Running head: REALITY-MONITORING

"Perhaps you only imagined doing it": Reality-Monitoring in Obsessive-Compulsive Checkers Using Semi-Idiographic Stimuli

Jesse R. Cougle[1], Paul M. Salkovskis[2], Susan J. Thorpe[3]

[1]Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford, OX1 3UD, UK

[2]Department of Psychology, PO Box 077, Institute of Psychiatry, de Crespigny Park, Denmark Hill, London, SE5 8AF, UK

[3]Department of Psychology, School of Human Sciences, University of Surrey, Guildford, Surrey GU2 7XH, UK

Correspondence concerning the manuscript may be addressed to Jesse R. Cougle, Department of Psychology, University of Texas, 1 University Station A8000, Austin, TX 78712-0187, Office: 512-471-3722. Email: cougle@mail.utexas.edu.

Abstract

Memory failures reported by obsessive-compulsive (OC) checkers often seem to be errors of “reality-monitoring”, or misremembering whether one performed or imagined performing an action. To examine these memory processes in the context in which such errors are said to occur, an in-home reality-monitoring experiment involving bothersome and non-bothersome actions was conducted with 21 OC checkers and 24 non-clinical controls. OC checkers reported poorer confidence in memory, but both groups performed similarly on tests of immediate and delayed free and prompted recall. Among OC checkers (but not controls), accuracy in recall and confidence in memory were correlated. Theoretical implications are discussed.

Key words: Obsessive Compulsive Disorder; Checking; Memory; Reality-monitoring

"Perhaps you only imagined doing it": Reality-Monitoring in Obsessive-Compulsive Checkers Using Semi-Idiographic Stimuli

1. Introduction

Obsessive-Compulsive (OC) checkers often attribute their checking to memory difficulties. Theoretical formulations focusing on the idea that a memory deficit may be responsible for repetitive checking behaviours have good face validity (Sher, Frost, & Otto, 1983; Sher, Mann, Frost, 1984; Sher, Frost, Kushner, Crews, & Alexander, 1989; Purcell, Maruff, Kyrios, & Pantellis, 1998). OC checking could readily be conceptualized as behaviour intended to compensate for poor memory. However, observations such as the situational specificity of checking behaviours have raised the possibility that poor *confidence* in memory could account for compulsive checking (Rachman 2002; Salkovskis 1996; Salkovskis & Kirk, 1997). The OC sufferer may check as a response to the experience of levels of confidence in memory that fall short of the standards they set for themselves; this discrepancy is most likely to occur when they believe that the consequences of an error are particularly serious. Salkovskis (1985; 1999) proposes that people who suffer from OCD are particularly sensitive to the possibility that their actions may result in them being responsible for harm to themselves or others. When applied to the decision as to whether one has completed an action, such beliefs would result in a further undermining of confidence levels and/or the requirement of still higher standards of confidence in recall. There is evidence that repetitive checking is counter-productive and can lead to a further decline in memory confidence (van den Hout & Kindt, 2003; Radomsky, Gilchrist & Dussault, 2006), and a cycle of checking behaviour.

There is some evidence consistent with both types of theory. Woods and colleagues (2002,) concluded in their recent meta-analysis of memory and checking studies that a deficit may exist for checkers on several different types of memory tasks, including verbal and visual recall, and recall of actions. However, they also found that the effect sizes for poor confidence in memory were much larger and more consistent across studies than those noted for memory deficits.

Some of the most convincing evidence of mnestic deficits among OC checkers was found in a neuropsychological investigation by Purcell, Maruff, Kyrios, and Pantelis (1998). They paired OC checkers with non-clinical controls from the general population and patients suffering from panic disorder and unipolar depression. OC checkers had lower scores than other groups on tests of spatial working memory, spatial recognition, and motor initiation and execution. Unfortunately, it was not clear how OC checkers performed relative to non-checking OCs. This is important because the direct memory deficit hypothesis is most relevant to checking and it would be important to examine how much obsessive rumination (characteristic of both OC checking and non-checking groups) may have affected the memory performance of obsessive-compulsive checkers in this study. The effects of rumination on test scores were investigated by Davis and Nolen-Hoeksema (2000), who found cognitive test scores among non-OCD ruminators similar to those typical of patients suffering from OCD. It is, therefore, possible that obsessions may serve as a distraction from the different tasks both groups were asked to perform.

Given the difficulty in identifying gross memory deficits, it has been suggested that the deficit is one of *reality monitoring* (Sher et al., 1983); that is, the recall of

whether an action has *actually* been performed or only *imagined*. Ecker and Engelkamp (1995) examined reality-monitoring in OC checkers, low-checking clinical, and high-checking clinical groups. They gave participants four different tasks: 1) mime an action (motor encoding), 2) imagine themselves performing an action, 3) imagine seeing someone else perform an action (motor-imaginal encoding), and 4) subvocal rehearsal (as a control condition). They found that OCD patients scored lower than low-checking controls on free-recall tests of motor-encoding and also made more mistakes of reality-monitoring. In addition, the motor imaginal and motor confusion (mistakes of reality-monitoring) scores were significantly correlated with their scores on the checking subscale of the MOCI (Hodgson & Rachman, 1978). OC participants obtained similar overall scores to high-checking clinical controls; however, they were found to make different types of errors. OC checkers were more likely to make type A errors (incorrectly remembering that they imagined an action they actually performed), and high-checking controls made more type B errors (recalling the performance of an action they actually imagined) than low-checking controls. In this study, memory tasks were carried out in a laboratory and not in the environment in which OC checkers experience their specific memory problems. The actions did not involve anxiety-provoking situations, nor were they personally relevant to the participants.

Some attempts have been made to test memory for actions in conditions that are anxiety-provoking for OC checkers. Anxiety experienced by the OC checker may interfere with the process of memory retrieval; the perception of poor retrieval could in turn motivate checking behaviours. Constans, Foa, Franklin, and Mathews (1995) tested reality-monitoring ability among OC checkers and non-clinical controls through the use

of neutral actions (e.g., capping and uncapping a pen) and anxiety-provoking actions (e.g., turning on and off a lamp). They found no difference in reality-monitoring ability between OC checkers and non-clinical controls. However, OC checkers were more likely to desire a greater vividness in recollection than controls. In fact, their memory for how anxiety-provoking items were left was significantly better than controls.

