

The Consequences of Everyday Inattention

by

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A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Psychology

Waterloo, Ontario, Canada, 2010

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Beginning with a series of several self-report questionnaire studies I examine the potential for everyday attention lapses to create an inability to form connections to the external world, particularly through the experience of chronic boredom, and to subsequently lead to depression. In the first study I examine this process through the intermediate role of memory failures in the onset of boredom and depression, while in the second I examine the role of self-efficacy and in the third I add psychological stress as a further intermediate step between attention lapses and depression. For each study significant associations are found between self-report measures of attention lapses and attention-related cognitive errors, as presumed causes, and boredom proneness and depression as presumed outcomes. Structural equation modeling is then used to show these associations are well explained by an Attention-to-Affect model in which the attention lapses and attention-related errors predict the onset of boredom and depression, in part through their effects on memory failures (Chapter 1), perceived self-efficacy (Chapter 2), and psychological stress (Chapter 3). That these Attention-to-Affect models provide much better fit for the data runs contrary to the typical conception of attention and memory problems as consequences of emotional distress. Following from these models I examine in more specific terms the disconnect experienced as a result of attention lapses, through a laboratory study employing the Sustained Attention to Response Task. This study (Chapter 4) revealed a significant influence of attentional challenges on blinking behaviour, suggesting that whenever our attentional capacity is tested we have a tendency to momentarily direct our thoughts inwardly, perhaps to re-evaluate our attentional performance, and that the timeframe of this redirection is expanded following lapses of attention, and the commission of attention-related errors.

Acknowledgements

I would like to give special thanks to my advisors Daniel Smilek and Mike Dixon for their guidance and enthusiasm for research, and to Al Cheyne for his astounding breadth of knowledge and assistance with my initial forays into structural equation modeling. I would also be extremely remiss if I did not express my gratitude to Andrea Nelson, for providing novel and interesting perspectives, abundant friendship, and, of course, data.

I would also like to thank Mike Chan-Reynolds for his support and occasional companionship, whenever he answers the phone or has enough time for a visit, and my family for always being supportive of my endeavours. I thank Dan van der Werf as well for assisting in my data collection. I would also like to thank all the members of the Smilek lab, past, present, and possibly future, for seeking my assistance with their projects and thereby expanding my own research experiences, without requiring nearly as much time as would be necessary to explore it all myself.

Dedication

This thesis is dedicated first and foremost to my loving wife, Candace. Without her support and encouragement I wouldn't be the same.

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Overview

“I sat down to-day, at about ten o'clock in the forenoon, in Sleepy Hollow, - a shallow space scooped out among the woods, which surround it on all sides, it being pretty nearly circular, or oval, and two or three hundred yards in diameter. The present season, a thriving field of Indian corn, now in its most perfect growth, and tasselled out, occupies nearly half the hollow; and it is like the lap of bounteous Nature, filled with breadstuff. On one verge of the hollow, skirting it, is a terraced pathway, broad for a wheel track, overshadowed with oaks, their long, knotted, rude, rough arms between earth and sky; the gray skeletons, as you look upward, are strikingly prominent amid the green foliage. Likewise there are chestnuts, growing up in a more regular and pyramidal shape; white pines, also; and a shrubbery composed of the shoots of all these trees, overspreading and softening the bank on which the parent stems are growing; - these latter being intermingled with coarse grass. Observe the pathway; it is strewn over with little bits of dry twigs and decayed branches, and the brown oak leaves of last year, that have been moistened by snow and rain, and whirled about by winds, since their departed verdure; the needle-like leaves of the pine, that we never noticed in falling, - that fall, yet never leave the tree bare; and with these are pebbles, the remains of what was once a gravelled surface, but which the soil accumulating from the decay of leaves, and washing down from the bank, has now almost covered. The sunshine comes down on the pathway with the bright glow of noon, at certain points; in other places there is a shadow as deep as the glow; but along the greater portion sunshine glimmers through shadow, and shadow effaces sunshine, imaging that pleasant mood of mind where gayety and pensiveness intermingle. ...

Now we hear the striking of the village clock, distant, but yet so near that each stroke is impressed distinctly upon the air. This is a sound that does not disturb the repose of the scene: it does not break our sabbath; for like a sabbath seems this place, and the more so on account of the cornfield rustling at our feet. It tells of human labor, but, being so solitary, now it seems as if it were on account of the sacredness of the sabbath. Yet it is not so, for we hear at a distance mowers whetting their scythes; but these sounds of labor, when at a proper remoteness, do but increase the quiet of one who lies at his ease, all in a mist of his own musings. There is the tinkling of a cow-bell, a noise how peevishly dissonant if close at hand, but even musical now. But, hark! there is the whistle of the locomotive, - the long shriek, harsh above all other harshness, for the space of a mile cannot mollify it into harmony. It tells a story of busy men, citizens, from the hot street, who have come to spend a day in a country village, - men of business, - in short, of all unquietness; and no wonder that it gives such a startling shriek, since it brings the noisy world into the midst of our slumbrous peace.” (Hawthorne, 1884, pp. 498-503).

In the epigraph above Hawthorne describes the wondrous bounty found in sustained attention to, and contemplation of, one's present and ongoing experience. The sheer breadth and detail of his observations, much of which has been omitted, highlights the richness that can be found in everyday life, if you are able and choose to look for it. In addition, the tone suggests an inherent pleasantness in the experience of attending to all the little details, one that isn't diminished even by the sound of workers in the distance or a cowbell that in other circumstances might have been an annoying disturbance. Contrast this pleasantness, then, with the profound change of mind and feeling brought about by the harsh shriek of a locomotive. The sound seems to demand an interruption of Hawthorne's attention, and furthermore, replaces his mental quietness with the noise and jumble of business; in short, with the mind of someone who in his hurried work is both distracted and distractable. This, it seems, is an unhappy mind, out of touch with the world around it. In this way, Hawthorne describes the complex interplay of attention and emotion, which is the topic of the current paper. Going forward I will argue that an inability to attend effectively to our ongoing, everyday, experiences is an important cause of emotional dysfunction, particularly to the extent that chronic attention lapses make it difficult to fully engage the external world and, in time, produce boredom proneness and, ultimately, depression.

My colleagues and I have argued that attention plays a key role in the experience of boredom proneness (Cheyne, Carriere, & Smilek, 2006; Carriere, Cheyne, & Smilek, 2008; Carriere, Nelson, Cheyne, & Smilek, 2010) inasmuch as boredom proneness may reflect a chronic failure to engage and sustain attention despite having ample stimulation available at the time (Berlyne, 1960; Damrad-Frye & Laird, 1989; Hebb, 1966). Specifically, one's general inability to engage and sustain attention, particularly in the face of personally significant goals, may become self-perceived as a lack of motivation and interest in work, school, and personal relationships, ultimately leading to persistent negative affect; all commonly identified in boredom (O'Hanlon, 1981; Sommers & Vodanovich, 2000). Interestingly, depression is often seen to bring with it a variety of very similar motivational, interpersonal and other cognitive deficits, as found in numerous studies (e.g., Christopher & MacDonald, 2005; Farrin et al., 2003; Hasher & Zacks, 1979; Karasu, Gelenberg, Merriam, & Wang, 2000; Wagle, Berrios, & Ho, 1999; Watts & Sharrock, 1985) and in the DSM-IV diagnostic criteria (American Psychiatric Association, 1994). Hence, extending from the experience of boredom proneness, I will argue throughout this paper that chronic attention lapses can also lead to the more serious and persistent negative affect characteristic of depression.

The initial state of mind described above by Hawthorne is not unlike that of one practicing mindfulness meditation. It is important to the present argument, then, that mindfulness techniques are being employed with some success in the treatment of depression (Kabat-Zinn, 1982; 2003; Segal, Williams, & Teasdale, 2002; Williams, Teasdale, Segal, & Kabat-Zinn, 2007). Given this new direction in the treatment of depression, Smallwood, Fishman and Schooler (2007) 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 (Smallwood et al., 2003) and is thought to exacerbate depressive symptoms by occupying attention and priming negative thoughts (Purdon, 2003). Although such cognitive failures have frequently been identified as an important component of depression they have traditionally 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 primarily at improving the functioning of basic attentional processes (Papageorgiou & Wells, 2000), the motivation behind this intervention has been derived from a questionable and 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 to this conceptual confusion, the present argument allows the straightforward approach of suggesting that depression may in some cases be treatable through attention training alone simply because chronic inattention was a primary mechanism in the initial onset of depression; and so treating attention allows the individual to re-engage with the world and eliminates the cause of emotional distress.

In the first three chapters I present a series of models in support of the hypothesis that attention lapses are capable of producing affective dysfunction. In Chapter 1 (previously published; Carriere et al., 2008), I build on a previous model of the interaction between attention lapses and memory failures, to show boredom proneness and depression may be caused by these cognitive deficits. In Chapter 2 (submitted for publication; Carriere et al., 2010), I examine whether attention lapses can be seen as influencing self-efficacy, and thereby contribute to boredom and depression. This model is extended in Chapter 3, to include psychological stress as an additional intermediate step in the route from inattention to depression. Finally, in Chapter 4, I provide experimental support for these models through an examination of the hypothesis that attention lapses produce immediate, momentary, tendencies to disengage from the external world.

Chapter 1

The Affective Consequences of Mindlessness

1.1 Introduction

Lapses of attention and memory failures, commonly known as absentmindedness, 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 that is sitting 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 basic cognitive processes such as attention and memory can have numerous unforeseen and potentially far reaching consequences. The present chapter examines some of the additional potential long-term consequences of momentary everyday attention lapses. In particular, I 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, & 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 previous work on everyday attention lapses by Cheyne, Carriere, and Smilek (2006), in which they 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.

Cheyne and colleagues (2006) have already hypothesized that attention plays a key role in many of the most common conceptions of boredom. Indeed, an examination of the research on boredom reveals that it is typically viewed as 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, particularly striking is the subjective experience of boredom in which one is unable to maintain attention on any object, despite being entirely free to do so, and the possibility of substantial individual differences in boredom proneness as a result of one's general tendency to be inattentive. Viewing inattention as contributing to a mental disconnection from and eventual emotional devaluation of the world around us, i.e., boredom, represents a novel reconception of the way emotion and cognition are typically thought to interact, and opens up new possibilities for managing our emotions.

Evidence in support of the idea that attention can have a direct causal influence on affective state comes from a study reporting that selective inhibition of distractor stimuli during visual search leads to affective devaluation of those stimuli (Fenske & Raymond, 2006). Unlike the endogenous attentional disconnect of boredom, in this case the visual search task itself creates the demand that one not pay attention to specific objects. Nonetheless, such research does support 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 Cheyne and colleagues (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, to test a causal model of the relation between attention lapses and affective dysfunction as reflected in boredom. Nonetheless, they proposed 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 well have similar influences on cognitive and affective aspects of depression. The relation between attention lapses and depression is supported by research conducted by Wagle, Berrios, and Ho (1999) and by Farrin and colleagues (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 clinical 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 one could expect to play a role in affective dysfunction is memory, particularly since 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. Wallace, Kass, and Stanny

(2002), however, 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 distinct 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; Raes et al., 2006; Moore, Watts, & Williams, 1988; 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 problems, 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, respectively, I modified the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), to become the MAAS-LO (See Method below), and also made a revised version of the Memory Failures Scale (MFS; Cheyne et al., 2006). To address the relations between these attention and memory deficits and affective dysfunction, boredom was measured 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). I also included a revision of the Attention-Related Cognitive Errors Scale (ARCES), allowing further examination of the possibility that the occurrence of everyday cognitive errors 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 an important role,

I predict the MAAS-LO and MFS will explain a significant amount of the variance in the BPS and BDI-II. The ARCES, however, is hypothesized to act primarily as a partial mediator between the MAAS-LO and MFS, so the ARCES itself should not explain a significant amount of the variance in the BPS or 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, I 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, I 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.

1.2 Method

1.2.1 Participants

Participants were 298 undergraduates enrolled in an Introductory Psychology course at the University of Waterloo who completed all five of the questionnaires below, while leaving no more than two responses blank for each questionnaire. The study was conducted online, as part of the initial mass testing battery completed each term. Demographic information is not available for his sample. Participants received bonus course credit as compensation for completing the questionnaires.

1.2.2 Measures

Included with the scales of interest were several samples of the general online assessments associated with Introductory Psychology courses. Participants were not aware of the relatedness of the scales and, while their presentation was not fully counterbalanced, the questionnaires were provided to participants in one of three random orders. These orderings allowed a good balance to the distribution of the questionnaires overall. Participants' mean item scores were calculated for each questionnaire in order to accommodate occasional response omissions.

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. Several minor adjustments are required in order to effectively use the MAAS as a measure of attention lapses. 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, I used a revised version of the MAAS including only the 12 items referring directly to attention lapses, which is now called the Mindful Attention Awareness Scale - Lapses Only (MAAS-LO). In addition, because the MAAS-LO is interpreted as a measure of attention lapses, I do not reverse score its items, as is conventional for the original MAAS (see Cheyne et al., 2006, for further 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 Attention-Related Cognitive Errors Scale (ARCES; Cheyne et al., 2006) was incorporated as an additional assessment of attentional impairment. The ARCES measures the frequency with which one experiences a variety of everyday behavioural and cognitive failures, for which an attention lapse is the most likely cause. 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 Appendix A). As well, two questions (originally items 3 and 5, see Appendix A) 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.

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 B.

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 I included the second edition of the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 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.

1.3 Results

Consistent with 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 1.1). The items of the revised ARCES and MFS all had good item-total correlations (see Appendixes A and B; see also Appendixes C and D for additional psychometric data for the ARCES and MFS). 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 1.1). 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 this is not atypical of an undergraduate student population.

Pearson Product-Moment correlation coefficients are presented in Table 1.2. 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 1.1. Means, Standard Deviations, Ranges, Skewness & Kurtosis (with standard errors), Alpha Coefficients for All Measures (N = 298)

	Mean	SD	Range	Skew ^a	Kurtosis ^b	α
Mindful Attention Awareness Scale – Lapses Only	3.25	0.73	1.0 - 5.58	-.07	.07	.84
Attention-Related Cognitive Errors Scale	3.07	0.65	1.0 - 4.92	.08	.36	.88
Memory Failures Scale	2.61	0.59	1.18 - 4.58	.58	.61	.85
Boredom Proneness Scale	3.55	0.66	1.85 - 144	-.11	-.45	.83
Beck Depression Inventory – II	0.56	0.44	0.0 - 2.29	1.62	3.12	.91

^a $SE = .14$

^b $SE = .28$

Table 1.2. *Pearson Product-Moment Correlations of All Measures (N = 298)*

	ARCES	MFS	BPS	BDI-II
Mindful Awareness of Attention – Lapses Only	.47	.48	.42	.40
Attention-Related Cognitive Errors		.61	.33	.28
Memory Failures			.44	.39
Boredom Proneness				.45
Beck Depression Inventory – II				

Note. For all coefficients, $p < .001$.

To further assess the previous finding of Cheyne and colleagues (2006) that the ARCES mediates the association between the MAAS-LO and MFS, a step-wise multiple regression analysis was conducted (Table 1.3). 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, I 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 this previous finding in the current results plays an important role in my 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 this previous finding and were designed to assess what role boredom proneness and depression are likely to play when added to this model.

Table 1.3. *Step-wise Multiple Regression Testing for Mediation of Memory Failures (MFS) and Mindful Awareness of Attention (MAAS-LO) by Attention-Related Cognitive Errors (ARCES)*

Dependent Variable: MFS

	β	t	p
Step 1			
MAAS-LO	.48	9.34	.001
Step 2			
MAAS-LO	.25	4.89	.001
ARCES	.50	9.91	.001

Final Model

$R = .65, F(2,295) = 106.98, p < .001$

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 1.4) 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 1.5). 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 1.4. *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)*

Dependent Variable: BPS

	β	t	p
Step 1			
ARCES	.33	5.93	.001
Step 2			
ARCES	.17	2.82	.005
MAAS-LO	.34	5.80	.001
Step 3			
ARCES	.02	0.24	.81
MAAS-LO	.27	4.51	.001
MFS	.30	4.57	.001

Final Model

$R = .50, F(3,294) = 32.81, p < .001$

Table 1.5. *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)*

Dependent Variable: BDI-II

	β	t	p
Step 1			
ARCES	.28	5.06	.001
Step 2			
ARCES	.12	2.01	.045
MAAS-LO	.35	5.78	.001
Step 3			
ARCES	-.01	0.11	.915
MAAS-LO	.28	4.65	.001
MFS	.26	3.78	.001

Final Model

$R = .46, F(3,294) = 26.28, p < .001$

A number of 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 does not impact model fit for the models I will 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 the data. Of primary interest was the initial hypothesis that everyday attention lapses and memory failures play causal roles in the onset of boredom and depression; hence, my first model was an Attention-to-Affect model 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, I developed an Affect-to-Attention model in which boredom proneness and depression together predict the propensity to experience attention lapses and memory failures. Next, I examined the hypothesis that only depression plays a causal role in boredom, attention lapses and memory failures but that these cognitive failures still played a causal role in boredom proneness. Finally, I modified this model so that boredom proneness instead played a causal role in depression, attention lapses and memory failures, with cognitive failures in turn also predicting depression.

The Attention-to-Affect 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 earlier regression analyses and initial hypotheses, the MFS was also entered as a partial mediator of the effect of the MAAS-LO on the BPS and BDI-II, and the ARCES was entered as a partial mediator of the effect of the MAAS-LO on the MFS. As discussed in the Introduction, the inability to maintain attention is a particularly compelling feature of boredom and on this basis I elected to represent the relation between the BPS and BDI-II causally for this model. The final model is presented in Figure 1.1; this model provided very good fit indices for the data, $\chi^2(2, N = 298) = 0.09, p = .956, CFI = 1.00, NFI = 1.00, RMSEA = .00$, consistent with my 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 emotional distress in the form of boredom and depression.

