THE EFFECTS OF A BRIEF MINDFULNESS INDUCTION ON METAMEMORY FOLLOWING REPEATED CHECKING

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Abstract

The effects of a brief mindfulness induction on metamemory following repeated checking

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Memory distrust has been found to be both associated with repeated checking behaviour in individuals with OCD (Radomsky, Rachman, & Hammond, 2001) and a product of repeated checking in non-clinical samples (van den Hout & Kindt, 2003a, 2003b). Interventions designed to target memory distrust could attenuate declines in confidence in memory following repeated checking, and thus the urge to check again. Mindfulness training has been defined as including processes such as the self-regulation of attention and metacognitive awareness (Bishop et al., 2004; Shapiro, Schwartz, & Bonner, 2006; Teasdale, 1999). It was hypothesized that a brief mindfulness intervention would attenuate decreases in metamemory following repeated checking. Participants were randomly assigned to one of three groups in which they listened to a short tape-recording of: 1) mindfulness instructions, 2) relaxation instructions or 3) a song selection (control group). Participants then completed a single and a repeated checking task. Participants were asked to provide memory, metamemory, and mood ratings. It was found that memory accuracy and metamemory scores decreased for all participants, but no differences between the groups were revealed. However, participants who scored high on a trait-measure of mindfulness exhibited greater declines in metamemory while reporting significantly lower anxiety and negative affect than those who scored high on the trait-measure. These findings are discussed in relation to a cognitive approach to compulsive checking.

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THE EFFECTS OF A BRIEF MINDFULNESS INDUCTION ON METAMEMORY FOLLOWING REPEATED CHECKING

Obsessive-compulsive disorder (OCD) is characterized by intrusive thoughts, images or impulses (obsessions) and/or repetitive behaviour, rituals or mental acts (compulsions) (American Psychiatric Association, 2000). The prevalence of OCD is estimated to be roughly 2.5% of the population based on community samples (APA, 2000), a significant percentage given its potentially debilitating effects on general functioning.

Repeated checking behaviour is one of the most predominant compulsions in OCD, and individuals who check compulsively often report that they do so because they feel uncertain about the status of the object in question (Rachman & Hodgson, 1980). Indeed, individuals who compulsively check have been found to experience feelings of uncertainty in many areas, including judgments of memory (Dar, 2004). It has been proposed that compulsive checkers experience pathological doubt due to impaired memory or a damaged capacity for information-processing (Rubenstein, Peynircioglu, Chambless, & Pigott, 1993; Sher, Mann, & Frost, 1984; Tallis, 1997). This memory deficit hypothesis has been challenged by researchers who have found that uncertainty may arise from a memory bias for remembering information relevant to the perceived threat itself rather than any actual impairment in memory or information processing (Rachman, 2002; Radomsky & Rachman, 1999; Radomsky, Rachman, & Hammond 2001; Tolin et al., 2001; see also Constans, Foa, Franklin, & Mathews, 1995). Furthermore, research has also demonstrated that decreases in aspects of metamemory, such as memory confidence, vividness and detail, follow repeated checking (van den

Hout & Kindt, 2003a, 2003b, 2004; Radomsky, Gilchrist, & Dussault, 2006; Coles, Radomsky, & Horng, in press).

A recent cognitive model of compulsive checking speculates that there are several elements that contribute to repeated checking behaviour, including a lack of confidence in memory (Rachman, 2002). Memory distrust is hypothesized to arise as a combined effect of three "multipliers": 1) inflated responsibility, 2) perceived probability of harm and 3) perceived seriousness of harm. Checking behaviour is then maintained by a "self-perpetuating mechanism" that involves decreased confidence, vividness and detail in memory. The perceived inability to accurately recall auditory, visual or other cues may propel an individual to seek further reassurance that a check has been completed, and this is often sought in the form of additional checks of the given object.

Research has demonstrated a relationship between metamemory and inflated responsibility in association with repeated checking. For example, it has been found that decreased confidence in memory is a function of elevated responsibility in compulsive checkers (Radomsky et al., 2001; Tolin et al., 2001). Radomsky and colleagues (2001) tested the memory of compulsive checkers to determine whether participants would show a positive memory bias for threat-relevant information under conditions of increased perceptions of responsibility. They found that a memory bias for threat-relevant information was related to increased perceptions of responsibility, but that confidence in memory decreased in association with the same elevation in perceived responsibility. Furthermore, Tolin and colleagues (2001) briefly exposed compulsive checkers, anxious controls and non-anxious controls to threat-relevant and neutral stimuli, and repeatedly asked them to recall as many of the presented items as possible. Self-reports showed a

decrease in memory confidence after repeated retrievals in the compulsive checkers, whereas no differences were observed between the groups on scores of memory accuracy. Taken together, the results of these studies suggest that there is a direct link between memory distrust and inflated responsibility. Thus, decreased confidence in memory could be related to elevations in perceived responsibility for threat-relevant stimuli in individuals with OCD, consistent with Rachman's (2002) cognitive theory of compulsive checking.

Many of the cognitive processes involved in OCD also occur in the general population (Gibbs, 1996; Rachman & de Silva, 1978). Research with non-clinical populations has found that decreased confidence in memory may be a direct result of engaging in repeated checking behaviour, as demonstrated by van den Hout, & Kindt (2003a, 2003b, 2004), Radomsky et al. (2006), and Coles et al. (in press). Initially, Van den Hout and Kindt (2003a, 2003b) proposed that decreased confidence in memory for specific checks following repeated virtual checking tasks on a computer is a byproduct of a cognitive transition that occurs when individuals switch from processing novel information to processing information that is familiar. That is, given that the more familiar (repeated) the event (activity), the less detailed and vivid it becomes in recollection (Johnson & Hawley, 1994), factors such as vividness and detail of a recollection are thought to be influential in evaluating how confident an individual might feel in their memory. Thus, it was suggested that memory distrust after repeated checking results from the transition of a simple (*perceptual*) type of processing to a more semantic (*conceptual*) form as the checks increase and the activity becomes increasingly familiar (van den Hout & Kindt, 2003a). To examine the hypothesis that repeated checking causes

memory distrust, van den Hout and Kindt (2003a, 2003b) assessed confidence in memory in student participants following various repeated checking tasks. Participants were trained to use a specially-designed interactive computer program of animated gas rings and light bulbs to turn a virtual stove and a virtual lamp on and off, as well as to check both sets of items repeatedly (many times) or not repeatedly (once) as requested by the experimenter. It was found that memory confidence scores did decrease significantly after repeated checking. Furthermore, it was also found that beliefs about the outcome of checking were more likely to be based on a feeling of *knowing* rather than of *remembering* (Tulving, 1985), suggesting that the more an activity is repeated, the less likely an individual is to rely on judgments of memory (2003b, see van den Hout & Kindt (2004) for a review). Perhaps the decreases in confidence in memory in those with OCD are mediated by increases in responsibility for items that are perceived to be linked to the threatening outcome (Radomsky et al, 2001; Tolin et al, 2001), as well as by a shift from one type of processing to another. Two recent investigations provide supplemental evidence of this effect when similar decreases were observed under conditions of increased ecological validity, such as checking of a stove and a water faucet in lab kitchens (Coles et al., in press; Radomsky et al., 2006). Even as repeated checking is considered to be a strategy for memory reassurance it paradoxically operates to undermine memory confidence (van den Hout & Kindt, 2004). That is, a lack of confidence in memory for whether the check had been completed correctly may serve as a justification for a future check or checks. Taken together, these studies suggest that repeated checking of an item affects metamemory in the form of waning judgments of confidence, vividness, and detail in memory. Thus, the distrust in memory judgments that

follows repeated checking may be understood as a consequence of the repeated checking itself, as well as a promoter of additional checking.

There is an inconsistency in the literature regarding whether repeated checking produces changes in the accuracy of memory for check(s). Van den Hout & Kindt (2003a, 2003b) found no evidence of decreases in memory accuracy when comparing memory for checks on a virtual stove following a single check versus following repeated checks, despite significant differences across time on metamemory variables. However, similar studies designed to replicate these results under ecologically valid conditions (i.e., in a lab kitchen with participants checking a real stove) found that participants exhibited declines in memory accuracy following repeated checking compared to following a single check (Coles et al., in press; Radomsky et al., 2006). The results of the latter studies suggest that checking a real stove produces more widespread effects of repeated checking than checking a virtual stove, with declines in memory accuracy being one such effect.

Cognitive-behavioural treatments for compulsive checking are currently the interventions of choice for OCD (Whittal & O'Neill, 2003). Treatments targeting faulty and/or dysfunctional beliefs and interpretations of the obsessions and compulsions, as well as exposure and response prevention (ERP), have been found to be efficacious for OCD in general (Whittal, Thordarson, & McLean, 2005), compulsive washing (Meyer, 1966), as well as for compulsive checking (Clark, 2000; Morrison & Westbrook, 2004). It has been suggested that interventions targeting processes of metamemory may be a beneficial addition to existing cognitive-behavioural interventions for compulsive checking (Muller & Roberts, 2005). The goal of such treatments would be consistent

with broader cognitive treatment models for compulsive checking, in that they would aim to help individuals reduce the urge to check repeatedly by targeting faulty beliefs regarding memory judgments, and to examine how these beliefs may be distorted by doubt. Memory of the check(s) would presumably be accessed more easily and accurately as metacognitive processing becomes less subject to evaluation. This could reduce the uncertainty related to a) memory judgments, and b) to the checked state of the object in question, and result in reduced time spent checking, thus promoting increased confidence in memory. The development of treatment strategies targeting metamemory is consistent with current cognitive theory and research on compulsive checking.

Among the newest strategies being integrated into cognitive-behavioural therapy (CBT) are mindfulness or acceptance-based therapies (Bishop et al., 2004; Lau & McMain, 2005). Mindfulness, or mindful experiencing, is a way of paying attention that originated in Buddhist meditation practices, and both its application as a treatment alone, as well as its integration into contemporary treatment approaches is increasing (Roemer & Orsillo, 2002). Mindfulness training has been described as a form of mental training that may reduce the kinds of cognitive vulnerability that appear to perpetuate psychopathology (Bishop et al., 2004). In this way, mindfulness could be conceptualized as being consistent with cognitive-behavioural approaches to psychopathology, however the focus in mindfulness-based approaches is on cognitive awareness as opposed to cognitive change (Lau & McMain, 2005).

Mindfulness has been defined as "...paying attention in a particular way: on purpose, in the present moment, and non-judgmentally. This kind of attention nurtures greater awareness, clarity and acceptance of present-moment reality..."(Kabat-Zinn,

1994, p. 4) and "...enhanced attention to and awareness of current experience" (Brown & Ryan, 2003, p. 822). For an extended elaboration of mindfulness meditation, see Kabat-Zinn, (1994). Although current attempts to operationalize the construct of mindfulness differ in precise detail, there is "...general agreement that [mindfulness] meditation is concerned with alterations to and/or training of attention of some kind" (Valentine & Sweet, 1999, p.60). Similarly, two qualities associated with its development and therapeutic utility appear to be consistent across definitions: 1) the self-regulation of attention, and 2) metacognitive awareness (Bishop, 2002; Bishop et al., 2004; Dimidjian & Linehan, 2003; Teasdale, 1999. *Self-regulation* of attention in mindfulness is suggested to be the ability to simultaneously observe all thoughts and yet to make note of the primary mental event (Bishop, 2002). Control of attention is thus maintained by the inhibition of an elaboration of the observed contents. This concept is different to *self-focused* attention, where a heightened awareness of internally generated information may in fact cause excessive and rigid attention to internal information (Ingram, 1990). Metacognitive awareness is said to develop with mindfulness practice by improving one's ability to accurately monitor one's internal cognitive process (Bishop et al., 2004), and by "separating reactions from sensory events" (Epstein, 1995, p. 110). Here, an individual is able to experience thoughts as mental events, and not as indications of the truth about oneself or anything external to it (Teasdale, 1999). In general, it is proposed that the practice of mindfulness permits the intentional maintenance of meta-processing (cognitive awareness) on objects of attention (Teasdale, 1999). The development of mindfulness is proposed to improve the sustained attention and switching capabilities that regulate the focus of attention and inhibit the over-processing of meta-cognitive material

(Bishop et al., 2004). Presumably, attentional resources can then be freed-up to process information relevant to current experience, and accommodate the integration of internal and external events simultaneously.

