effect. Thus, the present analysis indicates the bivariate association between the ARCES and BDI-II is entirely accounted for by the MAAS-LO and MFS. Therefore, as with boredom proneness, the data suggest attention-related cognitive errors and depression are associated only via their shared relations with lapses of attention and memory failures.

Table 4
Step-wise multiple regression testing for Mediation of Attention-Related Cognitive Errors (ARCES) and Boredom Proneness (BPS) by Mindful Awareness of Attention (MAAS-LO) and Memory Failures (MFS)

	β	t	p
Dependent variable: BPS			
Step 1			
ARCES	.32	5.88	.001
Step 2			
ARCES	.15	2.58	.01
MAAS-LO	.38	6.54	.001
Step 3			
ARCES	.03	0.43	.67
MAAS-LO	.32	5.52	.001
MFS	.25	3.86	.001
Final model	$R = .50$, $F(3, 300) = 33.6$, $p < .001$		

Table 5
Step-wise multiple regression testing for Mediation of Attention-Related Failures (ARCES) and Beck Depression (BDI-II) by Mindful Awareness of Attention (MAAS-LO) and Memory Failures (MFS)

	β	t	p
Dependent variable: BDI-II			
Step 1			
ARCES	.28	5.01	.001
Step 2			
ARCES	.12	2.08	.04
MAAS-LO	.34	5.66	.001
Step 3			
ARCES	.00	−0.03	.98
MAAS-LO	.28	4.64	.001
MFS	.26	3.88	.001
Final model	$R = .45$, $F(3, 300) = 25.82$, $p < .001$		

A number of alternative hypotheses regarding the causal relations between our measures were tested via path analyses using structural equation modeling (Arbuckle, 2005). As specifying a causal direction between the BPS and BDI-II variables does not impact model fit for any of the models we discuss, the relation between the BPS and BDI-II could be represented either causally or as a simple correlation without affecting how well the model fit our data. Our primary interest was in assessing our initial hypotheses that everyday attention lapses and memory failures play causal roles in the onset of boredom and depression; hence, our first model was designed to assess this hypothesis. Several alternative hypotheses were also tested using parallel models. First, to address the hypothesis that affective dysfunction is a cause of failures in basic cognitive mechanisms, rather than an outcome of these failures, we developed a model in which boredom proneness and depression together predict the propensity to experience attention lapses and memory failures. Next, we examined the hypothesis that only depression plays a causal role in attention lapses and memory failures but that these cognitive failures still played a causal role in boredom proneness. Finally, we modified this model so that boredom proneness instead played a causal role in attention lapses and memory failures, with cognitive failures in turn predicting depression.

Our first model assessed the simultaneous effects of the MAAS-LO and MFS on the BPS and BDI-II, using the MAAS-LO as an exogenous variable predicting the ARCES, MFS, BPS and BDI-II. Consistent with our regression analyses and initial hypotheses, the MFS was also entered as a mediator of the effect of the MAAS-LO on the BPS and BDI-II, and the ARCES was entered as a mediator of the effect of the MAAS-LO on the MFS. As discussed in the Introduction, we find the inability to maintain attention a particularly compelling feature of boredom and on this basis we elected to represent the relation between the BPS and BDI-II causally for this model. The final model is presented in Fig. 1; this model provided very good fit indices for the data, $\chi^2(2, N = 304) = 0.21$, $p = .902$, CFI = 1.00, NFI = 1.00, RMSEA = .00, consistent with our initial hypothesis that failures of basic cognitive mechanisms can play a causal role in affective dysfunction. Thus, the analyses support the conclusion that an initial propensity toward attention lapses is likely to lead one to experience more frequent attention-related cognitive errors (e.g., failing to see a desired object despite looking directly at it) and memory failures (e.g., forgetting appointments), and can also lead one to experience boredom and depression. A reversal of the model presented in Fig. 1, in which the BPS and BDI-II together predict both the MAAS-LO and MFS, and with the MAAS-LO mediating the relations between the BPS, BDI-II and ARCES (Fig. 2), provided much poorer fit indices for the data, $\chi^2(2, N = 304) = 8.43$, $p = .015$, CFI = .98, NFI = .98,RMSEA = .10. It was not possible to directly test the significance of the difference between these models, however, as the models are not nested. The alternative model with the best fit for the data was one in which only the causal associations from the MAAS-LO to the BDI-II, and from the MFS to the BDI-II were reversed from the model represented in Fig. 1, to assess the hypothesis that associations with all cognitive variables were the result of the BDI-II rather than the MAAS-LO. However, though the χ^2 was not significant, this proved again to be a somewhat poorer model ($\chi^2(2, N = 304) = 4.54$, $p = .104$, CFI = .99, NFI = .99,RMSEA = .07) than the model presented in Fig. 1. A related model in which the BPS was selected as the only exogenous variable, predicting the MAAS-LO and MFS, was equally poor, yielding a significant $\chi^2(2, N = 304) = 6.66$, $p = .036$, CFI = .99, NFI = .98, RMSEA = .09. The poorer fit of these models suggest our data best support the notion that failures of basic cognitive mechanisms play a causal role in the onset of boredom and depression, although the reverse cannot be ruled out.