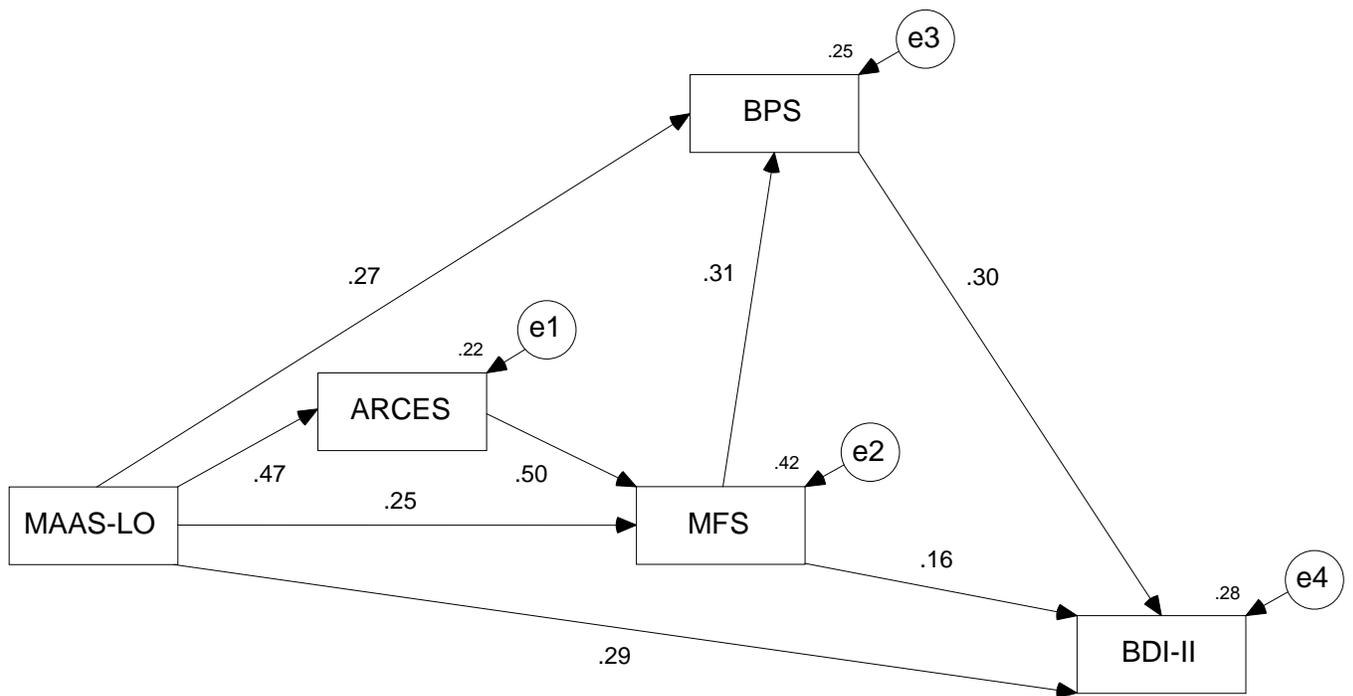


Figure 1.1. Final path model with significant path coefficients for self-reported attention (MAAS-LO, ARCES) and memory (MFS) failures and Boredom Proneness (BPS) and Beck Depression (BDI-II). All path coefficients are significant ($p < .01$).

The alternative Affect-to-Attention model, 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 (Figure 1.2), provided much poorer fit indices for the data, $\chi^2(2, N = 298) = 9.15, p = .010, CFI = .98, NFI = .98, RMSEA = .11$). 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, from the MFS to the BDI-II, and from the BPS to the BDI-II were reversed from the model represented in Figure 1.1, 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 chi-square was not significant, this proved again to be a substantially poorer model ($\chi^2(2, N = 298) = 4.13, p = .127, CFI = .99, NFI = .99, RMSEA = .06$) than the model presented in Figure 1.1. 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 $\chi^2(2, N = 298) = 7.91, p = .019, CFI = .99, NFI = .98, RMSEA = .10$. The poorer fit of these models suggest the 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.

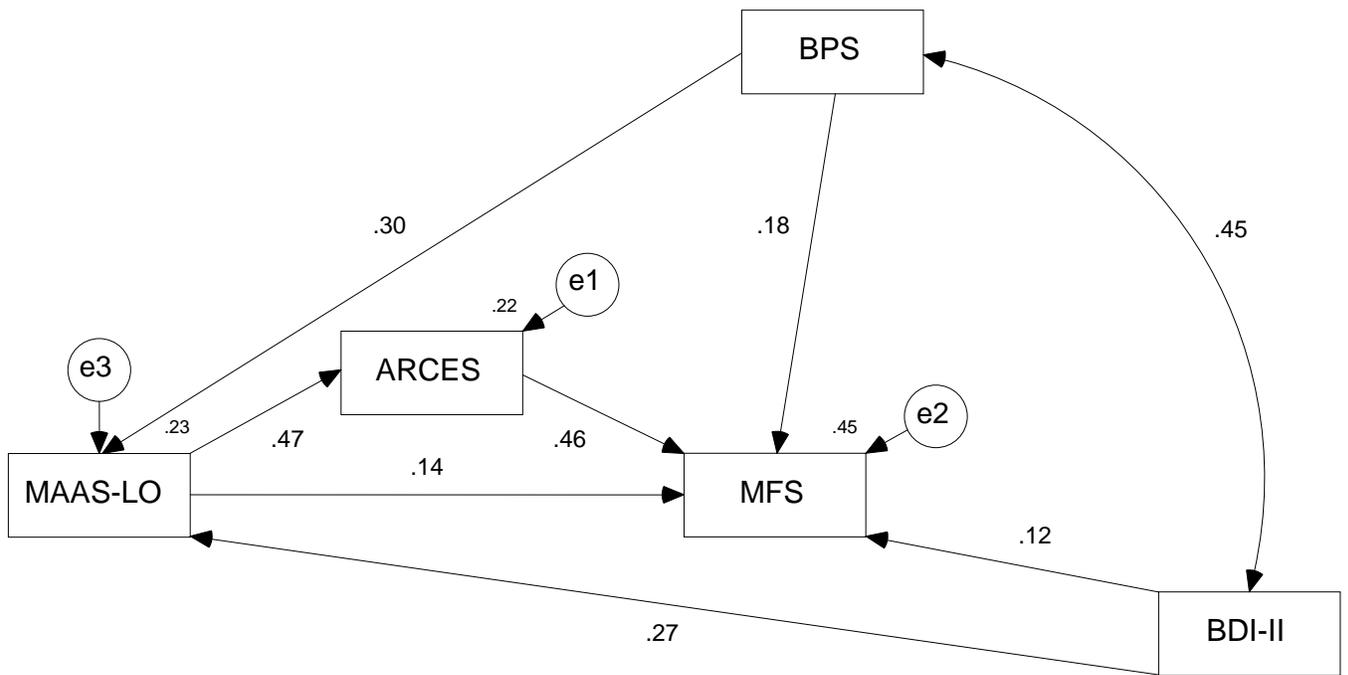


Figure 1.2. Alternative path model with significant path coefficients for self-reported Boredom Proneness (BPS) and Beck Depression (BDI-II) predicting attention (MAAS-LO, ARCES) and memory (MFS) failures. All path coefficients are significant ($p < .01$).

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 so sacrifice substantial parsimony in order to improve model fit. Again, as these models are not nested, a direct statistical comparison was not possible, but clearly the model best and most parsimoniously fitting the data is the Attention-to-Affect model, shown in Figure 1.1, 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, I do not believe the modification is theoretically defensible. Accordingly, my preferred model remains the Attention-to-Affect model as it is also able to account for the ARCES, BPS mediation while remaining consistent with cognitive theories and current and previous (Cheyne et al., 2006) findings of a partial mediation of the association between the MAAS-LO and MFS via the ARCES.

1.4 Discussion

Consistent with initial 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 an earlier finding (Cheyne et al., 2006) and is consistent with other previous findings of associations of the BPS with cognitive failures more generally (Wallace et al., 2002; Wallace et al., 2003). In a previous study (Cheyne et al., 2006) the MFS was also found to be strongly associated with the ARCES, suggesting 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 this mediation hypothesis, which is an important feature in the subsequent structural equation models as this assumption substantially reduced the number of potential models to be examined.

Given the strong evidence that the MAAS-LO and MFS mediate associations between the BPS, BDI-II and ARCES I eliminated direct paths between the BPS and BDI-II with ARCES in subsequent structural models. An Attention-to-Affect 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 (Figure 1.1). 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. Nonetheless, for this model I 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 the data and reflects only a preference for seeing boredom as playing a causal role in the onset of depression, while also allowing this preference to serve as guide for potential future models of the attention–affect relation.

A parallel Affect-to-Attention model, treating the BDI-II and BPS as common causes of the MAAS-LO and MFS, was much less satisfactory than the Attention-to-Affect model, 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 the 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 (Figure 1.1) 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., Borrell-Carrió & Epstein, 2004; Robertson, 2003), the present results suggest future research should also consider costs in terms of personal well-being.

In contrast to the traditional view of the interaction between attention and affect, the present findings suggest attention training might eliminate a major source of affective dysfunction in general, and thereby lead to a reduction in other symptoms of negative affect that are dependant on everyday cognitive failures. Therefore, attempts to treat primarily, or even solely, the cognitive problems underlying the onset of depression could be expected to achieve reasonable success. Indeed, this is the behavioural, if not motivational, focus of Wells' attention training therapy (ATT; Wells, 1990), and so such techniques may provide a direct manipulation of the basic cognitive deficits underlying the maladaptive thought control strategies responsible for depression; thus providing an important first step in both overcoming depression and reducing the likelihood of depressive relapse.

As a related matter of interest, neuroimaging studies have indicated a link between memory and emotion in the retrosplenial cortex (Maddock, 1999). Such findings not only support the present 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 previous findings (Cheyne et al., 2006), the present 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. In contrast to 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, the present 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, on the whole, the present study provides compelling evidence

that a conscious awareness of our actions is an important contributor to the effectiveness of even well-rehearsed everyday activities and to our long-term emotional well-being.

Chapter 2

Attention-Related Cognitive Failures and Perceived Self-Efficacy

2.1 Introduction

Absentminded lapses of attention are a common event in our daily lives. Although these lapses are generally taken to be rather trivial, they can nonetheless also have dramatic and life-threatening consequences. Indeed, absentmindedness may have been the primary cause of a recent major commuter train crash near Chatsworth, California when an engineer became too focused on sending text messages from his cell phone to either notice or respond to operating signals telling him he should stop the train (National Transportation Safety Board, 2008). Such examples highlight the dramatic consequences that disruptions in attention can have when they occur at inopportune moments, but, given the pervasiveness and ubiquity of attention lapses in everyday life, their cumulative effects may also hold the potential for other serious and less obvious consequences. In making this argument in the previous chapter I presented data supporting the hypothesis that mundane episodes of inattention, and their resulting cognitive and behavioural errors, are a potential cause of boredom and depression. The present chapter develops this argument further and tests the hypothesis that the influences of everyday inattention on boredom and depression are mediated, in part, by the effects of inattention on one's general perceived self-efficacy.

To examine the potential causal influence of inattention on boredom and depression, in Chapter 1 I conducted a large scale questionnaire study and used structural equation modeling to test and compare the statistical properties of two hypotheses: (1) that nonspecific basic cognitive failures in attention and memory are an initial cause of boredom proneness and depression; and (2) the reverse, that boredom proneness and depression cause nonspecific attention and memory failures. The first, Attention-to-Affect hypothesis (that everyday inattention has potential long-term emotional consequences) was compared to the second, Affect-to-Attention hypothesis (the traditional view that affective states influence cognitive function). To evaluate these hypotheses each model was compared against the null hypothesis, addressing the question of whether either model was capable of explaining the observed correlation among the relevant variables. Although allowing only indirect comparison between the models, this method has the potential to evaluate the respective ability of each model to reject the null. These analyses showed *only* the Attention-to-Affect model, modeling attention lapses and associated failures as the common cause of memory failures, boredom, and

depression, provided good fit for the data. Further analyses are still required, however, to determine additional mediating mechanisms through which simple and innocuous attention failures lead to complex affective states like depression.

One way for attention lapses to potentially influence our future affective state is through our sense of self-efficacy; that is, our judgement about our ability to successfully achieve our goals – usually in reference to a specific situation or activity (Bandura, 1977). Our sense of self-efficacy reflects both the expectation that we are capable of performing a task and the expectation that most others are not substantially *more* capable of performing the same task (Davis & Yates, 1982). For example, if I happen to believe I am an excellent ballroom dancer (reflecting a horribly erroneous sense of self-efficacy in that domain) then I would enrol in, and expect to outperform others in, an upcoming ballroom dance competition. Aside from specific domains, it is also possible to hold beliefs about our general ability to perform everyday tasks and even cope with novel challenges, perhaps through extrapolation from past experiences tackling unforeseen problems. Such beliefs reflect a generalized sense of self-efficacy (Tipton & Worthington, 1984), but could be undermined in the face of frequent attention lapses chronically interfering with our ability to perform even simple everyday tasks.

Reduced self-efficacy is associated with a tendency to view one's failures as the result of an inherent lack of ability rather than focusing more on situational factors or attributing them simply to insufficient effort (Bandura, 1997). The parallels between such beliefs and the counterproductive, negative affect-laden, biases of both boredom and depression are consistent with, and may even explain, Bandura's claim that depression is a potential outcome of decreased self-efficacy. In particular, if through our sense of inefficacy we come to believe our successes are the result of luck and failures represent our actual ability, depression will result in part because we devalue our accomplishments and overvalue our failures. Thus, reduced self-efficacy is thought to create cognitive biases that produce depression and could also potentially influence attention by continually directing it away from information that may be critical to successful task completion. Furthermore, since our sense of self-efficacy is relative to the ability of others, depression, and an unwillingness to even attempt tasks, is an especially likely result when we expect others would not have difficulty completing the same tasks with which we have had trouble (Davis & Yates, 1982). Ultimately this process suggests that even when initial failures are replaced with later successes we may still be less likely to engage in similar behaviour again. Furthermore, if those failures are very frequent in regular, everyday, activities, that we know are not problematic for most people, it follows that we may

eventually disengage from everyday behaviour in general, and become bored or depressed even without being able to later point to one major cause. From this point, it is only a small role reversal to suggest the frequent attention lapses that interfere in task success could in fact *precede* reductions in self-efficacy. In this way, attention lapses that disrupt everyday activities and lead to repeated failures may put in jeopardy our sense of self-efficacy and lead to boredom and depression.

Given previous observations that attention, self-efficacy, boredom, and depression are all theoretically and empirically linked, the present research again applied the Attention-to-Affect hypothesis of Chapter 1 to elucidate more precisely the structure of these relations. In particular, I sought to evaluate the potential causal flow from attentional errors – specifically attention lapses and subsequent attention-related errors – to a proneness to experience boredom and depression. This causal flow is consistent with findings from MacLeod and colleagues (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002), but contrasts with the traditional view of how emotion and attention are linked. Indeed, although not often articulated as a concrete hypothesis, the more common perspective is that emotions influence attention. This appears to be the received view, for example, in most research on attentional biases in anxiety and depression (e.g., Dalglish & Watts, 1990; Gotlib, McLachlan, & Katz, 1988; MacLeod, Mathews, & Tata, 1986; Mogg, Bradley, & Williams, 1995; Smallwood, 2004; see also a review in Ingram, Steidtmann, & Bistricky, 2008) and on the attentional effects of encountering emotionally salient information (e.g., biases toward negative emotions; Fenske & Eastwood, 2003), although, with respect to the latter, it is worth noting that attention has been shown to have reciprocal effects on the later emotional evaluation of stimuli (Fenske & Raymond, 2006).

2.2 The Present Study

To examine the hypothesis that perceived self-efficacy mediates the association between failures of basic cognitive mechanisms and affective distress (boredom proneness and depression), I conducted a path analysis using structural equation modeling in AMOS (Arbuckle, 2005) to examine the relations between five self-report questionnaires. Frequency of attention lapses and associated cognitive errors were assessed via the Mindful Attention Awareness Scale–Lapses Only and the Attention-Related Cognitive Errors Scale (MAAS-LO and ARCES; Carriere et al., 2008). Boredom was assessed via the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986) and depression via the Beck Depression Inventory – Second Edition (BDI-II; Beck, Steer, & Brown, 1996). Self-efficacy was measured via the Generalized Self Efficacy scale (GSE; Schwarzer & Jerusalem, 1995). Based on previous findings

and the present arguments, I predicted the MAAS-LO would explain a significant amount of the variance in the BPS and BDI-II, while the ARCES would function as a mediator between the MAAS-LO and GSE, such that the ARCES would not explain a significant amount of the variance in the BPS and BDI-II once relations with the MAAS-LO and GSE were accounted for. Several additional hypotheses were examined to address alternative theories about the relations among the MAAS-LO, GSE, BPS and BDI-II. In particular, I evaluated the more traditional Affect-to-Attention hypothesis that negative affect creates cognitive biases which influence attention (e.g., through reduction of attentional capacity by rumination) and our perceived self-efficacy. I also assessed an additional alternative hypothesis based on Bandura's work, which would predict that self-efficacy is the common cause of cognitive deficits and biases influencing both attention and affect.

2.3 Method

2.3.1 Participants

Participants were from an international sample of 184 respondents who completed all five of the questionnaires below via an attention lapse research website, <http://oops.uwaterloo.ca>. Participants included in the analyses completed all five questionnaires and had no more than two missing responses for each questionnaire; 140 participants had zero missing responses. Participants received no compensation for completing the questionnaires, aside from the information already available to them on our website. Not all participants opted to provide demographic information and given that this study was conducted online I have no information for these participants beyond their questionnaire responses. Of those participants who provided demographic information, there were 84 males and 94 females with a mean age of 35.95 ($SD = 13.38$; $n = 174$).

2.3.2 Measures

After first receiving the initial demographics questionnaire, the five questionnaires below were completed in random order across participants. In addition, the individual items within each questionnaire were randomly ordered, such that no two participants were likely to receive the same ordering of questionnaires and items. To accommodate occasional missing responses, item mean scores were calculated by averaging across the responses provided.

The 12-item Mindful Attention Awareness Scale–Lapses Only (MAAS-LO; Chapter 1) was selected as the measure of attention lapses. MAAS-LO items, such as “I find it difficult to stay

focused on what's happening in the present," ask about mindless behaviour in everyday situations using a six-point Likert scale ranging from *almost never* (1) to *almost always* (6). Responses indicating a greater frequency suggest a greater propensity toward everyday attention lapses. Aside from removal of three items, and the scale being direct-scored rather than reverse-scored, the MAAS-LO is identical to the MAAS originally developed by Brown & Ryan (2003).

A revised version of the Attention-Related Cognitive Errors Scale (ARCES; Cheyne et al., 2006) was incorporated as an assessment of notable cognitive and behavioural outcomes of attention lapses. The revised ARCES (Chapter 1) is a 12-item questionnaire measuring the frequency with which one experiences a variety of cognitive failures, for example: "I have absent-mindedly misplaced frequently used objects, such as keys, pens, glasses, etc." The ARCES employs a five-point Likert scale from *never* (1) to *very often* (5).

The 10-item General Self-Efficacy scale (GSE; Schwarzer & Jerusalem, 1995) was selected as a measure of one's perceived self-efficacy. The GSE includes items such as "I can always manage to solve difficult problems if I try hard enough" and "I am confident that I could deal efficiently with unexpected events," to index self-efficacy and uses a four-point Likert scale ranging from *not at all true* (1) to *exactly true* (4).

Boredom was measured via the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986). The 28-item BPS reflects situations in which we are likely to become bored (e.g., "Having to look at someone's home movies or travel slides bores me tremendously") and related characteristics of boredom (e.g., "Time always seems to be passing slowly"). The BPS uses a Likert scale ranging from *strongly disagree* (1) to *strongly agree* (7), with a *neutral* (4) midpoint.

As in Chapter 1, I used the Beck Depression Inventory (BDI-II; Beck et al., 1996) to measure depression. The BDI-II is a 21-item scale that addresses the diagnostic criteria for depression outlined in the DSM-IV (American Psychiatric Association, 1994). The BDI-II asks participants to select from a list of statements the one that best describes how they have been feeling throughout the last two weeks. Accordingly, the BDI-II includes statements such as "I am so sad or unhappy that I can't stand it" to indicate depression, and related normal mood statements such as "I don't criticize or blame myself more than usual."

2.4 Results and Discussion

Consistent with earlier findings (Chapter 1; Cheyne et al., 2006), the ARCES and MAAS-LO were found to have good distributional and psychometric properties. All measures showed a good range of scores, no significant deviations from normality in skewness and kurtosis, and demonstrated very satisfactory internal consistency (Table 2.1).