There is disagreement in the literature regarding whether mindfulness is a state or a trait quality. It has been argued that individuals may have an innate tendency to be/not to be mindful, in that they differ in their ability to sustain attention and be aware of present-moment internal and external experiences (Brown & Ryan, 2003). Conversely, others maintain that mindfulness is a strategy rather than a predisposition, in that mindful awareness can be evoked and maintained through training in attention-regulation (Bishop et al., 2004). While both arguments have validity, the latter description is more consistent with a cognitive-behavioural approach to treatment development, in that it assumes that the ability to be mindful is a mutable quality (i.e., it can be learned), and not an innate characteristic.

Empirical support for interventions based on Buddhist meditation training have been found to be useful in relapse prevention for those with recurrent depression (Teasdale, Segal, & Williams, 1995), with chronically suicidal patients with borderline personality disorder (Linehan, 2000), as well as the management of chronic pain (Kabat-Zinn, Lipworth, & Burney, 1985) and the mitigation of stress in non-clinical samples (Shapiro et al., 1998). Although not technically an acceptance-based strategy, Salkovskis and colleagues (1999) found that exposure was an effective means of decreasing catastrophic beliefs and anxiety in individuals with panic disorder. This approach to exposure bears a strong resemblance to mindfulness instructions that request individuals to stay in the present moment, and accept whatever emotion(s), sensation(s) or thought(s)

arise. Furthermore, it was recently found that individuals who participated in a focused breathing induction (similar in structure and content to mindfulness instructions) displayed a less volatile and emotionally reactive response to neutral, positive and negative slides, suggesting that mindfulness-type instructions positively effect emotional regulation (Arch & Craske, in press). In this way, theoretical rationales for other acceptance-based interventions are currently at the forefront of psychological innovations for many disorders, including substance abuse (Breslin, Zack, & McMain, 2002) and generalized anxiety disorder (GAD: Roemer & Orsillo, 2002; Wells, 2002). At the present time, mindfulness has yet to be investigated in relation to compulsive checking, or more particularly, associated memory distrust.

Accordingly, the primary rationale for this investigation is based on the assertion that it is the repeated processing of an object that changes when the event ceases to be novel (van den Hout & Kindt, 2003a, 2003b, 2004). Since the novelty of a situation has been found to increase attention and memory for specific stimuli (Carson, Shih, & Langer, 2001), approaching a stimulus mindfully may facilitate the ability to continuously gather novel information from the environment and draw fresh distinctions between stimuli. Mindfulness training could increase the likelihood that one will experience an event as new by engaging in cognitive processing that is perceptually based, and thus lead to increased vividness and detail in memory. Increasing the salience of these aspects of memory could result in less of a reduction in memory confidence. Mindfulness training may therefore provide a buffer to the memory distrust that occurs during repeated checking. Perhaps this would increase not only the potential for recall, but also the potential for a higher "feeling-of-knowing" (Tulving, 1985) that may be

synonymous and/or associated with increased confidence in memory (van den Hout & Kindt, 2004). Mindfulness training may affect future reports of metamemory by increasing awareness of one's cognitive processes through observation (rather than engagement of meta-cognitive activity) (Toneatto, 2002). Finally, mindfulness instructions may have a positive impact on emotion regulation during/following repeated checking by supporting the acceptance of negative thoughts.

Current research has begun to address questions regarding the mechanisms of action involved in mindfulness training (e.g. Arch & Craske, in press), with the goal of enhancing treatment interventions. Mindfulness training has been described as multifaceted, in that certain components of it may be more applicable to some clinical conditions than to others (Teasdale, Segal, & Williams, 2003). It has been speculated that mindfulness-based strategies could be especially useful in providing internal evidence about the futility of the compulsive strategies (Bishop et al., 2004). Consistent with the hypothesized features of self-regulation, it has been suggested that mindfulness interventions may also be associated with cognitive change (Baer, 2003).

The present study aimed to compare the effects of brief mindfulness instructions to the effects of brief muscular relaxation instructions and a control condition in a student population during a repeated checking task. Each group was directed to use the instructions they had heard on a recording to help them complete a repeated checking exercise on a threat-relevant item (a stove) in a lab kitchen, after which all participants were asked to make self-reported judgments of memory and metamemory.

The present study was thus designed to answer the following questions:

1. Does repeated checking lead to decreases in aspects of metamemory (confidence, vividness, and detail in memory)?

2. Does repeated checking lead to decreases in memory accuracy?

3. Do brief mindfulness instructions promote feelings of present-moment focus better than relaxation or control instructions?

4. Do brief mindfulness instructions promote enhanced metamemory after repeated checking compared to brief relaxation instructions or a control condition?

5. Do brief mindfulness instructions attenuate self-reports of negative affect after repeated checking compared to brief relaxation instructions or a control condition?

6. Do individuals who score higher on a measure of trait mindfulness exhibit a greater confidence, vividness, and detail of memory following repeated checking than those who score low on the same measure?

7. Do individuals who score higher on a measure of trait mindfulness exhibit less negative affect following repeated checking than those who score low on the same measure?

Hypotheses

It was predicted that participants would demonstrate decreases on scores in confidence, vividness, and detail of memory following the repeated checking task. Based on recent findings under equally ecologically valid conditions (Coles et al., in press; Radomsky et al., 2006), it was predicted that memory accuracy scores would also decrease. As a manipulation check, it was predicted that participants in the mindfulness condition would demonstrate higher self-reported scores of present-moment focus than those in the relaxation or control conditions following repeated checking, as well as at the end of the testing session 25 minutes later. Participants in the mindfulness condition were expected to demonstrate the smallest declines in metamemory, as well as the smallest increases in negative affect when compared to the other two conditions. It was also hypothesized that participants who scored high on the trait mindfulness measure would

display higher confidence, vividness and detail ratings after repeated checking than those who scored low on the same measure. Finally, it was hypothesized that participants who scored high on the trait mindfulness rating would report less negative affect following repeated checking than those who scored low on trait mindfulness.

Methods

Participants

Ninety-nine volunteer undergraduate students from Concordia University participated in this study. Participants were recruited through flyers posted in the university buildings of the Loyola campus of Concordia University and through announcements made in undergraduate classes. Participants' names were included in a draw for cash prizes as compensation for their time. Nine participants were excluded from analyses due to incomplete data.

On average, participants were 22.4 (SD = 3.3) years old and ranged in age from 18-34 years. Seventy-four percent of the overall sample was female. In the mindfulness condition, the mean age of participants was 22.2 (SD = 2.48) years, with a range of 19 to 30 years. The mean age of participants in the relaxation condition was 22.8 (SD =4.1) years, with a range from 18-34 years. The mean age of participants in the control condition was 22.8 (SD =4.10) years, with a range from 18 to 34 years. There were no differences between the conditions in age F (2, 86) = .22, *n.s.* Sixty-three percent of participants in the mindfulness conditions were female, seventy percent of participants in the relaxation condition were female, and ninety percent of participants in the control condition were female. As there was a significant difference between the conditions, F (2, 87) = 3.15, $p < .05$, independent sample t-tests were conducted comparing scores of men

and women on the: BDI-II, BAI, VOCI, self-report mindfulness ratings, TMS, and MAAS (see Measures below; see Appendix A for individual statistics). No significant differences were found, $p > .05$.

Information collected from the BDI-II, the BAI, and the VOCI (see Measures, below), was used to establish the non-clinical nature of the sample. There were no significant differences between the conditions on the BDI-II, $F(2,87) = .61$, *n.s.*, BAI, $F(2, 86) = .10$, *n.s.*, or the VOCI, $F(2,87) = 2.61$, n.s. Scores on self-report measures of obsessive compulsive, depressive and anxious symptomatology are displayed in Table 1.

Measures

Questionnaires (See Appendix B)

Vancouver Obsessional Compulsive Inventory (VOCI; Thordarson et al., 2004):

The VOCI is a 55-item self-report instrument designed to measure obsessive-compulsive symptomatology. There are 6 component subscales assessing various symptoms and features that have been found to be associated with OCD: checking; contamination; hoarding; indecisiveness; just right; and obsessions. The VOCI possesses good inter-item reliability in student, community, OCD, and clinical control populations, as well as high test-retest reliability in clinical samples (Thordarson et al., 2004). The VOCI is a relatively new measure, and its use in research is increasing (Radomsky et al., in press).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996):

The BDI-II is a 21-item self-report instrument for the measurement of the severity of depressive symptomatology (Beck et al., 1996). For each item, respondents indicate which of four self-evaluative statements best describes their experience of a particular

Table 1

Mean scores (SD) on measures assessing obsessive-compulsive, depressive and anxious symptomatology

Condition	VOCI[a]	BDI[b]	BAI[c]
MC	26.97 (23.25)	8.47 (5.30)	13.63 (10.94)
RC	23.20 (20.78)	9.57 (6.45)	13.43 (7.51)
CC	36.53 (25.55)	10.53 (9.28)	14.52 (10.81)
Total	28.90 (23.70)	9.52 (7.17)	13.85 (9.77)

Note. Groups did not differ on any measure (all p's > 0.05). MC = Mindfulness Condition *(n = 30)*, RC = Relaxation Condition *(n = 30)*, CC = Control Condition *(n = 30)*.

[a] VOCI refers to the Vancouver Obsessional Compulsive Inventory (Thordarson, Radomsky, Rachman, Shafran, Sawchuk, & Hakstian, 2004).

[b] BDI-II refers to the Beck Depression Inventory, Second Edition (Beck, Steer, & Brown, 1996).

[c] BAI refers to the Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988).

depressive symptom. The BDI-II demonstrates high internal consistency and good test-retest reliability, as well as good convergent and divergent validity (Beck et al., 1996).

Beck Anxiety Inventory (BAI; Beck, & Steer, 1990):

The BAI is a well-validated 21-item self-report instrument for the assessment of mainly physiological symptoms of anxiety (Beck, & Steer, 1990). In clinical and non-clinical samples, the BAI exhibits good internal consistency (Creamer, Foran, & Bell, 1995; Fydich, Dowdall, & Chambless, 1992), however test-retest reliability was only moderate in both groups (Creamer et al., 1995; Fydich et al., 1992). The BAI also demonstrates excellent divergent validity in comparison with other measures of anxiety (Creamer et al, 1995; Fydich et al, 1992).

Toronto Mindfulness Scale (TMS; Bishop et al., 2003):

The TMS is a 10-item self-report instrument for the assessment of mindfulness as a subjective experience and a state quality. Using a 5-point Likert-type scale, respondents answer questions such as "I noticed when I became lost in my thoughts, daydreams or fantasies" and "I was aware of my experiences constantly changing" with qualitative descriptors ranging from *not at all* to *very much*. Higher scores indicate higher levels of mindfulness. It is intended to measure the level of mindfulness during a single point in time and one's ability to attain a mindful state following a meditation exercise. The TMS was found to be reliable and valid for individuals with and without previous mindfulness meditation experience (Bishop et al., 2003).

Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003):

The MAAS is a 15-item self-report instrument measuring the general tendency to sustain attention to what is occurring in the present-moment in daily life. Using a 6-point

Likert scale from *almost always* to *almost never*, respondents rate how often they feel, for example, like they are acting on automatic pilot and are preoccupied. Higher scores reflect higher mindfulness. The MAAS was found to be a reliable instrument for college-aged and general-adult populations, and to discriminate between individuals with and without previous mindfulness mediation experience. The authors report good internal consistency (coefficient $\alpha = .82$), and found that the MAAS was significantly positively correlated with features such as openness to experience, and negatively correlated with others such as rumination.

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)

The PANAS is a self-report instrument designed to measure two independent dimensions of mood: negative and positive indicators of affect. Each of the negative and positive affect subscales consist of 10-items in the form of adjectives of mood states, and respondents are instructed to indicate to what extent they are experiencing each item from 1 (*very slightly or not at all*) to 5 (*extremely*). It has been found to be a reliable and valid measure of positive and negative affect (Crawford & Henry, 2004; Watson, Clark, & Tellegen, 1988).

Memory Measures (See Appendix C)

Memory Accuracy

Participants were asked to indicate on a diagram (see Figure 1) displaying six stove knobs, which three knobs they checked during the most recent trial. They were asked to do so at both Time 1 (following a single check) and Time 2 (following repeated checking).

Subjective Rating Scales (See Appendix D)

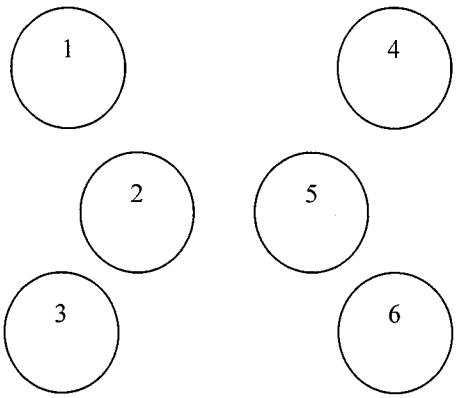

Figure 1. Display guide to stove knobs.

Metamemory: Memory confidence, vividness and detail

Participants were asked to rate, on a scale of 0-100, how confident they were in their memory that they had completed the last trial properly, as well as how vivid and how detailed was their memory of the last trial. Participants were told that "0" represents "not at all and "100" represents "extremely".

Anxiety (Subjective Units of Distress Scale [SUDS; Wolpe, 1958]):

To measure self-reported anxiety at baseline, Time 1 and Time 2, participants were asked to rate their anxiety on a Subjective Units of Distress Scale (SUDS; Wolpe, 1958), ranging from zero (no anxiety/feelings of calmness) to 100 (extreme anxiety/feelings of panic).

Other Rating Scales

Focus on the present moment

To assess the degree to which the metacognitive aspects of mindfulness changed over the course of the experiment, participants were asked to rate their current state of mindfulness, ranging from zero (not at all focused on the present moment) to 100 (totally focused on the present moment).

State of relaxation

To assess self-reported state of relaxation, participants were asked to rate how relaxed they felt, ranging from 0 (not at all relaxed) to 100 (completely relaxed).

Procedure (see Figure 2 and Appendix E)

Following the provision of informed consent (see Appendix F), participants were randomly assigned to one of three conditions: 1) mindfulness condition (MC), 2) relaxation condition (RC), or 3) control condition (CC). Experimenters were blind to

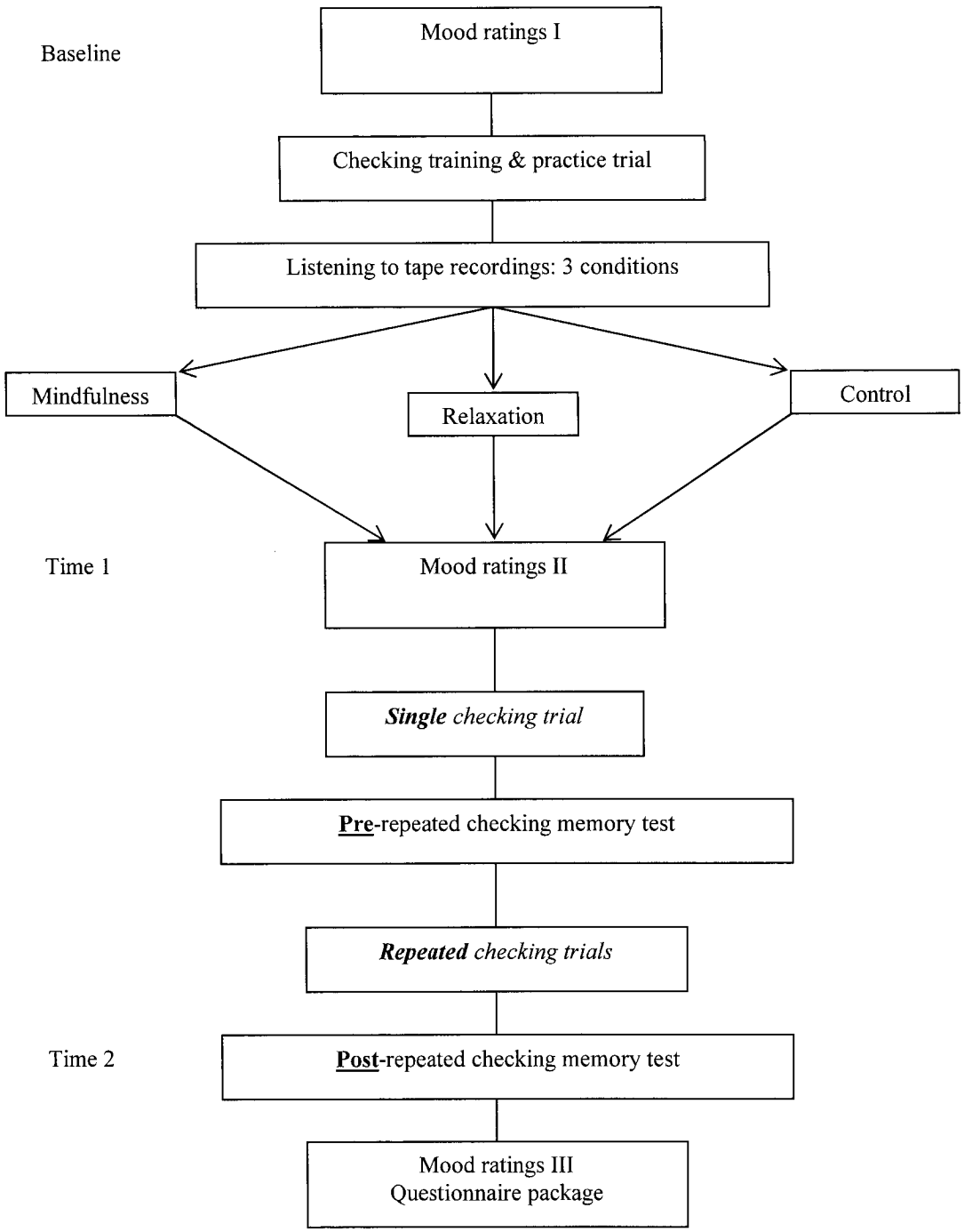

Figure 2. Experimental procedure.

participants' conditions. Participants were invited to sit in a quiet lab space where they were first asked to provide SUDS ratings, as well as ratings of mindfulness and relaxation, and to complete the PANAS. The experimenter then asked participants to move to the laboratory kitchen to be trained to properly and safely turn on, turn off, and check the knobs on the stove (see Figure 3). All plastic knobs were removed from the stove except for the one participants would use during the experiment.

Checking trials were completed with the participant in the kitchen and the experimenter in another room however, for the training period, the experimenter remained in the kitchen with the participant. Participants were told that communication with the experimenter would be via intercom, and that the doors between the rooms would remain closed but unlocked for the duration of the experiment. The experimenter explained that the knobs on the stove were referred to as knob 1, knob 2, etc., and the participant was furnished with a guide on the wall next to them indicating the knobs and their corresponding numbers (see Figure 1). The participants were trained to a) turn-on, b) turn-off, and c) check a set of three knobs on the stove in a standardized manner. An example of a single checking task on the stove was, "Now I would like you to turn on knobs 1, 3, and 6; tell me when you are finished (communication via intercom that they have done so). Now I would like you to turn them off; tell me when you are finished (communication via intercom that they have done so). Now I would like you to check them; tell me when you are finished (communication via intercom that they have done so)."After the experimenter explained what would happen during the checking trials, one practice trial was completed with the experimenter in the room.

The experimenter then invited the participant to a quiet lab space and explained

Figure 3. Test stove.

that the participant would be listening to a tape-recording. The experimenter told the participant that they need only to sit and listen to the tape, and asked that they not engage in any other activity. The participant was left alone in the room with the door closed for the duration of the tape. The recorded instructions were either: a) mindfulness instructions, asking the participant only to focus on the rhythm and flow of their breath, b) relaxation instructions, asking that the participant try to relax fully and attain a sense of calmness through muscular relaxation exercises, or c) a recording of "Whistle While You Work"©, from the "Snow White and the Seven Dwarves"© soundtrack (See Appendix G for transcripts of tape-recordings).

The experimenter returned after the recordings had finished and took another set of SUDS, mindfulness and relaxation ratings, and asked the participant to complete a second PANAS. After one checking trial (Time 1), a short memory test was given to the participants to assess memory accuracy for which knobs they had just checked, their confidence in memory for the check, and how vivid and detailed was their memory of that check. Following this, the experimenter reminded all three groups of participants of what they had listened to prior to training, and to attempt to use those instructions to better complete the task they would be beginning in a moment. The participant then returned to the kitchen to complete the checking tasks with the experimenter via the intercom. After 4 checking trials, the experimenter again reminded the participants via intercom of the instructions they had listened to prior to training, and to attempt to use those instructions to better complete the task for the upcoming trials. The participant continued to complete 4 more checking tasks with the experimenter via the intercom. In total, the participants completed 8 checks of the stove.

After the checking trials had been completed, participants returned to the quiet lab space to complete the Time 2 memory test. The experimenter took final SUDS, mindfulness, and relaxation ratings, and participants completed the rest of the questionnaires (VOCI, BDI-II, BAI, MAAS), as well as a final PANAS. When they completed the questionnaires, participants were debriefed and thanked for their time and participation (see Appendix H for debriefing script).

Results

Missing Data

Missing data was addressed on a per analyses basis. A participant was not excluded from other analyses if s/he had not answered a question relevant to a given analysis.

Metamemory

To determine if there were differences between the conditions on confidence, vividness or detail of memory, participants' ratings at Time 1 and Time 2 were compared using a 2 X 3 mixed MANOVA. As expected, there was a main effect for time, F (3, 85) = 35.31, $p < .001$. Follow-up univariate ANOVAs for confidence (F (1, 87) = 89.13, $p <$ .001), vividness (F (1.87) = 101.86, $p < .001$), and detail (F (1, 87) = 89.70, $p < .001$), revealed that metamemory scores fell significantly from Time 1 to Time 2. There were not any significant differences between the conditions, F (6, 172) = .93, *n.s.*, nor was there a significant interaction of condition and time, F (6, 172) = .88, *n.s.* Metamemory and memory accuracy results are presented in Table 2.