More recently, Hermans and colleagues (2003) built on the work of Constans et al. (1995) through the use of ideographically-selected stimuli. OC checkers and yoked non-anxious controls were asked to perform or imagine a series of actions: three relevant compulsive actions, six irrelevant compulsive actions, and six neutral actions. No differences were found between groups for reality-monitoring ability. In addition, memory accuracy did not vary by category of action. OC checkers also reported lower confidence in memory than controls, but only for neutral actions.

Threat and responsibility appraisals influence the occurrence of checking behaviour (Ladouceur, Rhéaume, & Aublet, 1997). Given the importance of responsibility for harm in cognitive models of compulsive checking (Rachman, 2002; Salkovskis 1999) and the specificity of OC checkers memory problems, what is needed is an evaluation of memory for actions in an environment for which compulsive checkers feel personally responsible, focussing on stimuli normally checked by these individuals. Radomsky, Rachman, & Hammond (2001) evaluated memory in the homes of OC checkers. Participants were asked to check an item that normally causes distress or discomfort (e.g., the stove). In addition, responsibility was manipulated by having participants (high responsibility) or the experimenter (low responsibility) carry out different checks. Participants were also told that they would be tested afterwards on their

memory for the check and for other things that may have happened during the check (i.e., threat irrelevant information). The experimenter provided threat irrelevant information by coughing, clipping a coloured pin to his shirt, or reading aloud different 4-digit lists during each check. Participants were more likely to remember threat-relevant information (e.g., how many times they touched the stove) than threat-irrelevant information (e.g., the colour of the experimenter's pen), and this memory bias was augmented under conditions of high responsibility. The absence of an anxious control group in this study, however, means that it was not possible to evaluate whether or not memory biases were specific to compulsive checkers.

The aim of the present study was to test reality-monitoring ability, memory for actions, and confidence in memory among OC checkers and Non-Clinical Controls (NCCs) in the course of home visits using stimuli that are and are not bothersome to them. We predicted that OC checkers would not have memory deficits relative to controls but that they would express less confidence in their memory than controls, especially concerning items which are particularly bothersome to them. In addition, given that two different experiments have recently linked increased responsibility with decreased confidence in memory among OCs (Boschen & Vulksanovic, in press; Moritz *et al.*, in press), we predicted that an experimental manipulation of responsibility for harm would result in lower confidence in memory for individuals in the "high responsibility" condition compared to participants in the "low responsibility" condition and that these effects would be present for OC checkers but not NCCs.

2. Method

2.1. Participants

The experiment was completed by patients who met DSM-IV (SCID) criteria for OCD (n=21) and whose primary compulsion was checking. NCCs (n=24) from Oxford, England, and the surrounding area. Controls were recruited by word of mouth and from among staff at the Warneford Hospital in Oxford. Patients were recruited from therapists associated with the Oxford University Psychiatry department. Some also responded to advertisements in self-help newsletters. A payment of seven pounds was given to all participants upon completion of the experiment.

Participant demographic and psychometric information is given in Table 1. Group differences were examined using chi-square (for gender) and ANOVA tests.

2.2. Design

In-home visits were scheduled with the experimenter (JC). Upon arrival, participants were asked to either perform or imagine performing actions which the participant thought were bothersome and non-bothersome. After completing these tasks, participants were given a two-minute filler task and were then asked to recall the actions they had previously performed and imagined performing. In addition, they rated their confidence in each recollection. Following the free recall task, participants were given a list of the actions used and were asked to determine whether they actually performed it or only imagined performing each. Again, they provided ratings of their confidence in their memory for each recollection. Anxiety, depression, discomfort, and urge to check ratings were taken throughout these tasks using Visual Analogue Scales.

Participants were then asked to refrain from checking and were randomised to one of the two experimental groups using sampling without replacement. In one condition, participants were told that they were responsible for anything bad that may happen as a result of their not checking and in the other that the experimenter was responsible for these things. A contract was given to confirm the agreement. The researcher then left the participant's house and, after an hour, phoned them for a post-experiment interview lasting approximately 15 min. Memory was again assessed for imagined and performed actions (free recall, prompted recall, and confidence in memory). In addition, several ratings which dealt with how they had been feeling since the experimenter left were made.

2.3. Measures

Visual analogue scales assessing anxiety, discomfort, urge to check, and depression were used at various points during the experiment. These measures were rated from 0 (e.g., 'Not at all anxious') – 100 (e.g., 'Extremely anxious').

Participants completed measures of depression (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961), anxiety (BAI; Beck, Epstein, Brown, & Steer, 1988), OC symptoms (OCI; Foa, Kozak, Salkovskis, Coles, & Amir, 1998), and responsibility beliefs (RAS) and appraisals (RIQ; Salkovskis et al., 2000).

2.4. Procedure

Participants completed the questionnaires in their own time before a home visit was arranged with the researcher. Upon arrival at the participants' home, the researcher explained to them the Visual Analogue (VA) scales that would be used. Participants were then shown a list of 11 common activities which can elicit checking obsessions and were

asked to rate how bothersome each checking-related action was for them. The list is provided in Table 2. The two most bothersome and two least bothersome categories were identified for use in the subsequent reality-monitoring tasks. Memory tasks were then explained to participants: “Now, I’m going to ask you in a minute to perform a task or *imagine yourself* performing a task. By imagining, I mean to picture yourself in your mind performing the action that I may give you. Is that clear? For example, I can either draw a ‘two’ like this (draw two) or imagine myself drawing a ‘two’.” Further discussion was continued until it was clear that the participant fully understood the task procedure.

They were taken through six different tasks associated with each of the chosen categories (24 in all), alternating between actual and imagined actions and troublesome and non-troublesome categories. The list of actions was standardized, but if an item was not available in the home (e.g., if one did not have a stereo to unplug), a suitable alternative which was related to the category would be found (they may have been asked to unplug a coffee-maker). They were asked to report how they were feeling by using the VA scales after completing each category of actions. After they had completed the tasks, they were asked to complete anxiety (BAI) and depression (BDI) inventories during a two min distraction time interval. They were then asked to recall all of the actions they did or imagined themselves doing in any order. A confidence in memory rating (0 = not at all confident, 100 = extremely confident) was obtained for each recalled item. VA scale readings were taken again.