Pearson Product-Moment correlation coefficients are presented in Table 2.2. All coefficients are moderate to large. As predicted, the ARCES and MAAS-LO were positively correlated, and both were negatively correlated with the GSE. Furthermore, as predicted, the GSE was also associated with the BPS and BDI-II. Overall, the correlations between attentional and mood measures replicated my previous findings (Chapter 1).

Once again, my initial hypothesis was that attention lapses (here measured via the MAAS-LO) would influence our general sense of self-efficacy primarily through their impact on our ability to perform everyday tasks (measured via the ARCES). Thus, to address the question of whether the ARCES mediates the association between the MAAS-LO and GSE, a step-wise multiple regression analysis was conducted (Table 2.3). At step two, when the ARCES was added, the beta weight for the MAAS-LO was considerably reduced and lost significance, indicating a substantial mediation of the relation between the MAAS-LO and GSE via the ARCES. This suggests that one's everyday inattention leads to a decreased sense of self-efficacy primarily through the attention-related cognitive errors that also result from attention lapses. Accordingly, when modeling the ability of self-efficacy to mediate the relation between inattention and emotional distress, no direct connection should be necessary between the MAAS-LO and GSE scales.

Table 2.1. Means, Standard Deviations, Ranges, Skewness & Kurtosis (with standard errors), Alpha Coefficients for All Measures (N = 184)

	Mean	SD	Range	Skew ^a	Kurtosis ^b	α (n)
Mindful Attention Awareness Scale – Lapses Only	3.69	0.96	1.08 - 5.92	-0.10	-0.25	.90 (179)
Attention-Related Cognitive Errors Scale	3.23	0.77	1.33 - 5.0	0.26	-0.30	.91 (176)
Generalized Self-Efficacy	2.99	0.60	1.30 - 4.0	-0.57	-0.28	.91 (172)
Boredom Proneness Scale	4.09	1.07	1.43 - 6.46	-0.31	-0.38	.92 (162)
Beck Depression Inventory – II	0.85	0.58	0.0 - 2.43	0.60	-0.28	.92 (170)

^a SE = .18

^b SE = .36

Table 2.2. *Pearson Product-Moment Correlations of All Measures (N = 184)*

	ARCES	GSE	BPS	BDI-II
Mindful Awareness of Attention – Lapses Only	.66	-.21	.56	.55
Attention-Related Cognitive Errors		-.29	.50	.48
Generalized Self-Efficacy			-.41	-.49
Boredom Proneness				.64
Beck Depression Inventory – II				

Note. For all coefficients, $p < .001$

Table 2.3. *Step-wise Multiple Regression Testing for Mediation of Generalized Self-Efficacy (GSE) and Attention Lapses (MAAS-LO) by Attention-Related Cognitive Errors (ARCES)*

Dependent Variable: GSE

	β	t	p
Step 1			
MAAS-LO	-.22	2.97	.003
Step 2			
MAAS-LO	-.03	0.30	.762
ARCES	-.28	2.98	.003

Final Model

$R = .30, F(2,181) = 9.05, p < .001$

My primary interest was in extending our knowledge about the role that everyday attention lapses play in the onset of boredom and depression. Hence, an SEM was constructed based on the theory-driven hypotheses that 1) attention lapses (measured via the MAAS-LO) would influence our general sense of self-efficacy (measured via the GSE) primarily through their impact on our ability to perform everyday tasks (measured via the ARCES), and 2) the association of boredom proneness (measured via the BPS) and depression (measured via the BDI-II) with everyday task errors is mediated by self-efficacy. A second and more traditional Affect-to-Attention hypothesis reversed these predictions, producing a model in which boredom and depression predict attention lapses and self-efficacy. In addition, I tested an alternative model based on Bandura's (1997) assertion that decreased self-efficacy would produce cognitive changes that have both attentional and emotional effects.

The Attention-to-Affect model assessed the simultaneous effects of the MAAS-LO and GSE on the BPS and BDI-II, using the MAAS-LO as an exogenous variable predicting the ARCES, GSE, BPS and BDI-II. Consistent with the present regression analyses, the GSE was also entered as a partial 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 GSE. This model, presented in Figure 2.1, provided very good fit indices for the data, $\chi^2(3, N = 184) = 4.34, p = .227, CFI = .996, NFI = .988, RMSEA = .049, BCC = 29.15$, consistent with the Attention-to-Affect hypothesis, via changes in self-efficacy.

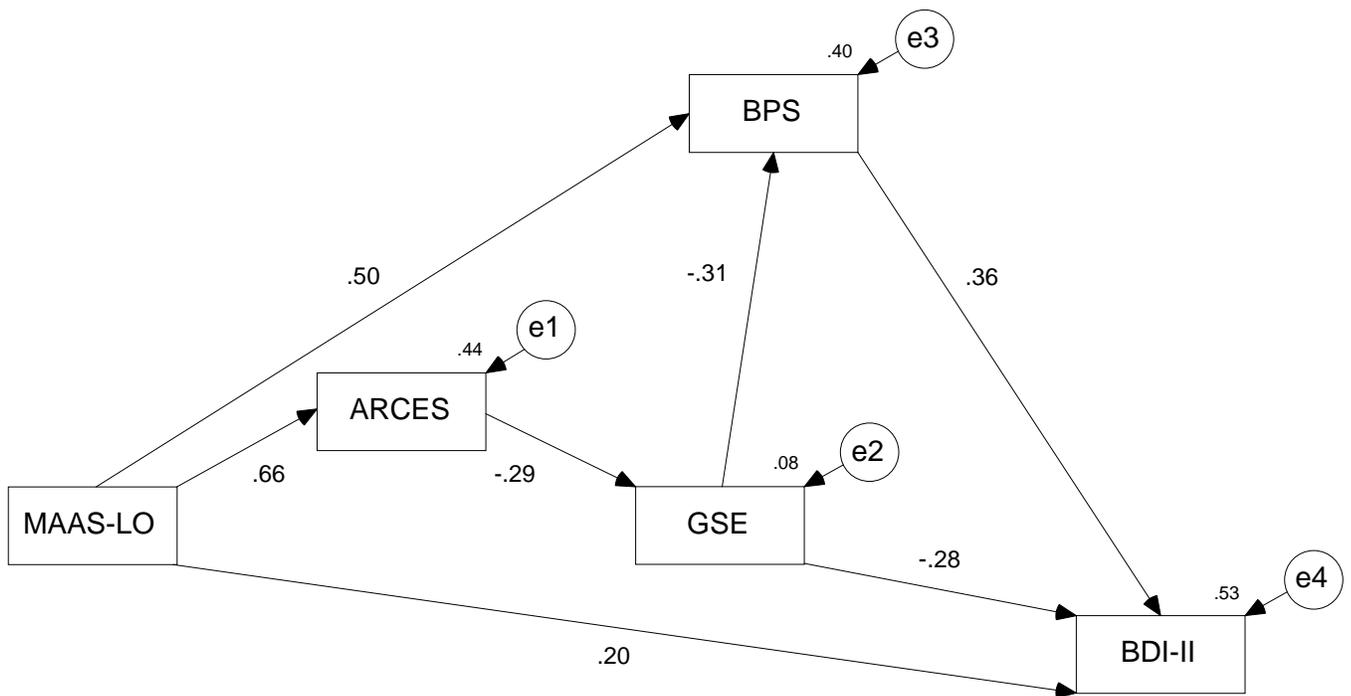


Figure 2.1. Predicted Attention-to-Affect path model with path coefficients for self-reported attention (via MAAS-LO, ARCES) and self-efficacy (via GSE) measures predicting boredom proneness (via BPS) and depression (via BDI-II) measures. All path coefficients are significant ($p < .001$).

The Affect-to-Attention model, in which the BPS and BDI-II were treated as correlated exogenous variables that jointly predict both the MAAS-LO and GSE, and with the MAAS-LO mediating the relations between the BPS, BDI-II and ARCES, is shown in Figure 2.2. As the Affect-to-Attention model that implicitly directs most research would not specifically predict a direct influence of self-efficacy on attention-related errors, without influencing attention lapses first, the direction of the path between the ARCES and GSE remains consistent with the model shown in Figure 2.1. This model provided much poorer fit indices for the data, $\chi^2 (3, N = 184) = 15.47, p = .002, CFI = .964, NFI = .957, RMSEA = .151, BCC = 40.28$, though it was not possible to directly test the significance of the difference between this model and the Attention-to-Affect model as they are not nested. Nonetheless, this model, which most closely matches the conventional idea of how affect relates to cognitive functioning, clearly does a poor job of representing the obtained pattern of correlations and thus the implication is that conventional theories may be inadequate. A large source of variance left unaccounted in the traditional model involved the relation between the GSE and MAAS-LO, suggesting that the ARCES did not effectively mediate the MAAS-LO–GSE relation in this model. Accordingly, the model was adjusted to provide a direct link from the MAAS-LO to the GSE. This change reduced the degrees of freedom of the model, and substantially improved model fit, $\chi^2 (2, N = 184) = 9.37, p = .009, CFI = .979, NFI = .974, RMSEA = .142, BCC = 36.25$, but still did not fit the data well.

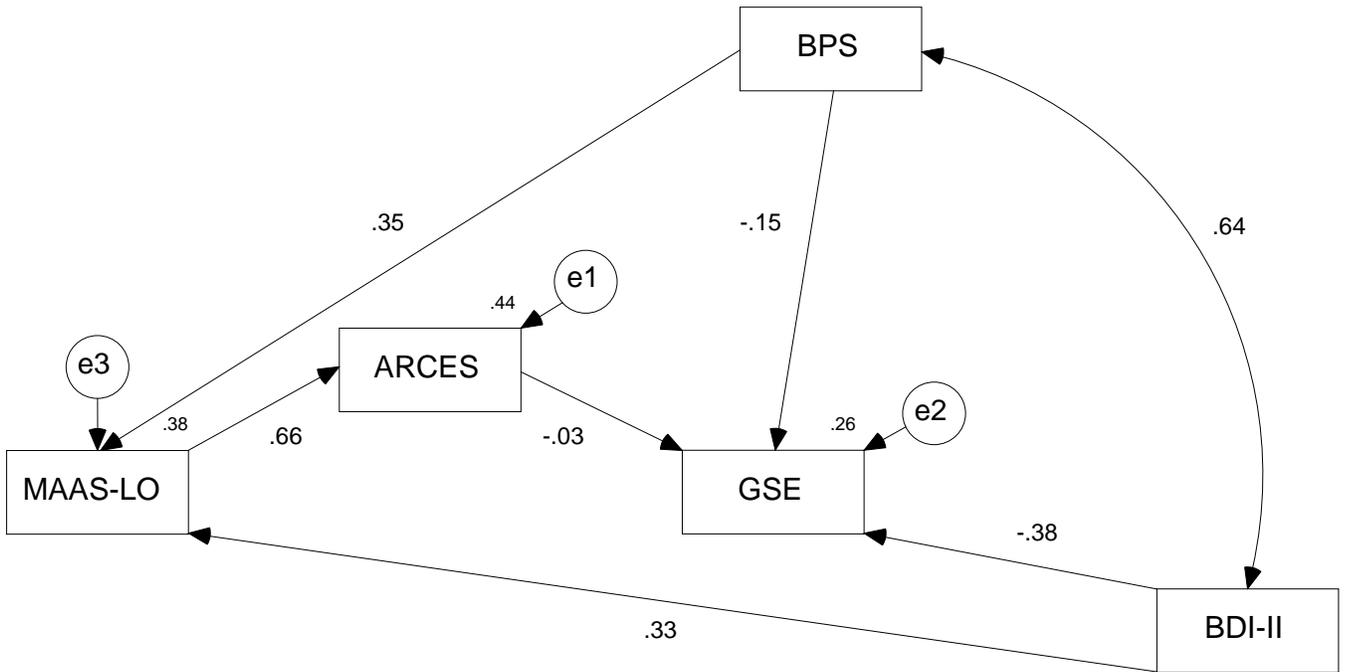


Figure 2.2. Alternative path model with path coefficients for self-reported boredom proneness (via BPS) and depression (via BDI-II) measures predicting attention (via MAAS-LO, ARCES) and self-efficacy (via GSE) measures. Path coefficients shown are significant ($p < .001$) except those connecting the GSE scale with the ARCES ($p = .63$) and BPS ($p = .08$).

An additional alternative to the Attention-to-Affect model comes from Bandura (1997), who noted both the causal relation of self-efficacy on negative emotions, including anxiety and depression, as well as its potential impact on future performance of everyday tasks. On this view, self-efficacy could be seen as the primary cause of boredom, depression, and attention lapses. Accordingly, I revised the model shown in Figure 2.1 to reverse the directionality of the relation between self-efficacy and inattention. Since the ARCES is a measure of cognitive errors resulting from attention lapses, however, the most theoretically compelling model is one in which there is a direct relation between the GSE and both the MAAS-LO and ARCES, allowing self-efficacy to produce cognitive errors at least in part through its influence on attention lapses. As such, this alternative model has one less degree of freedom than the Attention-to-Affect model. This model provided reasonably good fit for the data, $\chi^2(2, N = 184) = 4.21, p = .122, CFI = .994, NFI = .988, RMSEA = .078, BCC = 31.09$. That this model fits the data relatively well is perhaps not surprising, given that it shares the majority of its features with the well-fitting Attention-to-Affect model. It is, however, less parsimonious than the Attention-to-Affect model, with one fewer free parameter. In this case it is possible to further evaluate the models on the basis of their BCC fit indices. The BCC fit index is intended to address improvements in model fit resulting from changes in parsimony, with models achieving lower BCC values being considered preferable. Although parsimony is not the only difference between these models, such comparison would regardless suggest the Attention-to-Affect model ($BCC = 29.15$) should be seen as the better of the two.

On the whole, the theoretically-derived Attention-to-Affect model, shown in Figure 2.1, best and most parsimoniously fits the data. Within this model, the MAAS-LO predicts all cognitive and affective variables, with the GSE mediating relations between the MAAS-LO, BPS and BDI-II. Nonetheless, the Affect-to-Attention model and Bandura's model, of course, cannot be fully ruled out through SEM analyses alone.

2.5 Concluding Remarks

Expanding on the research presented in Chapter 1, which postulated attention lapses as a common cause in a sequence of cognitive, behavioural and affective outcomes, the present study was designed to investigate self-efficacy as a potential mediator between attention lapses and emotional distress. As a conceptual extension of the earlier Attention-to-Affect model, this study served to enhance our understanding of the role that everyday inattention plays in generating boredom and depression. This theoretically derived model, using attention lapses to predict self-efficacy as well as emotional

distress, provided very good fit for the data. In addition, consistent with theory and our previous findings, parallel models representing the received view that emotional distress leads to cognitive failures continued to provide poorer support for the data. Modeling self-efficacy instead as the primary cause of boredom, depression, and inattention similarly failed to improve on the Attention-to-Affect model, overall providing good support for the notion that basic failures of attention are an important component in the onset of emotional distress.

While correlational data cannot provide definitive knowledge about causation, a benefit of structural equation modeling is that it allows us to use known associations to evaluate the likelihood of predicted experimental outcomes in advance of such study. A continuing limitation of the present models is that they rely solely on self-report questionnaire assessments of attention and emotion. Nonetheless, a continuing strength of the particular measures of attention I employed is that they have been validated against a behavioural measure of attention (Cheyne et al., 2006; Smilek, Carriere, & Cheyne, 2010). Accordingly, the results obtained in the present study should be interpreted as a stimulus for additional research on the potential long-term consequences of seemingly innocuous lapses of attention in everyday life.

Taken together, and consistent with my previous findings (Chapter 1), the present results suggest momentary lapses of attention can lead to a variety of cognitive errors. Moreover, in conjunction with such errors (e.g., going to the fridge to get some milk, and instead taking out the juice), such attention lapses may causally influence our affective well-being via their influence on our sense of self-efficacy. Thus, the present findings once again highlight that maintaining an awareness of our actions is an important contributor not only to the outcomes of everyday activities, but to our long-term emotional well-being.

Chapter 3

The Stress of Everyday Experiences

3.1 Introduction

In 2008 a Canadian medivac helicopter pilot crashed while attempting a night landing in an isolated area; the cause of the crash was determined to be a miscalculation of the helicopter's altitude when the pilot's attention was divided between landing and explaining the procedure to the first officer and paramedics onboard (Transportation Safety Board of Canada, 2008). Such examples illustrate the potentially dire consequences of brief attention lapses and attention-related cognitive errors when they occur at an inopportune moment; but chronic attention lapses, even involving shifts to one's own thoughts, may lead to consequences that are just as debilitating. In the previous chapters, for example, I have presented evidence that absentmindedness can have important consequences not only for ongoing task performance, but also for our general emotional well-being. The present chapter further develops the argument that attention impacts emotional well-being by testing the hypothesis that everyday attention lapses can produce depression, at least in part, via their influence on one's stress level.

The models presented in the previous chapters focused on primarily cognitive sources of affective dysfunction, but I am also interested in exploring intermediate affective states that might further illuminate the mechanisms underlying the route from attention lapses to depression. One such potential linking mechanism is stress, as attention lapses can make it more difficult to perform our normal, everyday activities and through such interference we may become stressed. Unfortunately, stress has traditionally been an ambiguous term, used to reference both potentially demanding situational contexts and the individual's responses to such situations. In order to reduce this confusion for stress research, Selye (1984) argued that 'stress' should be reserved to describe physiological or emotional outcomes while the term 'stressors' should be used to describe those events that cause stress. Interestingly, Selye also argued that stress is a potential consequence of almost all physical, cognitive, or emotional activity – essentially everything we do or feel has the potential to produce a stress response in the body, even if to a very minimal extent. Accordingly, to say someone is stressed reflects the recognition of an abundance of the stress response rather than a categorical change in our present state, but stress could also have a more subtle influence on our emotions and behaviour. In this way, if everyday inattention happens to have extraordinary consequences, such as narrowly

avoiding a plane crash, it would likely produce sufficient stress to become noticeable. Similarly, if we experience an extraordinary abundance of minor attention-related errors in everyday life, then over time our stress level could also become sufficiently elevated to be perceived as bothersome; this type of stress production parallels that seen in “daily hassles” research (e.g., McIntyre, Korn, & Matsuo, 2008; Monroe, 1983) and represents an indirect link between attention lapses and stress. I would take this view one step further, however, to suggest the experience of chronic inattention could *directly* produce stress, perhaps because inattention makes it more difficult to accomplish many everyday tasks (e.g., reading; Smallwood & Schooler, 2006), regardless of whether it actually leads to errors.

3.1.1 Exploring the Link Between Attention Lapses and Stress

The most relevant, though admittedly indirect, link between attention lapses and stress comes from the work of Broadbent and colleagues in their development of the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982), which assesses the frequency with which individuals experience everyday cognitive failures, including attention-related errors. These authors noted that reports of frequent cognitive failures appeared to be associated with a vulnerability to stress, as student nurses scoring high on the CFQ were more likely to report a higher degree of neuroticism (via the Middlesex Hospital Questionnaire; Crown & Crisp, 1966) after being placed in a stressful working environment. Similar associations of cognitive failures and stress have also previously been addressed by Reason (1988), who additionally noted that absentmindedness and stress could be interchanged as either cause or effect, depending on the situation being considered. From this bidirectional perspective, having a general tendency toward absentmindedness could make one more vulnerable to negative cognitive and emotional reactions when encountering a stressor, consistent with Broadbent’s findings, but being faced with a stressor could also increase absentmindedness, and thus create cognitive problems that were not previously present.