Memory Accuracy

To determine if there were differences in memory between Time 1 and Time 2, participants' reports of which knobs they had checked on the single trial (Time 1) and on

Table 2

Participants' memory accuracy (1-3) and metamemory (0-100) ratings following a single check and following repeated checks

Condition		Time 1	Time 2
	Rating	*M (SD)*	*M (SD)*
MC*			
	Accuracy	2.97_{a} (0.18)	2.43_{b} (0.77)
	Confidence	93.47_{a} (11.36)	62.40_{b} (32.73)
	Vividness	88.37_{a} (11.13)	53.37_{b} (33.13)
	Detail	85.20_{a} (19.21)	48.70_{b} (34.84)
RC*			
	Accuracy	3.00_{a} (0.00)	2.60_{b} (0.62)
	Confidence	95.67_{a} (10.37)	60.67_{b} (31.99)
	Vividness	91.70_{a} (10.44)	57.50_{b} (30.12)
	Detail	85.93_{a} (18.11)	56.67_{b} (31.52)
CC*			
	Accuracy	2.87_{a} (0.51)	2.77_{b} (0.61)
	Confidence	94.33_{a} (8.78)	63.17_{b} (32.15)
	Vividness	91.50_{a} (9.57)	62.50_{b} (30.51)
	Detail	91.13_{a} (9.48)	62.67_{b} (31.40)

Note. MC = Mindfulness Condition *(n = 30)*, RC = Relaxation Condition *(n = 30)*, CC = Control Condition *(n = 30)*. Means in the same row that share the same subscript do not differ at $p > 0.05$.
*ps > 0.05.

the last trial of the repeated checks (Time 2) were compared using a 2 X 3 mixed ANOVA. The independent variables were condition and time, and the dependent variable was memory accuracy. A significant main effect for time was found, F (1, 87) = 25.71, p < .001. Follow-up comparisons revealed that memory accuracy was significantly higher at Time 1 than Time 2. However, there were no significant differences between the groups, F (2, 87) = .52, *n.s.*, nor was there a significant interaction between group and time, F (2, 87) = 1.69, *n.s.*

Manipulation check:Mindfulness

To establish whether or not the mindfulness manipulation was effective, participants' ratings of how focused they were on the present moment across time were compared using a 3 X 3 mixed ANOVA with time (Baseline versus Time 1 versus Time 2) as the within-participants factor, and condition (MC versus RC versus CC) as the between-participants factor. It was expected that there would be no differences between the participants on this measure at baseline, but that participants in MC would report feeling more focused on the present moment at Time 1 and Time 2 than those in RC and CC. There was a significant main effect for time, F (2,174) = 6.50, p < .002, indicating that scores were significantly different across time. Pairwise comparisons revealed that present-moment focus scores were higher at Baseline than at either Time 1 or at Time 2. Contrary to expectations, however, there were no significant differences between the conditions for mindfulness scores F (2, 87) = 2.36, *n.s.*, nor was there a significant interaction between time and condition, F (4,174) = .24, *n.s.*

The Toronto Mindfulness Scale (TMS) was used to assess changes in participants' level of mindfulness across time. TMS scores were compared at Baseline,

Time 1 and Time 2 using a 3 X 3 mixed ANOVA with time as the within-participants factor, and condition as the between-participants factor. Again it was predicted that TMS scores would be higher at Time 2 than Time 1, and that MC would display significantly higher scores than RC or CC. There was a main effect for time, F (2, 174) = 13.28, $p <$ .001, indicating that scores were significantly different across time. Follow-up paired comparisons revealed that scores in all conditions were significantly higher at Time 1 than at baseline, but that they fell again from Time 1 to Time 2. Contrary to expectations, however, there were no significant differences between the conditions for TMS scores F (2, 87) = .66, *n.s.*, nor was there a significant interaction between condition and time, F (4,174) = 1.63, *n.s.* See Table 3 for mean values on mindfulness ratings and TMS scores across time and group.

To determine if there were any differences between the conditions on the trait mindfulness measure, a between-participants one-way ANOVA was conducted with condition as the between participants factor and MAAS scores as the dependent variable. As expected, there were no significant differences between the conditions, F (2, 87) = .31, *n.s.*

Mood variables

To determine if there were differences between the conditions on anxiety or relaxation ratings from Baseline to Time 1 to Time 2, participants' self-report scores were compared using a 3 X 3 mixed MANOVA. There was a main effect of time, F (4, 84) = 2.82, $p <$ .001. Univariate ANOVAs revealed that there was a main effect for time on the SUDS variable assessing anxiety, F (2, 174) = 5.82, $p <$ .004, but not for relaxation ratings, F (2, 174) = 1.35, *n.s.* Paired comparisons revealed that SUDS scores were

Table 3

Participants' PMF ratings (0-100) and TMS scores at Baseline, Time 1 and Time 2.

Group		Baseline	Time 1	Time 2
	Score	*M (SD)*	*M (SD)*	*M (SD)*
MC*				
	PMF	86.25_{a} (10.72)	$84.52_{a,b}$ (12.62)	78.93_{b} (19.46)
	TMS	22.00_{a} (6.14)	23.67_{b} (7.37)	18.23_{c} (7.74)
RC*				
	PMF	79.83_{a} (13.61)	$75.30_{a,b}$ (22.31)	73.33_{b} (19.62)
	TMS	21.63_{a} (7.40)	23.67_{a} (8.22)	21.07_{b} (7.28)
CC				
	PMF	77.67_{a} (17.77)	75.50_{a} (19.84)	72.50_{a} (24.56)
	TMS	23.13_{a} (6.78)	24.43_{a} (7.84)	22.27_{b} (9.24)

Note. PMF = present-moment focus; TMS = Toronto Mindfulness Scale; MC = Mindfulness Condition *(n = 30)*, RC = Relaxation Condition *(n = 30)*, CC = Control Condition *(n = 30)*. Means in the same row that share the same subscripts do not differ at $p < .05$.
*No significant differences between the groups, $ps > .05$.

significantly lower at Time 1 than at Baseline, but that there were no differences in scores between Time 1 and Time 2. There were no significant differences between the conditions on the SUDS or relaxation ratings, F (4, 174) = .96, *n.s.*, nor was there a significant interaction of condition and time, F (8, 170) = .66, *n.s.*

To assess the differences in positive and negative affect between the conditions and across time, scores on the positive and negative affect scales of the PANAS were compared across time using a 3 X 3 mixed MANOVA. There was a main effect for time, F (4, 84) = 16.93, $p < .001$. Follow-up univariate ANOVAs revealed that time was differentially significant for the positive affect (F (2, 174) = 27.64, $p < .001$) and negative affect (F (2, 174) = 6.86, $p < .001$) scales. Paired comparisons revealed that for positive affect, scores fell from Baseline to Time 1 to Time 2, and for negative affect scores did not differ significantly from Baseline to Time 1, but did display a significant decrease from Time 1 to Time 2. There were not, however, any significant differences between the conditions on positive or negative affect, F (2, 174) = .74, *n.s.*, nor was there a significant interaction of condition and time, F (8, 170) = 1.08, *n.s.* Planned comparisons for condition, however, revealed a trend for negative affect subscale mean scores in the mindfulness condition to be lower than those in the control condition, F (2, 87) = 1.49, $p < .09$.

Trait mindfulness, repeated checking, and metamemory

To evaluate if there were any differences in metamemory ratings across time between individuals who scored high on the trait mindfulness measure versus those who scored low, a median split was performed on the MAAS. A 2 X 2 MANOVA was conducted with group (high MAAS versus low MAAS) as the between-participants

variable, time as the within-participants variable (Time 1 versus Time 2), and confidence, vividness and detail of memory as the dependent variables. There was a significant interaction of group and time, F (3, 86) = 4.09, $p < .01$, indicating that there was a significant difference between the high MAAS group and the low MAAS groups on metamemory scores after a single check versus after repeated checks. Follow-up univariate ANOVAs revealed that there was a significant interaction between group and time on reports of confidence in memory, F (1, 88) = 4.51, $p < .01$, but not on reports of vividness of memory, F (1, 88) = .04, *n.s.*, or detail in memory, F (3, 86) = .66, *n.s.* Additional follow-up comparisons revealed that while there was no difference between the high MAAS and low MAAS group on memory confidence following a single check, there was a significant difference between the groups following repeated checking (See Figure 4). The high MAAS group displayed a greater decline in memory confidence from Time 1 to Time 2 than did the low MAAS group. There was also a significant main effect of time, F (3, 86) = 35.88, $p < .001$, indicating that metamemory scores were significantly different across the two time points. Follow-up paired comparisons revealed that scores on memory confidence, vividness and detail significantly decreased following the repeated checking task.

Trait mindfulness, repeated checking and mood variables

To assess participants' self-report scores on anxiety and relaxation ratings according to their scores on a trait mindfulness measure (MAAS), participants were divided into high and low MAAS groups based on a median split. A 2 X 3 MANOVA was performed, with group (high MAAS versus low MAAS) as the between-participants

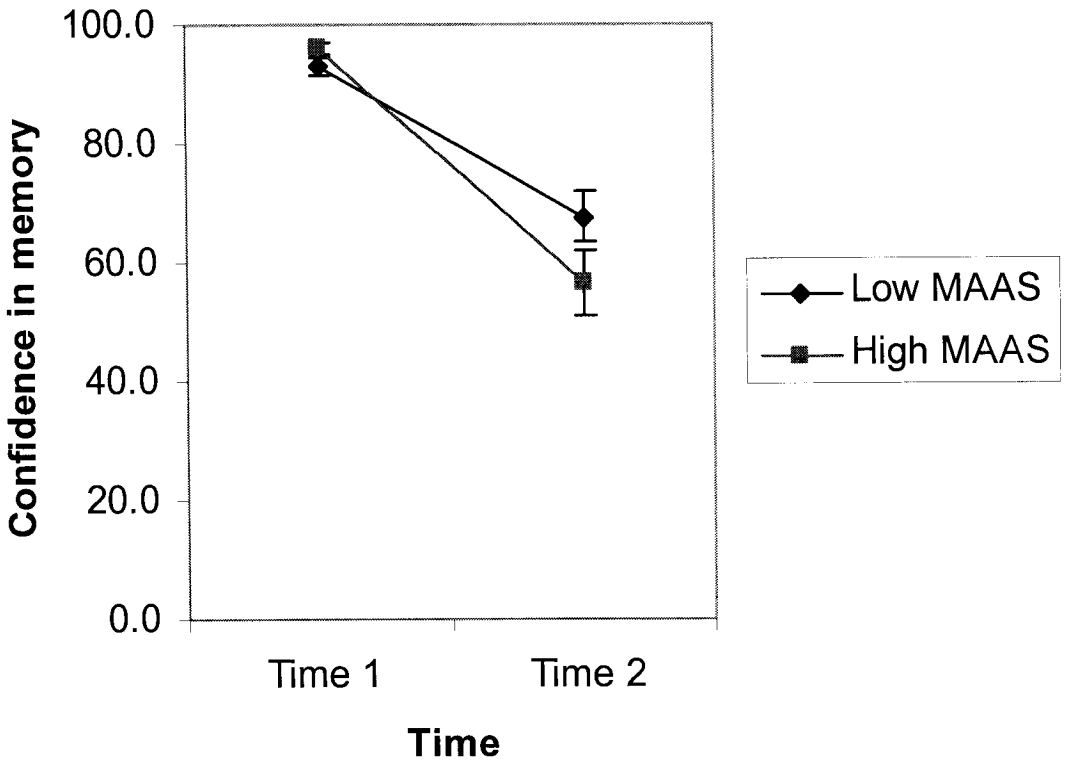

Figure 4. Confidence in memory (mean scores) after a single check versus after repeated checking in high and low groups on Mindful Attention & Awareness Scale (MAAS; Brown & Ryan, 2003) scores. Low MAAS = participants who scored < 4 on the Mindful Attention and Awareness Scale *(n = 45)*, High MAAS = participants who scored > 4 the Mindful Attention and Awareness Scale *(n = 45)*.

variable, time (Baseline versus Time 1 versus Time 2) as the within-participants variable, and SUDS (anxiety) and relaxation ratings as the dependent variables. A main effect was revealed for time, F (4, 85) = 2.82, $p < .03$. Follow-up univariate ANOVAs revealed significant differences across time in the anxiety variable, F (2, 176) = 5.80, $p < .004$, but not for the relaxation variable, F (2, 176) = 1.37, *n.s.* Paired comparisons revealed that anxiety fell significantly for all participants from Baseline to Time 1, and remained stable from Time 1 to Time 2. A main effect was also revealed for group, F (2, 87) = 3.82, $p < .03$, and follow-up comparisons revealed that the groups were significantly different on their scores on anxiety, F (1, 88) = 4.33, $p < .04$, but not on relaxation, F (1, 88) = .01, *n.s.* It was shown that the participants in the high MAAS group scored lower on anxiety overall than those in the low MAAS group. See Figure 5 for high and low MAAS scores over time on mean anxiety ratings.

