Running head: MEMORY CONFIDENCE

Believe in yourself: Manipulating beliefs about memory causes checking

Gillian M. Alcolado* and Adam S. Radomsky

Department of Psychology, Concordia University, Canada

*Corresponding author address: Concordia University Department of Psychology, 7141 Sherbrooke St. West, Montreal, QC, H4B 1R6.

Abstract

One of the most common compulsions in obsessive-compulsive disorder (OCD) is repeated checking. Although individuals often report that they check to become more certain, checking has been shown to have the opposite effect - increased checking causes increased uncertainty. However, checking may also be thought of as beginning *because of* memory uncertainty. Beliefs about responsibility, over-estimation of threat, intolerance of uncertainty, perfectionism, and importance of and control of thoughts are already known to affect different aspects of OCD symptomatology. Beliefs about memory, however, are not currently considered to influence compulsive behaviour. In the current study, beliefs about memory were manipulated to test whether or not they affected urges to check. Ninety-one undergraduate participants received (positive or negative) false feedback about their performance on aspects of a standardized memory test, and then completed two additional memory tasks. Their urges to check following these tasks were assessed. Consistent with our hypotheses, individuals in the low memory confidence condition had greater urges to check following the memory tasks than those in the high memory confidence condition, demonstrating that manipulations of beliefs about memory can influence checking. Results and implications are discussed in terms of cognitive-behavioural models of and treatments for OCD.

Keywords: OCD; checking; beliefs; memory; confidence; doubt.

Believe in yourself: Manipulating beliefs about memory causes checking

Obsessive-compulsive disorder (OCD) is a an anxiety disorder (American Psychiatric Association, 2000), affecting approximately 3.1% of the population (Stein et al., 1997). The disorder is characterized by obsessions (i.e., repetative intrustive thoughts, images, impulses) and/or compulsions (i.e., repeated behaviour designed to decrease/prevent negative thoughts/events; American Psychatric Association, 2000). Two of the most frequently reported compulsions in OCD are those related to repeated checking or washing behaviours, with approximately seventy-five percent of the OCD population reporting engaging in either or both types of rituals (Ball, Baer, & Otto, 1996). The aim of the current experiment was to examine whether manipulating beliefs about memory could affect urges to check, as a clearer understanding of the cognitive mechanisms underlying this aspect of the disorder could improve treatment and quality of life for individuals with OCD.

OCD was historically difficult to treat, until exposure and response prevention (ERP) became the first successful psychological intervention for the disorder (Meyer, 1966; for a reveiw, see Abramowitz, 2006) . Developed from learning principles and animal research, ERP required clients to expose themselves to their feared obsessions (e.g., by turning off a stove) without allowing them to engage in compulsive or neutralizing behaviour (e.g., by not checking that it was actually off), and to observe the eventual decrease of their anxiety and fear (see Marks, 1973, for an overview). Although this treatment has been found to be equally as effective as pharmacotherapy, it still leaves a number of people unwell (e.g., Foa et al., 2005).

Salkovskis (1985) posited that the manner in which people respond to stimuli associated with OCD is based on their elevated beliefs about their personal responsibility towards preventing harm to themselves and others. This theory has been well supported by empirical research (e.g., Lopatka & Rachman, 1995; Arntz, Voncken, & Goosen, 2007). For example, Lopatka and Rachman (1995) manipulated participants' responsibility beliefs in different situations and found that those who felt responsible had greater urges to check items they typically verified than those who did not, despite the fact that they were all diagnosed with OCD. This demonstrated that beliefs about responsibility play an important role in checking behaviour. Later, the Obsessive Compulsive Cognitions Working Group (OCCWG) identified three groups of belief domains related to OCD and its differential diagnosis, and created a unified tool to assess them (OCCWG, 2005). These were responsibility and over-estimation of threat, intolerance of uncertainty and perfectionism, and importance of and control of thoughts (OCCWG, 2005).

Targetting these maladaptive cognitions in treatment was an obvious progression. Research shows that cognitive-behavioural therapy (CBT) for OCD changes beliefs and that this cognitive change is responsible for symptom reduction (e.g., O'Connor et al., 2005; although there is still some debate about this, see Clark, 2005). An open trial of a manualized form of cognitive therapy for OCD has proven to be effective at treating the symptoms of the disorder, the beliefs associated with disorder, and co-occurring depression and anxiety (Wilhelm et al., 2005). Impressively, a portion of these individuals had previously failed to benefit from ERP but improved following cognitive therapy (CT), implying that targeting maladaptive beliefs in therapy may be sufficient for improvement (Wilhelm et al., 2005). CBT has also been shown to be comparable in effectiveness to that of ERP (Whittal, Thordardson, & McLean, 2005). More recently, a randomized controlled trial of CT for obsessions showed that compared to stress management and waitlist control groups, the CT group improved significantly more on measures of OC beliefs, and had an advantage at post-treatment (Whittal et al., 2010).

As such, it may be that a broader cognitive understanding of OCD may contribute to more eficacious treatments of the disorder. Rachman (2002) proposed a cognitive theory of compulsive checking which postulated that people will check under circumstances in which they feel they have an elevated sense of responsibility for preventing serious harm, especially when they feel they cannot be sure that the threat has been removed. He further hypothesized that checking becomes more severe with the increase of three cognitive multipliers: (1) the perceived probability of harm occurring, (2) the perceived seriousness of harm, and (3) the perceived responsibility for preventing harm. Interestingly, he posited that when one feels more responsible for the outcome of an event, one also believes that the likelihood of it happening has increased.

Rachman also suggested a number of elements that help maintain checking behaviour once it has begun. One repeatedly checks in a futile search for a certain end to the harm (which does not exist). This act of checking increases one's perceived responsibility for eliminating the harm, and the perceived probability of the harm, both of which are already known to promote checking behaviour, thus prolonging the checking cycle indefinitely. Furthermore, the act of checking itself is meant to increase certainty, but checking has the paradoxical effect of reducing memory confidence, which then in turn induces more checking as one continues to strive for certainty in a self-perpetuating cycle (Rachman, 2002).

Rachman's (2002) model has been supported by empirical research from more than one research group showing that repeated checking actually does decreases, rather than increases, memory confidence. van den Hout and Kindt (2003a) asked participants to engage in repeated checking of a computerized virtual gas stove. After being taught to use the stove (the pre-test), half of the participants continued to check the stove (relevant checking condition), while the other half checked virtual light bulbs (irrelevant checking condition), before all participants completed a final post-test check of the stove. Participants were asked at pre and post test which knobs they had manipulated and how confident they were about their answers. Although there were no differences between the groups on memory accuracy, participants who had continued to check the stove (i.e., relevant checking) demonstrated significantly decreased memory *confidence* in their answers as compared to the pre-test, and as compared to the participants in the other condition (i.e., irrelevant checking). Therefore, this study showed that repeated checking undermines confidence in one's memory (van den Hout & Kindt, 2003a). The authors proposed that repeated checking causes the object being checked to become more familiar, changing processing of the event from perceptual to conceptual. When perceptual processing is reduced, less vivid and detailed information is encoded, and this contributes to memory distrust (van den Hout & Kindt, 2003a).

