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Memory bias, confidence and responsibility in compulsive checking

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Abstract

Recent research suggests that there is a positive memory bias for threatening information in compulsive cleaners. However, the relationship between OCD and memory is likely to be more complex when the compulsive behaviour is checking. Hence, we decided to explore this relationship in a clinical sample of people who check compulsively. Participants completed a diagnostic interview and were then asked to complete a standard 'baseline' check which normally causes distress/discomfort. Two additional checks were then completed—one under conditions of high responsibility and one under low responsibility. The order of responsibility manipulation was randomized across participants. After each check, participants completed a Memory and Confidence Interview which assessed memory for threat-relevant and threat-irrelevant aspects of the check, and also confidence in memory for the check. One week later, participants came into the laboratory to complete additional Memory and Confidence Interviews after watching a videotape of the checks completed earlier in their own homes. These videotaped checks were taken as conditions of 'no responsibility'. Results show a positive memory bias for threat-relevant information. As responsibility was inflated, this positive memory bias was amplified. Under conditions of no responsibility, no memory bias was detectable. Also, responsibility appears to have had a greater impact on confidence in memory than on memory itself in OCD. The results are discussed in terms of the mnestic deficit theory of OCD and in terms of cognitive-behavioural approaches to understanding the disorder.

Listening to patients, it is easy to understand why one might assume that there is a memory deficit in obsessive compulsive disorder (OCD). Patients will say they are checking the stove, door, thermostat, etc., repeatedly because they aren't 'sure' that they did it correctly earlier. This uncertainty lends itself well to memory deficit models of compulsive behaviour generally, and compulsive checking in particular. The disorder is characterized by, among other things, repetitive

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behaviour (APA, 1994). This behaviour appears to result from some kind of incomplete or inappropriate processing in compulsive checkers.

Earlier research on samples of compulsive checkers demonstrated a variety of memory deficits. One example of this was a study by Sher, Frost, Kushner, Crews, and Alexander (1989), in which compulsive checkers were less able to remember information than noncheckers, particularly information about actions completed during the study. The authors concluded that since checkers recalled fewer actions than noncheckers, there is a memory deficit associated with OCD. However, the 'actions' to be recalled were the experimental tasks completed earlier (e.g. "QUESTIONNAIRES", "DIGITS FORWARD AND BACKWARD", "VISUAL REPRODUCTION", etc.), and were not related to the specific concerns of the participants.

The conclusion that a memory deficit occurs in OCD is consistent with information processing approaches to understanding memory in the anxiety disorders. While early models of information processing and emotional arousal implied increased attentional and memorial biases in association with anxiety states (Bower, 1981; Kovacs & Beck, 1978), it was soon demonstrated that attentional biases in favour of threatening information do indeed occur in association with anxiety, but there was little support for the possible occurrence of memory biases in anxiety (see Williams, Watts, MacLeod, & Mathews, 1988 or Mathews (1997) for reviews). To account for the absence of memory bias in association with anxiety disorders, new and complex information processing models were developed that incorporated the presence of attentional biases in the absence of memory biases (e.g. Mogg, Mathews, & Weinman, 1987). These models proposed that attentional resources are biased towards the processing of threatening information, but *because* the information is threatening, there is a degree of cognitive avoidance which results in decreased elaboration of the information, and therefore decreased recall. This idea is based on the dissociation between activation and elaboration of information proposed by Graf and Mandler (1984).

The idea that OCD may result from a failure to appropriately process information has also resulted in new theoretical explanations and treatment recommendations (e.g. Watts, 1995). These ideas are consistent with the fact that patients with OCD tend to report a great deal of doubt and uncertainty about their memory. It is however possible that it is primarily a lack of confidence in their memory, rather than a deficit in memory itself, that plays a role in the development and/or maintenance of OCD (Rachman, 1973; Rachman & Hodgson, 1980). Reports of low confidence in memory in OCD were reported as early as Freud (1909) who wrote, "In obsessional neuroses the uncertainty of memory is used to the fullest extent as a help in the formation of symptoms". Treatments based on improving information processing by increasing the salience of a particular check (designed to increase retrievability and confidence in memory) have demonstrated some initial promise, but with decreasing returns over time (Tallis, 1993).

Additionally, there have been neuropsychological explanations of the disorder based on reports of a number of memory deficits (see Tallis, 1997 for a review). The exact results of neuropsychological tests are not pertinent to the present study but, it is important to note that these models tend to assume *deficits* in information processing. It is worth mentioning that neuropsychological test results are not normally adjusted for the effects of extremely low confidence in memory in the presence of normal memory functioning. During neuropsychological testing, responses which are withheld/delayed (because of doubt/uncertainty) or, in more severe cases, answers such as 'I don't know' instead of 'I think it might be———' will almost always result in low test scores, and may provide seeming evidence of neuropsychological deficits where there are none (Shafran, 1995).