To assess participants' scores on the positive and negative affect subscales of the PANAS according to their scores on the MAAS, participants were divided into high and low MAAS groups based on a median split. A 2 X 3 MANOVA was performed, with group (high MAAS versus low MAAS) as the between-participants variable, time (baseline versus Time 1 versus Time 2) as the within-participants variable, and positive affect and negative affect subscale scores as the dependent variables. A significant effect for time was revealed, F (4, 85) = 17.56, $p < .001$. Follow-up univariate ANOVAs revealed significant effects for both the positive subscale, F (2, 176) = 27.79, $p < .001$, and the negative subscale, F (2, 176) = 6.79, $p < .001$. Paired comparisons revealed a different pattern of results for the two scales. For the positive subscale, scores decreased significantly from baseline to Time 1 to Time 2. For the negative subscale, scores were

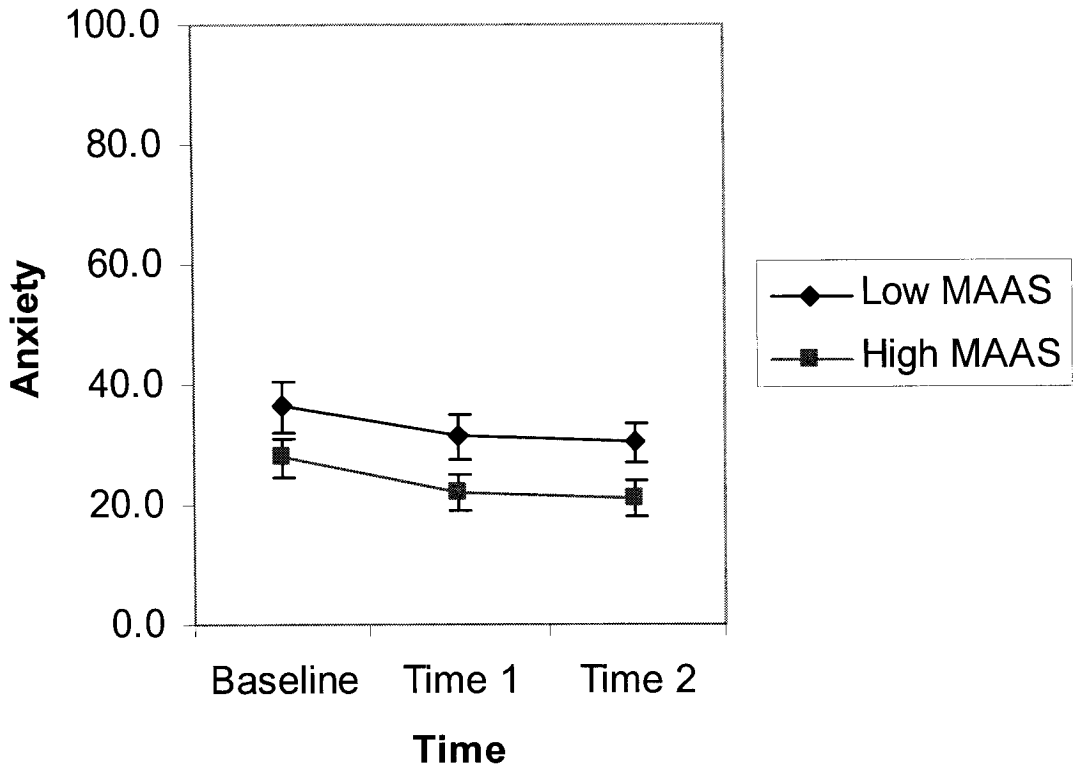

Figure 5. Anxiety (mean scores) across time in high and low groups on Mindful Attention & Awareness Scale (MAAS; Brown & Ryan, 2003) scores. Low MAAS = participants who scored < 4 on the Mindful Attention and Awareness Scale *(n = 45)*, High MAAS = participants who scored > 4 the Mindful Attention and Awareness Scale *(n = 45)*.

stable from baseline to Time 1, but fell significantly from Time 1 to Time 2. There was not a significant interaction of MAAS group and time, F (4, 85) = 0.99, *n.s.*, nor for MAAS group, F (2, 87) = 2.06, *n.s.*, A trend was revealed however for MAAS group on scores on the negative subscale, F (1, 88) = 3.02, $p < .09$. This trend suggests that negative affect subscale scores were lower in the high MAAS group than in the low MAAS group.

Discussion

The results of the present study are consistent with previous research suggesting that memory distrust results from repeated checking (Coles et al., in press; Radomsky et al., 2006; van den Hout & Kindt, 2003a, 2003b, 2004). Declines in metamemory variables after repeated checking were observed, providing further empirical support for the importance of the role of metamemory in compulsive checking. It was also revealed that there was a decrease in memory accuracy following repeated checking, a finding not entirely consistent with some repeated checking literature (e.g., van den Hout and Kindt, 2003a; 2003b), however consistent with research conducted with similar ecological validity (Coles et al., in press; Radomsky et al., 2006). Neither brief mindfulness nor relaxation training had an effect on memory or metamemory variables following repeated checking. Significant differences were revealed however in both metamemory and affect ratings once participants were divided into high and low groups based on scores on a trait-mindfulness measure (MAAS); scoring high on the MAAS was associated with greater declines in metamemory following repeated checking than scoring low on the MAAS, and the high MAAS group reported lower anxiety and negative affect following repeated checking than the low MAAS group.

Metamemory, memory accuracy and repeated checking

All conditions did report significant decreases in confidence, vividness and detail of memory subsequent to engaging in repeated checking of the stove. The replication of this result is particularly interesting in light of the fact that the decrease in metamemory variables occurred after only eight checks. Previous research had found the same results after many more checks (Radomsky et al., 2006; van den Hout & Kindt, 2003a, 2003b), and a recent study (Coles et al., in press) isolated the occurrence of memory confidence declines as being somewhere between 10 and 15 checks on an object. This suggests that some of the mitigating factors of the self-perpetuating mechanism of compulsive checking (such as memory confidence) could begin to have an impact at an earlier point than has been suggested. Alternately, the extra cognitive demands that were placed on the participants above and beyond the checking protocol (e.g. instructions to use the message that was heard on the tape to help with the task) could be responsible for the earlier declines. Decreases in metamemory are likely an extremely robust effect of repeated checking, and therefore difficult (if not impossible) to modify, and it even appears that perceived threat may have less to do with decrements in metamemory following repeated checking than was previously believed (Coles & Horng, 2006). An important next step in research on repeated checking will be the further investigation of the connection(s) between metamemory and the urge to check. It will be crucial to determine if interventions targeting the urge to check will have an effect on the metacognitive processes that appear to be automatic under conditions of repeated activitiy. Understanding this association will have implications for symptom reduction in individuals who check compulsively.

The observed declines in memory accuracy following repeated checking lends support to earlier research completed under conditions of high ecological validity (Coles et al. in press; Radomsky et al., 2006). Participants in the present study were only required to check on a threat-relevant item (the stove) due to the established finding of an association between threat-relevance of a task, perceived responsibility and memory distrust (Radomsky et al., 2001; Tolin et al., 2001). It is likely that the combination of increased ecological validity and repeated checking of a high-threat item allowed for a replication of this memory accuracy result. Perhaps the robust effects of repeated checking extend to affect memory accuracy as well as metamemory. That is, it is possible that there is a cascade of effects of repeated checking, such that checking produces declines in metamemory, the further consequence of which is an interference and/or difficulty in the actual ability to accurately recall aspects of a check. Conceivably then, declines in metamemory following repeated checking may contribute to a damaged capacity for information-processing, and not the other way around, as has been suggested by researchers supporting a memory deficit hypothesis as a factor in the development of compulsive checking (Rubenstein et al., 1993; Sher et al., 1984; Tallis, 1997).

Metamemory, mindfulness and repeated checking

A main focus of this study was to determine how a brief mindfulness induction would affect metamemory variables after a single check versus after repeated checks compared to relaxation or control manipulations. The results of this study are limited by the fact that the groups were not asked to provide metamemory ratings following checking of the stove prior to having listened to the tapes, as it was not desirable to direct

the participants to think about attentional factors until they had been subjected to the manipulation.

The attempt to study mindfulness and its associated mechanisms in a lab setting was a difficult task in that mindfulness is an acquired response that is proposed to require time and practice (Bishop et al., 2004). It was also challenging to experimentally produce, detect, and measure a sense of non-judgmental acceptance. Thus, the brief training that participants underwent in the present study was intended to introduce the idea of mindful awareness and present-moment focus to the participants, and to generate an analogue of long-term training in mindfulness practice. Although it was anticipated that metacognitive adjustment would be difficult to detect, it was expected that comparisons with the relaxation and control groups would permit a satisfactory contrast in a lab setting. Research suggests that meaningful variations in mindfulness can be found in populations without previous meditation experience (Baer, Smith, & Allen, 2004; Brown & Ryan, 2003) suggesting that individuals can be trained to develop mindful attention and awareness. A relaxation group was included as a contrast to mindfulness training, as it has been found to be effective in individuals with anxiety (Öst, 1987; Öst & Breitholtz, 2000), particularly in the short-term (Arntz, 2003). Relaxation techniques have also been found to have a positive effect on a variety of health problems, including GAD and panic disorder (Borkovec & Costello, 1993; Öst & Westling, 1995). Combining the effects of relaxation and breathing exercises has been found to lead to improvements in visual memory (Nava, Landau, Brody, Linder & Scächinger, 2004), suggesting that relaxation instructions may have been able to attenuate decreases in reports of vividness and detail of memory. EEG studies have shown that both slow- and

fast- wave activity have been observed in individuals under conditions of meditation signifying that individuals are both calm and alert when meditating (Dunn, Hartigan, & Mikulas, 1999), a state inherently different from relaxation alone.

Despite the validity of the contrasting conditions, it appears that the robust effects of repeated checking may have impeded the effectiveness of the interventions. Although mindfulness is speculated to be a skill or strategy that can be taught, the fostering of mindfulness and the dependence on its resilience as a state quality is theorized to require ongoing practice, and not just a brief introduction to the topic (Bishop et al., 2004). Recent research has proven this not to be the case (see Arch & Craske, in press), however given the metacognitive processes that may be at work during a task like repeated checking (as evidenced by the significant changes in metamemory), the training could have further burdened an otherwise occupied cognitive and metacognitive system. It is likely that the effects of repeated checking are particularly resistant to change and become strengthened as the number of checks increases, or that repeated checking works to negate attempts to engage simultaneously in other cognitive activity. Thus, in this paradigm, the training may have added to the cognitive load instead of relieving it, where repeated checking of the stove exhausted attentional resources such that the anticipated novel experiencing of each moment was inhibited.

Trait mindfulness, repeated checking and metamemory

There is a propensity in the literature to discuss mindfulness as an effective intervention at the level of information-processing. This idea, however, is not supported by the results of the present study. Rather, it was found that individuals who scored highest on a trait-measure of mindfulness suffered the greatest declines in metamemory,

suggesting that being more mindful may negatively affect metamemory in a checking paradigm. Being mindful thus appears to be ineffective at protecting an individual from the robust effects of repeated checking on metamemory. It could be that the *capacity* to be more mindful is not equivalent to *being* mindful, in that it is unknown whether being predisposed to be mindful actually corresponds with being mindful in experience, a quality that might be better observed following prolonged mindfulness training. Maybe whether or not you are more mindful is associated to a lesser extent with the negotiation of external experience (checking) with metamemory (judgements about memory for checking) than to the effortful balancing of metacognitive processing ("I am not confident in my memory") with cognitive processing ("I do not remember"). Thus, considering that compulsions may be understood as attempts to control aversive internal and external experiences, perhaps tracking changes in metamemory was not an appropriate context to identify mechanism(s) of action in mindfulness.