Both Broadbent and Reason focused on stressors as *situational conditions* that might negatively affect the state of the individual and, as such, stress was seen as a reaction to these situations; one which, according to Broadbent, could be exacerbated by a general tendency toward cognitive failures. On this view, environmental stressors are first required to induce stress in the individual, while cognitive factors may serve to moderate the *extent* to which stress is induced. Stress has not always been viewed as a response to specific situational conditions, however. Indeed, stress has also been seen as a *cognitive-emotional trait* (Lazarus, 1993) which can persist across situational conditions or even despite the absence of such conditions. On this view, there may sometimes be no identifiable

situational cause for an individual's stress. A trait perspective offers a counterbalance to the situational view. That is, stress becomes an abundance of tension, arousal, and other nonspecific emotional distress across situations, consistent with an individual differences perspective and specifically with the hypothesis that individual differences in a set of physical and emotional traits affect various situations in everyday life. Within this framework, we depart somewhat from Broadbent's view of the role of everyday cognitive failures in stress. Rather than relying on some specific situational stressor, it is attention lapses, and the cognitive errors that we chronically make as a result of these attention lapses, which would function as a stressor. Furthermore, expanding on Selye's (1984) suggestion above, *stress* would refer more generally to the host of unpleasant affective states, such as general irritability, that attention lapses help to create, and which then have the potential to produce additional emotional distress in the form of depressive affect.

3.1.2 Stress and Depression

Stress has long been identified as an important contributor to disease in general, and is thought to be especially important in the initial onset and relapse of depression (Depue, 1979). Most notably, the contributions of stressors to depression are fundamental to the diathesis-stress model of depression. Such models are based on the theory that dysfunctional beliefs or behaviours tend to produce depression only when accompanied by stressful life events (for an interesting evaluation of diathesis-stress models of depression, see Robins & Block, 1989). The development of depression after stressful events may be further influenced by the tendency to experience chronic stress (Hammen, Kim, Eberhart, & Brennan, 2009), and even mild levels of daily stress appear to have the potential to produce mood disturbance over short timescales (DeLongis, Folkman, & Lazarus, 1988). Additionally, decisions made while one is depressed may also create an environment in which the probability of experiencing future stressful events is increased (Hammen & Shih, 2008), thus creating a potentially vicious emotional downward spiral.

3.1.3 Stress and Boredom Proneness

Unlike the strong relation between stress and depression, the present body of research provides two observations that suggest stress may not play a substantial role in the generation of boredom proneness via attention lapses. First, following a review of the existing literature on boredom and stress in vigilance tasks, Thackray (1981) argued that in boring situations stress is actually elicited by the requirement, and failure, to maintain alertness rather than boredom. Thus, boredom and stress are

seen to be associated primarily through their common link to the failure to remain alert (i.e., to the inability to sustain attention to task-relevant aspects of the current situation). Second, evidence to support a boredom–stress association is found quite inconsistently, with studies failing to show both substantial prediction of stress via boredom (e.g., Rooijen, 1991) and of boredom via stress (e.g., Shaw, Caldwell, & Kleiber, 1996). In addition, other studies simply assume boredom produces stress (Wiesner, Windle, & Freeman, 2005), or explicitly combine them into the singular construct of boredom-stress (Parasuraman & Purohit, 2000), while using them to predict some other emotional or behavioural outcome. Such ad hoc mergers of boredom and stress are difficult to incorporate with the present theoretical considerations, in which boredom proneness and stress are distinct, but potentially related, emotional traits.

Given the notable similarity in the way that boredom and stress are both typically viewed from a situational perspective, it is worthwhile to clarify once again that my interest in boredom remains not as a response to situations that seem to almost inherently demand disengagement. Instead, I am interested in boredom as a trait – as one’s general propensity toward disengagement regardless of such situational demands. As my theoretical predictions are also based on stress as a general emotional trait, and consistent with Thackray’s (1981) review, it should thus be their common relation to attention lapses that is primarily responsible for any observed relation between boredom proneness and stress.

3.2 Stress Study 1

Guided by the above theoretical and empirical considerations, and to further investigate routes through which attention lapses and associated errors influence depressive affect in particular, Stress Study 1 examined whether stress partially mediates these relations. In this study inattention was measured via the Mindful Attention Awareness Scale–Lapses Only (MAAS-LO; Chapter 1) and errors resulting from inattention were measured by the Attention-Related Cognitive Errors Scale (ARCES; Chapter 1; Cheyne et al., 2006). Boredom was measured via the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986), while stress and depression were both measured via their respective subscales on the Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995). Stress and boredom appear to be only minimally related, but stress – as a general abundance of tension, arousal or other nonspecific emotional distress – should nonetheless play an important role as a partial mediator of the relation between attention lapses and depression. Thus, based on my previous findings, I predicted the MAAS-LO would explain a significant amount of the variance in the BPS

and DASS-Depression. Furthermore, as a measure of behavioural consequences of inattention, the ARCES should act as a partial mediator between the MAAS-LO and DASS-Stress. As a result, the ARCES would not explain a significant amount of variance in DASS-Depression once relations with the MAAS-LO and DASS-Stress were accounted for.

3.2.1 Method

3.2.1.1 Participants

Participants were 134 undergraduate students from the University of Waterloo, selected as part of a larger study assessing the associations between anxiety and attention and who had completed a series of screening questionnaires for course credit. The screening measures included the Beck Depression Inventory-II (Beck, Steer, & Brow, 1996), the trait version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and the Boredom Proneness Scale (Farmer & Sundberg, 1986). In order to limit the potential confound of depressive affect in this sample for the purposes of the larger study, students scoring moderate to high on the BDI-II (≥ 19) or who did not respond 0 to question 19 regarding suicidality were excluded from participation. This restriction was also of some benefit to the present study, as it allowed the study to evaluate whether attention lapses are predictive of emotional distress even in the case of entirely sub-clinical levels of depressive affect. The remaining students were then oversampled for high (≤ 36) and low (≥ 47) scores on the STAI trait anxiety measure, again for the purposes of the larger study. Participants received partial course credit in exchange for their participation. The mean participant age was 19.1 ($SD = 3.32$; $N = 133$; one participant opted not to provide her age), including 65 males (age $M = 19.0$; $SD = 4.23$) and 69 females (age $M = 19.1$; $SD = 2.16$).

3.2.1.2 Measures

Six questionnaires were completed in random order across participants, including three questionnaires not included as part of the present study. The additional questionnaires included the Attentional Control Scale (Derryberry & Reed, 2002), the Social Desirability Scale (Strahan & Gerbasi, 1972), and the STAI. Item mean scores were calculated for each questionnaire in order to accommodate three participants who each omitted a single response from the BPS; there were no other response omissions. Following the questionnaires, participants completed a set of eye-tracking tasks that were part of the larger study, in which they viewed a series of threat-related and harm-related images and attempted to solve difficult anagrams.

The 12-item Mindful Attention Awareness Scale–Lapses Only (MAAS-LO; Chapter 1) was selected as a measure of attention lapses. MAAS-LO items ask about mindless behaviour in everyday situations, such as “I find it difficult to stay focused on what’s happening in the present.” The MAAS-LO incorporates a Likert scale ranging from *almost never* (1) to *almost always* (6), with responses indicating greater frequency suggesting a greater propensity toward everyday attention lapses. Aside from removal of three items and the scale being direct-scored as opposed to reverse-scored the MAAS-LO is identical to the MAAS originally developed by Brown & Ryan (2003).

A revised version of the Attention-Related Cognitive Errors Scale (ARCES; Cheyne et al., 2006) was incorporated as an assessment of notable outcomes associated with everyday attention lapses. The revised ARCES (Chapter 1) is a 12-item questionnaire measuring the frequency with which one experiences a variety of everyday cognitive failures or action slips for which an attention lapse is the most likely cause, and employs a Likert scale of five possible responses, ranging from *never* (1) to *very often* (5). The ARCES is conceptually similar to the CFQ, which Broadbent and colleagues (1982) previously used to relate everyday cognitive failures and stress responses, but is specific to errors caused by attention lapses (Cheyne et al., 2006; Smilek et al., 2010).

Boredom was measured via the Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986). The 28-item BPS reflects one’s responses to situations in which we are likely to become bored (e.g., “Having to look at someone’s home movies or travel slides bores me tremendously”) and related trait characteristics of boredom (e.g., “Time always seems to be passing slowly”). The BPS uses a Likert scale ranging from *strongly disagree* (1) to *strongly agree* (7), with a *neutral* (4) midpoint. This scale was only included in the prescreening questionnaires.

Stress and depression were measured via the relevant subscales of the short form of the Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995), as the DASS was designed with the specific intent of providing good discrimination between depression, anxiety, and stress, and it has been shown to provide good long-term stability for each subscale (Lovibond, 1998). The 21-item DASS includes 7 questions for each subscale, asking about one’s experiences over the past week, and is scored using a Likert scale ranging from *did not apply to me at all* (0) to *applied to me very much, or most of the time* (3). Response values are typically doubled in the short form of the DASS, in order to retain total score compatibility with the long form which has 42 items, however no doubling was necessary for the mean item scores in the present study. To measure negative affect (depression) the DASS includes statements such as “I felt downhearted and blue” and “I couldn’t seem to experience

any positive feelings at all,” while to measure tension (stress) it includes statements such as “I found myself getting agitated” and “I tended to over-react to situations.” While the DASS does not attempt to address the DSM-IV (American Psychiatric Association, 1994) criteria for depression, its depression subscale has nonetheless been shown to correlate strongly with the previous gold standard measures, the BDI (Antony, Bieling, Cox, Enn, & Swinson, 1998; Lovibond & Lovibond, 1995) and BDI-II (Gloster et al., 2008), the latter having been used in my previous models (Chapters 1 & 2). Furthermore, for the purposes of the present study, I find the clearer focus of the DASS on the more common experience negative affect particularly appealing as I am concerned with the ability of attention lapses to predict emotional distress in general, regardless of severity.

3.2.2 Results and Discussion

All measures were found to have good distributional and psychometric properties. All measures also showed a fairly good range of scores, with little deviation from normality in skewness and kurtosis, and demonstrated very satisfactory internal consistency (Table 3.1). The depression subscale of the DASS included the most substantial deviation from normality, but was still acceptable and to be expected to some extent given that participants were selected on the basis of having low depression scores.

Pearson Product-Moment correlation coefficients are presented in Table 3.2. All coefficients are moderate to large, excluding the DASS-Stress relation to the BPS which was small. As predicted, all measures were positively correlated. Furthermore, the correlations between attentional and mood measures are consistent with those of the previous chapters.

To assess whether the association of boredom proneness with attention lapses and attention-related cognitive errors was mediated by stress, a step-wise multiple regression analysis (Table 3.3) was conducted. In this analysis, with the BPS as the dependent variable, when the MAAS-LO was added the beta weight for the ARCES was substantially reduced and no longer significant. The addition of the DASS-Stress scale had virtually no effect on the model; both the ARCES and MAAS-LO betas retained their previous values. Thus, the present analysis indicates the zero-order association of the DASS-Stress and BPS is almost entirely accounted for by common variance in the MAAS-LO, suggesting that stress and boredom proneness may be related only to the extent that they are both closely related to lapses of attention. This finding corroborates earlier work by Thackray (1981) examining the relation of boredom and stress in vigilance task performance. Accordingly, when

modeling the overall ability of attention lapses to predict affective dysfunction, stress should not serve as a predictor of boredom proneness.

Table 3.1. Means, Standard Deviations, Ranges, Skewness & Kurtosis (with standard errors), Alpha Coefficients for All Measures (N = 134)

	Mean	SD	Range	Skew ^a	Kurtosis ^b	α
Mindful Attention Awareness Scale – Lapses Only	3.09	0.80	1.25 - 5.17	0.06	-0.37	.86
Attention-Related Cognitive Errors Scale	2.78	0.57	1.50 - 4.67	0.41	0.87	.85
DASS–Stress	0.83	0.52	0.0 - 2.43	0.75	0.06	.79
Boredom Proneness Scale	3.42	0.69	1.61 - 5.43	0.15	0.47	.86
DASS–Depression	0.51	0.43	0.0 - 2.43	1.23	1.94	.79

^a SE = .21

^b SE = .42

Table 3.2. *Pearson Product-Moment Correlations of All Measures (N = 134)*

	ARCES	Stress	BPS	Depression
Mindful Awareness of Attention – Lapses Only	.67**	.41**	.39**	.44**
Attention-Related Cognitive Errors		.52**	.36**	.40**
DASS–Stress			.23*	.58**
Boredom Proneness				.40**
DASS–Depression				

Note. * $p < .01$, ** $p < .001$

Table 3.3. *Step-Wise Multiple Regression Testing for Mediation of Attention-Related Cognitive Errors (ARCES) with Boredom Proneness (BPS) by Mindful Awareness of Attention (MAAS-LO) and Stress (DASS-Stress)*

Dependent Variable: BPS

	β	t	p
Step 1			
ARCES	.36	4.42	.001
Step 2			
ARCES	.17	1.61	.110
MAAS-LO	.28	2.58	.001
Step 3			
ARCES	.16	1.37	.174
MAAS-LO	.27	2.53	.013
DASS–Stress	.03	0.34	.733

Final Model

$R = .41, F(3,130) = 8.98, p < .001$

Consistent with my primary interest in extending our knowledge about the role of everyday attention lapses in the onset of depressive affect, the present Attention-to-Affect model was designed to address the hypothesis that the DASS-Stress serves as an intermediary in the relations between attention lapses and depression. The Attention-to-Affect model assessed the simultaneous effects of the MAAS-LO and DASS-Stress on the BPS and DASS-Depression, using the MAAS-LO as an exogenous variable predicting the ARCES, DASS-Stress, BPS and DASS-Depression. Consistent with theory and the present regression model, DASS-Stress was entered as a partial mediator of the effect of the MAAS-LO on DASS-Depression, and the ARCES was entered as a partial mediator of the effect of the MAAS-LO on DASS-Stress, but no path was provided from DASS-Stress to the BPS. This model, presented in Figure 3.1, provided very good fit indices for the data, $\chi^2(3, N = 134) = 3.42, p = .332, CFI = .998, NFI = .985, RMSEA = .032$, consistent with the hypothesis that basic attentional failures can play a causal role in depression via stress. That the MAAS-LO was a weaker predictor of DASS-Stress than was the ARCES is unexpected given the theory discussed in the Introduction, and, as a result, the path from the MAAS-LO to DASS-Stress was not significant in this model ($p = .30$). Caution should be exercised when interpreting this aspect of the model, however, given the relatively small sample size for such a model, and restriction of the sample to individuals with low scores on the BDI-II. Thus, on the whole, the present analysis does generally support the conclusion that an initial propensity toward attention lapses and the consequences they entail are likely to lead to greater stress (as tension or nonspecific emotional distress), which then contributes to the onset of depressive affect.

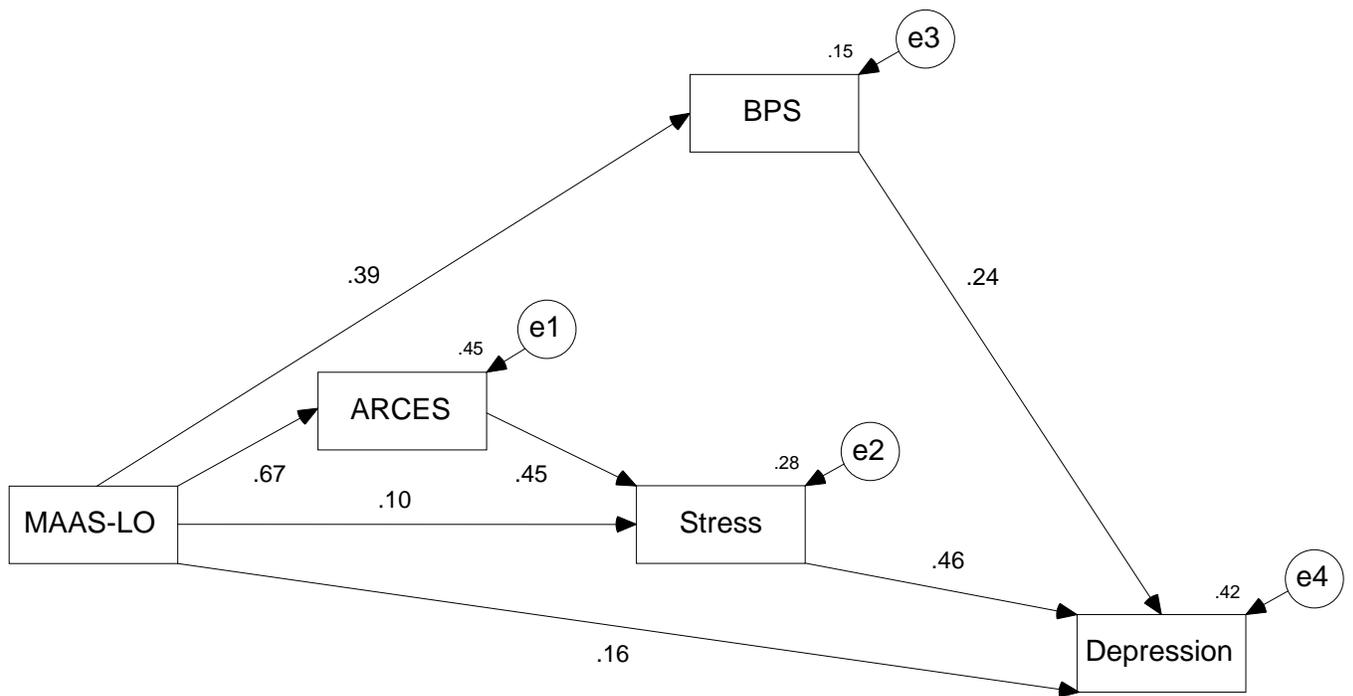


Figure 3.1. Predicted Attention-to-Affect path model with path coefficients for self-reported attention (via MAAS-LO, ARCES) and stress (via DASS-Stress) measures predicting boredom proneness (via BPS) and depression (via DASS-Depression) measures. Aside from the path from the MAAS-LO to DASS-Stress ($p = .30$), all path coefficients are significant ($p < .001$; except MAAS-LO to DASS-Depression, $p < .05$).

The present analysis once again supports the theory that failures of basic cognitive mechanisms play an important causal role in the onset of boredom and depression through stress, and is consistent with the findings of the previous chapters, in which memory failures (Chapter 1) and self-efficacy (Chapter 2), respectively, were found to partially mediate the link between attention lapses and depression. With respect to the latter finding, it is interesting that self-efficacy and stress are also related, to the extent that self-efficacy can be seen as essential to our ability to cope with daily stressors. So, I was interested in conducting an additional, and larger, study in order to better integrate the present stress findings with the previous self-efficacy findings.

3.3 Stress Study 2

Attempts to minimize or avoid the effects of stress on our lives have been collectively described as *coping*, and generally fall into two categories: emotion focused coping, whereby the individual attempts to reappraise the situation in a more benign way, and problem focused coping, where the individual attempts to change the situation (Coyne, Aldwin, & Lazarus, 1981; Coyne & Lazarus, 1980). Both coping strategies are based on an initial appraisal of the situation and one's abilities, followed by subsequent reappraisals after initial outcomes have been assessed. As such, a stress-coping feedback loop is created, in which the apparent causal flow is dependent on how early you break in to the process (Coyne, Aldwin, & Lazarus, 1981). Since general self-efficacy is essentially a belief in our ability to handle unforeseen situations, it should play an important role at the earliest stages of this cycle. Indeed, a number of recent studies have shown the importance of self-efficacy in reducing stress and maintaining general mental health (e.g., Jerusalem & Hessling, 2009; Nauta, Liu, & Li, 2010; Rees & Freeman, 2009) or preventing job stress and burnout (Schwarzer & Hallum, 2008) when individuals encounter stressful situations. Thus, consistent with previous findings (Chapter 2), I again hypothesized that attention-related errors would predict self-efficacy, which, based on existing coping theory, would then also predict stress, as well as boredom proneness and depression. In other respects, however, I expected this broader model to be similar to the model presented in Stress Study 1.