The researcher then prompted participants with each item alternating randomly between categories. Participants reported whether they performed or imagined each

action and their confidence in their recollections. VA scale readings were obtained, and participants were asked to finish the BDI and BAI if they were not completed by now.

The next stage of the experiment involved a responsibility manipulation. 'High' or 'low' responsibility contracts based on those used in the Lopatka and Rachman (1995) study were presented to participants after they completed the in-home memory tasks. The 'low responsibility' contract indicated that the experimenter would be responsible for any harm that would come as a result of not checking the relevant memory items during a one hour period. The 'high responsibility' contract stated that, during this one hour period, the participant would be responsible for any harm associated with the memory task items. Participants were placed in two different conditions through the use of either of the following instructions:

a) "I know that I've asked you to perform tasks that may be very distressing to you, but I want you to refrain from checking for the next hour. I will call you in an hour's time, but until then, I'd like you to please refrain from checking. During this hour, I want you to know that *I'll be completely responsible* for any harm that may come as a result of your not checking. I will be responsible only for this hour and only concerning the items we have dealt with. Just to make sure that you understand this agreement, I've made a contract. I'd like to go over the main points with you (went over main points on low-responsibility contract)."

b) "I know that I've asked you to perform tasks that may be very distressing to you, but I want you to refrain from checking for the next hour. I will call you in an hour's time, but until then, I'd like you to please refrain from checking. I want you to know that *I will not be responsible* for any harm that may

come as a result of your not checking during this hour. You will be completely responsible for anything bad that happens with these items. Just to make sure that you understand this agreement, I've made a contract. I'd like to go over the main points with you (went over main points on high-responsibility contract)."

After the participant had read the contract, two copies were signed by the researcher and the participant. One copy was left with the participant. VA scale readings were taken again. An envelope with an enclosed scale was given to the participant and he/she was instructed not to open it. They were told that they would be phoned in an hour's time. They were reminded not to check during the following hour. In addition, they were told to take a ten minute walk.

After an hour passed, the researcher phoned participants for a post-experiment interview. Current anxiety, discomfort, urge to check, and depression ratings were taken. Tests of free recall were repeated. Participants were prompted with any items omitted from the free recall list, and were asked whether they imagined or performed the action. Confidence in memory ratings were taken for each action reported. Participants were asked to rate how much they checked any of the experiment items during the one hour period: 0 (not at all), 1 (a very small amount, or less than a minute), 2 (a moderate amount, more than once but less than ten times, or more than one minute but less than five minutes), 3 (frequently, or between 10 and 20 times, or 10 and 20 minutes), or 4 (very frequently, over 20 times or 20 minutes).

Participants were then asked to open the envelope and examine the rating scales included. They were asked several questions and rated their response using each scale. First, they were asked to rate how much of the past hour they had been directly thinking

about the actions the experimenter had asked them to perform or imagine performing (had been actively ruminating about them in the front of their minds). They were then asked to rate how much of the hour, in addition to the time *directly* thinking about those actions, they were still there at the *back* of their minds (meaning that they have been actively thinking about something else while still having an awareness of those actions). Participants were also asked how hard they tried to 'deliberately go over in your mind what you had done or how you had left things'. Next, they were asked to rate their current discomfort associated with the actions and their highest level of discomfort during the past hour. They were then asked to rate how likely it seemed at present that something bad would happen in connection with the actions they performed; they also rated the highest level of likelihood they felt during the past hour. In addition, responsibility for harm ratings were completed which related to the level they currently felt and the highest level they felt during the past hour. After completing these general ratings, participants were asked to give five ratings for each category of actions they completed. They indicated how confident they were that there was no problem with the way items were left, their anxiety associated with the item, their discomfort about the item, their present urge to check the item, and their greatest urge to check the item during the past hour. Final anxiety, discomfort, urge to check, and depression ratings were then obtained.

3. Statistical Analyses

Unless otherwise stated, 2 (OC vs NCC) X 2 (Immediate vs Delayed) X 2 (Bothersome vs Non-Bothersome) repeated measures ANCOVAs were used throughout. Because education level was positively correlated with greater memory accuracy, $r = .39$, $p < .01$,

and was also significantly higher among NCCs, it was used as a covariate in each analysis. Where interactions were significant, simple main effects analyses were carried out using one-way ANCOVAs.

4. Results

In the first section below, participants' reactions to engaging in the experimental tasks are analyzed in order to indicate the way in which the memory task was perceived; this section also describes an analysis of the experimental manipulation check. The key memory variables are presented next as the principal test of the hypothesis. Thirdly, correlations are considered.

4.1. Reaction to Experimental Tasks

4.1.1. Visual Analogue Scales

Visual analogue scales which were presented to participants before and after each category of actions to be imagined or performed, after the responsibility contracts were signed, and before and after the phone interview. These ratings indicate the participants' response to participation in the study. Repeated measures ANCOVAs were used to examine group and time of assessment differences. Scores for anxiety did not significantly vary across the time points of the experiment, $F(10,410)=1.58$, $p=.11$, at which it was measured, but a main effect was found for group, $F(1,41)=102.27$, $p<.0001$, with OC checkers reporting significantly greater anxiety than NCCs (OC: $M=47.35$, SE=2.7; NCC: $M=8.31$, SE=2.6). No group X time interaction was found ($F<1$). Similar results were found for measures of discomfort, where scores did not significantly vary across time, $F(10,410)=1.31$, $p=.23$, and OCs reported greater discomfort than NCCs, $F(1,41)=97.07$, $p<.0001$; OC: $M=46.72$, SE=2.9; NCC: $M=6.02$, SE=2.8. No group X