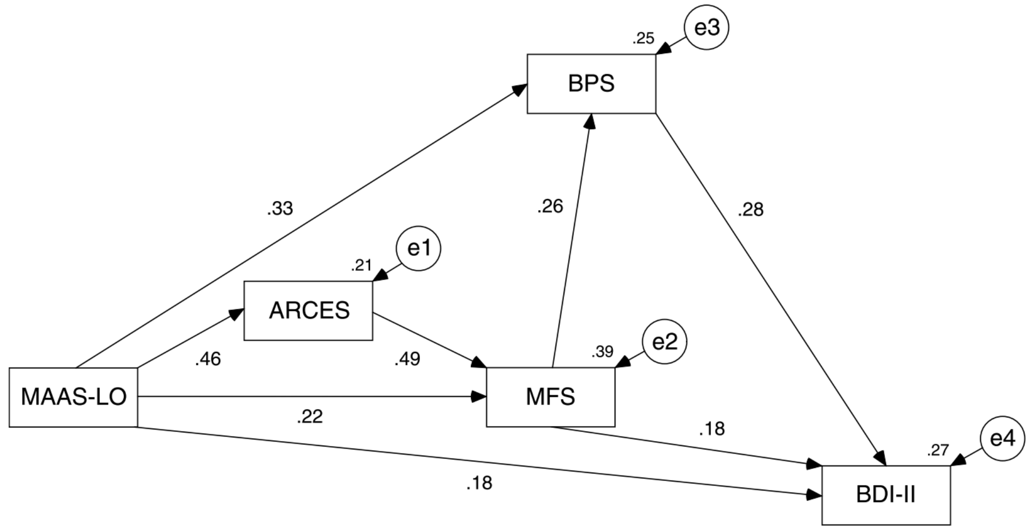

Fig. 1. Final path model with significant path coefficients for self-report attention (MAAS-LO, ARCES) and memory (MFS) measures and Boredom Proneness (BPS) and Beck Depression (BDI-II) measures: all path coefficients shown are significant ($p < .01$).

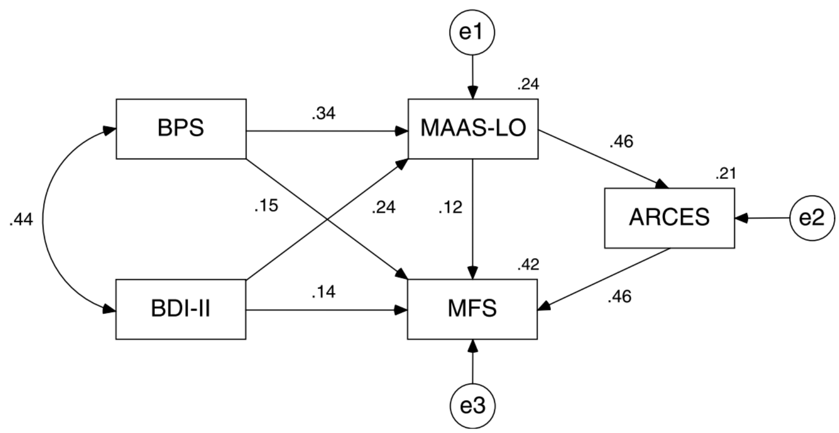

Fig. 2. Alternative path model with significant path coefficients for self-report Boredom Proneness (BPS) and Beck Depression (BDI-II) measures and attention (MAAS-LO, ARCES) and memory (MFS) measures: all path coefficients shown are significant ($p < .01$).