3.3.1 Method

3.3.1.1 Participants

Participants were 399 undergraduate students (137 males) from the University of Waterloo, who completed a series of online questionnaires examining cognitive functioning and general emotional

experience, including the measures of interest for this study. The data were completed over three consecutive terms, in order to reach a sufficient sample size. Of those participants who provided their age, the mean was 20.8 ($SD = 4.85$; $n = 392$). The selected participants completed all five questionnaires and had no more than two missing responses from any questionnaire; 355 participants had zero missing responses. As compensation for their time participants received partial course credit.

3.3.1.2 Materials

In addition to the same measures included and described in Stress Study 1, the 10-item General Self-Efficacy scale (GSE; Schwarzer & Jerusalem, 1995) was added as a measure of one's perceived self-efficacy. The GSE includes items such as "I am confident that I could deal efficiently with unexpected events," and uses a four-point Likert scale ranging from *not at all true* (1) to *exactly true* (4). Accordingly, the GSE is a measure of self-efficacy regardless of situation, as a more trait-level belief in one's ability to cope with most situations. The questionnaires were completed in random order, except for the BPS which was collected first as part of the initial mass testing completed every term with psychology students at the University of Waterloo.

3.3.2 Results and Discussion

Once again, the ARCES and MAAS-LO were found to have good distributional and psychometric properties. All measures showed a good range of scores with very satisfactory internal consistency, with only the GSE reflecting a small degree of kurtosis (Table 3.4). Pearson Product-Moment correlation coefficients are presented in Table 3.5. All coefficients are significant, and the majority are moderate to large. As predicted by the theory discussed in the Introduction, both the MAAS-LO and ARCES show strong relations with DASS-Stress. Furthermore, consistent with the findings of Chapter 2 and the present theory, the GSE showed strong relations with the BPS, DASS-Stress, and DASS-Depression.

Table 3.4. Means, Standard Deviations, Ranges, Skewness & Kurtosis (with standard errors), Alpha Coefficients for All Measures (N = 399)

	Mean	SD	Range	Skew ^a	Kurtosis ^b	α
Mindful Attention Awareness Scale – Lapses Only	3.10	0.79	1.00 - 5.33	-0.08	-0.31	.87
Attention-Related Cognitive Errors Scale	2.83	0.60	1.08 - 5.00	0.39	0.96	.87
Generalized Self-Efficacy	3.00	0.45	1.10 - 4.00	-0.27	1.13	.88
DASS–Stress	0.92	0.62	0.0 - 2.86	0.47	-0.31	.87
Boredom Proneness Scale	3.51	0.64	1.93 - 5.43	-0.11	-0.45	.84
DASS–Depression	0.74	0.68	0.0 - 2.86	0.99	0.26	.90

^a SE = .12

^b SE = .24

Table 3.5. *Pearson Product-Moment Correlations of All Measures*

	ARCES	GSE	Stress	BPS	Depression
Mindful Awareness of Attention – Lapses Only	.53	-.18	.49	.37	.49
Attention-Related Cognitive Errors		-.21	.42	.41	.33
Generalized Self-Efficacy			-.30	-.43	-.35
DASS–Stress				.32	.66
Boredom Proneness					.41
DASS–Depression					

Note. $N = 399$, all $p < .001$

The hypothesis that attention lapses, and their associated cognitive errors, would impact boredom proneness and depression in part through their influence on our general sense of self-efficacy and stress level was again addressed using structural equation modeling. As in Stress Study 1 this model was designed such that stress and boredom proneness were independent consequences of attention lapses. In the past, findings have consistently shown that attention-related errors (ARCES) and boredom proneness (BPS) are separate consequences of everyday attention lapses, and thus did not need a direct connection between the ARCES and BPS in order to produce a well-fitting model (Cheyne et al., 2006; Chapters 1 & 2). For the present sample, however, the hypothesized Attention-to-Affect model did not fit the data well, owing to a substantial residual covariance between the ARCES and BPS. Although it is inconsistent with previous findings, and quite possibly a chance anomaly in the present data, the requirement of a path connecting the ARCES and BPS is not fundamentally inconsistent with the Attention-to-Affect model on the whole. Thus, I added this path for the model shown in Figure 3.2. This Attention-to-Affect model provided good fit indices for the data, $\chi^2(3, N = 399) = 7.41, p = .06, CFI = .994, NFI = .990, RMSEA = .061$, consistent with the hypothesis that attention lapses produce boredom and depression via changes in self-efficacy and stress. The largest remaining residual covariance was between the MAAS-LO and GSE and, unlike the residual between the ARCES and BPS, it was not large enough to warrant inclusion of this path in the model.

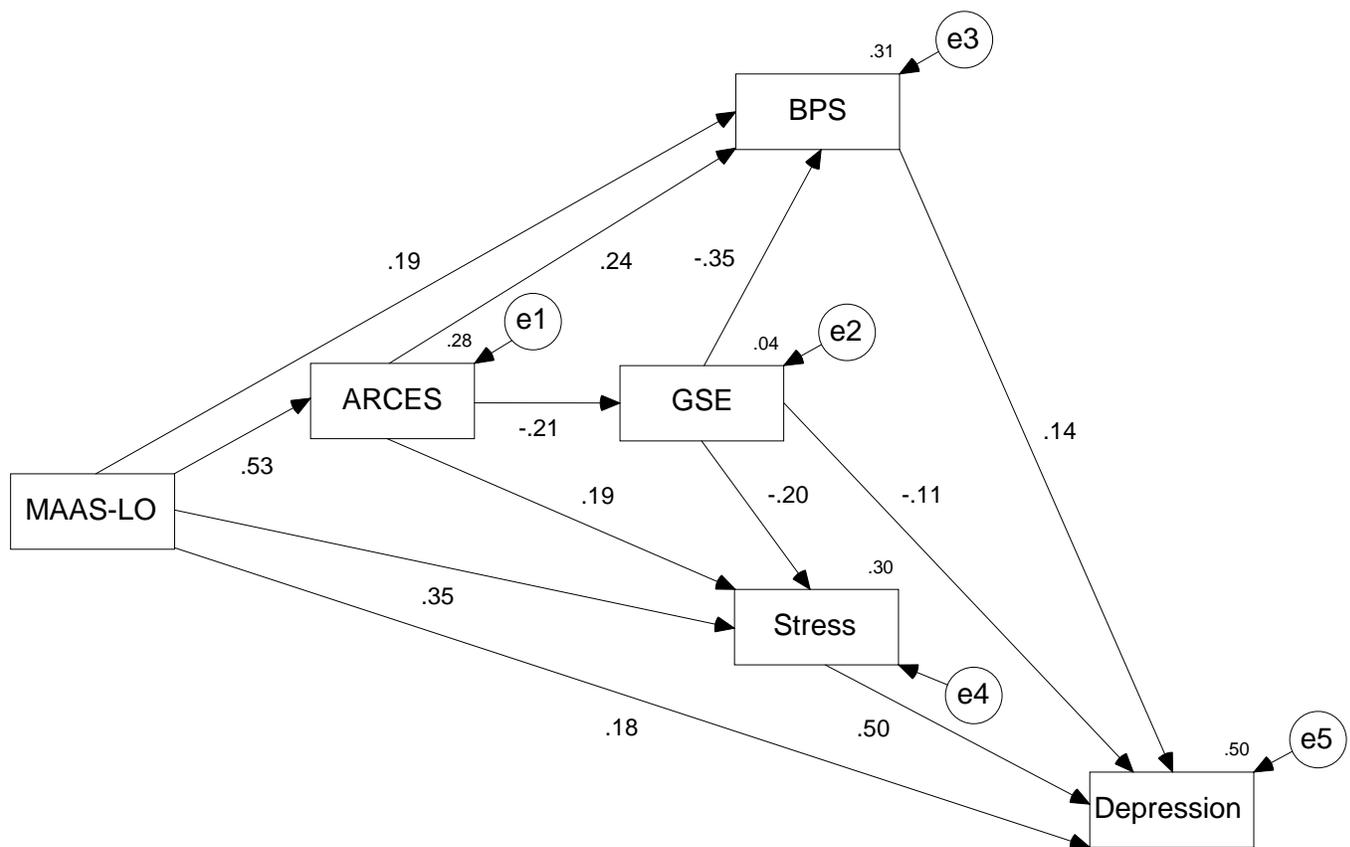


Figure 3.2. Predicted Attention-to-Affect path model with path coefficients for self-reported attention (via MAAS-LO, ARCES), self-efficacy (GSE) and stress (via DASS-Stress) measures predicting boredom proneness (via BPS) and depression (via DASS-Depression) measures. All path coefficients are significant ($p < .001$; except GSE to DASS-Depression, $p < .01$).

The present model once again provided good support for our proposed Attention-to-Affect model of how everyday attention lapses and mood are related, while simultaneously increasing the complexity of the model. Although my typical technique has thus far been to compare the proposed Attention-to-Affect model with an alternative Affect-to-Attention model, with the present set of variables it is unclear how exactly these alternative models should be specified. Some alternative models may rival the fit of our Attention-to-Affect model, but subtly misrepresent the currently received theories about how attention and affect are related with respect to self-efficacy and stress. Other alternative models may represent theory well, but provide poorer model fit and thus call the theory into question. It is not my claim to have addressed all potential alternatives, nor my intention to overfit the data in order to produce the best possible alternative model as a comparison. I therefore leave it up to the reader to carefully consider which alternative Affect-to-Attention models are as theoretically defensible as the Attention-to-Affect model, and to put these theories to the test.

3.4 Concluding Remarks

Starting from my earlier models (Chapters 1 & 2), which postulated attention lapses as a common cause of a sequence of cognitive, behavioural and affective outcomes, the present studies were designed to investigate an additional potential mediator between attention lapses and affective dysfunction. The addition of stress, as an individual tendency to experience an unpleasant abundance of tension, arousal and general emotional distress, allowed the expansion of my causal model from initial attention failures to affective outcomes. Once again, the present findings provided good support for the view of attention lapses as a cause of boredom and depression. I also focused primarily on stress as a mediator of the relation between attention and depression, to test Thackray's (1981) assertion that the association of boredom and stress was potentially just a by-product of the common influence of attention lapses. Consistent with this view, the present findings provide good support for the notion that stress and boredom are indeed separate and independent consequences of everyday attention lapses.

The present findings are also consistent with a view of attention lapses as potential stressors in their own right – capable of producing stress without the major life events typically identified as causes of stress. As such Broadbent's view of cognitive failures moderating the link between potential stressor events and the stress response may be reconceptualised as, rather, reflecting the tendency for individuals who are already experiencing stress due to chronic inattention to encounter even greater stress when placed in demanding situations. There remains the distinct possibility, however, that

everyday inattention also increases the likelihood that we encounter difficult life situations, or that we handle them more poorly, and so stressful life events are still an important and necessary component of the attention–stress relation. As I did not specifically inquire about these participants’ experience of stressful life events the present findings cannot address this question.

It is important to always acknowledge that correlational data cannot provide definitive knowledge about causation. Nonetheless, an important benefit of structural equation modeling is that it allows us to use known interrelations to evaluate the likelihood of predicted experimental outcomes in advance of such study. That several different studies, each of which evaluated separate mediators of the link between attention lapses and affective distress, have produced similar findings makes their predictions all the more compelling. Accordingly, just as with the previous findings (Chapters 1 & 2), the results obtained in the present studies should be interpreted as highly suggestive of a need for additional research on the potential long-term consequences of seemingly innocuous lapses of attention in everyday life.

As with the previous chapters, a limitation of the present models is that they rely solely on self-report questionnaire assessments of attention and mood, although a strength of these measures of attention is that they have been validated against relevant indices of the Sustained Attention to Response Task (Cheyne et al., 2006; Smilek et al., 2010). In any case, this limitation is to a certain extent a necessity in that, thus far, my research has been on trait-level tendencies of the individual. That is, I investigated general tendencies to be inattentive, stressed, bored, or depressed in everyday life regardless of specific situations one might encounter. Taking these general tendencies to the level of specific situations may not be easily accomplished because any given situation will inevitably introduce its own additional complexities; such complexities are often unexpected, and thus interpretation of the results is made more difficult. For example, it is probable that, although attention lapses may have a primary role in the aetiology of depression, depressed affect will be associated with self-focused depressive rumination that provides additional attentional load and is associated with mind-wandering away from important characteristics of the task at hand (Smallwood et al., 2003; Smallwood, O’Connor, Sudbery, & Obonsawin, 2007) – and this process is likely to play out over both long and short timescales. Furthermore, laboratory tasks that attempt to manipulate mood may also involve unintentional manipulations of sustained attention, or vice versa, which can make it difficult to evaluate the causal relation between attention and affect even in an experimental setting. Nonetheless, with careful control and interpretation, future studies might benefit from including more

state level measures of attention lapses and an attempt to discover the cognitive and behavioural foundations of the disengagement from everyday experience that I have argued plays an important role in the onset of boredom and depression.

On the whole, the present results provide good support for the hypothesis that attention lapses can set in motion processes that ultimately lead to boredom and depression, including those working via their influence on our stress level. This process is likely to be, in part, also mediated by the effects of failures of attention on our general sense of our ability to accomplish both everyday and novel tasks. These models redefine the role of attention lapses in our everyday emotional experiences, and are all the more compelling as a result of the consistency with which attempts to address the causal relations underlying these experiences produce similarly well-fitting models. Nonetheless, the precise ways in which attention plays a profound role in our general emotional well-being will not be fully understood until we have examined the fundamental cognitive, behavioural, and emotional precursors of these trait-level tendencies.

Chapter 4

Reactivity to Attentional Challenges

4.1 Introduction

In the previous chapters I have presented data that test the hypothesis that mundane episodes of inattention, and their resulting cognitive and behavioural errors, are a potential cause of general emotional distress, including boredom and depression. One of the mechanisms I have argued is likely to play a key role in this process is the subjective disconnection, and disengagement, from ongoing experience that is a probable outcome of chronic attention lapses. This is consistent with existing emotional theory, inasmuch as both boredom and depression are often seen to incorporate a loss of motivation, productivity, or interest in everyday routines, which ought to be reflective of this disengagement. An important assumption of the disengagement hypothesis, and the models I have presented, is that attention lapses themselves have negative effects on our emotions, and that the cumulative effect of these emotional reactions over time is a noticeable change in our general emotional well-being. Such emotional responses to inattention need not be subjectively striking; indeed, the initial responses may well be small, and perhaps even generally go unnoticed, but when they occur frequently enough their effects have the potential to be greatly amplified. What is now needed to support this theory of long-term emotional change as a result of inattention is direct evidence that people do react to attention lapses and their consequences. The present study therefore seeks to explore these origins of the proposed disengagement mechanism through the measurement of direct and immediate physiological responses to errors on a sustained attention task.

Perhaps the most common and readily recognized form of everyday inattention is mind wandering. Mind wandering is essentially an attentional disengagement from the external environment, in favor of internal processing (Smallwood & Schooler, 2006), and it has been singled out as a major contributor to errors on sustained attention tasks (e.g., Cheyne, Carriere, & Smilek, 2006; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997; Smallwood et al., 2004). Consistent with this view, periods of mind wandering have been shown to involve a decreased neural analysis of external events (Christoff et al., 2009; Smallwood et al., 2008; Weissman, Roberts, Visscher, & Woldorff, 2006). As well, research has shown eye fixations made when attempting to read while mind wandering are longer than those made when on-task, and are less affected by lexical and linguistic properties of the text (Reichle, Reineberg, & Schooler, in press). More critical to the present study is recent research

showing that periods of mind wandering during reading are also characterized by a greater blinking frequency than periods of on-task attention to the text (Smilek, Carriere, & Cheyne, 2010). To explain this finding Smilek and colleagues offered the hypothesis that an increased blink frequency is an effective mechanism by which to physically filter out external information in order to facilitate the internal focus needed to sustain the activation required for off-task processing. Put another way, when attention is directed internally the external world is also shut out. Thus, there is the potential that everyday attention lapses could produce similar consequences, and a change in blinking behaviour following attentional failures, then, could be seen as an indicator or even a potential cause of disengagement from the external world.

One possible roadblock to studying attention-related blink rates in a laboratory setting is the strong strategic connection between blink behaviour and task demands. For example, research has shown that blinking is highly regulated during visual tasks, tending to occur either before stimulus presentation or after stimulus detection (e.g., Fogarty & Stern, 1989; Orchard & Stern, 1991; Fukuda, 1994). Thus, since the full duration of continuous attention tasks is typically longer than blinking can be inhibited, it is likely that some strategic task synchronization will occur, so as to minimize the loss of critical information. In studies showing strategic blinking effects, participants are typically given explicit instructions about the timing of onsets and offsets of visual stimuli. In vigilance or sustained attention tasks, however, this information is more likely to be implicitly extracted from salient task characteristics. Along these lines, research has shown that individuals who are lipreading implicitly withhold blinking until visually noticeable pauses in the speech (Lesner & Hardick, 1982). Similarly, a recent study reported that participants watching a movie blinked in synchrony both with themselves when watching the same movie on a different occasion, and with other individuals watching the same movie (Nakano et al., 2009). In this case, the source of the synchrony appeared to be scene breaks or, even more importantly, personally meaningful break points such as the end of an action sequence or the departure of the main character. If one views action sequences or main characters as equivalently important to the individual as the presentation of stimuli in a visual search task, then these more real-world findings are remarkably consistent with the more typical laboratory task findings above. Furthermore, they suggest that, for a sustained attention task involving frequent presentation of stimuli, blinking will be limited to periods when stimuli are not present, or are unchanging. Accordingly, we might expect any attention-related differences in blinking behaviour to appear only after the participant has had the opportunity to fully examine the currently presented stimulus.

The Sustained Attention to Response Task (SART; Robertson et al., 1997) is an ideal candidate for creating inattention in a laboratory setting and examining blinking behaviour in relation to attention lapses. The SART was developed with the intention of providing a brief, reliable, and valid measure of failures of sustained attention (Robertson et al., 1997), defined as a self-sustained, conscious, mode of thought and observation during monotonous tasks that encourage automatic, or mindless, responding. This monotony is established through the rapid presentation of digit stimuli approximately once every second, and the infrequent presentation of target stimuli. An important feature of the SART is that, unlike previous vigilance tasks, it involves only one simple response decision, to press or not to press, and pressing is the correct response for approximately 89% of trials. The SART thus allows for the development of a habitual response pattern that must be occasionally overridden by an attentive, conscious, decision not to press. Accordingly, the continuation of the habitual response on a trial when it was not indicated (a NOGO trial) is taken as a task-related consequence of a failure of sustained attention. Thus, the critical attention failure measure yielded by the SART is a count of failures to withhold a response when presented with the NOGO signal (SART error). Robertson and colleagues (1997) have shown SART error rates to have good test-retest stability over a period of two weeks ($r = .76$), suggesting individual SART performance is relatively stable over time.