Replicating and extending this work, Radomsky, Gilchrist, and Dussault (2006) asked non-clinical participants to engage in essentially the same experimental protocol as van den Hout & Kindt (2003a), but to use a real stove and a real faucet, instead of virtual burners and light bulbs. Results demonstrated that memory confidence, vividness, and detail had all decreased robustly for participants in the relevant checking condition, but not for those in the irrelevant checking condition (Radomsky, Gilchrist, et al., 2006). Coles, Randomsky, and Horng (2006) replicated and extended these findings by showing that decreases in memory confidence can be seen in as few as two checking trials, and that decreases in meta-memory (confidence, vividness, and detail) led to a change in the type of memory reported (i.e., the memory became 'known' rather than a specific 'remembering'; Coles et al., 2006).

The same effect has been found in clinical populations, using both similar and dissimilar paradigms. Boschen and Vuksanovic (2007) used van den Hout and Kindt's (2003a) virtual stove paradigm to examine the effects of repeated checking on meta-memory with a clinical population. Repeated checking significantly decreased memory confidence and meta-memory, but not memory accuracy for the check (Boschen & Vuksanovic, 2007). Tolin and colleages (2001) repeatedly exposed participants with OCD, non-anxious controls, and students to a set of objects that were either safe, unsafe, or neutral. Subsequently, they were asked to recall as many objects as possible and to rate their confidence in their answers. Memory accuracy was the same across groups but participants with OCD had a decline in memory confidence for the unsafe objects as the number of trials increased, supporting the idea that people with OCD have decreased memory confidence for threatening information (Tolin et al., 2001).

Recent research has demonstrated that the opposite effect is also true - low memory confidence predicts repeated checking. In their psychometric investigations, Nedeljkovic and colleagues (2009) replicated the finding by Nedeljkovic and Kyrios (2007) that low trait meta-memory factors such as memory confidence was predictive of OCD symptoms, moreso than other OCD-related cognitions reported by the OCCWG (2005). Surprisingly, low memory confidence was more predictive of OC symptoms than were cognitions already puported to be predictive of OCD, such as beliefs about importance of control over thoughts, perceived responsibility, and intolerance of uncertainty. This relationship, and its predictive power over and above other OC cognitions, was observed even when using a student analogue population (Nedeljkovic et al., 2009). Similarly, Coulge, Salkovskis, and Wahl (2007) found that OCD checkers had poorer perceptions of their own memory ability, and less confidence in their memory for OCD-related stimuli. These findings call for investigation into low memory confidence (i.e., negative beliefs about memory) as a risk factor for OCD. Although Rachman (2002) includes low memory confidence as one belief that contributes to the self-perpetuating mechanism of checking (whereby repeated checking leads to low memory confidence, which causes more repeated checking), the OCCWG neglected to include beliefs about memory early on in the development of their Obsessive Beliefs Questionnaire (OCCWG, 1997). As such, closer examination of the potential influence of beliefs about memory on compulsive checking is necessary.

The aim of this study was to directly examine Rachman's (2002) hypothesis that low memory confidence contributes to the self-perpetuating checking mechanism by investigating experimentally whether increased urges to check follow induced low memory confidence. Repeated evidence has shown that, as Rachman (2002) postulated, repeated checking does indeed lead to lower memory confidence (e.g., van de Hout & Kindt, 2003a). To date, only correlational evidence has suggested that the reverse holds true – that low memory confidence leads to more repeated checking (e.g., Nedeljokovic et al., 2007). The ability to empirically and experimentally demonstrate this phenomenon would add to the support for low memory confidence as an important obsessive belief, and suggest a new target of treatment (i.e., negative maladaptive beliefs about one's own memory), which could increase the efficaciousness of CT for OCD.

Beliefs about memory were manipulated (by giving positive or negative false feedback following the completion of portions of a standardized memory test) in a student population to see if they could effect changes in urges to check on three subsequent laboratory-based memory tests. It was hypothesized that participants in whom a low level of memory confidence (i.e., negative beliefs about memory) had been induced would have increased urges to check during laboratory-based memory tasks as compared to those participants in whom a high level of memory confidence (i.e., positive beliefs about memory) had been induced. If the manipulation of memory-related beliefs result in changes in checking symptoms, the inclusion of this domain as one of the belief types that contribute to OCD symptomatology may be warranted.

Methods

Participants

Participants were 119 undergraduate students at Concordia University participating for either course credit or an entry for a cash draw. Inclusion criteria were the ability to understand, read, and communicate in English. Six participants' data were omitted due to outliers on the dependent variables of interest (using the outlier exclusion method according to Tabachnick & Fidel, 2007). One additional participant's data had to be omitted because at the end of the study they reported complete disbelief of the feedback about their memory performance (see below). Finally, twenty one participants' data were removed because the manipulation check question (see post-feedback questionnaire, below) showed that the false feedback had not had the appropriate effect, either because they believed themselves to have a good memory (reporting an excellent, good, or average memory) after receiving information that they had a poor memory, or because they believed themselves to have a bad memory (reporting an average, fair, or poor memory) after receiving information that they had a good memory. This left ninety-one participants in total, with forty-three participants in the low memory confidence (LMC) condition and forty-eight participants in the high memory confidence (HMC) condition. It should be noted that those who were excluded due to failure of the manipulation did not differ from those for whom the manipulation worked in terms of age, $t(110) = 0.73$, n.s., or sex, $\chi^2(1) = 0.30$, n.s.. They also did not differ on the baseline memory abilities as assessed by their scaled *Faces* scores, $t(110) = 0.89$, n.s., *Letter-Number Sequencing* scores, $t(110) = 1.58$, n.s., or *Spatial*

Span scores, $t(20) = -0.85$[1], n.s. (all components of the *Wechsler Memory Scale-III* used in the current study – see below for details*)*.

The mean age of participants was 23.56 ($SD = 6.05$) years old, with participants ranging from 19 to 47 years of age. Eighty-five percent of the sample was female. There were no significant differences between the two conditions in age, $t(89) = -0.76$, n.s., or sex, $\chi^2(1) = 0.47$, n.s..