time interaction was found ($F<2$). A main effect for group was also found for urge to check, $F(1,42)=43.53$, $p<.0001$, and this was qualified by a significant group X time interaction, $F(10,420)=3.62$, $p<.05$. Follow-up tests revealed that differences in urge to check ratings were not present at baseline, $F(1,42)=2.85$, $p=.099$; OC: $M=28.86$, SE=5.9; NCC: $M=14.75$, SE=5.5. However, during VAS assessment points 2 to 11, urge to check ratings were significantly higher among OCs than NCCs ($F>10$, $p<.002$, OC: $M=40.59$, SE=3.5; NCC: $M=6.18$, SE=3.3). A main effect of group was found for depression ratings, $F(1,42)=33.16$, $p<.0001$, but not time, $F(10,420)=1.04$, $p>.40$. A group X time interaction was also found, $F(10,420)=2.40$, $p<.01$. Follow-up tests revealed greater depression ratings among OCs than NCCs for each time point ($F>18$, $p<.0001$; OC: $M=27.09$, SE=3.1; NCC: $M=1.64$, SE=2.9). Among OCs, depression ratings differed significantly over time, $F(10,200)=2.00$, $p<.05$. Pairwise comparisons indicate that depression was significantly higher at time points 7, 9, and 10 than at time point 2, $p<.05$. Depression was also significantly higher at time point 9 than at point 5, $p<.05$. These findings suggest that depression was higher during the later stages of the experiment than at baseline. Overall, these results suggest that OCs were significantly more distressed while carrying out the memory tasks than NCCs, and that the task provoked the urge to check in OC patients but not controls.

4.1.2. Manipulation Check

The responsibility contract did not result in any significant effects for either group during the follow-up period. Perceived levels of responsibility, urge to check, and mood ratings during the delay period did not differ significantly between participants in the high- and low-responsibility conditions ($F<1$), nor were any group X contract interactions found

for these variables ($F<1$). OC checkers reported greater levels of responsibility (low contract: $M=47.63$, SE=8.2; high contract: $M=53.87$, SE=9.1) during the delay period than NCCs (low contract: $M=19.15$, SE=8.2; high contract: $M=10.52$, SE=8.0), $F(1,42)=17.15$, $p<.0002$. There was a marginally significant group X contract interaction for the amount of glancing and checking behaviour during the delay period, $F(1,41)=2.88$, $p=.097$. However, follow-up tests revealed no significant differences between high and low responsibility contracts for either NCCs or OC checkers, $p>.10$.

4.2. Memory effects

4.2.1. Free recall accuracy

Group means and standard deviations for memory accuracy (maximum score = 12) and confidence in memory ratings are given in Table 3. Free recall accuracy was examined according to whether participants correctly recalled what actions they performed or imagined themselves performing without being prompted. The crucial main effects of group were not significant ($F<1$), nor were there any significant interactions involving group and time of test or item type ($F<2$). In addition, no main effects of group, item type, or time of memory test were found ($F<1$). These results suggest comparable memory for actions in terms of reality-monitoring between OC checkers and NCCs in tests of free recall. No effect of responsibility contract on memory accuracy was found for either group, $p>.10$.

4.2.2. Analysis of Free Recall Errors

Free recall errors were calculated for both groups through an analysis of instances where participants did not recall an action which was performed or imagined (no recollection errors) or errors where confusion was made between an actual or imagined action

(reality-monitoring errors). A 2 (OC vs NCC) X 2 (Bothersome vs Non-bothersome) X 2 (Immediate vs Delayed) X 2 (Imagined actions vs Performed actions) repeated measures ANCOVA was carried out to examine 'no recollection' errors. No significant differences were found between groups for no-recollection errors ($F<1$; OC: $M=2.64$, SE=.2; NCC: $M=2.39$, SE=.2), but both groups were more likely to forget actions which they had imagined relative to actions they performed, $F(1,42)=9.92$, $p<.005$. A 2 (OC vs NCC) X 2 (Bothersome vs Non-bothersome) X 2 (Immediate vs Delayed) X 2 (Imagined actions recalled as performed vs Performed actions recalled as imagined) repeated measures ANCOVA was carried out to examine 'reality monitoring' errors. Groups did not significantly differ in errors of reality monitoring, $F(1,42)=2.34$, $p=.13$ (OC: $M=.19$, SE=.05; NCC: $M=.31$, SE=.05). No main effects or interactions for free recall reality-monitoring errors were found ($F<4$).

Free recall errors which involved actions which were neither performed nor imagined were analyzed using a 2 (OC vs NCC) X 2 (Bothersome vs Non-bothersome) X 2 (Immediate vs Delayed) X 2 (Actions recalled as imagined vs Actions recalled as performed). No significant differences were found between groups, $F(1,42)=.26$, $p>.60$ (OC: $M=2.83$, SE=.2; NCC: $M=2.69$, SE=.2). A main effect of error type (performed vs imagined) was found, $F(1,42)=12.37$, $p<.002$, which was qualified by a significant item type X time X error type X group interaction, $F(1,42)=4.53$, $p<.05$. Follow-up tests revealed a marginally significant item type X error type X group interaction for the immediate recall period, $F(1,42)=3.79$, $p=.058$, though this interaction was absent for the delayed free recall test ($F<1$). Further analyses of immediate tests revealed a significant group X item type interaction for items recalled as imagined, $F(1,42)=4.39$, $p<.05$,

though this interaction was not present for items recalled as performed (F<1). Additional analyses found a trend for OCs reporting a greater number of imagined recollection errors for non-bothersome items than NCCs, F(1,42)=3.10, p=.086 (OC: M=3.69, SE=.3; NCC: M=2.90, SE=.3), though no group differences were found for bothersome items (F<1).

4.2.3. Prompted recall accuracy

Prompted recall was taken after reality-monitoring tasks were completed and during the phone interview by providing participants with a list of actions they performed or only imagined performing. Participants were asked to state whether they performed or imagined performing each action. No differences between groups emerged, F(1,42)=1.32, p>.20, but a significant main effect for item type was found, F(1,42)=6.91, p<.05. This reflects the fact that participants recalled non-bothersome items (M=10.70, SE=.2) with greater accuracy than bothersome items (M=10.09, SE=.2). No effect of responsibility contract on memory accuracy was found for either group, p>.10.

Prompted recall errors came in two forms: stating that one performed an action he/she actually imagined or stating one imagined an action that he/she actually performed. No significant interactions or differences between groups were found for these errors (F<1).