It was possible to improve all the alternative models by including one more parameter linking the BDI-II or BPS with the ARCES. However, these models approached saturation, allowing only one degree of freedom, and in both cases contradicted the results of our earlier regression analyses that suggest no such link to the ARCES should be necessary. Again, as these models are not nested, a direct statistical comparison was not possible but clearly the model best fitting the data is the first model, shown in Fig. 1, in which the MAAS-LO predicts all cognitive and affective variables, with the MFS mediating the relations between the MAAS-LO, BPS and BDI-II. The alternative models could also be improved by reversing the causal direction between the MFS and ARCES, such that the ARCES no longer mediated the association between the MAAS-LO and MFS, as this modification allowed the relation between the ARCES and BPS to be mediated by the MFS. Although this modification accounts for the necessary mediation of the association between the ARCES and BPS, our preferred model remains that shown in Fig. 1 as it is also able to account for the ARCES, BPS mediation while remaining consistent with our current and previous (Cheyne et al., 2006) finding of a partial mediation of the association between the MAAS-LO and MFS via the ARCES.

Discussion

Consistent with our hypotheses that attention lapses and memory failures mediate the association of attention-related cognitive failures with boredom proneness and depression, regression analyses showed the MAAS-LO and MFS accounted for virtually all of the shared variance between the ARCES and the BPS as well as the BDI-II. The finding with regard to the BPS replicates our earlier finding and is consistent with other previous findings of associations of the BPS with cognitive failures more generally (Wallace et al., 2002, 2003). In our previous study (Cheyne et al., 2006) we also found the MFS was strongly associated with the ARCES, and suggested that attention-related cognitive errors might contribute to memory failures, partially mediating the relation between attention lapses and memory failures. The present regression results continue to support the mediation hypothesis, which is an important feature in our subsequent structural equation models as this assumption substantially reduced the number potential models to be examined.

Given the strong evidence that the MAAS-LO and MFS mediate associations between the BPS, BDI-II and ARCES we eliminated direct paths between the BPS and BDI-II with ARCES in our subsequent structural models. A model with attention lapses as a common cause of all other variables and with memory failures as a partial mediator between attention lapses and affective dysfunction provided a well-fitting model for the data (Fig. 1). Moreover, it was not possible to improve on this model without adding parameters. No causal assumptions were necessary with regard to the relation between the BPS and BDI-II, as the direction of this association did not impact model fit. For this model we chose to use the BPS as a predictor of the BDI-II given the strong attentional component of boredom identified in the Introduction; however, this decision had no effect on the fit of the model to our data and reflects only our belief that future research on the potential for boredom to play a causal role in the onset of depression would be a worthwhile endeavour.

A parallel model treating the BDI-II and BPS as common causes of the MAAS-LO and MFS was much less satisfactory than the model shown in Fig. 1, providing further support for the notion that everyday attention lapses and memory failures can be good causal predictors of affective dysfunction. Similar alternative models that treated either the BDI-II or BPS as a common cause of the MAAS-LO and MFS were also much less satisfactory. The major problem with all these parallel models was that they required a direct link of the BDI-II or BPS to the ARCES, despite regression analyses suggesting no such link should be necessary. Furthermore, it is unclear how depression and boredom could bypass attention lapses to directly influence the attention-related cognitive errors that are measured by the ARCES. As an alternative method of resolving the poor fit of these models for our data, the causal link between the ARCES and MFS could be reversed such that the ARCES no longer mediates the relation between the MAAS-LO and MFS. This adjustment resolves the need for a direct link between the BPS and ARCES as their association is then mediated by the MFS. Unfortunately, it is unclear how memory failures could play a causal role in the attention-related cognitive errors measured by the ARCES. Thus, modeling the MAAS-LO as the common cause of all other variables (Fig. 1) appears to be at least more parsimonious than modeling the BDI-II or BPS as the common cause of the MAAS-LO and MFS. This outcome is consistent with literature reviewed in the Introduction observing that conventional treatments for depression tend to employ methods that provide coping mechanisms for dealing with difficulty sustaining attention in everyday situations.