In order to verify that the sample was non-clinical in nature, the MCQ (Wells & Cartwright-Hatton, 1999), MACCS (Nedeljkovic & Kyrios, 2007), VOCI (Thordarson et al., 2004), OBQ (OCCWG, 2005), BAI (Beck & Steer, 1990), and BDI-II (Beck, Steer, & Garbin, 1996) were administered to all participants (see *Measures* for questionnaire descriptions and Table 1 for means and standard deviations). There were no significant differences between the groups on cognitions related to confidence in memory, as evidenced by the MCT scores, $t(89) = 0.81$, n.s., the subscale of the MCT that specifically measures cognitive confidence $t(89) = 1.50$, n.s., MACCS scores, $t(89) = 1.24$, n.s., or the subscale of the MACCS that specifically measures memory confidence, $t(89) = 1.63$, n.s.. There were no significant differences between the groups on OCD behaviours and beliefs, as evidenced by VOCI scores, $t(79.88) = 0.57$[2], n.s., the subscale of the VOCI which specifically measures checking compulsions in OCD, $t(89) = 1.10$, n.s., or OBQ scores, $t(89) = 0.90$, n.s. There were no differences between the groups on anxiety and depression, as evidenced by BAI scores, $t(89) = 1.19$, n.s., and BDI-II scores, $t\ (89) = -0.17$, n.s..

Measures

---

[1] Levene's test of homogeneity of variance was significant ($p = .001$), therefore *t* and *df* values reported assume unequal variances.

[2] Levene's test of homogeneity of variance was significant ($p = .049$), therefore *F* and *df* values reported assume unequal variances.

The Metacognitions Questionaire (MCQ-30; Wells & Cartwright-Hatton, 1999) is a 30-item self report questionnaire that assesses metacognitive beliefs along five factors (cognitive confidence, positive beliefs about worry, cognitive self-consciousness, negative beliefs about uncontrollability of thoughts and anger, and beliefs about the need to control thoughts). It is an updated and shortened version of the original MCQ (Cartwright-Hatton & Wells, 1997) that exhibits good fit to the original five factors. It has good-excellent internal consistency with α scores ranging from 0.72 to 0.93 across the factors. The test-retest reliability for the total scale is 0.75 and its significant correlations with tests measuring similar concepts supports the convergent validity of its five factors (Wells & Cartwright-Hatton, 1999). It was administered to check for baseline differences between participants on metacognitive beliefs, using both the total score and the subscale measuring cognitive confidence. In the current sample, the internal consistency of the MCT was excellent, $\alpha = .92$.

The Memory and Cognitive Confidence Scale (MACCS; Nedeljkovic & Kyrios, 2007) is a recently developed 28-item self-report questionnaire that measures trait meta-memory, which encompasses four factors: concentration and attention, decision-making abilities, perfectionism regarding one's memory, and confidence in one's memory abilities. All of these factors have been found to be associated with symptoms of OCD (Nedeljkovic & Kyrios, 2007). Exploratory factor analysis supported the existence of these four factors, suggesting it is adequately valid (and a recent study using confirmatory factor analysis has confirmed this factor structure; Nedeljkovic et al., 2009), with item loadings ranging from 0.45 to 0.81 on each of their respective factors. Its reliability is also good to excellent, with internal consistency for the overall scale at 0.92, and α levels for the four subscales ranging from 0.79 to 0.93. It was administered to check for differences between participants on trait meta-memory using both the total score and the confidence in memory subscale. In the current sample, the internal consistence of the MACCS was excellent, $\alpha = .94$.

The Vancouver Obessional Compulsive Inventory (VOCI; Thordarson et al., 2004) is a 55-item self-report questionnaire on a 0 (not at all) to 4 (very much) point Likert scale that measures agreement with symptoms of OCD across a broad range of obsessions, behaviours, and personality characteristics known to be associated with the disorder. The six factors assessed in this scale are contamination, checking, obsessions, hoarding, 'just right', and indecisiveness. The total scale and subscales all have good internal consistency, with α levels ranging from 0.79 to 0.98 (Thordarson et al., 2004). The measure also exhibits excellent test-retest reliability (r = 0.91; Radomsky, Ouimet, et al., 2006) as well as convergent and discriminant validity (Thordarson, et al., 2004; Radomsky, Ouimet, et al., 2006). With a non-clinical student sample it exhibits excellent internal consistency ($\alpha = 0.96$; Thordarson et al., 2004) and high convergent validity ($r = 0.83$; Radomsky, Ouimet et al., 2006). It was administered to assess OCD (especially checking) symptoms. In the current sample, the internal consistency of the VOCI was excellent, $\alpha = .95$.

The Obsessional Beliefs Questionnaire (OBQ-44; OCCWG, 2005) is a 44-item self-report inventory that assesses the degree to which one has beliefs associated with OCD symptomatology. Scale items load onto three factors: responsibility and threat estimation, perfectionism and intolerance for uncertainty, and importance and control of thoughts (OCCWG, 2005). Internal consistency is good with *Cronbach's* α ranging from 0.89 to 0.93 across the three subscales. The criterion, convergent and discriminant validity are all good (OCCWG, 2005). It was administered to assess OCD-relevant beliefs. In the current sample, the internal consistency of the OBQ-44 was excellent, $\alpha = .95$.

The Beck Anxiety Inventory (BAI; Beck & Steer, 1990) is a 21-item self-report questionnaire that assesses symptoms of anxiety. It has high internal consistency (*Cronbach's alpha* = 0.92) and test retest reliability (*r* = 0.75) as well as discriminant and convergent validity with a clinical sample (Beck et al., 1988). With a non-clinical sample it has high internal consistency with a *Cronbach's α* of 0.90 and good convergent validity (Osman et al., 1997). It was administered to assess anxious symptomatology. In the current sample, the internal consistency of the BAI was very good, *α* = .89.

The Beck Depression Inventory II (BDI-II; Beck, Steer, & Garbin, 1996) is 21-item self-report measure that assesses symptoms of depression and suicidality. It has high internal consistency, with an *α* level of 0.91, and high convergent validity, as it correlates strongly with the original BDI with an *r* of 0.93 (Dozois, Dobson, & Ahnberg, 1998). It was administered to assess depressive symptomatology. In the current sample, the internal consistency of the BDI-II was good, *α* = .78.

Three *Wechsler Memory Scale-III (WMS-III) subtests (Faces, Letter-Number Sequencing, & Spatial Span;* Wechsler*,* 1997*)*. The WMS-III is a battery of tests that measures various facets of memory. *Faces* is a measure of immediate visual memory. Participants are shown a series of faces for two seconds each, and then shown a second set of faces and asked if they have seen each face before or not. *Letter-Number Sequencing* assesses auditory working memory. Participants are read increasingly longer strings of randomly ordered numbers and letters, and then asked to repeat them back with the numbers first in numerical order, followed by the letters in alphabetical order. Finally, *Spatial Span* is a measure of visual working memory. The administrator taps a series of blocks in increasingly longer sequences and asks the participant to tap them in the same order. This is followed by a similar task in which participants must now tap them in backwards order. The reliability coefficients (*r*) were estimated using the split-half internal consistency method. The mean *r* values for Faces, Letter-Number Sequencing, and Spatial Span, across all age groups are on average 0.74, 0.82, and 0.79, respectively. Confirmatory factor analysis shows that the full WMS has five factors (immediate & delayed auditory memory, immediate and delayed visual memory, and working memory). The WMS-III correlates highly with its predecessor, the WMS-R with *r* values ranging from 0.86 to 0.97 across all indexes, indicating good to excellent construct validity (The Psychological Corporation, 1997). The reason for its inclusion in this study was not only as a tool for giving false feedback, but also to ensure that participants did not differ, on average, in their general memory abilities. It should be noted that all items of each subtest were administrated, regardless of their respective discontinue rules, so that all participants would have the same amount of exposure to the test. The discontinue rules were implemented later, for scoring purposes (i.e., if a participant correctly answered an item after they should technically have been discontinued from that subtest, they received a 0 for that item).