Prior research has already provided indirect evidence of reactivity to the consequences of attention lapses in the SART. For NOGO trials immediately following another NOGO trial, or with only one intervening GO trial, individuals tend to show (1) a substantially increased probability of committing an error and (2) a speeding of reaction times (Cheyne, Carriere, & Smilek, 2010; Cheyne, Solman, Carriere, & Smilek, 2009). These findings are potentially suggestive of at least some reactivity to attentional challenges, but their interpretation is somewhat compromised by the fact they are temporally disconnected from the challenge itself by at least one second. Furthermore, these potential reactions to attentional challenge are observable only insofar as they influence the participant's subsequent key press reaction time. Focusing on blink behaviour instead of key presses effectively overcomes these interpretive hurdles, by allowing observation of reactivity through the full duration of the critical NOGO trial and being physically disconnected from the primary task response. It is, however, worthwhile to take this potential reactivity into account, and to specifically examine blink behaviour outside of these unusual NOGO trials in order to determine whether typical reactions to discrete attentional challenges, rather than connected series' of challenges, may produce a disconnection from one's ongoing experience.

The present study is intended to be largely exploratory with respect to the relation between blinking and attention in the SART, but, based on the foregoing review, I predicted that participants would largely inhibit blinking on each trial until after stimulus presentation. While there are no specific cues for the precise timing of stimulus onset in the SART, the uniformity of trial length in itself provides a very reliable temporal cue. This will have the effect of synchronizing blinking across participants, just as the movie clips did in the study by Nakano and colleagues (2009). Additionally, when a NOGO trial is encountered on the SART it represents an attentional challenge for the participant, requiring a change in behaviour and potentially encouraging self-evaluation of ongoing task performance. Such internally directed thought is reminiscent of task-related mind wandering, to the extent that it represents a distraction from processing of the ongoing task at hand. Therefore, given the hypothesis that blinking behaviour reflects an individual's engagement with external events, and is increased during mind wandering, I expected to find changes in blinking behaviour surrounding the critical NOGO trials on the SART, relative to trials on which a participant's attentional state was not challenged. This blink reaction could serve to moderate the ability of external information to interfere with more internally focused thought. A change in the synchrony of blink behaviour surrounding NOGO trials could manifest as an increase in the overall probability of eyelid closure on NOGO trials, as participants momentarily evaluate their performance. As well, the hypothesis that attention lapses result in task disengagement offers the further prediction that NOGO error trials will have higher probabilities of blinking than both correct NOGO trials and temporally paired GO trials, as errors are more salient events for evaluating attentional performance and should produce more internal processing. As the present study is admittedly mainly exploratory, two groups of participants were collected. This allowed the formation of more specific hypotheses on the basis of findings from the first group, and replication of those findings in the second group.

4.2 Method

4.2.1 Participants

Participants were two groups of 44 and 47 undergraduate psychology students from the University of Waterloo research experiences group. The second group was collected so as to provide replication of, and support for, findings observed with the first group. Six participants from the first group and six participants from the second group were excluded on the basis of extended sections of missing eye tracking data, most likely due to substantial head movements made after system calibration. An

additional two participants were subsequently excluded from the first group on the basis of providing fewer than ten (approximately 15%) correct (1) or error (1) NOGO responses, and six participants were excluded from the second group due to computer error (1), failure to calibrate (1), blindness in one eye (1), blinking less than once per minute (1), or providing fewer than ten error responses (2). This reflects a large proportion of participant data loss, but the majority was expected as a result of the need to complete a full block of SART trials without interruptions for recalibration. For the first group the final selection of participants with complete data included 10 males and 26 females with a mean age of 20.17, $SD = 2.09$. For the second group the final selection of participants with complete data included 14 males and 21 females with a mean age of 18.74, $SD = 1.22$. In appreciation of their time participants received partial course credit.

4.2.2 Apparatus

4.2.2.1 SART

The Sustained Attention to Response Task (SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) is widely used as a behavioral measure of sustained attention failures. The SART requires participants to respond to a sequentially presented series of digits and to withhold a response when an infrequent critical NOGO digit appears. The version employed for the present study is the same as was used in Smilek et al. (2010), but it was reprogrammed in SR Research Experiment Builder for use with the eye tracker. The mask presented following each digit was a double ringed annulus shape (⊙), to avoid disproportionate masking of the digit 8 at larger font sizes. The outer ring was sized such that it did not overlap with any digits, even at the largest font size, while the inner ring was sized such that it had minimal overlap with digits in any of the five standard font sizes (48, 72, 94, 100, 120). As well, the intervening number of GO trial digits (digits 1, 2, 4–9) appearing between NOGO trials (the digit 3) was specifically varied from 0 (i.e., sequential NOGO trials) to 16, with each interval being used exactly twice over the course of the task. This range represents the full complement of potential NOGO-to-NOGO intervals for the standard SART. In order to accommodate this distribution of target intervals 315 SART trials were completed, and SART error rates were calculated as a proportion of NOGO trials on which the default response was not withheld. Each block of SART trials was recorded as one trial for the eye tracker, in order to achieve constant monitoring of the eyes, with tags inserted to the data recording at the point of display changes so that individual SART trials could be extracted in post-processing. Participants responded to GO trials by

using the index finger of their dominant hand to pull the trigger button on a Microsoft SideWinder gamepad, and were instructed to respond as quickly as they could while also trying not to make any mistakes.

4.2.2.2 Eye-tracking

As individuals completed the SART, pupils and corneal reflections were monitored using an SR Research Ltd. EyeLink 1000 desk-mounted eye tracking system. Both eyes were calibrated prior to each block of SART trials, and a blink was defined as a period in which a pupil was not detected for either eye for at least 10 ms over a 25 ms period (sampled at 1000 Hz). The system was calibrated using a randomly ordered presentation of 9 calibration dots, and the system's default settings for acceleration and velocity thresholds were used for saccade detection.

Two display screens were used. The stimulus displays for the SART were presented to participants on a Dell 2407WFP 24" LCD colour monitor at a resolution of 1920 x 1200. During the task the participants' eye movements were also presented to the experimenter on a second monitor, so that observations about real-time calibration and gaze position could be made. This allowed the experimenter to evaluate system performance throughout the experiment and to note which participants had to be excluded from analysis on the basis of calibration loss over time. As participants could not be interrupted during the SART without potentially affecting their sustained attention to the task, this method ensured both optimal eye data integrity and comparability of behaviour for the remaining participants.

4.2.3 Procedure

All participants first completed a series of questionnaires that are not included in the present analyses, including the MAAS-LO (Chapter 1), ARCES (Chapter 1), and DASS (Lovibond & Lovibond, 1995). Following the questionnaires, participants were given instructions for performing the SART and then completed a block of 18 practice trials, including 2 NOGO trials. The experimenter observed participant performance during the practice trials and corrected any participants who did not appear to be following the instructions (e.g., withholding their responses for GO trials). After completion of the practice trials participants completed the SART twice, with calibration of the eye tracker being performed prior to each block of trials. The two blocks used different sequences of digit presentation, but within each block all participants received the exact same digit sequence. As each block of trials lasted approximately 6 minutes, the total amount of time spent performing the SART was

approximately 12 minutes. Following each block of the SART, including the practice block, participants were asked to answer a series of pilot questions in which they rated their current subjective experience with respect to boredom, depression, self-efficacy, stress, anxiety, task difficulty, and the passage of time, then they observed but did not respond to a block of 27 SART trials. As with the initial questionnaires, these pilot questions are not included in the present analyses.

4.3 Results

Mean SART error rates, reaction times (for responses of at least 200 ms; Cheyne et al., 2009), blink measures, and questionnaire scores for both samples are reported in Table 4.1. On average, participants responded in error for 40% of NOGO trials, and made correct responses to GO trials within 390 ms of stimulus onset. Large individual differences in blink behaviour were found, as indicated by the high standard deviation, but on average participants blinked approximately 30 times per minute, or about once every two trials, for a mean duration of 106 ms.

Table 4.1. *Sample Means and Standard Deviations for SART and Eye Tracking Measures*

	Sample One (N=36)		Sample Two (N=35)	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
SART Errors	.41	.15	.40	.19
GO Reaction Time	381.8	53.5	397.8	80.8
Number of Blinks	366.8	259.6	355.9	203.4
Mean Blink Duration	100.1	37.8	112.0	54.8

In order to determine whether the task demands of the SART caused participants to synchronize their blinking behaviour with stimulus presentation, I first looked at the overall viewing patterns of the two groups. The most informative trials are those on which participants' attention is explicitly tested and so the NOGO trials were selected for analysis, along with the preceding and following trials as a comparison sample. Since prior research has indicated atypical response behaviour is observed for NOGO trials immediately following another NOGO trial, or with only one intervening GO trial (Cheyne et al., 2010), these trials were excluded, leaving 60 NOGO trials for analysis. This exclusion ensured both the critical NOGO event and the trials preceding a critical event were representative of reactions to discrete instances of attentional challenge, rather than combined reactions to near-simultaneously repeated attentional challenges. Although combined reactions to repeated attentional challenges are also interesting in their own right, the present task design involved too few of these trials to get an accurate measure of participant behaviour in response to such events. In addition to the above exclusion, as with the trials preceding a NOGO trial, only GO trials were selected for analysis following a critical NOGO event, leaving 56 trials for inclusion in this measure. The primary comparison will be between NOGO trials and the preceding GO trial, but examination of the subsequent GO trial allows us to see whether reactivity to attentional challenges typically persists beyond the NOGO trial itself. The two samples are considered separately for the following analyses, and only those findings which replicate across samples receive critical discussion.

I began by examining the overall viewing behaviour for the NOGO trials on which participants correctly withheld their response, and the preceding and following trials, shown in Figure 4.1. This figure plots the overall probability of participants having their eyes open over the course of a trial, with negative time indicating the tail end of the preceding trial. Confidence intervals are plotted at each millisecond for both GO trials preceding a NOGO trial, and for NOGO trials. In Panel A the viewing behaviour of participants in the first sample shows virtually 100% viewing of the stimulus during its entire presentation, with viewing probability declining substantially beginning approximately 100 ms after stimulus offset for GO trials and approximately 250 ms after stimulus offset for NOGO trials. Similarly, viewing probability reaches its minimum approximately 325 ms after stimulus offset for GO trials and approximately 400 ms after stimulus offset for NOGO trials. Finally, viewing probability appears to recover significantly more rapidly for GO trials than for NOGO trials, as indicated by the non-overlapping confidence intervals, though both reach full recovery within 750 ms of stimulus offset. There is no significant difference in viewing behaviour between GO trials preceding or following NOGO trials, indicating that reactivity is restricted to the

NOGO trial itself. Panel B shows the viewing behaviour of participants in the second sample and presents a strikingly similar pattern of findings. Indeed, there are only two noticeable departures between Panels A and B. First, the minimum GO trial viewing probabilities are lower in the second sample than the first, though not significantly so. Second, the minimum NOGO trial viewing probability is higher in the second sample than the first, though again this difference is not significant. Overall, these findings suggest that viewing behaviour following events that test attention is substantially different from viewing behaviour following events that do not test attention, but is in both cases highly synchronized with task demands.

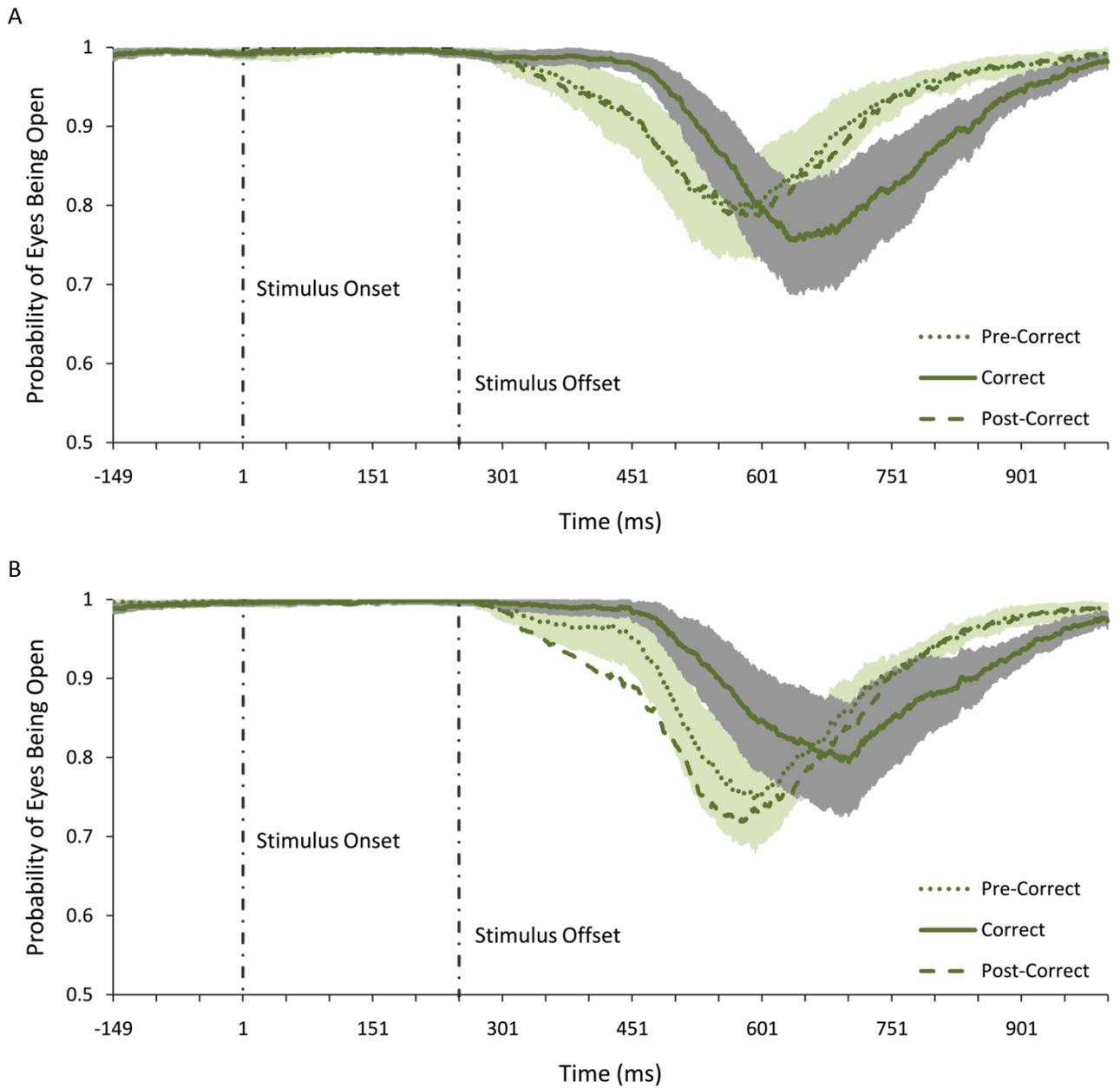


Figure 4.1. Overall probability of participants' eyes being open during NOGO trials with a correctly withheld response and surrounding GO trials for Sample One (Panel A) and Sample Two (Panel B). 95% CI is shown for preceding GO trials and NOGO trials.

An equivalent analysis was performed for NOGO trials on which participants failed to correctly withhold their response (i.e., committed a SART error), shown in Figure 4.2. Again confidence intervals are plotted at each millisecond for both GO trials preceding a NOGO trial, and for NOGO trials. In Panel A the viewing behaviour of participants in the first sample shows virtually 100% viewing of the stimulus during its entire presentation, just as was found for trials with correctly withheld NOGO responses. Thus, SART errors are clearly not typically caused by a failure to observe the stimulus. Once more viewing probability declined substantially shortly after stimulus offset for GO trials, and after a longer delay for NOGO trials, with this also translating into a similar disparity between GO and NOGO trials in the time to reach the minimum viewing probability. Furthermore, as with correct withholds, viewing probability recovers significantly more rapidly for GO trials than for NOGO trials, though in this case it appears viewing probability may not fully recover until within 50 ms of the start of the subsequent trial (see negative time points for the Post-Error line, upper left hand corner). Panel B once more shows the viewing behaviour of participants in the second sample, and it again presents a strikingly similar pattern of findings. There is only one noticeable departure between Panels A and B; the minimum viewing probability is reached approximately 50 ms earlier in Panel A than in Panel B, for NOGO trials and GO trials preceding NOGO trials. Overall, these findings again suggest that viewing behaviour following critical events is substantially different from viewing behaviour following non-critical events, and is highly synchronized with task demands. Furthermore, they suggest potentially significant differences in blink behaviour following attention-related error responses than following correctly withheld responses.

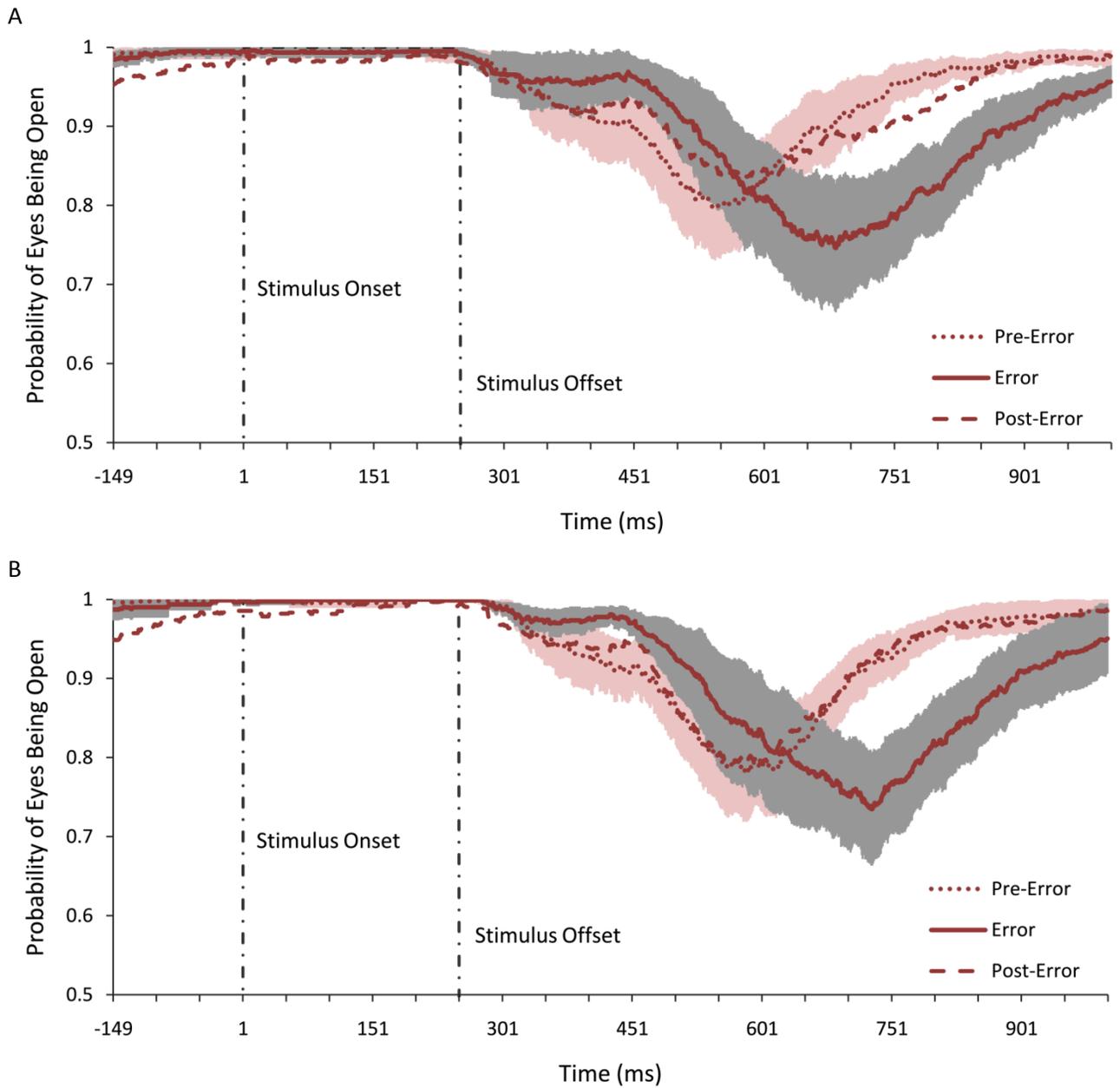


Figure 4.2. Overall probability of participants' eyes being open during NOGO trials with an error response and surrounding GO trials for Sample One (Panel A) and Sample Two (Panel B). 95% CI is shown for preceding GO trials and NOGO trials.