4.2.4. Confidence in memory

Reports of confidence in memory for free recall showed significant differences between groups, F(1,31)=4.56, p<.05, with OC checkers reporting significantly lower confidence in recollections. This main effect was qualified by a significant time X item type X group interaction, F(1,31)=7.23, p<.05. Follow-up tests revealed a trend for a time X group interaction among bothersome items (F(1,34)=3.00, p=.09) that was not present

for non-bothersome items, $F(1,36)=2.17$, $p=.15$. Additional analyses revealed that, compared to OC checkers, NCCs reported significantly greater confidence for bothersome items in the immediate testing period, $F(1,37)=6.85$, $p<.05$, though groups did not differ significantly for bothersome items in the delayed test, $F(1,35)=2.85$, $p=.10$. No effect of responsibility contract on memory confidence was found for either group, $p>.10$.

Confidence in memory for prompted recall items was analysed, and a main effect for group was found, $F(1,42)=15.33$, $p<.001$, with OCs reporting significantly less confidence in memory than NCCs. No significant differences were found across time of test, nor were any interactions found. There was a trend for participants to report greater confidence in memory for non-bothersome items ($M=85.75$, SE=1.8) than bothersome items ($M=81.50$, SE=1.8; $F(1,42)=3.17$, $p=.08$). In addition, no effect of responsibility contract on memory confidence was found for either group, $p>.10$.

4.3. Analysis of situational variables and correlational analyses

4.3.1. Post-experiment interview ratings

State measures which were taken by the phone interview were analysed. Self-report ratings for anxiety, discomfort, urge to check and depression were significantly higher in OCs than controls, $F>15$, $p<.0005$. These were taken at the beginning and at the end of the interview. Significant differences between groups were found for checking/glancing during the past hour, $F(1,42)=5.91$, $p<.05$, whether or not they sought reassurance, $F(1,42)=11.00$, $p<.005$, rumination about items during the past hour (front of mind: $F(1,42)=11.90$, $p<.005$; back of mind: $F(1,42)=14.96$, $p<.001$), present discomfort about items, $F(1,42)=35.40$, $p<.0001$, discomfort about items during the past hour,

F(1,42)=37.64, p<.0001, present perception of likelihood of harm, *F*(1,42)=28.37, p<.001, peak likelihood of harm during the past hour, *F*(1,42)=31.13, p<.0001, and present responsibility for harm, *F*(1,42)=35.50, p<.0001. These differences reflect the fact that OC checkers rated themselves significantly higher on these measures than controls.

Post-experiment interview measurements were then analyzed which concerned each of the four specific categories of actions participants chose. These item categories were previously ranked by participants as the first and second most bothersome and the first and second least bothersome. A 2 (OCD vs Controls) X 2 (Bothersome vs Non-Bothersome) X 2 (First vs Second) repeated measures ANCOVA was carried out which found no main effects between bothersome and non-bothersome categories (F<1) or first- and second-rated categories (F<1) on the measure of confidence that there is no problem with the way an item was left. A significant main effect was found between groups, *F*(1,42)=32.62, p<.0001. Also, a significant group X item type interaction was found, *F*(1,42)=6.00, p<.05. This interaction was due to OCs reporting less confidence for bothersome items (*M*=61.43, SE=5.0) than non-bothersome items (*M*=75.48, SE=4.2; *F*(1,20)=8.88, p<.01), though this difference was absent in NCCs (*F*<2). Significant main effects for groups were found in which OC checkers scored higher than NCCs in measures of anxiety, (*F*(1,42)=64.54, p<.0001), discomfort (F(1,42)=58.65, p<.0001), urge to check at present (*F*(1,42)=26.42, p<.0001), and the peak urge to check in the past hour (*F*(1,42)=61.60, p<.0001) associated with the test items. Again, significant interactions were found between item type and group for anxiety (*F*(1,42)=14.77, p<.001), discomfort (*F*(1,42)=15.78, p<.001), urge to check at present (*F*(1,42)=21.88,

p<.0001), and peak urge to check during the past hour ($F(1,42)=11.03$, p<.005). These interactions indicate that OC checkers scored higher on these measures for bothersome items than for non-bothersome items ($F>9$). NCCs reported greater peak urge to check for bothersome items than non-bothersome items, $F(1,23)=9.13$, p<.01, though this distinction was not present with any other post-experiment measure.

4.3.2. Responsibility beliefs and memory performance

To test whether perceived responsibility for harm during the delay period and at the time of the second memory test may have led to recollection errors after the delay period, partial correlation analyses were carried out which controlled for memory performance on the immediate (in-home) memory tests. Analyses found no significant relationship between responsibility levels and delayed memory performance for bothersome items. However, among non-bothersome items tested for prompted recall, a significant negative correlation was found between accuracy and levels of responsibility reported at the delayed memory test, $r(42)=-.42$, p<.005, and during the delay period, $r(42)=-.37$, p<.05. This suggests that participants reporting greater levels of responsibility were more likely to make errors of prompted recall for non-bothersome items.

Partial correlation analyses were also carried out on confidence in memory reports, while controlling for confidence in memory expressed on immediate memory tests. Confidence in memory reported for the delayed tests was not correlated with responsibility levels for bothersome items. However, among non-bothersome items, levels of responsibility reported at the delayed memory test, $r(36)=-.35$, p<.05, and peak levels of responsibility during the delay period, $r(36)=-.35$, p<.05, were negatively correlated with confidence in memory on the delayed test of free recall. These findings

suggest that participants reporting greater levels of responsibility were more likely to report poorer confidence in memory for free recall recollections of non-bothersome items at the delayed memory test.

4.3.3. Correlational Analyses

OC participants' ratings for confidence in memory correlated significantly with accuracy in delayed prompted tests for bothersome, r=.63, p<.005, and non-bothersome items, r=.64, p<.005. No significant correlations were found on these measures with NCCs (bothersome, r=-.20; non-bothersome, r=.16). These results suggest that OC checkers, but not NCCs, tend to report higher confidence when they recall accurately and lower confidence when their recollections are inaccurate.