Mood, mindfulness and repeated checking

In contrast to expectations, neither the mindfulness nor the relaxation manipulations appeared to have a particular effect on participants' feelings of anxiety or state of relaxation. Again, the instrument that did detect differences in participants' mood states was the MAAS, in that those who scored high on this measure experienced the least amount of anxiety and negative affect. This result suggests that a willingness to be mindful may be a protective quality against the negative emotional effects of repeated checking, but does not necessarily increase positive emotions during the task. The trend for those in the mindfulness condition (MC) to experience greater declines in negative affect than those in the control condition (CC) corroborates this assertion and suggests

that an attitudinal component of mindfulness may be crucial for change. If, as suggested earlier, being mindful allows an individual to better navigate the effects of metacognitive activity with that of cognitive experience, it could be that the regulation of emotion (and not aspects of information-processing) are the means by which this is accomplished. Perhaps then the effects of mindfulness training are more appropriately accessed through an investigation of emotion. Indeed, Arch & Craske (in press) have found that a brief focused breathing induction (analogous to mindfulness training) was effective at decreasing negative affect in response to aversive stimuli, while increasing the willingness to respond to the same stimuli.

Implications & Future Directions

One clinical implication of these results is that mindfulness training (or relaxation training) may not be an effective means of attenuating the self-perpetuating mechanism that propels an individual to continue checking. As being mindful may protect against the negative emotional effects associated with repeated checking, mindfulness training may have a role in relapse prevention, as has been found in depression (Teasdale et al., 1995). Possibly mindfulness training could help an individual to *accept* that declines in metamemory will occur with repeated checking, and to use that acceptance as justification to check less, because checking less can help to preserve metamemory. These results suggest that it may be important to ask individuals "How confident/sure do you need to be?" or "Do you need a clear image of the check being performed correctly in order to refrain from checking again?". Mindfulness training could then be incorporated into effective treatments for the purposes of modifying expectations of (and

emotional reactions to) memory clarity through understanding and acceptance of the deleterious and counterproductive effects of repeated checking.

Future investigations might examine the idea that compulsive checkers are less likely to be mindful by assessing for trait mindfulness prospectively, and grouping participants according to level of mindfulness prior to the checking paradigm. Alternately, to assess mindfulness training with increased ecological validity, a more detailed and involved mindfulness training could be conducted, with pre- and post-checking assessments of metamemory and mood. Such investigations would help to further develop and clarify the burgeoning research base examining mindfulness training and its clinical utility.

Summary

The present study replicated earlier findings that metamemory declines are a product of repeated checking behaviour. This result demonstrates that the effects of repeated checking are rapid and robust. The reporting of distrust in memory in relation to repeated checking activity could be understood as evidence corroborating the effects of abnormal checking behaviour, and perhaps even as a risk factor to its development. This study also represents an important attempt to apply mindfulness training to the metacognitive aspects of repeated checking behaviour. Clinically, it appears that neither brief mindfulness nor brief relaxation training are an effective means of reducing declines in metamemory following repeated checking. These results do serve to re-direct the search for the mechanisms of mindfulness training away from information-processing, and towards emotion regulation.

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Appendix A

Sex differences between the conditions

Independent sample t-tests were conducted to determine the extent of the sex differences between the groups. No significant differences were found on the BDI-II, $t(88) = -.672$, n.s., BAI, $t(87) = -.386$, n.s., the VOCI, $t(88) = .735$, n.s., the self-report mindfulness rating at baseline, $t(88) = -.473$, n.s., time 1, $t(88) = -1.304$, n.s., and time 2, $t(88) = -.454$, n.s., the state mindfulness measure (TMS) at baseline, $t(88) = .693$, n.s., time 1, $t(88) = -1.133$, n.s., and time 2, $t(88) = -.882$, n.s., as well as the trait mindfulness measure (MAAS, only taken at time 2), $t(88) = -.532$, n.s.

Appendix B

Questionnaires

Vancouver Obsessive-Compulsive Inventory (VOCI)

Beck Depression Inventory (BDI-II)

Beck Anxiety Inventory (BAI)

Toronto Mindfulness Scale (TMS)

Mindful Attention Awareness Scale (MAAS)

Positive and Negative Affect Scale (PANAS)

VOCI

Please rate each statement by putting a circle around the number that best describes how much the statement is true of you. Please answer every item, without spending too much time on any particular item.

How much is each of the following statements true of you?	**Not at all**	**A little**	**Some**	*Much*	**Very Much**
1. I feel compelled to check letters over and over before mailing them.	0	1	2	3	4
2. I am often upset by my unwanted thoughts of using a sharp weapon.	0	1	2	3	4
3. I feel very dirty after touching money.	0	1	2	3	4
4. I find it very difficult to make even trivial decisions.	0	1	2	3	4
5. I feel compelled to be absolutely perfect.	0	1	2	3	4
6. I repeatedly experience the same unwanted thought or image about an accident.	0	1	2	3	4
7. I repeatedly check and recheck things like taps and switches after turning them off.	0	1	2	3	4
8. I use an excessive amount of disinfectants to keep my home or myself safe from germs.	0	1	2	3	4
9. I often feel compelled to memorize trivial things (e.g., licence plate numbers, instructions on labels).	0	1	2	3	4
10. I have trouble carrying out normal household activities because my home is so cluttered with things I have collected.	0	1	2	3	4
11. After I have decided something, I usually worry about my decision for a long time.	0	1	2	3	4
12. I find that almost every day I am upset by unpleasant thoughts that come into my mind against my will.	0	1	2	3	4
13. I spend far too much time washing my hands.	0	1	2	3	4
14. I often have trouble getting things done because I try to do everything exactly right.	0	1	2	3	4
15. Touching the bottom of my shoes makes me very anxious.	0	1	2	3	4
16. I am often upset by my unwanted thoughts or images of sexual acts.	0	1	2	3	4
17. I become very anxious when I have to make even a minor decision.	0	1	2	3	4
18. I feel compelled to follow a very strict routine when doing ordinary things.	0	1	2	3	4

How much is each of the following statements true of you?	Not at all	A little	Some	Much	Very Much
19. I feel upset if my furniture or other possessions are not always in exactly the same position.	0	1	2	3	4
20. I repeatedly check that my doors or windows are locked, even though I try to resist the urge to do so.	0	1	2	3	4
21. I find it very difficult to touch garbage or garbage bins.	0	1	2	3	4
22. I become very tense or upset when I think about throwing anything away.	0	1	2	3	4
23. I am excessively concerned about germs and disease.	0	1	2	3	4
24. I am often very late because I can't get through ordinary tasks on time.	0	1	2	3	4
25. I avoid using public telephones because of possible contamination.	0	1	2	3	4
26. I am embarrassed to invite people to my home because it is full of piles of worthless things I have saved.	0	1	2	3	4
27. I repeatedly experience the same upsetting thought or image about death.	0	1	2	3	4
28. I am often upset by unwanted thoughts or images of blurting out obscenities or insults in public.	0	1	2	3	4
29. I worry far too much that I might upset other people.	0	1	2	3	4
30. I am often frightened by unwanted urges to drive or run into oncoming traffic.	0	1	2	3	4
31. I almost always count when doing a routine task.	0	1	2	3	4
32. I feel very contaminated if I touch an animal.	0	1	2	3	4
33. One of my major problems is repeated checking.	0	1	2	3	4
34. I often experience upsetting and unwanted thoughts about losing control.	0	1	2	3	4
35. I find it almost impossible to decide what to keep and what to throw away.	0	1	2	3	4
36. I am strongly compelled to count things.	0	1	2	3	4

How much is each of the following statements true of you?	Not at all	A little	Some	Much	Very Much
37. I repeatedly check that my stove is turned off, even though I resist the urge to do so.	0	1	2	3	4
38. I get very upset if I can't complete my bedtime routine in exactly the same way every night.	0	1	2	3	4
39. I am very afraid of having even slight contact with bodily secretions (blood, urine, sweat, etc.).	0	1	2	3	4
40. I am often very upset by my unwanted impulses to harm other people.	0	1	2	3	4
41. I spend a lot of time every day checking things over and over again.	0	1	2	3	4
42. I have great trouble throwing anything away because I am very afraid of being wasteful.	0	1	2	3	4
43. I frequently have to check things like switches, faucets, appliances and doors several times.	0	1	2	3	4
44. One of my major problems is that I am excessively concerned about cleanliness.	0	1	2	3	4
45. I feel compelled to keep far too many things like old magazines, newspapers, and receipts because I am afraid I might need them in the future.	0	1	2	3	4
46. I repeatedly experience upsetting and unacceptable thoughts of a religious nature.	0	1	2	3	4
47. I tend to get behind in my work because I repeat the same thing over and over again.	0	1	2	3	4
48. I try to put off making decisions because I'm so afraid of making a mistake.	0	1	2	3	4
49. I often experience upsetting and unwanted thoughts about illness.	0	1	2	3	4
50. I am afraid to use even well-kept public toilets because I am so concerned about germs.	0	1	2	3	4
51. Although I try to resist, I feel compelled to collect a large quantity of things I never actually use.	0	1	2	3	4
52. I repeatedly experience upsetting and unwanted immoral thoughts.	0	1	2	3	4
53. One of my major problems is that I pay far too much attention to detail.	0	1	2	3	4
54. I am often upset by unwanted urges to harm myself.	0	1	2	3	4
55. I spend far too long getting ready to leave home each day because I have to do everything exactly right.	0	1	2	3	4

BDI-II

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for each group.

1) Sadness

0 I do not feel sad.
1 I feel sad much of the time.
2 I am sad all the time.
3 I am so sad or unhappy that I can't stand it.

2) Pessimism

0 I am not discouraged about my future.
1 I feel more discouraged about my future than I used to be.
2 I do not expect things to work out for me.
3 I feel my future is hopeless and will only get Worse.

3) Past Failure

0 I do not feel like a failure.
1 I have failed more than I should have.
2 As I look back, I see a lot of failures.
3 I feel I am a total failure as a person.

4) Loss of Pleasure

0 I get as much pleasure as I ever did from the Things I enjoy.
1 I don't enjoy things as much as I used to.
2 I get very little pleasure from the things I used to enjoy.
3 I can't get any pleasure from the things I used to enjoy.

5) Guilty Feelings

0 I don't feel particularly guilty.
1 I feel guilty over many things I have done or should have done.
2 I feel quite guilty most of the time.
3 I feel guilty all the time.

6) Punishment Feelings

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7) Self-Dislike

0 I feel the same about myself as ever.
1 I have lost confidence in myself.
2 I am disappointed in myself.
3 I dislike myself.

8) Self-Criticalness

0 I don't criticize or blame myself more than usual.
1 I am more critical of myself than I used to be.
2 I criticize myself for all the faults.
3 I blame myself for everything bad that happens.

9) Suicidal Thoughts or Wishes

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry ther out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10) Crying

0 I don't cry any more than I used to.
1 I cry more now than I used to.
2 I cry over every little thing.
3 I feel like crying but I can't.

11) Agitation

0 I am no more restless or wound up than usual.
1 I feel more restless or wound up than usual.
2 I am so restless or agitated that it's hard to stay still.
3 I am so restless or agitated that I have to keep moving or doing something.

12) Loss of Interest

0 I have not lost interest in people or activities.
1 I am less interested in other people or things than before.
2 I have lost most of my interest in other people or things.
3 It's hard to get interested in anything.