Given the apparent difference in the time point at which viewing probability began to decline during GO and NOGO trials, the latency to post-stimulus blink onset was examined for these trials. Figure 4.3 shows the post-stimulus blink onset latencies for participants in the first (Panel A) and second (Panel B) samples. Both panels indicate a significant difference between blink latencies during the GO trials preceding a NOGO trial and NOGO trials with a correctly withheld response (Sample One: two-tailed $t(35) = 4.73, p = .000$; Sample Two: two-tailed $t(32) = 5.33, p = .000$), or on which an error was committed (Sample One: two-tailed $t(35) = 5.76, p = .000$; Sample Two: two-tailed $t(31) = 4.61, p = .000$). Thus, when faced with an attentional challenge participants took significantly longer to initiate their routine blink behaviour; this suggests an important reaction to the challenge itself, since it occurred regardless of response accuracy. There were no significant differences in blink onset latency between error and correct NOGO trials, or between latencies for pre- and post-NOGO trials.

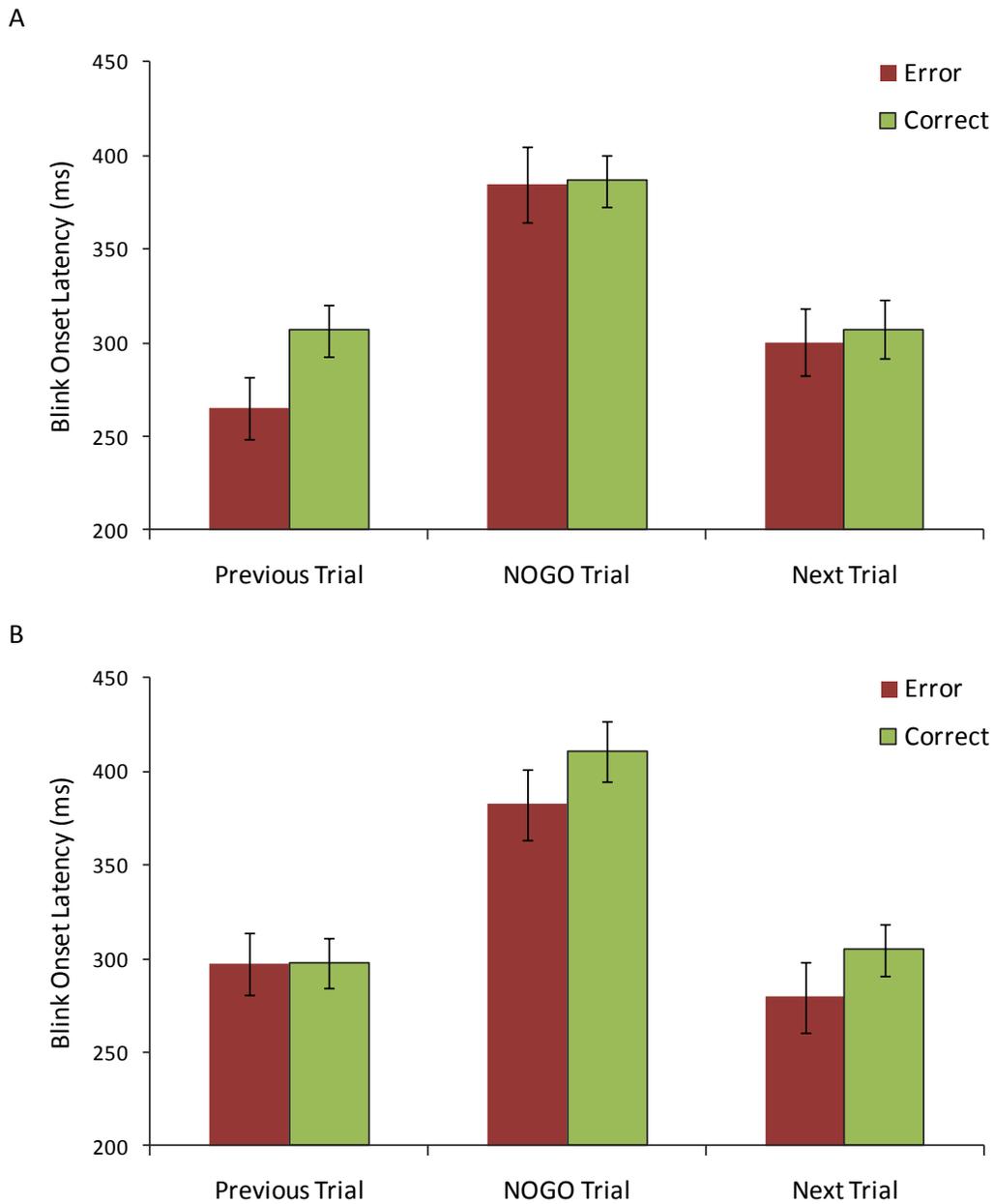


Figure 4.3. Mean post-stimulus blink onset latency during NOGO trials and surrounding GO trials for Sample One (Panel A) and Sample Two (Panel B). Error bars indicate 1 SEM.

The apparent differences in time to full viewing recovery between NOGO trials and the immediately preceding GO trials were examined next. Figure 4.4 shows the overall mean proportion of trial time spent blinking for participants in the first (Panel A) and second (Panel B) samples. There are two main findings. First, participants spent significantly more time with their eyes closed during NOGO trials on which errors were committed than during the immediately preceding trials (Sample One: two-tailed $t(35) = 3.89, p = .000$; Sample Two: two-tailed $t(34) = 2.89, p = .007$). Second, participants spent significantly more time with their eyes closed during NOGO trials on which errors were committed than during NOGO trials on which their response was correctly withheld (Sample One: two-tailed $t(35) = 2.12, p = .041$; Sample Two: two-tailed $t(34) = 2.09, p = .044$). As such, although participants showed delayed blinking behaviour regardless of response accuracy, they showed an extended blink reaction only for trials on which an error was committed. To further examine this extended blink reaction, it was broken down to its two constituent components: number of blinks and blink duration. The mean number of blinks during GO trials prior to NOGO error trials was 0.57 ($SD = 0.46$) for the first sample and 0.58 ($SD = 0.40$) for the second sample, while during NOGO error trials it was 0.81 ($SD = 0.47$) for the first sample and 0.73 ($SD = 0.40$) for the second sample. These differences were both statistically significant (Sample One: two-tailed $t(35) = 4.30, p = .000$; Sample Two: two-tailed $t(34) = 2.07, p = .047$). The mean blink duration, by comparison, was nearly identical for NOGO error trials and their preceding GO trials (Sample One: GO $M = 152.9$ ms, $SD = 156.5$; NOGO $M = 147.6$ ms, $SD = 84.2$; Sample Two: GO $M = 131.8$ ms, $SD = 67.2$; NOGO $M = 134.3$, $SD = 59.6$). Accordingly, the differences in blink duration between GO and NOGO error trials were not statistically significant (Sample One: two-tailed $t(35) = 0.26, p = .798$; Sample Two: two-tailed $t(32) = 0.26, p = .795$).

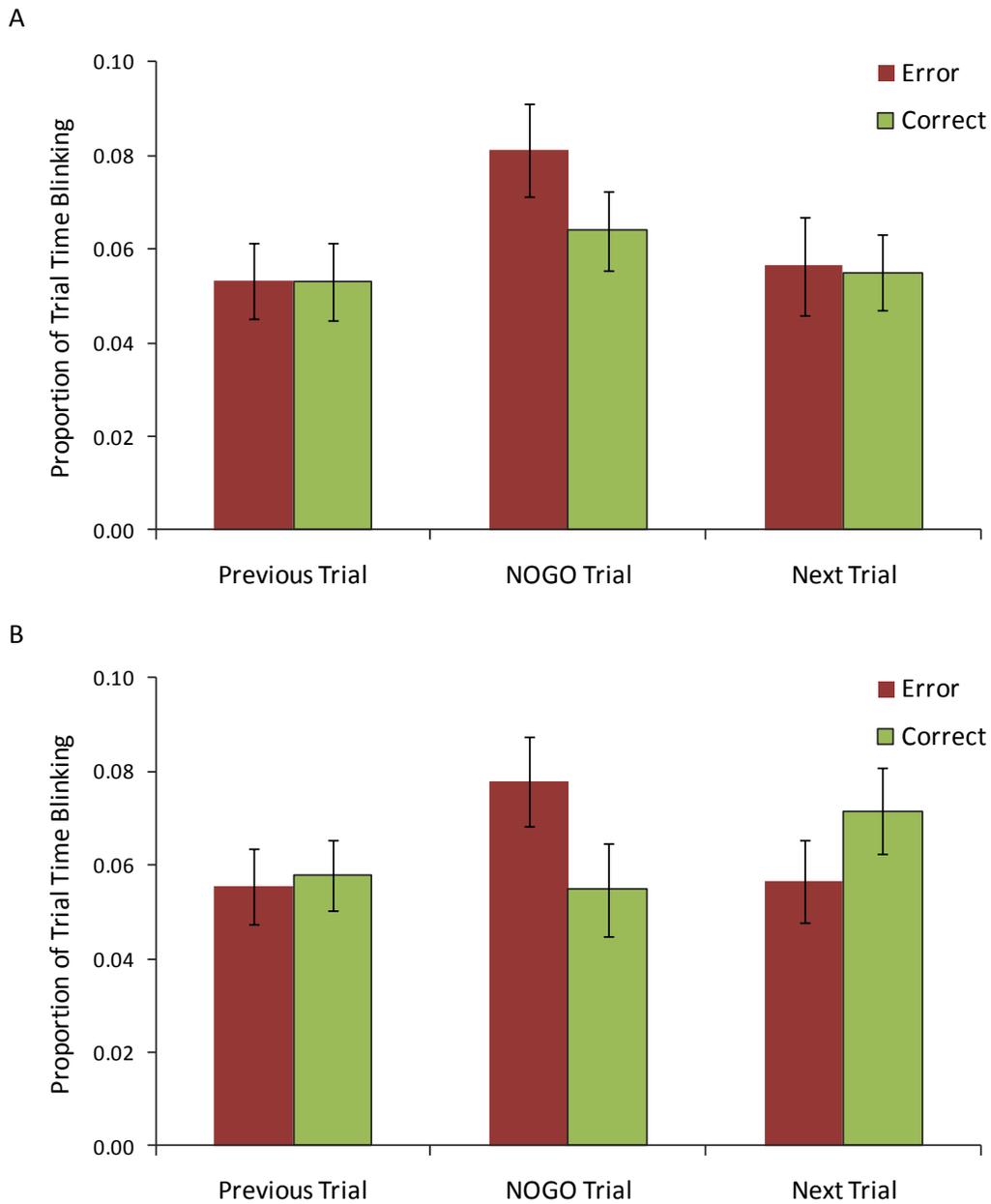


Figure 4.4. Mean proportion of trial time spent blinking during NOGO trials and surrounding GO trials for Sample One (Panel A) and Sample Two (Panel B). Error bars indicate 1 SEM.

Taken together, the present findings support three main conclusions. First, participants viewing behaviour was, overall, highly synchronized with the presentation of stimuli during the SART, withholding blinks until after digit presentation. Second, blinks were withheld longer following attentional challenges than when attention was not being challenged. Finally, when participants committed errors, and thus their failure to sustain attention was made obvious, they took longer to resume regular viewing behaviour, due to an increased rate of blinking.

4.4 Discussion

The present study was designed to address the question of whether attention lapses, and in particular attention-related errors, have the potential to result in a disengagement from one's ongoing experience. Disengagement was measured as a change in blinking behaviour (i.e., momentarily shutting off the external world) surrounding attentional challenges in a sustained attention task. The results showed substantial synchrony of blinking behaviour around the offset of the critical stimuli, and a significantly delayed blink reaction when those stimuli represented an attentional challenge. In addition, I found that when participants failed to rise to an attentional challenge, and withhold their key presses, they spent more time blinking prior to the next trial – potentially allowing them a moment to better reflect on the mistake. These findings are consistent with previous research discussed in the Introduction, which showed synchrony of blink behaviour with visual task demands (e.g., Fukuda, 1994; Nakano et al., 2009) and a greater blink frequency during periods of internally directed thought than periods of on-task reading (Smilek et al., 2010).

While a blink necessarily suppresses visual processing as a result of the eyelid's physical occlusion of the retina, previous research has shown that cortical visual system suppression actually begins prior to retinal occlusion, and extends after this occlusion has terminated (Bristow, Frith, & Rees, 2005; Manning, Riggs, & Komenda, 1983; Ridder & Tomlinson, 1997; Volkman, Riggs, & Moore, 1980). Interestingly, Volkman and colleagues (1980) have shown visual suppression persisting for 200 ms following blink onset, which reflects a typical continuation of visual suppression for 50 to 100 ms after at least partial return of stimulation to the retina. These suppression effects are important to interpreting the present results and their relation to previous SART findings. In particular, previous research (Cheyne et al., 2010; Cheyne, Solman, Carriere, & Smilek, 2009) has identified a substantially increased probability of error commission on the second of two successive NOGO trials, especially when an error was committed on the first of the pair. One interpretation of these findings is that they reflect a continued state of mind wandering across trials (although this interpretation is not

consistent with the similarly increased error probability following correctly withheld responses). The present findings suggest an alternative: as a reaction to the attentional challenge of NOGO trials participants showed a much later return to near 100% viewing probability when an error was committed, and so the visual system may not yet have been fully prepared by the onset of the subsequent stimulus, thereby potentially hampering stimulus recognition and affecting response selection. Even for NOGO trials with correctly withheld responses similar, though not quite as dramatic, delays were found in the return to near 100% viewing probability and so this same explanation applies to the increased probability of error commission on successive NOGO trials. Of course, a strategic explanation – that participants simply do not expect successive NOGO trials and take the opportunity to reduce their vigilance – applies equally well, so in the future our understanding of reactivity to attentional challenges would benefit from research attempting to adjudicate these possibilities.

In the Introduction I discussed the motivation for the present study in terms of the hypothesis that mundane episodes of inattention, and their resulting cognitive and behavioural errors, are a cause of general emotional distress. The key mechanism presumed to be involved in this process is a subjective disconnection from, and disengagement with, ongoing experience as a result of chronic attention lapses. As an initial attempt to experimentally address the validity of this mechanism, blinking behaviour was examined after attentional challenges. The data provided some support for the disengagement hypothesis, in the form of an increased blink frequency following attention-related errors. This increased blink behaviour serves to shut out the external world following errors, and therefore assists the individual in focusing more internally for at least a few moments. Such reactions to inattention, however, if sufficiently frequent or occurring in sufficiently important scenarios, might lead to an inadequate sense of stimulation by, and engagement with, the world around us. At the same time, the recognition of these attentional difficulties could also influence our sense of our ability to cope with both everyday tasks and novel challenges that require periods of sustained attention to manage them effectively. These processes form the foundation of the Attention-to-Affect models presented in the previous chapters.

A notable limitation of the present study is that, although some evidence was found for the proposed disengagement mechanism, given that participants' affective state was not measured following attentional challenges, the present data were unable to show the corresponding change in emotional state that the Attention-to-Affect model predicts should occur. Future research would thus

benefit from an attempt to either directly or indirectly measure emotional state surrounding attentional challenges. Furthermore, that previous research has found elevated blink rates *during* rather than after mind wandering would suggest similar effects should have been found in the present study, as a difference in blink rate for the trials preceding correct and error NOGO responses. It is likely that the lack of a difference in blink behaviour between these trials is largely due to the need to synchronize blink behaviour with the progression of the task itself, and so future research might attempt to minimize visual task demands, perhaps by incorporating an auditory, rather than visual, presentation of stimuli.

Despite its limitations, the present findings overall provide an enlightening first look at the reactivity elicited by attentional challenges, and by the failure to meet those challenges. While exploratory in nature, several interesting findings were found to replicate well across the two samples collected. Perhaps most informative are the findings of delayed blink behaviour following attentional challenges, and an increased blink frequency following attentional failures. This latter finding is particularly supportive of the theory that attention lapses lead to greater disengagement from one's ongoing experiences and, if they occur frequently enough, may over time produce sufficient disengagement to evolve into the more complex negative affective traits whose development was modeled in the previous chapters.

General Conclusion

Through a series of self-report questionnaire studies I examined the potential for everyday attention lapses to create chronic boredom and, subsequently, to lead to depression. In the first chapter I examined this process through the intermediate role of memory failures, while in the second I examined the role of self-efficacy, and in the third I added psychological stress as a further intermediate between attention lapses and affective dysfunction. Each study provided good support for the hypothesis that attention lapses can serve as an initial cause of boredom and depression while acting in part through memory failures, self-efficacy, and stress, respectively. Following from these models I found experimental support for the hypothesized disconnect from one's present experiences as a result of attention lapses, through a laboratory study employing the Sustained Attention to Response Task. This study revealed a significant influence of attentional challenges on blinking behaviour, suggesting that whenever our attentional capacity is tested we have a tendency to momentarily direct our thoughts inwardly, and that the overall duration of this redirection is significantly expanded, through an increased blink rate, following lapses of attention and the commission of attention-related errors.

Research in a number of other domains is likely to see some 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 with respect to depression (e.g., Attention Training Therapy; Wells, 1990).

An important limitation of the model studies presented in the first three chapters is that they rely solely on self-report questionnaire assessments of attention and affect, although the strength of the particular measures of attention employed is that they have already been validated against a behavioural measure of attention (Cheyne et al., 2006; Smilek et al., 2010). As well, a related limitation of the current research is that it used samples of undergraduate university students

(Chapters 1 & 3) or the general population (Chapter 2) and provided only a self-report questionnaire assessment of depression. In particular, this could limit the applicability of the present findings to the experience of sub-clinical depression as a follow-up clinical assessment of individuals responding with high levels of depression was not performed. In this case, for future studies on the role of basic cognitive mechanisms in sub-clinical depression, it may make sense to continue to use measures of sub-clinical depression, such as the DASS (Lovibond & Lovibond, 1995), which was used for the studies in Chapter 3, or the CES-D (Radloff, 1977), rather than the clinically-oriented BDI-II. However, it is worth highlighting that Papageorgiou & 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 the present conclusions when using a clinically depressed sample. Furthermore, I 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 the present samples, I would predict attention lapses and their related errors should still play a causal role in the onset of depression.