Verbal Rating Scales (0-100). A standard 100-point scale (0 being not at all, and 100 being extremely) was used to answer various questions. After the Memory Game™ (the first laboratory-based memory task, see *Procedure*, below) task, this scale was used to assess participants' urges to check that they had correctly answered the question "Which was the first card pair that you found?", and their urge to destroy the results of the exercise and to try again. The questions were recited as such "What is your urge to check the correct answer on a scale of 0 to 100 with 0 being not at all and 100 being an extreme urge the correct answer"; and "What is your urge to destroy the results of this exercise and try again, on a scale of 0 to 100 with 0 being not at all and 100 being an extreme urge to destroy the results and try again".

After the light task (the second laboratory-based memory task, see *Procedure*, below), this scale was used to assess participants' urges to check that the light was actually off, following the question "What did I ask you to do as we left the laboratory kitchen?", and their urge to destroy the results of the exercise and to try again. The questions were recited as such: "What is your urge to check that the light is actually off, on a scale of 0 to 100 where 0 is not at all and 100 is an extreme urge to check that the light is actually off"; and "What is your urge to destroy the results of this exercise and try again, on a scale of 0 to 100 with 0 being not at all and 100 being an extreme urge to destroy the results and try again". Finally, following debriefing at the end of the study, this scale was used to assess the believability of the study.

Post-Feedback Questionnaire. This manipulation check questionnaire was administered to participants under the guise of providing the laboratory with information about the skills of the experimenter who delivered the feedback about their WMS-III performance. There were a number of buffer items, but the one item of interest was "Following this feedback, I believe my memory is: a) excellent; b) good; c) average; d) fair; e) poor", to assess that the false feedback had achieved the desired effect in participants (i.e., that those in the low memory confidence condition now felt they had poorer memories than those in the high memory confidence condition). It was necessary to assess the quality of the manipulation in this way so as not to arouse suspicions from participants as to the true nature of the study. This manipulation check revealed that the manipulation was successful in seventy-six percent of participants overall, and only data from these participants was included in the final analyses.

Time to complete a memory game. The experimenter used a stop-watch to record the time it took for participants to uncover all of the correct card pairs from The *Original Memory Game*™ (Milton Bradley, 2007). A 6 x 5 grid of thirty cards (fifteen pairs), depicting drawings of typical toys, food, and animals was used from a set of seventy six cards belonging to this children's game.

Procedure

Participants were told that they were participating in a study investigating the validity of some new memory tasks that the laboratory wanted to use in future research studies, by comparing their performance and thoughts about these new tests to their performance and thoughts about portions of an already validated memory test – the Wechsler Memory Scale-III (WMS-III).

Following the informed consent process participants were asked to complete a questionnaire package which was comprised of well validated and commonly used self-report measures (see *Measures* for the complete list). Participants then completed the three subtests of the WMS-III mentioned above (also see *Measures*). Participants were subsequently assigned to one of two conditions intended to alter their beliefs about their memory: the low memory confidence (LMC) condition, or the high memory confidence (HMC) condition. This was done via a random draw from an envelope to ensure randomization and blindness to condition assignment until this point in the study. The experimenter pretended to have forgotten something in order to excuse themselves from the room to do this. The experimenter then returned and pretended to tabulate participant WMS-III scores while in the same room as the participant to ensure credibility of the feedback. Their actual results, however, were not given (see below).

During the memory feedback (see below), all participants were shown a figure of a normal curve so the experimenter could indicate where their scores fell along the continuum, and given the following pre-amble to their feedback: "Alright so the scores we report to you are in percentile ranks. Are you familiar with percentile ranking? What it means is that we have a database of scores of thousands of men and women in North America across all the age ranges, and that's what we compare your scores to. Each age range is comprised of a representative sample of the different ethnicities that exist in North America, as well as a range of students, blue collar and white collar workers who took the test. All of that is just to say that as much as possible we are trying to compare your scores to the real population that is out there. So it is technically possible to have scored very highly on the test, but to still get a low ranking, or vice versa, to score very low, but still get a high ranking. The range of scores on this test is also normally distributed, meaning that we expect most people to fall at about the mid-point (or 50^{th} percentile)..."

Participants in the LMC condition were then told: "... but your scores were actually between the 35^{th} and 40^{th} percentile, which is very low (participants were shown the normal curve and the experimenter indicated on the figure where their scores fell). Your scores were significantly lower compared to the standard scores of people your age on this test, so most people your age would have performed better than you on average across these three tasks. This means you may not be able to rely on your memory to tell you how well you've done. You may already be aware of this. For example, think about how many times you've been sure you know where your keys are, only to find out that you don't. If you're interested, at the end of the study, I can give you a resource list that we have in the lab that contains information about how to improve your memory."

Participants in the HMC condition were then told: "... but your scores were actually between the 85^{th} and 90^{th} percentile, which is very high (participants were shown the normal curve and the experimenter indicated on the figure where their scores fell). Your scores were significantly higher compared to the standard scores of people your age on this test so most people your age would have performed worse than you on average across these three tasks. This means you may be able to rely on your memory to tell you how well you've done. You may already be aware of this. For example think about all the times you haven't been sure you know where your keys are, but then they are in the first place you looked. If you're interested, at the end of the study, I'd like to talk to you about getting your permission to contact you for future studies, because we are interested in testing people like you who have good memories."

Following this, all participants completed the *Post-Feedback Questionnaire* as a manipulation check, although they were told it was because the laboratory was in the process of evaluating the performance of the experimenter. At this point a second experimenter took over administration of this protocol in order to keep the researchers blind to the memory confidence condition of participants, so that this knowledge would not bias the way that data was collected. Then participants were asked to complete our 'laboratory's newer memory tasks' in the laboratory kitchen.

This began with the Memory Game™ task, where participants were told that the objective of the game was to find the matching pair of each card out of an array of cards arranged face down on a table, while only turning over two cards at a time. Then the experimenter left the laboratory kitchen to go back to the original testing room, and the participant was asked to shut off the light as they left (this was the light task, but participants did not know it yet). Once back in the original testing room, participants answered a few questions about what the first card pair was that they had found, as well as urges to check if their answer to this question was correct and whether they would like their 'results' for the particular task to be destroyed so they could try again (for exact wording see *Measures*). They were also asked about the last thing they had been asked to do (turn off the light), their urge to check that the light was actually off, and their urge to destroy the results and try again (for exact wording see *Measures*).