13) Indecisiveness

0 I make decisions about as well as ever.

1 I find it more difficult to make decisions than usual.
2 I have much greater difficulty in making decisions than I used to.
3 I have trouble making any decision.

14) Worthlessness

0 I do not feel I am worthless.
1 I don't consider myself as worthwhile and useful as I used to.
2 I feel more worthless as compared to other people.
3 I feel utterly worthless.

15) Loss of Energy

0 I have as much energy as ever.
1 I have less energy than I used to have.
2 I don't have enough energy to do very much.
3 I don't have enough energy to do anything.

16) Changes in Sleeping Pattern

0 I have not experienced any changes in my sleeping pattern.
1a I sleep somewhat more than usual.
1b I sleep somewhat less than usual.
2a I sleep a lot more than usual.
2b I sleep a lot less than usual.
3a I sleep most of the day.
3b I wake up 1-2 hours early and can't get back to sleep.

17) Irritability

0 I am no more irritable than usual.
1 I am more irritable than usual.
2 I am much more irritable than usual.
3 I am irritable all the time.

18) Changes in Appetite

0 I have not experienced any changes in my appetite.

1a My appetite is somewhat less than usual.
1b My appetite is somewhat greater than usual.
2a My appetite is much less than usual.
2b My appetite is much greater than usual.
3a I have no appetite at all.

19) Concentration Difficulty

0 I can concentrate as well as usual.
1 I can't concentrate as well as usual.
2 It's hard to keep my mind on anything for very long.
3 I find I can't concentrate on anything.

20) Tiredness or Fatigue

0 I am no more tired or fatigued than usual.
1 I get more tired or fatigued more easily than usual.
2 I am too tired or fatigued to do a lot of the things I used to do.
3 I am too tired or fatigued to do most of the things I used to do.

21) Loss of Interest in Sex

0 I have not noticed any recent change in my interest in sex.

1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interest in sex completely.

B.A.I.

Below is a list of common symptoms of anxiety. Please read each item in the list carefully. Indicate how much you have been bothered by each symptom during the PAST WEEK, INCLUDING TODAY by placing an X in the corresponding space in the column next to each symptom.

		Not at all	**Mildly. It did not bother me much**	**Moderately. It was very unpleasant but I could stand it**	**Severely I could barely stand it**
1	Numbness or tingling				
2	Feeling hot				
3	Wobbliness in legs				
4	Unable to relax				
5	Fear of worst happening				
6	Dizzy or lightheaded				
7	Heart pounding or racing				
8	Unsteady				
9	Terrified				
10	Nervous				
11	Feelings of choking				
12	Hands trembling				
13	Shaky				
14	Fear of losing control				
15	Difficulty breathing				
16	Fear of dying				
17	Scared				
18	Indigestion or discomfort in abdomen				
19	Faint				
20	Face flushed				
21	Sweating (not due to heat)				

Toronto Mindfulness Scale

Instructions: We are interested in what you just experienced. Below is a list of things that people sometimes experience. Please read each statement. Next to each statement are five choices: "not at all", "a little", "moderately", "quite a bit" and "very much". Please indicate the extent to which you agree with each statement. In other words, how well does the statement describe what you just experienced, just now?

	Not at all	A little	Moderately	Quite a bit	Very much
1. I remained open to whatever thoughts and feelings I was experiencing.	0	1	2	3	4
2. I noticed the kinds of things my attention tended to become involved with.	0	1	2	3	4
3. I noticed when I became lost in my thoughts, daydreams or fantasies.	0	1	2	3	4
4. I was aware of my experiences constantly changing.	0	1	2	3	4
5. I found myself observing unpleasant feelings without getting drawn into them.	0	1	2	3	4
6. I noticed how my feelings expressed themselves in my body as physical sensations.	0	1	2	3	4
7. I noticed how my mind tended to cling to certain thoughts and feelings that I was experiencing.	0	1	2	3	4
8. I acknowledged each thought or feeling regardless of whether it was pleasant or unpleasant.	0	1	2	3	4
9. I felt as if I was watching my thoughts and feelings in my mind, as if I had some distance from them.	0	1	2	3	4
10. I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant.	0	1	2	3	4

MAAS

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and mark the appropriate answer in the space next to that word. Indicate to what extent you are experiencing the following emotions **in the present moment**. Use the following scale to record your answers.

1 = Very slightly or not at all
2 = A little
3 = Moderately
4 = Quite a bit
5 = Extremely

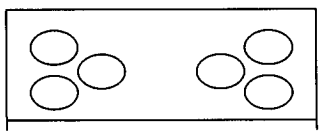
1. interested	_____	11. irritable	_____
2. distressed	_____	12. alert	_____
3. excited	_____	13. ashamed	_____
4. upset	_____	14. inspired	_____
5. strong	_____	15. nervous	_____
6. guilty	_____	16. determined	_____
7. scared	_____	17. attentive	_____
8. hostile	_____	18. jittery	_____
9. enthusiastic	_____	19. active	_____
10. proud	_____	20. afraid	_____

Appendix C

Memory Accuracy Question (1)

Metamemory Rating Scale (2)

1. Which three knobs did you check on the last trial?
(Please indicate your answer on the following diagram by marking an "X" in the appropriate spot(s).



2. On a scale of 0-100 where 0 means "not at all" and 100 means "extremely", how would you rate:

-your confidence in your answers to question 1? _____

-the vividness (e.g. clarity, intensity) of your memory of the last checking trial: _____

-the detail (e.g. particular visual features) in your memory of your last checking trial: _____

-your confidence that all the knobs are turned off? _____

3. Pease read the following:

"**Knowing**" the knobs are all off means that you have a general sense that they are off. Even if you do not have a concrete detailed memory, you just know they are turned off. For example, your memory of tying your shoes this morning is probably "known" as opposed to remembered.
"**Remembering**" the knobs are turned off means you can go through your memory and bring up the detailed process (with specific features) of turning them off. For example, your memory of finding the lab in the PY building is probably "remembered" as opposed to just "known."

Once the above distinction is clear, please answer the following:

Think about the **last trial** and indicate by circling below which kind of memory best applies.

remembering knowing

4. Think about your answers to the questions above and indicate, on a scale of 0 to 100, the degree to which you agree with the following statements (0 = not at all true of my memory; 100 = completely true of my memory):

"It's as though the memory is there. But it isn't definite enough" _____
"I remember doing it in a way but it's all fuzzy" _____
"I can remember that I've done it. But the memory isn't clear somehow" _____

Now, please answer the following questions on the same scale:

"It's as though the memory isn't there, but it is definite enough." _____
"I don't remember doing it, but in a way it's all clear." _____
"I can't remember that I've done it, but the memory is clear somehow." _____

Appendix D

Rating Scales

a) Subjective Units of Distress Scale (SUDS)

b) Present Moment Focus Rating Scale

c) Relaxation Rating Scale

a) Please rate your current level of anxiety on a scale of 0 – 100:

_____

0 — *No anxiety*

100 — *Extreme anxiety*

b) Please rate your current ability to focus on the present moment on a scale of 0-100:

_____

0 — *No focus*

100 — *Focus on the present moment*

c) Please rate how relaxed you feel currently on a scale of 0-100:

_____

0 — *Not at all relaxed*

100 — *Completely relaxed*

Appendix E

Experimental Procedure

1. Hi, thank you for coming. This study is about checking behaviour. The first thing we'd going to do is just ask you a few questions about how you're feeling right now. Then we're going to show you how to use the stove in our kitchen, and to complete a set of operations as verbally instructed. Following this, we're going to ask you to listen to a tape-recorded message. The recording is only about 5 minutes long, and all you have to do is just sit and listen. Because we want to know what you think about the message, it would help us out a great deal if you would not engage in any other activity while you are listening, like reading or writing, and try and give the tape your full attention. Then we're going to ask you to complete some more operations in the kitchen, answer a few more questions and some questionnaires. The whole process should take about an hour to complete, and we will offer you the opportunity to enter your name in a draw for 1 of 5 cash prizes ranging in value from $50 to $250 for your participation. It is important to remember that you have the right to withdraw from participating at any time, without any negative consequences. All information obtained from you is completely confidential, and will be stored under lock and key for a period of seven years after which point it will be shredded. Also, we keep identifying information stored separately from all other information collected in our research. If there are any questions, please feel free to ask me at any time. If you agree with all the conditions, please sign this consent form at the bottom.

2. *(Time 0: Take SUDS, mindfulness and relaxation ratings, and ask participant to complete the PANAS & the TMS).*

3. Now please follow me into the kitchen so that I can show you how to use the stove. I'd like to emphasize that there are a lot of operations to go through but no tricks or surprises involved.

4. Stove: There are 6 knobs that you may be operating. We will refer to them as numbers 1, 2, 3, 4, 5, and 6. You will be operating knobs in sets of threes at any given time. For example, if I asked you to turn on numbers 1, 4 and 2 on, you would turn the corresponding knobs from the off mark a quarter turn to the right, where the knob will point between the 7 and the 8 like this (*demonstration*). Then come to the intercom and let me know when you are finished. It's good to keep the knob in your hand and use it like a key. When I ask you to turn them off, you will turn the knobs off you just manipulated in the same order and wiggle them back and forth. Then come back to the intercom and let me know when you are finished. Just to let you know, knob 5 doesn't turn to the left. When I ask you to check them, you will turn the knobs just manipulated to max and then back off, and then to min and then back off again. Following this you should wiggle the knob to make sure it is in place properly. Then come back to the intercom again and let me know that you are finished. Because this stove is not entirely reliable, it is important to go through the procedure of wiggling and checking the knobs properly because the knobs are sometimes easily mistaken as off when they really are not. The lights are also kind of faint, so I just want to advise you to take care not to burn yourself.

5. Now, we won't be using this one-way mirror. As you can see, it is closed. Therefore, we won't be watching you in any way, and we leave the responsibility of carrying out these tasks properly to you. We trust you for your responsible nature.

6. Why don't we do a practice trial? (Stay in the room with participant).

7. Now I'd like you to turn on knobs 6, 2, 3. Tell me when you're finished.

8. Now I'd like you to turn them off. Tell me when you're finished.

9. Now I'd like you to check them. Tell me when you're finished.

10. Great. Thanks for doing that. (Glance at the controls on the stove as if to indicate you've noticed something, then pretend to scribble something on your paper).

11. Before we go on to begin, I'd just like you to come into the other room for a moment (Lead participant into other room).

12. Thanks again for doing this. I just have to let you know that you made a mistake on the checking task. Please try to be more careful next time, to make sure that nothing goes wrong.

13. So, before we begin the checking tasks, I'd like you to spend a few minutes listening to a tape-recording that should help you do better on them. You see, this study is about helping people who check, and we think that bearing in mind some of the information that you hear on the tape will help people do tasks like this. So please try and listen to the tape with the idea that you will use the information to help you when you go back to the kitchen.

14. I'm going to start the tape now. Please try and give your full attention to the recorded message. This is an important part of the study, and all you have to do is listen. I will be outside the room. Please let me know when the tape has finished.

15. (When tape is finished) Great. Thanks for doing that.

16. *(Time 1: Take SUDS, mindfulness and relaxation ratings, and ask participant to complete the PANAS and the TMS).*

17. I'd like you to please come back to the kitchen now so we can start doing the tasks on the stove. I will go to the other room to give you the instructions via the intercom. When you finish each of the instructions, just come to this intercom tell me OK, so that I know you've finished the task (*demonstration*). Any questions?

18. (TRIAL 0 – Pre-trial) Please try and remember the message of the tape that you heard, and to try and use what you've heard to help you get through the tasks.