Although correlational data cannot provide definitive knowledge about causation, the benefit of structural equation modeling is that it allows us to predict experimental outcomes in advance of a longitudinal study. The results obtained in the present study suggest a clear need for additional research on the potential long-term consequences of relatively small lapses of basic attention and memory processes. While there is a growing literature suggesting attention failures can be costly in terms of human error (e.g., Borell-Carrio´ & Epstein, 2004; Robertson, 2003), the present results suggest future research should also consider costs in terms of personal well-being.

In light of mindfulness techniques being used successfully in the treatment of depression, Smallwood, fishman, and Schooler (in press) have recently suggested individuals with depression and dysphoria may suffer from meta-cognitive problems resulting in the use of counter-productive thought control strategies. Indeed, ruminative thinking, in particular, is very common among depressed individuals and is thought to exacerbate depressive symptoms by occupying attention and priming negative thoughts (Purdon, 2003). As discussed in the Introduction, although such cognitive failures have frequently been identified as an important component of depression they have been viewed as an outcome, not a cause, of the more complex emotional dysfunctions present in depression. As such, even when a course of treatment has been directed at improving the functioning of basic attentional processes (Papageorgiou & Wells, 2000), the motivation behind this intervention was derived from a complex theory of interactions between rumination, self-focused attention, and maladaptive beliefs reflective of the typical view of depression as a cause of cognitive dysfunction. In contrast, our findings suggest attention training might eliminate a major source of affective dysfunction in general, and thereby lead to a reduction in other depressive symptoms that are dependant on everyday cognitive failures. Therefore, treating the cognitive problems underlying the onset of depression, as is the focus of Wells' attention training therapy (ATT; Wells, 1990), may provide a direct manipulation of the basic cognitive deficits underlying the maladaptive thought control strategies responsible for depression and be an important first step in both overcoming depression and reducing the likelihood of depressive relapse.

Research in a number of other domains could benefit from further consideration of the role of everyday cognitive failures.

First, the potential causal importance of everyday attention and memory deficits could be re-assessed in areas where research has previously viewed these deficits as symptomatic, such as post-traumatic stress disorder (Vasterling et al., 2002) and additional emotional or anxiety disorders (Mathews & MacLeod, 2005). Second, treatment techniques could be re-assessed to determine the extent to which current practices in the treatment of affective dysfunction address everyday attention and memory deficits and whether more intensified treatment of these deficits would help to speed recovery or reduce the likelihood of relapse. In particular, additional research is necessary to determine the extent of the beneficial effects of attention training (ATT; Wells, 1990) with respect to depression.

One limitation of the present study is that it relies solely on self-report questionnaire assessments of attention and memory; although the strength of the particular measures of attention we employed is that they have already been validated against a behavioural measure of attention (Cheyne et al., 2006). Nonetheless, future studies might benefit from including behavioural measures of attention lapses. Another possible limitation of our current research is that we used a sample of undergraduate university students who were provided only a self-report questionnaire assessment of depression. In particular, this could limit the applicability of our findings to the experience of sub-clinical depression as we did not perform a follow-up clinical assessment of individuals responding highly to the BDI-II. In this case, it would make sense to use other measures of sub-clinical depression, such as the CES-D (Radloff, 1977), rather than the clinically-oriented BDI-II for future studies of the role of basic cognitive mechanisms in sub-clinical depression. However, Papageorgiou and Wells (2000) did perform a clinical assessment of depression in their research on the effectiveness of attention training, and so their findings appear to support our conclusions when using a clinically depressed sample. Furthermore, we find no reason to presume a discontinuous relation between the cognitive and affective difficulties associated with clinical and sub-clinical depression. Therefore, had a clinical assessment of depression been performed for our sample, we would predict failures of basic cognitive mechanisms should still play a causal role in the onset of depression.