Participants were fully debriefed by the original experimenter (including an explanation for the need for deception about their test results and the methods used on the WMS-III) and a second consent form was given so that participants could consent to the use of their data after hearing about the deception used in the study.

Results

Missing Data

There were very few missing data points. When a value was missing from a questionnaire, the average of that participant's answers to the other questions in that measure was used to replace that missing value (Tabachnick & Fidel, 2007). A missing value on one analysis did not exclude that participant's data from other analyses.

Urges to Check

Following the Memory Game™ task, a MANOVA with condition assignment as the independent variable and urges to check the correct answer and urges to destroy the results and try again as the outcome variables of interest revealed a main effect of group, $F(2, 87) = 7.19$, $p = .001$, partial $\eta^2 = 0.14$. Follow-up one-way ANOVAs (using a Bonferonni correction to the alpha level: $\alpha = 0.05/2$ tests, new $\alpha = .025$; per Field, 2009) showed a significant effect of condition on urges to check, such that those in the LMC condition had greater urges to check than those in the HMC condition $F(1, 89) = 5.70$, $p = .019$, partial $\eta^2 = 0.06$. The same effect was evident between conditions for urges to destroy the results and try again, meaning that those in the LMC condition had greater urges to destroy the results than those in the HMC condition, $F(1, 90) = 12.51$, $p = .001$, partial $\eta^2 = 0.12$ (see Figure1).

Following the light task, a MANOVA with condition assignment as the independent variable and urges to check if the light was off and urges to destroy the results and try again as the outcome variables of interest revealed a main effect of condition, $F(2, 88) = 5.13$, $p = .008$, partial $\eta^2 = 0.10$. Follow-up one-way ANOVAs (using Bonferonni's correction to the alpha level: $\alpha = 0.05/2$ tests, new $\alpha = .025$) showed a marginally significant effect of condition on urges to check, such that those in the LMC condition had greater urges to check than those in the HMC condition, $F(1, 90) = 4.77$, $p = .032$, partial $\eta^2 = 0.05$. For urges to destroy the results and try again, there was a significant difference between the conditions, such that those in the LMC condition had greater urges to destroy the results and try again than those in the HMC condition, $F(1, 90) = 8.29$, $p = .005$, partial $\eta^2 = 0.08$ (see Figure 2).

Memory Ability

Independent-samples *t*-tests scores on the components of the Wechsler Memory Scale-III (WMS-III) were conducted to assess whether or not pre-manipulation, the groups did not differ on their actual memory abilities. There were no differences between the groups on their scaled *Faces* scores, $t(89) = -1.04$, n.s., *Letter-Number Sequencing* scores, $t(89) = -0.65$, n.s., or *Spatial Span* scores, $t(89) = 1.23$, n.s..

Independent-samples *t*-tests of scores on the answers to the questions posed in the laboratory tasks were also conducted to ensure that the groups did not differ on their performance of these tasks. Groups did not differ on ability to answer the questions "What was the first card pair that you found?", $t(89) = 0.12$, n.s., and "What did I ask you to do as we left the lab kitchen?", *t*(89) = -0.11, n.s.. They also did not differ on times to complete the Memory Game™ task, *t*(89) = 0.44, n.s..

Discussion

Beliefs about Memory and Urges to Check

Results were mainly consistent with the study hypotheses. It was hypothesized that participants in the low memory confidence (i.e., negative beliefs about memory) condition would have greater urges to check than those in the high memory confidence (i.e., positive beliefs about memory) condition for all of the laboratory-based memory tasks. The results of the Memory Game™ task were consistent with this hypothesis. Participants in the LMC condition had significantly greater urges to check (that they had correctly remembered the first card pair they found) than those in the HMC condition. They also had significantly greater urges to destroy the results of that task and try again. The results of the light task were also consistent with this hypothesis. Participants in the LMC condition had marginally significant greater urges to check that the light was actually off than those in the HMC condition. They also had significantly greater urges to destroy the results of that task and try again.

These results showed support for our hypothesis that low memory confidence/negative beliefs about memory can indeed cause urges to engage in checking behaviour. This would imply that checking behaviour could be started by initial doubts about one's memory or low memory confidence. This is consistent with Rachman's (2002) self-perpetuating cycle, part of his cognitive theory of compulsive checking. Previous research had shown that repeated checking leads to decreased memory confidence in student (e.g., van den Hout & Kindt, 2003a; Radomsky et al., 2006) and clinical (Hermanns et al., 2003; Boschen & Vuksanovic, 2007) populations, supporting the notion that repetition can lead to memory distrust. It is the first time to our knowledge however, that experimental manipulations of memory distrust can lead to repetition. Until now, low memory confidence has been shown to predict OCD symptomatology in clinical and student populations only in studies using correlational designs (Nedeljokovic & Kyrios, 2007; Nedeljkovic et al., 2009). This supports the theory that repeated checking and low memory confidence form a self-perpetuating cycle through which an individual with OCD would continue to check in hopes of gaining memory confidence, but fail to be able to do so (Rachman, 2002). These results also concur with earlier research suggesting that beliefs about memory have a powerful influence over checking behaviour (Cougle et al., 2007), in addition to beliefs about personal responsibility (e.g., Lopatka & Rachman, 1995), and the other domains of beliefs included in the OBQ-44 (OCCWG, 2005).

These results are striking as they show the relatively strong and immediate impact that a fairly brief manipulation of low memory confidence can have. Despite the fact that participants had turned off the light less than two minutes before answering a question about this basic and straightforward task, many of them then wanted to check to make sure that the light was off. The questions about 'destroying the results and trying again' were another, perhaps indirect way, of assessing checking behaviour, and yet significant differences between the groups were seen. It should be noted, however, that no one ever explicitly asked to repeat the task, nor was it ever offered as a possibility that they could *actually* repeat the task.

Strengths and Limitations of the Study

One strength of the work is that beliefs about memory have been shown to cause urges to check directly, using a straightforward experimental design. It must be noted however, that these results do not show definitively that negative beliefs about memory are *necessary* to provoke checking urges – merely that they are sufficient. Another strength of this study is that an ecologically valid task (i.e., checking to see if a light is actually off, something that participants would presumably occasionally do in their own lives), was used to assess urges to check.

Perhaps the most important limitation of the work is that an urge to check is not necessarily equivalent to actual checking behaviour. As they were not given the opportunity to engage in checking behaviour, we cannot conclude that their urges to check would have predicted perfectly their compulsions. Urges to check, however, have been a common proxy for checking over the years (e.g., Lopatka & Rachman, 1995), and are likely highly associated with real checking behaviour.

Implications and Future Directions

The results of this study have implications for many domains of OCD-related interests. First of all these results supported the cognitive model of checking behaviour (Rachman, 2002), furthering our knowledge of the aetiology of this compulsion. These results also add to the growing body of literature that demonstrates that checking behaviour is a product of low memory confidence (e.g., van den Hout & Kindt, 2003a), rather than low memory ability, as some have suggested in the past (see Tallis, 1997, for a review).