Trial 0 (pre-trial):

Now, I'd like you to operate the stove.
Please turn on knobs 2, 5, 1
Please turn them off
Please check them

19. (Go back to kitchen). Before we go on to begin, I'd just like you to come into the other room for a moment so you can answer a few questions. (Lead participant into other room) I'll be in the next room, just let me know when you've finished. *(Give participant pre-trial memory test (T1)).*

20. Alright, let's go back into the kitchen. We will start the do some more operations now, and it will go the same way, just say OK after each step to let me know you're done. Any questions?

21. Last thing – it's critically important to this study to try to remember what you've heard on the tape. The main purpose of this study is to see if what you heard on the tape helps you to do the operations in the kitchen. Please try and keep the tape's message in mind during every part of each task that you do. Thanks a lot.

22. TRIALS 1-4 *(START TIMER)*

Trial 1

Now, I'd like you to operate the stove.
Please turn on knobs 5, 4, 6
Please turn them off
Please check them

Trial 2

Please turn on knobs 3, 2, 6
Please turn them off
Please check them

Trial 3

Please turn on knobs 4, 5, 2
Please turn them off
Please check them

Trial 4

Please turn on knobs 3, 1, 5
Please turn them off
Please check them

23. *(Give 4 trials and briefly remind participants again of instructions they heard via the intercom).* I just want to remind you again to try and remember the words of the tape you listened to, and to try and use what you've heard to help you get through the tasks.

24. TRIALS 5-8

Trial 5

Please turn on knobs 4, 6, 5
Please turn them off
Please check them

Trial 6

Please turn on knobs 2, 4, 1
Please turn them off
Please check them

Trial 7

Please turn on knobs 2, 1, 3
Please turn them off
Please check them

Trial 8
Please turn on knobs 5, 4, 1
Please turn them off
Please check them

25. (STOP TIMER – Record time on SUDS sheet).

26. Let's go into the other room now.

27. (Give participant post-trial memory test (T2)).

28. (Time 2: When finished with post-test, take SUDS, mindfulness and relaxation ratings).

29. Now I'd like you to answer the questionnaires. There are no right or wrong answers. Just answer those questions at your own pace without spending too much time on any one

question. I'll be in the next room, so when you're finished, just let me know. Any questions? *(Give questionnaire package, plus the final PANAS and TMS).*

Appendix F

Informed Consent Form

Participant ID _____

CONSENT FORM TO PARTICIPATE IN RESEARCH

This is to state that I agree to participate in a program of research being conducted by Dr. Adam S. Radomsky in the Psychology Department of Concordia University.

A. PURPOSE

I have been informed that the purpose of this study is to advance our understanding of the factors that predict and maintain repetitive checking behavior.

B. PROCEDURES

If you agree to participate in this study, you will be asked to complete a questionnaire package that includes a series of questions regarding your thoughts, feelings and behaviours. The questionnaire package should take less than 20 minutes to complete, and will take place in SP-215. Following this, you will be asked to listen to a brief tape recording, and then to perform specific checking tasks on items in the laboratory kitchen in SP-215. This experiment should take approximately 60 minutes to complete. At the end of the experiment, any questions you might have about the experiment will be answered and we will fully explain the hypotheses of the study. You will be offered the opportunity to enter your name in a draw for 1 of 5 cash prizes ranging in value from $50 to $250.

C. CONDITIONS OF PARTICIPATION

I understand that I am free to withdraw my consent and discontinue my participation in this study at any time, without any negative consequences whatsoever. I understand that all information obtained will be kept strictly confidential and will be stored under lock and key. Access to this information will be made available only to restricted members of Dr. Radomsky's research team. I understand that to ensure my confidentiality all data will be coded by number only and will be kept separate from my name. I understand that data from this study may be published, but that no identifying information will be released. I understand that the study will take approximately 2 hours to complete.

If you have any questions concerning the study, please feel free to ask the experimenter now. If other questions or concerns come up following the study, please feel free to contact our lab at (514) 848 – 2424, extension 2199. Should you have any questions as your rights as a participant, please contact Adela Reid, Office of Research Services, at (514) 848-2424, extension 7481.

Adam S. Radomsky, Ph.D., Assistant Professor
Laurie Gelfand, Graduate Student

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print) _____ SIGNATURE _____

GENDER _____ AGE _____

WITNESS SIGNATURE _____

DATE _____

Appendix G

Condition Instructions

a) Mindfulness Condition

b) Relaxation Condition

c) Control Condition

Mindfulness Condition

(Adapted from Segal, Williams, & Teasdale, 2002)

First, settling into a comfortable sitting position in your chair...uncrossing your legs and placing your feet flat on the floor if possible...if you feel comfortable, closing your eyes...adopting a comfortable position...and focusing on the present moment...bringing your awareness to the physical sensations in your body...focusing your attention on the sensations of touch and pressure in your body where it makes contact with your chair and the floor...spend a moment or two exploring these sensations...now bringing your attention to your breath moving in and out of your body...there is no need to try to control the breathing in any way...simply letting the breath breathe itself...as best as you can, also attitude of allowing your experience to be your experience...it's fine it you aren't feeling relaxed...there is nothing, no particular state to be achieved...as best you can, simply allow your experience to be what it is, without needing it to be other than what it is...sooner or later, your mind will wander away from the focus on the breath to thoughts, planning, daydreaming, drifting along...this is okay...it's what minds do...it's part of being human...when you notice that your mind is no longer on your breath, gently congratulate yourself...you have come back and are once more aware of your experience...you may want to acknowledge where your mind has been...noticing that you sometimes judge thoughts when they come up as good or bad....right or wrong...and we judge ourselves for having them...we try to push uncomfortable thoughts and feelings away...distract ourselves...or otherwise change our experience...noticing that if your mind does this...seeing if you can just allow whatever you are thinking or feeling to be as it is...letting go of the struggle with your experiences...noticing that if your mind does this...seeing if you can just allow whatever you are thinking or feeling to be as it is...focusing on the present moment...letting go of the struggle with your experience...everything that comes up is just what has come up in your field of awareness...our thoughts, feelings, and bodily sensations are always changing...just noticing this...gently bringing your awareness back to focus on the shifting pattern of sensations in your body as you breathe...renewing your intention to pay attention to the ongoing inbreath or outbreath...whichever you find...remember that there is nothing to be changed...no particular state to be achieved...just bring your attention to your breathing and your focus to the present moment...just noticing the sensations in your body as your bring breath into your body...as it travels through your body...and as it leaves your body...however often you notice that your mind has wandered, gently bringing your attention back to the breath...simply following in awareness the changing pattern of physical sensations that come with each inbreath and each outbreath...as best you can bringing a quality of compassion to your awareness...perhaps seeing the repeated wanderings of the mind as opportunities to bring patience to your own experience....continue to focus on your breathing for a few more moments...and now bringing your awareness to the present moment...bringing your awareness to your body sitting in your chair...noticing the parts of your body that touch the chair...and bringing your attention to the room...and, whenever you are ready, opening your eyes or looking around the room....

Relaxation Condition

(Adapted from Barlow & Craske, 1994)

First, settling into a comfortable sitting position in your chair...uncrossing your legs and placing your feet flat on the floor if possible...if you feel comfortable, closing your eyes...just sit quietly for a few seconds...adopting a comfortable position...give yourself permission to relax...you should be thinking about feeling calm and relaxed...if you aren't feeling relaxed, try to bring on this feeling... ...as best you can, simply allow your experience to be relaxed...sooner or later, your mind will wander to thoughts, planning, daydreaming, drifting along...this is the time to reorient...try and bring on a feeling of calmness and relaxation...in order to help you feel relaxed...we are going to guide you through a series of exercises where you will first tense your muscles and release the tension...this will allow you to relax deeply...just sit quietly...now, you are going to start to build tension in your lower arms, wrist, fingers, knuckles and hands...focus on the tension...notice the sensations of pulling, of discomfort, of tightness...now release the tension, let your hands and lower arms relax...focus your attention onto the sensations in your hands and arms...feel the release from tension...you are going to start to build tension in your upper arms by pulling the arms back and in towards your sides...focus on the tension... ...now release the tension, let upper arms relax...feel the release from tension...you are going to start to build tension in your lower legs by flexing your feet and pulling your toes toward your upper body...feel the tension spreading through your feet, ankles, shins, calf muscles...focus on the tension...now release the tension, let your legs relax onto the chair...feel the release from tension...the warmth and heaviness of relaxation... you are going to start to build tension in your upper legs by pulling the knees together and lifting your legs off the chair...focus on that part of your legs...feel the tension...focus on the tension...now release the tension, let your legs drop heavily onto the chair...feel the release from tension...the difference in your legs...focus on the sense of comfort... you are going to start to build tension in your stomach by pulling your stomach in toward your spine...feel the tension and tightness...focus on the tension...now release the tension, let your stomach go...feel the release from tension...feel the comfort of relaxation... now build up the tension around your chest by taking a deep breath and holding it...hold your breath...now let the air escape and resume normal breathing...feel the difference as your muscles relax...now pull your shoulders up toward your ears...feel the tension in your shoulders, down your back, in your neck, the back of your head...focus on the tension, then let your shoulders droop down...now release the tension, let the shoulders droop down...feel the release from tension...focus on the comfort of relaxation... you are going to start to build tension in your face by clenching your teeth, forcing the corners of your mouth into a foced smile...hold the tension...feel the tightness...now release the tension, letting the mouth drop down and the muscles around the throat and jaw relax...feel the release from tension... now build tension in your eyes by squeezing your eyes tightly together...now release and let the tension disappear from around your eyes...feel the release from tension... now build up the tension in your forehead by raising your eyebrows up as high as you can...hold the tension and then relax...letting the eyebrows back down, the tension leaving your forehead...focus on the sensation of relaxation... now your whole body is relaxed and comfortable...feel yourself becoming more relaxed...let all the tension leave your body...your breathing is slow and regular...feel comfortable and relaxed...spend a moment in this relaxed state...and now bringing your awareness to your body sitting in your chair...noticing the parts of your body that touch the chair...and bringing your attention to the room...and, whenever you are ready, opening your eyes or looking around the room....

Control Condition

(Lyrics of "Whistle While You Work" © taken from the
"Snow White and the Seven Dwarves"© movie soundtrack*)

Just whistle while you work
And cheerfully together we can tidy up the place
So hum a merry tune
It won't take long
When there's a song to help you set the pace

And as you sweep the room
Imagine that the broom
Is someone that you love, and soon
You'll find you're dancing to the tune
When hearts are high
The time will fly
So whistle while you work

*Song plays for approximately seven minutes, with same lyrics repeated

Appendix H

Debriefing Script

DEBRIEFING

We're done with the experimental part of these tasks. Thank you so much for your time and cooperation. If you have time now, I can provide you with some information about the background of this study.

Debriefing: The purpose of this study is to learn more about the factors that influence checking behaviours. Some of the ratings that we asked you to make before and each checking task are some of the factors that we believe help to drive checking behaviour. In this study, we want to learn more about the effects of repeated checking and how relaxation, mindfulness training or just listening to music would affect whether you had confidence in your memory for the checks. As you may know, when people with obsessive-compulsive disorder check something like whether they locked the door or not, they tend not just to check it once, they check it many times. For this reason, it's important to understand what impact this repeated checking has on the factors that made them want to check in the first place. We wanted to see what impact repeated checking would have on your confidence in your memory for the final state of the item. By comparing your confidence after listening to the tapes, we are able to see whether your confidence in your memory goes up or down during repeated checking. You may know that many people with OCD check repeatedly in part because they can't remember, or aren't confident in their memory of doing something (like locking a door), so they think that they have to go back and check, otherwise they will be responsible for anything that goes wrong as a result of not checking.

So in summary, the information that we have collected from this series of studies should help us to better understand what drives repetitive checking behaviour. Together, this information will give us a better idea of what factors are important to address in treatment for compulsive checking and this information will be used in developing a new treatment protocol for compulsive checking.