As a related matter of interest, recent neuroimaging studies have indicated a link between memory and emotion in the retrosplenial cortex (Maddock, 1999). Such findings not only support our conclusions, but also provide a good starting point for future research on the causal role of memory failures in affective dysfunction. Similarly, a recent study of the brain areas active during mind-wandering (Mason et al., 2007) suggests a “default network” of cortical areas which could be examined further in future studies of the effects of mind-wandering on one’s affective state. Using these studies as a basis for future research could allow the neural underpinnings of the causal role of basic cognitive mechanisms in affective state to be more easily discovered, and may provide valuable insight into new treatment methods for affective dysfunction.

Consistent with our previous findings (Cheyne et al., 2006), our results again suggest momentary lapses of attention can lead to a variety of cognitive errors. Moreover, in conjunction with their subsequent and concurrent memory failures, such attention lapses may causally influence our affective well-being. Although inconsistent with most theories of the role of cognitive deficits in depression, the present findings are compatible with a re-conception of the potential causal importance of attention and memory deficits in depression and affective disorders in general. Similarly, our results suggest these same attention and memory failures are important contributors to the experience of boredom, namely the ability to sustain interest and engagement with the environment. It seems reasonable that boredom proneness, in turn, may be a potential contributor to the development of dysphoric states and depression. Thus, we again find evidence that conscious awareness of our actions is an important contributor to the effectiveness of even well-rehearsed everyday activities and to our long-term well-being.

Appendix A

Table A.1
Internal consistency of Revised Memory Failures Scale

	Previous item number	Item	Corrected item-total correlation
1.	3	I forget people's names immediately after they have introduced themselves	0.44
2.	New	I forget to pass on messages (e.g., phone messages)	0.52
3.	6	I forget what I went to the supermarket to buy	0.56
4.	9	I forget passwords	0.55
5.	4	I forget people's names, even though I rehearsed them	0.60
6.	7	I forget important dates like birthdays and anniversaries	0.55
7.	2	I forget appointments	0.61
8.	New	I forget to set my alarm	0.41
9.	5	I find I cannot quite remember something though it is on the tip of my tongue	0.51
10.	10	I remember facts but not where I learned them	0.42
11.	11	Even though I put things in a special place I still forget where they are	0.56
12.	8	I double-book myself when scheduling appointments	0.39

Instructions: The following statements are about minor memory lapses everyone experiences from time to time, but we have very little information about just how common they are. The great majority of time these little foibles are harmless, though they do have serious safety implications in industry and everyday life. We want to know how frequently these sorts of things have happened to you.

Table A.2
Internal consistency of Revised Attention-Related Cognitive Errors Scale

	Previous item number	Item	Corrected item-total correlation
1.	10	I have gone to the fridge to get one thing (e.g., milk) and taken something else (e.g., juice)	0.54
2.	12	I go into a room to do one thing (e.g., brush my teeth) and end up doing something else (e.g., brush my hair)	0.56
3.	New	I have lost track of a conversation because I zoned out when someone else was talking	0.57
4.	1	I have absent-mindedly placed things in unintended locations (e.g., putting milk in the pantry or sugar in the fridge)	0.54
5.	5	I have gone into a room to get something, got distracted, and wondered what I went there for	0.65
6.	7	I begin one task and get distracted into doing something else	0.60
7.	2	When reading I find that I have read several paragraphs without being able to recall what I read	0.48
8.	9	I make mistakes because I am doing one thing and thinking about another	0.64
9.	8	I have absent-mindedly mixed up targets of my action (e.g., pouring or putting something into the wrong container)	0.59
10.	11	I have to go back to check whether I have done something or not (e.g., turning out lights, locking doors)	0.56
11.	3	I have absent-mindedly misplaced frequently used objects, such as keys, pens, glasses, etc.	0.53
12.	6	I fail to see what I am looking for even though I am looking right at it	0.60

Instructions: The following statements are about minor mistakes and absent-mindedness everyone notices from time to time, but we have very little information about just how common they are. The great majority of time these little foibles are harmless, though they do have serious safety implications in industry and everyday life. We want to know how frequently these sorts of things have happened to you.

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