Correlational analyses were also carried out using both OCs and control participants' ratings of responsibility for harm felt during the delay period. Responsibility was found to correlate well with how much a participant glanced during the delay period, $r(45)$=.47, p<.005, whether or not they sought reassurance, $r(45)$=.42, p<.005, and how much they had been thinking about the relevant items in the front, $r(45)$=.55, p<.001, and the back, $r(45)$=.77, p<.001, of their minds. Responsibility for harm also correlated well with how much participants had deliberately gone over in their minds what they had done or how they had left things, $r(45)$=.56, p<.001, how uncomfortable they felt at present, $r(45)$=.49, p<.005, and peak discomfort they felt during the past hour, $r(45)$=.54, p<.001, about the things they did and the way they were left. In addition, correlations were found between responsibility and reports of how likely it seemed that something bad would happen in connection with the things they did (right now: $r(45)$=.52, p<.001; past hr.: $r(45)$=.59, p<.001).

5. Discussion

This study found no evidence for actual memory deficits in terms of reality-monitoring or memory for actions obsessive-compulsive checkers. The memory of OC checkers was at least as accurate as controls on both immediate and delayed tests of free and prompted recall. As predicted, confidence in memory was weaker in OCs than controls for both free recall and prompted recall tests, although for free recall tests, OCs showed poorer confidence in memory only for bothersome (i.e. OCD relevant) actions on the immediate memory test. Also, both OCs and controls remembered non-bothersome actions better than bothersome actions on tests of prompted recall. These findings are broadly consistent with those previous studies finding no reality-monitoring deficit in obsessive-compulsive checkers (Constans et al., 1995; McNally & Kohlbeck 1993). This research is also consistent with previous work demonstrating that OCs report less confidence in their memory than non-clinical controls (MacDonald, Antony, Macleod, & Richter, 1997; McNally & Kohlbeck, 1993).

The post-experiment interview revealed a number of differences between OCs and controls in terms of their reaction to the memory task. OCs reported that they were less confident “that there was no problem with the way an item was left”. OCs also reported less confidence for bothersome items than non-bothersome items, a difference absent in controls. In addition, controls scored lower on self-reported measures of anxiety, discomfort, urge to check at present and maximum urge to check in the past hour on tests relating to specific action sequences. With the exception of measures of peak urge to check, OCs, but not controls, scored higher on these measures if they were associated with bothersome items, rather than non-bothersome items. These results come

as no surprise given the specificity of checking problems in OCs, and they complement other findings in this study showing better recall for non-bothersome items than bothersome ones.

Although the experimental responsibility manipulation (contract) failed to impact the group responsibility levels, correlational analyses revealed that individual differences in self-reported feelings of responsibility were associated with memory accuracy and confidence, as well as other measures. Measures of perceived responsibility correlated with how much a participant ruminated about the significant items, how much the participants had gone over in their mind what they had done or how they had left things, and discomfort felt during the delay period. In addition, after controlling for memory performance on the immediate memory test, higher levels of responsibility during the one-hour delay period were associated with poorer prompted recall memory for non-bothersome items following the delay period. Higher responsibility ratings were also associated with poorer confidence in memory for non-bothersome items on the delay free recall test. These findings may be due to associations between responsibility and increased attentiveness to bothersome items during the delay period, rather than a direct association between responsibility and poor performance with non-bothersome items.

The perceived likelihood that something bad could happen in connection with the things one did was also correlated with responsibility ratings. This is consistent with Lopatka and Rachman's (1995) study which showed how an inflated sense of responsibility for an unwanted event is associated with a higher estimate of the likelihood that the unwanted event could occur.

It was not clear why the responsibility manipulation in the present study failed. We suspect that the responsibility contracts lacked sufficient credibility. Recent research has used other responsibility manipulations that were highly effective (Arntz, Voncken, & Goosen, 2007; Mancini & Gangemi, 2006), and this research found the expected relationships between responsibility and OC symptoms. The fact that this experiment took place in the homes of participants limited the choice of responsibility manipulations available, as other studied manipulations have been laboratory-based.

A curious finding among OCs, but absent in controls, was the correlation between delayed tests of prompted recall accuracy and ratings of confidence in memory. That is, OCs were more accurate in their judgement about how well they can rely on their memory for actions. This phenomenon may be due to excessive attention that OCs give to mental processes (Salkovskis, 1985). Comparable patterns of attention have been detected in panic disorder patients who make fewer errors in terms of bodily sensations (heart rates) (Ehlers & Breuer, 1992). These data are consistent with cognitive theories which focus on over-attentiveness as a contributing factor to anxiety disorders (eg, Beck, Emery, & Greenberg, 1985). It might be deduced from the findings of the present experiment that it is not memory difficulties *per se* that are the source of the problem. Rather, it may be beliefs about and over-attentiveness to memory processes that contribute to compulsive checking.

The results do not support the hypothesis that checkers have an actual deficit in memory which motivates them to check. Rather, they are most consistent with the cognitive-behavioural view that people suffering from OCD check because they experience levels of confidence in memory that do not meet the high standards they set

for themselves; that is, they try to be particularly sure because they have unusually high levels of concern about making an error.

Limitations to the study include the use of semi-ideographic methodology. Actions chosen for the memory task were chosen from a restricted list, resulting in some variability in items used, and it is possible that some actions may have been easier to recall than others. However, there was no evidence of systematic differences between groups in terms of items chosen. The fact that the experimenter was not blind to participant diagnostic status is a further issue; the careful scripting of the study should have prevented this potential bias from affecting the results. The study also lacked a clinical control group; the fact that memory was unimpaired in OCs means that this is not a major issue. Though research suggests poor memory confidence is specific to OC checkers (Cougle, Salkovskis, & Wahl, 2007), it is not known whether poor memory confidence would also be present among anxious controls and non-checking OCs when using in-home reality monitoring tasks.