Work has been devoted to the development of the OBQ-44 (OCCWG, 2005) in order to be able to better identify cognitions that are specific to OCD. However, some work has suggested that the measure as is, does not distinguish between OCD and other anxiety disorders (Tolin, Worhunsky, & Maltby, 2006). The results of the present study suggest the inclusion of a new belief domain - beliefs about memory and memory confidence be added to our conceptualization of beliefs relevant to OCD. Questionnaires evaluating meta-memory such as the MCT (Wells & Cartwright-Hatton & Wells, 1999) and/or the MACCS (Nedeljkovic & Kyrios, 2007) may be incorporated into a screening assessment of OC concerns. Refining a measure for capturing a broader range of OCD-related beliefs will not only help target treatment interventions to the beliefs that are causing the most maladaptive behaviours, but also aid screening for risk factors to developing the disorder, which is important for prevention and early treatment.

Elucidating the causal relationships between thoughts and checking can help to better refine treatments. Although a number of increasingly effective treatments exist (Abramowitz, 2006), a substantial percentage of patients are still unwell at the end of treatment (Foa et al., 2005). These results can lead to advances in treatment by targeting negative beliefs about memory in therapy. This could be accomplished via behavioural experiments and other cognitively-based strategies (e.g., those proposed by Radomsky, Shafran, Coughtrey & Rachman, 2010) including psychoeducation about the impact that erroneous (particularly negative) beliefs about memory can have. For example, an individual might believe they have a poor memory and therefore feel the need to check more often, but if they can be informed that their beliefs about memory are not actually the same as their actual memory ability, this might help them resist the urge to check – especially if they are also educated about the detrimental effects of checking itself on memory (e.g., van den Hout & Kindt, 2003a; Radomsky & Alcolado, 2010).

A behavioural experiment could be implemented to test whether an individual really does have a bad memory or just *thinks* they have a bad memory by objectively gathering and examining evidence from their everyday experiences (outside of OCD-related experiences) for and against these beliefs. If it turns out there is not much evidence for an actual memory problem, it may be just the beliefs that are driving the urge to check, showing that actual checking might not be necessary. (Incidentally, we do not recommend neuropsychological testing of memory ability as a part of these information gathering exercises; anxiety and depression are known to interfere with these tests and they are not necessarily ecologically valid. More helpful information typically comes from asking about everyday experiences.) An additional relevant behavioural experiment (outlined in Radomsky et al., 2010) involves asking a client to check a few times on one occasion, and to check ‘a lot’ on another occasion, recording how certain they feel about the status of the checked object after each episode. Clients will probably notice that the more they check, the less certain they feel, so that they eventually realise that in order to be more confident/certain, it is better not to check at all, and to trust their own memory.

Repeated checking-like behaviour has recently been shown to have additional detrimental effects, not only on memory confidence, but on confidence in attention and perception (Hermans et al., 2003; 2008; van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008, although see Dek, van den Hout, Giele & Engelhard, 2010, for a discussion of domain specificity). Future investigations of whether these relationships are also self-reinforcing (e.g., Does low confidence in attention/perception cause urges to check?) may prove valuable for further clarifying antecedents to checking behaviour that could include beliefs about cognitive domains other than memory. Finally, as this is the first study of this type, replication is needed to further support the finding that negative beliefs about memory leads to increased checking urges.

Summary

The present study showed that negative beliefs about memory can lead to urges to check. Previous experimental work in this area had only supported the reverse - that repeated checking led to low memory confidence. These results suggest that beliefs about memory are yet another important belief domain to be addressed in cognitive-behaviour therapy for OCD. Although further investigation and replication is required, these results have important implications for cognitive models of compulsive checking behaviour in OCD and other disorders, as well as for associated prevention and treatment strategies.

Author Notes

The authors would like to gratefully acknowledge Jesse Renaud, Laura Choinière, Vanessa Hunt-Ladouceur, Greg Medelson, Ivana Di Leo, and Stefanie Lavoie for their help with data collection, and to Corinna Elliott for WMS-III training. This research was facilitated in part by a Natural Sciences and Engineering Research Council of Canada (NSERC) Julie Payette Canada Graduate Scholarship awarded to the first author and by an NSERC Discovery Grant held by the second author.

References

Abramowitz, J.S. (2006). The psychological treatment of obsessive-compulsive disorder. *Canadian Journal of Psychiatry*, *51*, 407-416.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th edition. Text revision). Washington: American Psychiatric Association.

Arntz, A., Voncken, M., & Goosen, A. C. A., (2007). Responsibility and obsessive-compulsive disorder: An experimental test. *Behaviour Research and Therapy*, *45*, 425-435.

Ball, S. G., Baer, L., & Otto, M. W. (1996). Symptom subtypes of obsessive-compulsive disorer in behavioral treatment studies: a quantitative review. *Behaviour Research and Therapy*, *34*, 47-51.

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*, *56*, 893-897.

Beck, A. T., & Steer, R. A. (1990). *Beck anxiety inventory manual*. Toronto: Psychological Corporation.

Beck, A. T., Steer, R. A., & Garbin, M. G. (1996). *Beck depression inventory manual* (2nd ed.). San Antonio: Psychological Corporation.

Boschen, M. J., & Vuksanovic, D. (2007). Deteriorating memory confidence, responsibility perceptions and repeated checking: Comparisons in OCD and control samples. *Behaviour Research and Therapy*, *45*, 2098-2109.

Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: The meta-cognitions questionnaire and its correlates. *Journal of Anxiety Disorders*, *11*, 279-296.

Clark, D. A., (2005). Focus on "cognition" in cognitive behaviour therapy for OCD: Is it really necessary? *Cognitive Behaviour Therapy*, *34*, 131-139.

Coles, M. E., Radomsky, A. S., & Horng, B. (2006). Exploring the boundaries of memory distrust from repeated checking: Increasing external validity and examining thresholds. *Behaviour Research and Therapy*, *44*, 995-1006.

Cougle, J. R., Salkkovskis, P. M., & Wahl, Karina (2007). Perception of memory ability and confidence in recollections in obsessive-compulsive checking. *Journal of Anxiety Disorders*, *21*, 118-130.

Dek, E. C. P., van den Hout, M. A., Giele, C. L., & Engelhard, I. M. (2010). Repeated checking causes distrust in memory but not in attention and perception. *Behaviour Research and Therapy*, *48*, 580-587.

Dozois, D. J. A., Dobson, K. S., & Ahnberg, J.L. (1998). A psychometric evaluation of the Beck depression inventory-II. *Psychological Assessment*, *10*, 83-89.

Field, A. (2009). *Discovering statistics using SPSS*. London: SAGE Publications Ltd.

Foa, E. B., Liebowitz, M. R., Kozak, M. J., Davies, S., Campeas, R., Franklin, M. E., et al. (2005). Randomized, placebo-controlled trial of exposure and ritual prevention, clomipramine, and their combination in the treatment of obsessive-compulsive disorder. *American Journal of Psychiatry*, *162*, 151-161.