While inconsistent with most theories of the role of the cognitive deficits found in depression, the present findings are all compatible with a re-conception of the causal importance of attention lapses in depression, and potentially emotional distress in general. Similarly, in the models presented boredom proneness was also included as a predictor, rather than mere correlate, of depression as it seems reasonable that boredom proneness, which more clearly represents an inability to engage our environment, may be a potential contributor to the development of dysphoric states and depression. In the concluding experiment evidence was found to support this hypothesized disengagement following attention lapses, but more work is needed to fully understand the processes involved in the path from inattention to boredom and depression. In particular, while I have shown reactivity to attentional challenges in terms of blink behaviour, the present theory that chronic attention lapses lead to affective dysfunction would benefit strongly from future research showing emotional reactions to attentional challenges. Nonetheless, on the whole, the present research provides compelling first evidence that a conscious awareness of our actions is an important contributor not only to our effective completion of everyday tasks, but to our long-term emotional health.

Appendix A
**Internal Consistency of the Revised Attention-Related Cognitive
Errors Scale**

Number	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.	0.58
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).	0.60
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

Appendix B

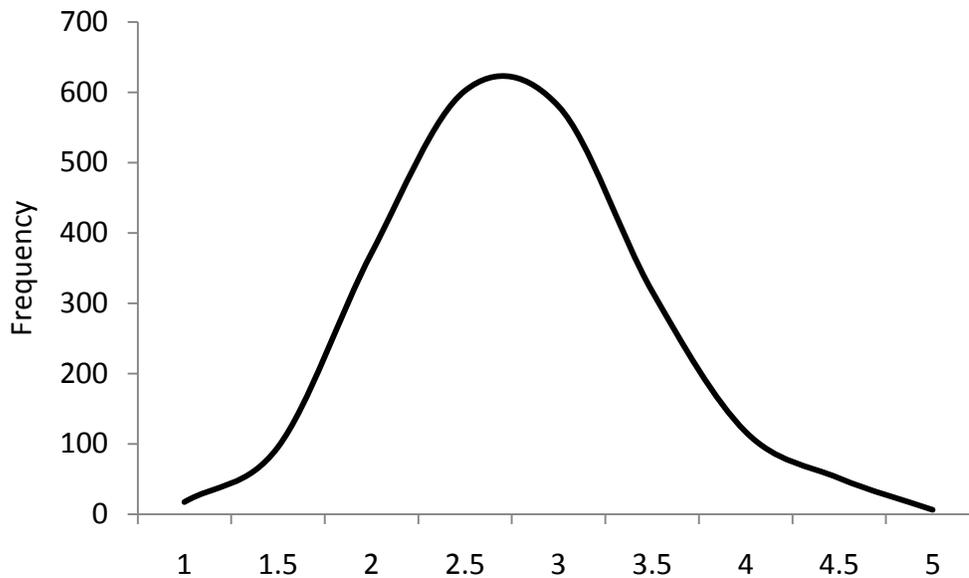
Internal Consistency of the Revised Memory Failures Scale

Number	Previous Item Number	Item	Corrected Item-Total Correlation
1.	3	I forget people's names immediately after they have introduced themselves.	0.46
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.	0.57
4.	9	I forget passwords.	0.56
5.	4	I forget people's names, even though I rehearsed them.	0.61
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.	0.57
12.	8	I double-book myself when scheduling appointments.	0.39

Appendix C

Psychometric Properties of the Attention-Related Cognitive Errors Scale and Related Measures

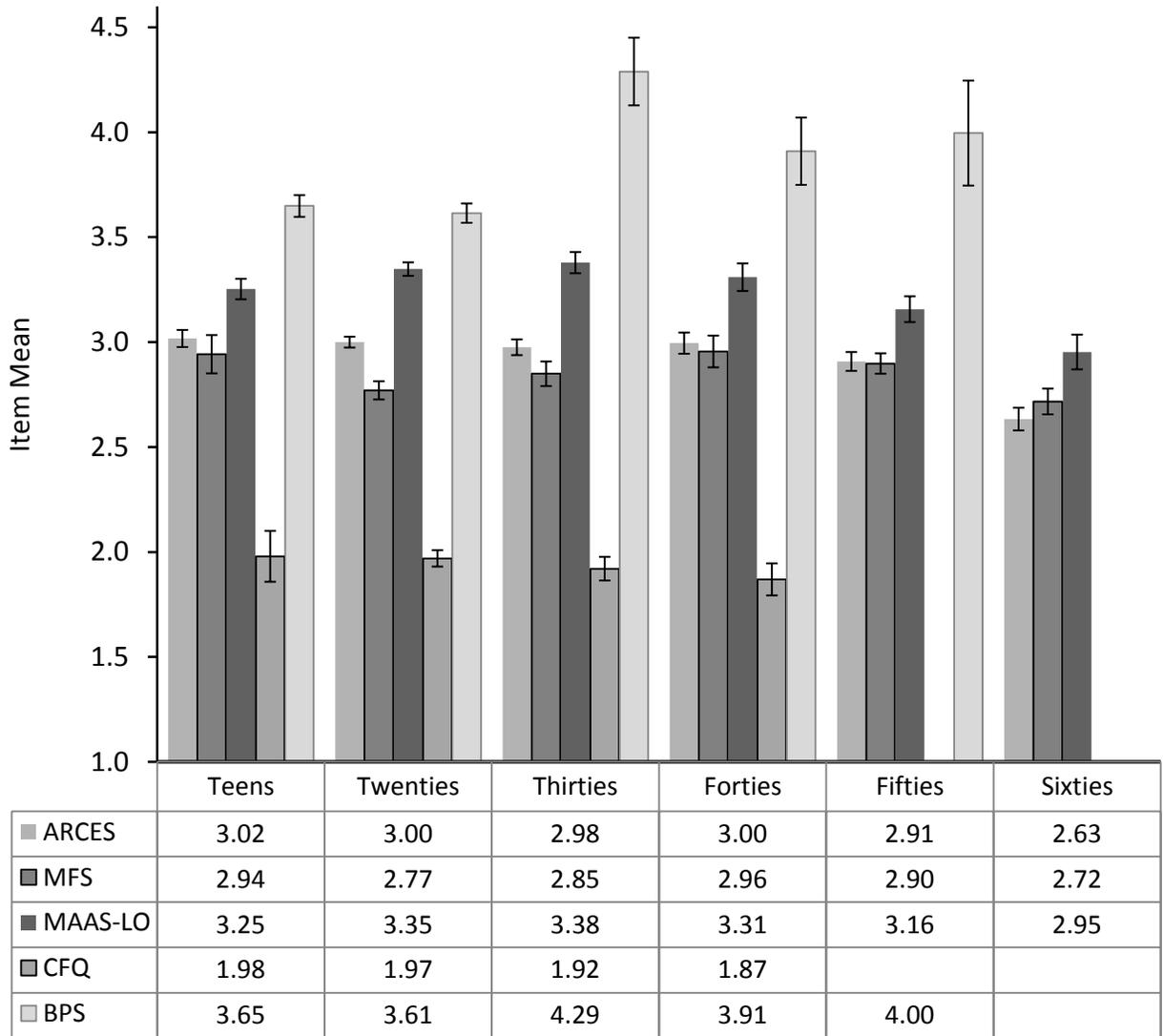
ARCES Item Mean



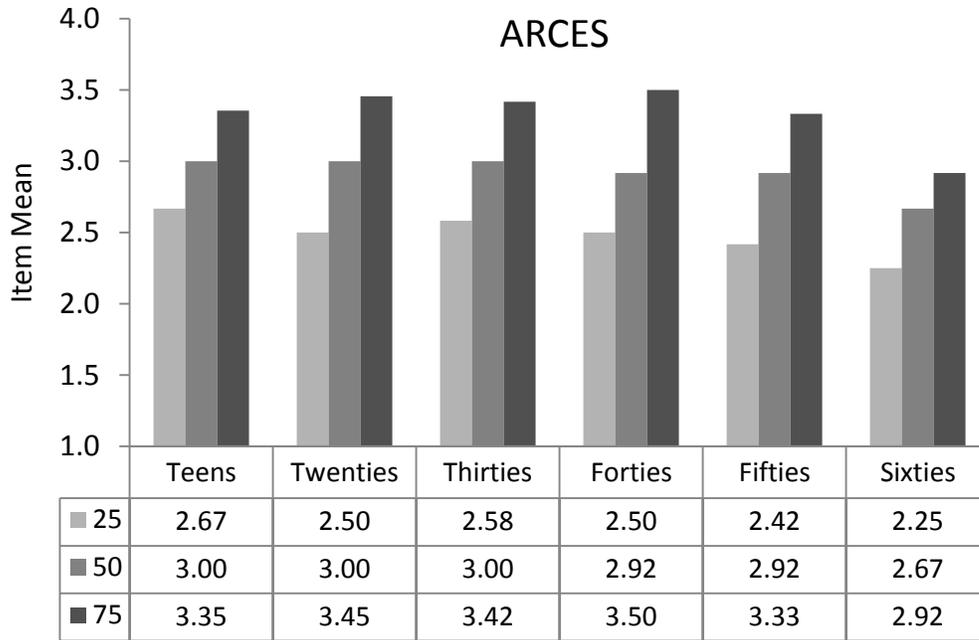
	1	1.5	2	2.5	3	3.5	4	4.5	5	
	17	95	371	602	580	317	117	51	6	Frequency
	0.8	5.2	22.4	50.3	77.2	91.9	97.4	99.7	100	Percentile
	0.8	4.4	17.2	27.9	26.9	14.7	5.4	2.4	0.3	Percentage
										Measure (N)*
-	2.42	2.65	3.09	3.44	3.85	4.16	4.79	-	-	MAAS-LO (2146)
-	2.03	2.36	2.63	2.88	3.31	3.53	3.78	-	-	MFS (1120)
-	0.33	0.37	0.40	0.46	0.53	0.54	0.63	-	-	SART Errors (1074)
-	1.07	1.30	1.69	2.07	2.40	2.66	3.07	-	-	CFQ (443)
-	3.09	3.28	3.52	3.71	4.02	4.31	4.67	-	-	BPS (919)
-	0.39	0.36	0.51	0.64	0.86	1.03	1.21	-	-	BDI-II (682)
-	0.54	0.62	0.72	0.97	1.17	1.53	1.69	-	-	DASS-Dep. (842)
-	0.42	0.42	0.56	0.86	0.91	1.27	1.54	-	-	DASS-Anx. (842)
-	0.68	0.80	0.92	1.23	1.41	1.57	2.01	-	-	DASS-Stress (842)
-	3.33	3.06	3.06	2.96	2.87	2.74	2.75	-	-	GSE (618)
-	0.84	0.88	1.01	1.11	1.37	1.46	1.62	-	-	ESS (1210)

* Cells with $n < 20$ are excluded

Measure by Decade



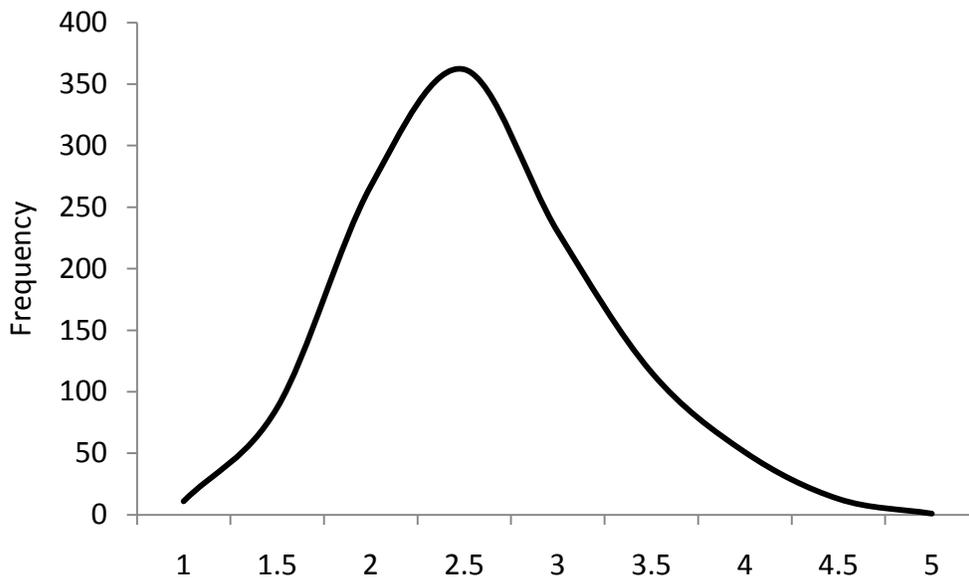
Score Quartiles by Decade



Appendix D

Psychometric Properties of the Memory Failures Scale and Related Measures

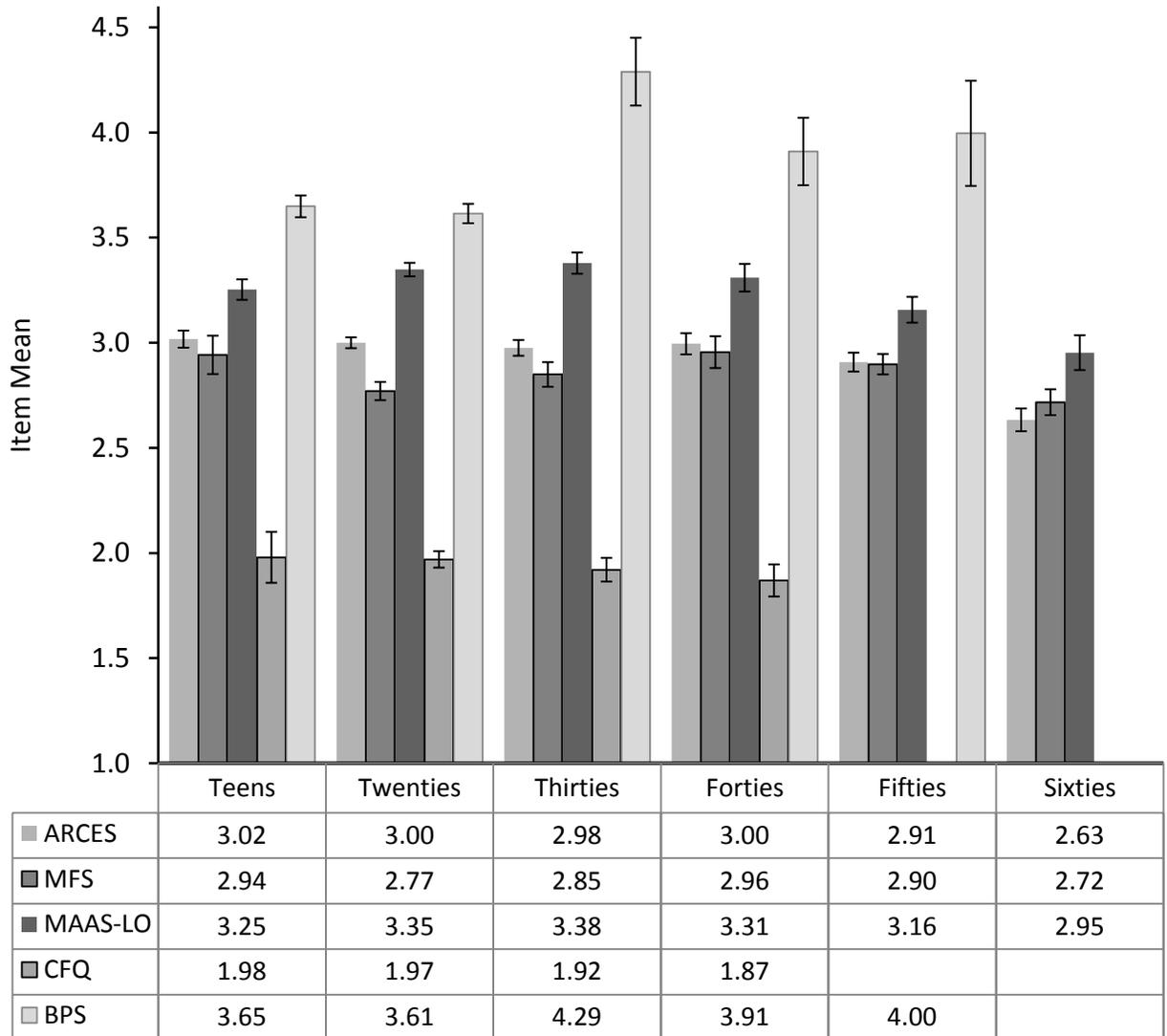
MFS Item Mean



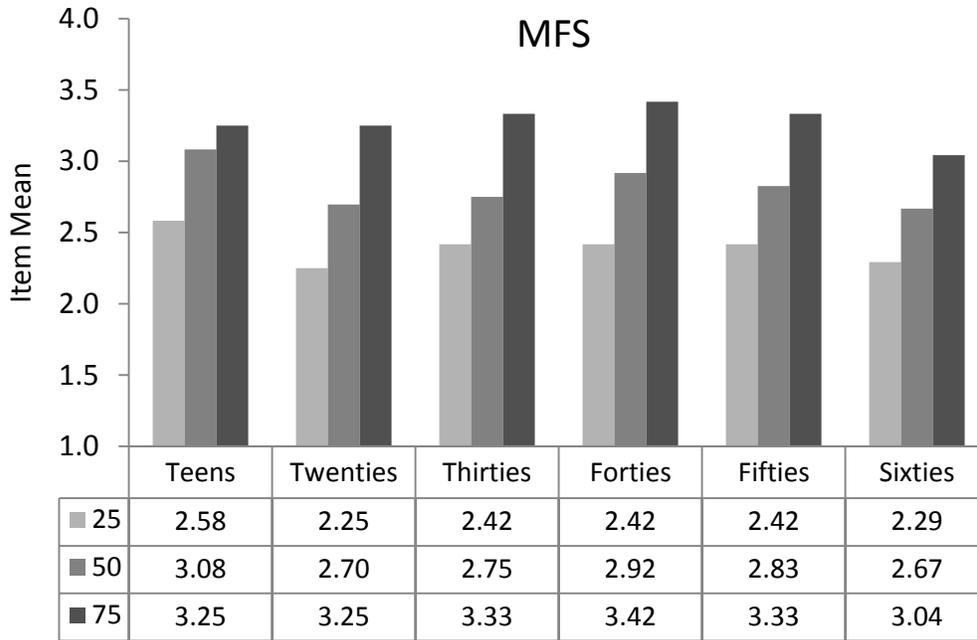
11	87	267	362	230	116	51	13	1	Frequency
1.0	8.6	32.1	63.9	84.1	94.3	98.8	99.9	100	Percentile
1.0	7.6	23.5	31.8	20.2	10.2	4.5	1.1	0.1	Percentage
<hr/>									
									Measure (N)*
-	2.29	2.58	2.93	3.24	3.62	3.77	-	-	ARCES (1120)
-	2.51	2.87	3.21	3.62	3.92	4.26	-	-	MAAS-LO (1125)
-	0.33	0.37	0.40	0.45	0.48	0.57	-	-	SART Errors (711)
-	3.09	3.32	3.65	3.87	4.08	4.57	-	-	BPS (359)
-	0.40	0.47	0.52	0.74	0.99	1.26	-	-	BDI-II (342)
-	0.74	0.92	0.99	1.17	1.35	1.34	-	-	ESS (768)

* Cells with $n < 20$ are excluded

Measure by Decade



Score Quartiles by Decade



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