The advantage of the present study's methodology is that it ensured that the memory tasks were meaningful to OC checkers in the environment where checking behaviour occurs. The inclusion of a delayed test gave an opportunity to examine how different thought patterns and memory processes could relate to responsibility and checking behaviours. Past work on OCD and memory was limited by the use of tasks which were far removed from the daily concerns of OCs (Bouvard & Cottraux, 1997; Purcell et al., 1998) or memory for actions tasks which did not take into consideration the specificity involved in checking problems and such phenomena as feelings of responsibility which may play an important role in maintaining OCD (Constans et al.,

1995; Ecker & Engelkamp, 1995; Hermans et al., 2003; McNally & Kohlbeck, 1993). Future research on memory and compulsive checking should take into consideration the importance of context in OC memory failures. The findings of the present study suggest that compulsive checking may be more effectively treated if beliefs about memory are targeted as part of cognitive-behavioural therapy (Salkovskis, 1999).

References

Aronowitz, B. R., Hollander, E., DeCaria, C., Cohen, L., et al. (1994). Neuropsychology of obsessive-compulsive disorder: Preliminary findings. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 7(2),* 81-86.

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

Beck, A. T., Emery, G., & Greenberg, R. L. (1985). *Anxiety disorders and phobias.* New York: Basic Books.

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(6),* 893-897.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4,* 561-571.

Benton, A. L. (1974). *The Revised Visual Retention Test (4th Edn.).* New York: The Psychological Corporation.

Boone, K. B., Ananth, J., Philpott, L., Kaur, A., et al. (1991). Neuropsychological characteristics of nondepressed adults with obsessive-compulsive disorder. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 4(2),* 96-109.

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

Bouvard, M. & Cottraux, J. (1997). Comparative study of normal subjects and obsessive compulsive subjects on intrusive thoughts and memory. *Encephale, 23(3),* 175-179.

Cohen, L. J., E. Hollander, et al. (1996). Specificity of neuropsychological impairment in obsessive-compulsive disorder: a comparison with social phobic and normal control subjects. *Journal of Neuropsychiatry and Clinical Neuroscience 8(1),* 82-85.

Constans, J. I., Foa, E. B., Franklin, M. E., & Mathews, A. (1995). Memory for actual and imagined events in OC checkers. *Behaviour Research and Therapy, 33(6),* 665-671.

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

Davis, R. N. & Nolen-Hoeksema (2000). Cognitive inflexibility among ruminators and non-ruminators. *Cognitive Therapy & Research, 24(6),* 699-711.

Ecker, W., & Engelkamp, J. (1995). Memory for actions in obsessive-compulsive disorder. *Behavioural and Cognitive Psychotherapy, 23*, 349-371.

Ehlers, A. & Breuer, P. (1992). Increased cardiac awareness in panic disorder. *Journal of Abnormal Psychology, 101*, 371-382.

Foa, E. B., Kozak, M. J., Salkovskis, P. M., Coles, M. E., & Amir, N. (1988). The validation of a new obsessive-compulsive disorder scale: The Obsessive-Compulsive Inventory. *Psychological Assessment, 10*, 206-214.

Hermans, D., K. Martens, K., DeCort, K., Pieters, G., & Eelen, P. (2003). Reality-monitoring and metacognitive beliefs related to cognitive confidence in obsessive-compulsive disorder. *Behaviour Research and Therapy, 41(4),* 383-401.

Hodgson, R. J. & Rachman, S. J. (1978). Obsessive-compulsive complaints. *Behaviour Research and Therapy, 15,* 385-389.

Hollander, E., E. Schiffman, E., Cohen, B., Rivera-Stein, M. A., et al. (1990). Signs of central nervous system dysfunction in obsessive-compulsive disorder. *Archives of General Psychiatry, 47(1),* 27-32.

Ladouceur, R., J. Rheaume, & Aublet, F. (1997). Excessive responsibility in obsessional concerns: a fine-grained experimental analysis. *Behaviour Research and Therapy, 35(5),* 423-427.

Lopatka, C. & S. Rachman (1995). Perceived responsibility and compulsive checking: an experimental analysis. *Behaviour Research and Therapy, 33(6),* 673-684.

MacDonald, P. A., Antony, M. M., Macleod, C., & Richter, M. A. (1997). Memory and confidence in memory judgements among individuals with obsessive compulsive disorder and non-clinical controls. *Behaviour Research and Therapy, 35(6),* 497-505.

Mancini, F. & Gangemi, A. (2006). The role of responsibility and fear of guilt in hypothesis-testing. *Journal of Behavior Therapy and Experimental Psychiatry, 37*(4), 333-346.

McNally, R. J. & P. A. Kohlbeck (1993). Reality-monitoring in obsessive-compulsive disorder. *Behaviour Research and Therapy, 31(3),* 249-253.

Moritz, S., Wahl, K., Zurowski, B., Jelinek, L., Fricke, S., & Hand, I. (in press). Enhanced perceived responsibility decreases metamemory but not memory accuracy in obsessive compulsive disorder (OCD). *Behaviour Research and Therapy.*

Mueller, J. H. (1980). Anxiety and encoding processes in memory. *Personality and Social Psychology Bulletin, 5(3),* 288-294.

Purcell, R., Maruff, P., Kyrios, M., & Pantellis, C. (1998). Neuropsychological deficits in obsessive-compulsive disorder: a comparison with unipolar depression, panic disorder, and normal controls. *Archives of General Psychiatry, 55(5),* 415-423.

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy, 40(6),* 625-639.

Radomsky, A. S., Gilchrist, P. T., & Dussault, D. (2006). Repeated checking really does cause memory distrust. *Behaviour Research and Therapy, 44(2),* 305-316.

Radomsky, A. S., & Rachman, S. (1999). Memory bias in obsessive-compulsive disorder (OCD). *Behaviour Research and Therapy, 37(7),* 605-618.

Radomsky, A.S., Rachman, S., & Hammond, D. (2001). Memory bias, confidence and responsibility in compulsive checking. *Behaviour Research & Therapy, 39(7),* 813-822.

Salkovskis, P. M. (1985). Obsessional-compulsive problems, a cognitive-behavioural analysis. *Behaviour Research and Therapy, 23(5),* 571-583.

Salkovskis, P. M. (1999). Understanding and treating obsessive-compulsive disorder. *Behaviour Research and Therapy, 37 Suppl 1,* S29-52.

Salkovskis, P. M., & Kirk, J. (1997). Obsessive-compulsive disorder. In D. M. Clark & C. G. Fairburn (Eds.), *The science and practice of cognitive-behaviour therapy*. Oxford: Oxford University Press.