Hermans, D., Martens, K., De Cort, K., Pieters, G., & Eelen, P. (2003). Reality monitoring and metacognitive beliefs related to cognitive confidence in obsessive-compulsive disorder. *Behaviour Research and Therapy*, *41*, 383-401.

Hermans, D., Engelen, Y., Grouwels, L., Joos, E., Lemmens, J., & Pieters, G. (2008). Cognitive confidence in obsessive-compulsive disorder: Distrusting perception, attention and memory. *Behaviour Research and Therapy*, *46*, 98-113.

Lopatka, C., & Rachman, S. (1995). Perceived responsibility and compulsive checking: An experimental analysis. *Behaviour Research and Therapy*, *33*, 673-684.

Marks, I. M. (1973). New approaches to the treatment of obsessive-compulsive disorders. *The Journal of Nervous and Mental Disease*, *156*, 420-426.

Meyer, V. (1966). Modification of expectations in cases with obsessional rituals. *Behaviour Research and Therapy*, *4*, 273-280.

Milton Bradley (2007). *Original memory game.* Longueil: Hasbro Canada.

Nedeljkovic, M., & Kyrios, M. (2007). Confidence in memory and other cognitive processes in obsessive-compulsive disorder. *Behaviour Research and Therapy*, *45*, 2899-2914.

Nedeljkovic, N., Moulding, R., Kyrios, M., & Doron, G. (2009). The relationship of cognitive confidence to OCD symptoms. *Journal of Anxiety Disorders*, *23*, 463-468.

O'Connor, K., Freeston, M. H., Gareau, D., Careau, Y., Dufour, M. J., Aardema, F., et al., (2005). Group versus individual treatment in obsessions without compulsions. *Clinical Psychology and Psychotherapy*, *12*, 87-96.

Obsessive Compulsive Cognitions Working Group (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy*, *35*, 667-681.

Obsessive Compulsive Cognitions Working Group (2005). Psychometric validation of the obsessive belief questionnaire and interpretations of intrusions inventory – Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*, 1527-1542.

Osman, A., Kopper, B. A., Barrios, F. X., Osman, J. R., & Wade, T. (1997). The Beck anxiety inventory: Reexamination of factor structure and psychometric properties. *Journal of Clinical Psychology*, *53*, 7-14.

The Psychological Corporation (1997). *WAIS-III WMS-III Technical Manual.* San Antonio: The Psychological Corporation.

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*, 625-639.

Radomsky, A. S., Gilchrist, P. T., & Dussault, D. (2006). Repeated checking really does cause memory distrust. *Behaviour Research and Therapy*, *44*, 305-316.

Radomksy, A. S., Ouimet, A. J., Ashbaugh, A. R., Lavoie, S. L., Parrish, C. L., & O'Connor, K. P. (2006). Psychometric properties of the French and English versions of the Vancouver Obsessional Compulsive Inventory and the Symmetry Ordering and Arranging Questionnaire. *Cognitive Behaviour Therapy*, *35*, 164-173.

Radomsky, A. S., Shafran, R., Coughtrey, A. E., & Rachman, S. (2010). Cognitive-behavior therapy for compulsive checking in OCD. *Cognitive and Behavioral Practice*, *17*, 119-131.

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioral analysis. *Behaviour Research and Therapy*, *23*, 571-583.

Stein, M. B., Forde, D. R., Anderson, G., & Walker, J.R. (1997). Obsessive-compulsive disorder in the community: An epidemiologic survey with clinical reappraisal. *American Journal of Psychiatry*, *154*, 1120-1126.

Tabachnick, B. G., & Fidell, L. S. (2007). Using Multivariate Statistics (5th ed.). Boston: Pearson Education Inc.

Tallis, F. (1997). The neuropsychology of obsessive-compulsive disorder: A review and consideration of clinical implications. *British Journal of Clinical Psychology*, *36*, 3-20.

Thordarson, D. S., Radomsky, A. S., Rachman, S., Shafran, R., Sawchuk, C. N., & Hakstian, A. R. (2004). The Vancouver Obsessional Compulsive Inventory (VOCI). *Behaviour Research and Therapy*, *42*, 1289-1314.

Tolin, D. F., Abramowitz, J. S., Brigidi, B. D., Amir, N., Street, G. P., & Foa, E. B. (2001). Memory and memory confidence in obsessive-compulsive disorder. *Behaviour Research and Therapy*, *39*, 913-927.

Tolin, D. F., Worhunsky, P., & Maltby, N. (2006). Are "obsessive" beliefs specific to OCD? A comparison across anxiety disorders. *Behaviour Research and Therapy*, *44*, 469-480.

van den Hout, M. A., Engelhard, I. M., de Boer, C., du Bois, A., & Dek, E. (2008). Perseverative and compulsive-like staring causes uncertainty about perception. *Behaviour Research and Therapy*, *46*, 1300-1304.

van den Hout, M., & Kindt, M. (2003a). Repeated checking causes memory distrust. *Behaviour Research and Therapy*, *41*, 301-316.

Wechsler, D. (1997). *The Wechsler Memory Scale* (3rd ed.). San Antonio: The Psychological Corporation.

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behaviour Research and Therapy*, *42*, 385-396.

Whittal, M. L., Thordardson, D. S., & McLean, P. D. (2005). Treatment of obsessive-compulsive disorder: Cognitive behavior therapy vs. exposure and response prevention. *Behaviour Research and Therapy*, *43*, 1559-1576.

Whittal, M. L., Woody, S. R., McLean, P. D., Rachman, S. J., & Robichaud, M. (2010). Treatment of obsessions: A randomized controlled trial. *Behaviour Research and Therapy*, *48*, 295-303.

Wilhelm, S., Steketee, G., Reilly-Harrington, N. A., Deckersbach, T., Buhlmann, U., & Baer, L. (2005). Effectiveness of cognitive therapy for obsessive-compulsive disorder: An open trial. *Journal of Cognitive Psychotherapy: An International Quarterly*, *19*, 173-179.