Salkovskis, P. M., Wroe, A. L., Gledhill, A., Morrison, N., Forrester, E., Richards, C., Reynolds, M., & Thorpe, S. (2000). Responsibility attitudes and interpretations are characteristic of obsessive compulsive disorder. *Behaviour Research and Therapy, 38(4),* 347-372.

Sher, K. J., Frost, R. O., & Otto, M. (1983). Cognitive deficits in compulsive checkers, an exploratory study. *Behaviour Research and Therapy, 21(4),* 357-363.

Sher, K. J., Mann, B., & Frost, R. O. (1984). Cognitive dysfunction in compulsive checkers, further explorations. *Behaviour Research and Therapy, 22(5),* 493-502.

Sher, K. J., Frost, R. O., Kushner, M., Crews, T. M., & Alexander, J. E. (1989). Memory deficits in compulsive checkers, replication and extension in a clinical sample. *Behaviour Research and Therapy, 27(1),* 65-69.

van den Hout, M. and M. Kindt (2003). Repeated checking causes memory distrust. *Behaviour Research and Therapy, 41(3),* 301-316.

Wechsler, D., & Stone, C. (1945). *Manual for the Wechsler Memory Scale*. New York: The Psychological Corporation.

Woods, C.M., Vevea, J.L., Chambless, D.L., & Bayen, U.J. (2002). Are compulsive checkers impaired in memory? A meta-analytic review. *Clinical Psychology: Science & Practice, 9(4),* 353-366.

Author Notes

[1]Jesse R. Cougle, Department of Experimental Psychology, University of Oxford, Oxford, UK.

[2]Paul M. Salkovskis, Professor of Clinical Psychology and Applied Science, Department of Psychology, Institute of Psychiatry, London, England.

[3]Susan J. Thorpe, Department of Psychology, University of Surrey, Surrey, England.

This study was conducted for partial completion of the first author's MSc at the University of Oxford, and was supervised by the second author. Portions of this research were previously presented at the 2003 annual meeting of the Association for the Advancement of Behavior Therapy, Boston, Massachusetts.

Correspondence concerning the manuscript may be addressed to Jesse R. Cougle, Department of Psychology, University of Texas, 1 University Station A8000, Austin, TX 78712-0187, Office: 512-471-3722. Email: cougle@mail.utexas.edu .

Table 1.

Demographic and psychometric data.

	OC checkers		Non-clinical controls		Group comparisons
Gender	8 male 13 female		9 male 15 female		X^2=.002, p>.5
	mean	SD	Mean	SD	
BDI	20.43	(8.6)	3.63	(3.9)	F(1,43)=74.44, p<.0001
BAI	20.29	(9.5)	5.21	(3.5)	F(1,43)=51.93, p<.0001
OCI	72.76	(28.4)	19.50	(13.0)	F(1,43)=68.07, p<.0001
OCI - checking	20.71	(7.9)	3.42	(3.2)	F(1,43)=96.44, p<.0001
RAS	4.93	(0.6)	3.87	(0.8)	F(1,43)=25.12, p<.0001
RIQ beliefs	44.69	(22.1)	31.13	(18.8)	F(1,39)=4.49, p<.05
RIQ freq.	1.68	(0.9)	0.88	(0.7)	F(1,40)=10.37, p<.005
Age	37.29	(10.0)	41.79	(13.8)	F(1,39)=2.88, p=.10
Years of education past age 12	6.80	(2.4)	7.46	(2.6)	F(1,43)=5.54, p<.05

Table 2.

Categories of actions used in reality-monitoring tests and number of participants labelling each category among their two most bothersome or two least bothersome compulsions.

Actions	Non-clinical Controls	OC checkers
1. Door	13 Bothersome	13 Bothersome 1 Non-bothersome
2. Windows	1 Bothersome 3 Non-bothersome	
3. Lights	4 Non-bothersome	2 Bothersome 5 Non-bothersome
4. Plugs	1 Bothersome 6 Non-bothersome	7 Bothersome 6 Non-bothersome
5. Sharp objects	1 Bothersome 12 Non-bothersome	8 Non-bothersome
6. Cooker/Oven	13 Bothersome 1 Non-bothersome	7 Bothersome
7. Poisons (bleach, medicine, etc.)	14 Non-bothersome	2 Bothersome 5 Non-bothersome
8. Ordering	1 Bothersome 6 Non-bothersome	1 Bothersome 7 Non-bothersome
9. Reading	4 Bothersome 1 Non-bothersome	3 Bothersome 5 Non-Bothersome
10. Water taps	2 Bothersome 1 Non-bothersome	1 Bothersome 3 Non-bothersome
11. Wallet/purse, money, and keys	12 Bothersome	6 Bothersome 2 Non-bothersome

Table 3.

Free recall and prompted recall memory accuracy and confidence in memory.

		OC Checkers		Non-clinical Controls	
		Accuracy Mean (SD)	Confidence in Memory Mean (SD)	Accuracy Mean (SD)	Confidence in Memory Mean (SD)
Immediate	FR-B	5.57 (1.9)	77.39 (18.7)	5.54 (2.4)	93.64 (8.0)
	FR – NB	5.90 (2.4)	87.37 (14.4)	7.21 (2.8)	95.27 (5.3)
	PR – B	10.14 (1.5)	72.82 (14.5)	9.83 (1.3)	89.27 (9.1)
	PR – NB	10.81 (1.1)	79.17 (16.0)	10.83 (1.3)	92.43 (6.7)
Delayed	FR – B	5.81 (2.1)	82.80 (16.8)	6.42 (2.9)	94.26 (7.0)
	FR – NB	6.76 (2.8)	83.94 (16.8)	8.42 (2.6)	95.04 (6.4)
	PR – B	10.38 (1.4)	74.40 (15.7)	9.96 (1.9)	89.65 (9.3)
	PR – NB	10.33 (1.5)	77.78 (17.5)	10.79 (1.2)	93.47 (7.1)

Note: FR = Free recall; PR = Prompted recall; B = Bothersome actions; NB = Non-bothersome actions.