Table 1

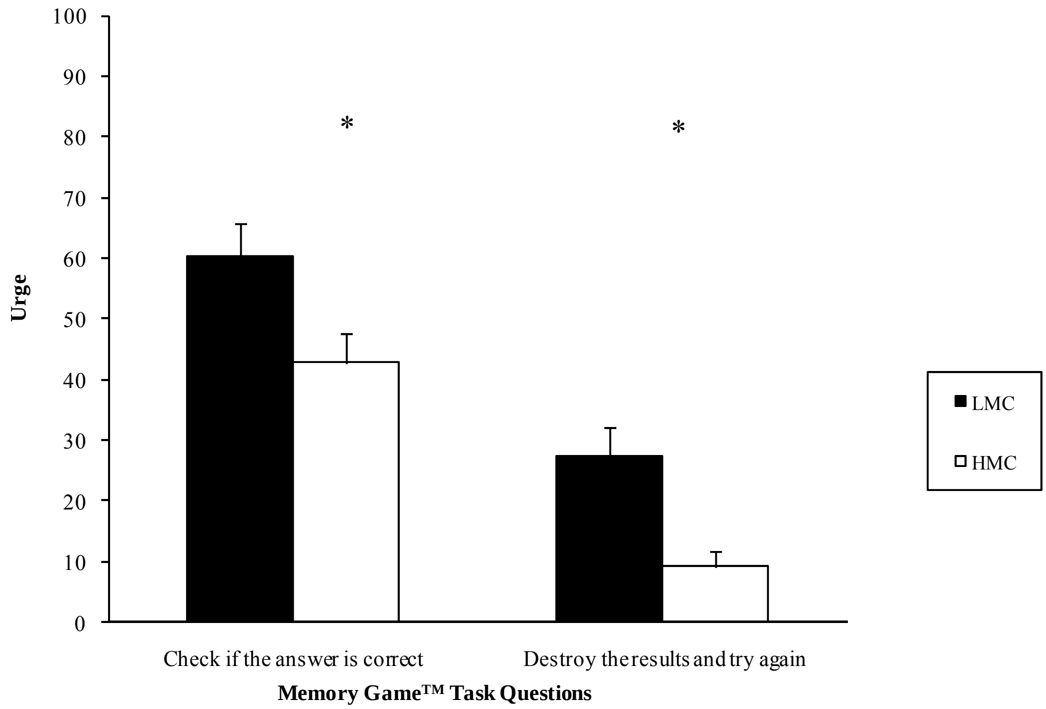
Mean scores and standard deviations by group on measures assessing cognitive confidence, obsessive-compulsive, anxious, and depressive symptoms

	LMC		HMC	
Questionnaire	Mean	SD	Mean	SD
MCQ	59.20	15.67	56.67	14.08
MCQ-CC*	11.09	3.86	9.94	3.46
MACCS	71.75	20.80	66.72	17.96
MACCS-CONF**	36.89	12.10	33.13	9.91
VOCI	32.92	29.78	31.66	23.57
VOCI-CHECK***	3.56	4.66	2.62	3.44
OBQ-44	132.33	43.30	124.12	43.47
BAI	12.33	10.25	10.07	7.92
BDI-II	8.96	6.85	9.21	7.16

Note. *Denotes the subscale of the MCQ (Metacognitions Questionnaire) that measures cognitive confidence, **denotes the subscale of the MACCS (Memory and Cognitive Confidence Scale) that measures memory confidence, ***denotes the subscale of the VOCI (Vancouver Obsessional Compulsive Inventory) that measures checking symptomatology

Figure 1

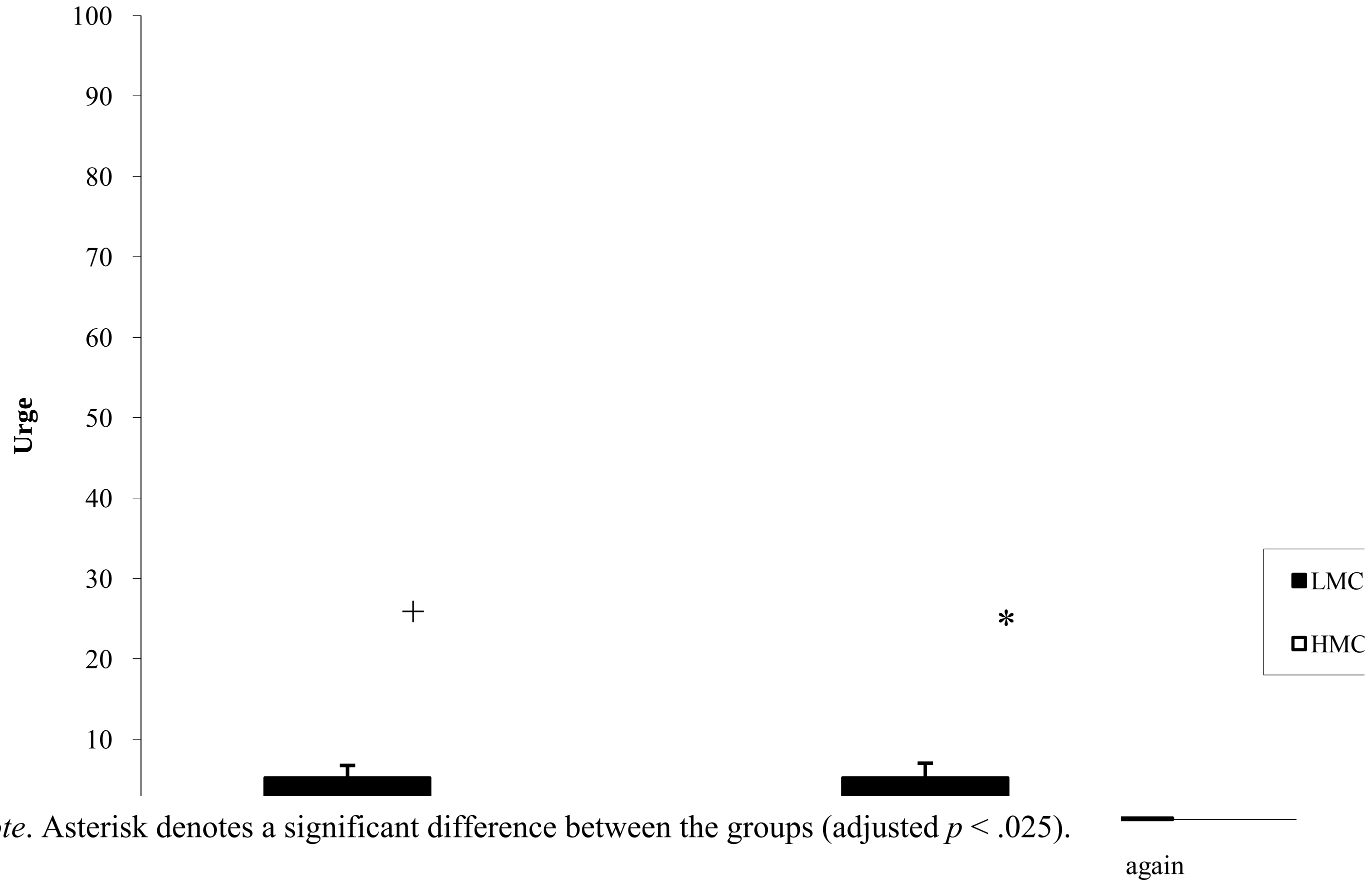
Mean urges scores during the Memory Game^{TM} task by group



Note. Asterisks denote significant differences between the groups (adjusted *p*'s < .025)

Figure 2

Mean urges scores during the light task by group



Note. Asterisk denotes a significant difference between the groups (adjusted $p < .025$).

Plus sign denotes a marginally significant difference between groups ($p = .032$)