The prevailing models of information processing and neuropsychological functioning in anxiety disorders generally, and OCD specifically, appear to be supported by the available data, but are inconsistent with many patient reports and other information from the clinic. Patients appear to have an *extremely good memory* for objects and events which have made them anxious (with the possible exception of some post-traumatic stress disorder patients), and can describe threatening situations in excruciating detail—often in the absence of detailed memory for non-threatening aspects of the situation. One patient recently remarked about an event that occurred during the previous week, "When I went into the meeting, I saw a red spot on the wall and wondered if it was blood. It was small, about 1 cm in diameter and a deep red. It could have been a smear of jam but I wasn't sure." When asked what the meeting was about, the patient could not remember. Reports like this and our own earlier results of enhanced memory for contaminated objects in compulsive cleaners (Radomsky & Rachman, 1999) lead one to believe that instead of a *memory deficit* in association with anxiety, there is perhaps a *memory bias* at work. (Incidentally, none of the memory deficit models of OCD can account for, let alone predict, the evidence of superior memory shown by patients with OCD under clearly specifiable conditions.)

We hypothesized that failures to demonstrate a memory bias arise not from the absence of the bias, but rather because of the methodologies used to test for its presence (see Rachman, 1998, pp. 45–50; Radomsky & Rachman, 1999). Accordingly, we conducted an experiment using compulsive handwashers as participants and objects (instead of words) as stimuli. The objects were either contaminated (i.e. changed from non-threatening to threatening), or touched but not contaminated (i.e. made salient but remaining non-threatening), by the experimenter. The OCD group had a memory bias (at a later surprise recall test) in favour of contaminated objects (threatening stimuli), while an anxious control group and an undergraduate control group did not. There was no evidence of a memory deficit in the OCD group, and no evidence of neuropsychological deficits. We concluded that in order to detect memory biases in association with different anxiety problems, it was important to select participants with a specific, circumscribed fear, and to select stimuli which the participants perceived as threatening (Radomsky & Rachman, 1999). While words, and even pictures may represent threatening objects or situations, they are rarely perceived as dangerous—even by extremely troubled patients. It is therefore important to use ecologically valid stimuli in order to ascertain how threatening and non-threatening information is processed in association with fear and anxiety disorders.

Our evidence of a memory bias in a sample of compulsive handwashers was interesting, but we felt that memory probably plays a larger role in compulsive *checking*. Patients rarely say that they are washing their hands again and again because they don't recall washing them earlier, but they do report an inability to remember if a check, say of the stove, was completed correctly. Patients who engage in compulsive checking tend to blame their poor memory for their desire to check something repeatedly.

Constans, Foa, Franklin, and Mathews (1995) conducted an experiment using ecologically valid stimuli in a sample of compulsive checkers. They asked participants to engage in a number of activities repeatedly (e.g., lighting and blowing out a candle, turning a faucet on and off, etc.), and then later to recall the final state of the objects involved in these activities. OC checkers had superior recall for the final resting state of activities in the high anxiety condition whereas control participants did not. Constans et al. (1995) did not expect to find this memory bias in favour of threat-relevant information and were not able to explain their results at the time.

Checking behaviour in OCD is substantially different from washing behaviour in OCD, and different OCD subtypes may well have different correlates (underlying beliefs, attentional biases, etc.) that require different approaches to examinations of information processing (Radomsky, Rachman, & Hammond, 1999). Of particular importance to compulsive checking is the concept of inflated responsibility (Salkovskis, 1985). It has been demonstrated that reductions in perceived responsibility can result in steep declines in discomfort and urges to check (Lopatka & Rachman, 1995; Shafran, 1997). It is reasonable then to expect that manipulations of responsibility will have a direct influence on memory in OCD, particularly in compulsive checking.

We therefore decided to conduct a study of memory in compulsive checking, with particular attention to responsibility, and to its effects on confidence, and on memory for both threat-relevant and threat-irrelevant information. We expected that increases in perceived responsibility would result in an amplification of a positive memory bias in favour of threat-relevant information, and in decreased confidence in memory. Similarly, reductions in perceived responsibility should result in both reduced bias and increased confidence in memory for information related to checking behaviour. Finally, under conditions of no responsibility, we expect that there should be no detectable memory bias, and further increases in confidence in memory.

1. Method

1.1. Participants

Participants were invited to participate in the study if they reported spending at least an hour a day on checking behaviour which included checks of a ritualistic nature. (People whose checks involved only a simple glance at an object, or which took less than 60 s to complete were excluded.)

Participants (n=11) were diagnosed with the Anxiety Disorder Interview Schedule (DiNardo, Brown, & Barlow, 1994) and completed the Maudsley Obsessional Compulsive Inventory (MOCI—Rachman & Hodgson, 1980) and the Beck Depression Inventory-2 (BDI—Beck, Steer, & Garbin, l996) before beginning the study. Ten of the 11 participants were female. Other participant characteristics are displayed in Table 1. All participants met DSM-IV diagnostic criteria for OCD.

Table 1
Participant characteristics

	Mean	Standard deviation	Minimum	Maximum
Age	42.1	15.5	24.0	71.0
Post-secondary education (yr)	1.1	1.3	0.0	4.0
BDI	20.3	14.3	2.0	46.0
MOCI total	20.4	6.7	6.0	28.0
MOCI checking	6.7	1.5	4.0	9.0
MOCI washing	6.7	3.3	0.0	11.0
MOCI doubting	5.6	1.6	2.0	7.0
MOCI slowness	2.8	1.9	0.0	6.0

2. Procedure

Participants completed a baseline task in their home that caused maximum distress if left unchecked; this initial check was closely observed by the experimenter.

Participants were then subjected to one of two responsibility manipulations: under the high responsibility condition, participants signed a Responsibility Contract in which they agreed to take complete responsibility for the check and its consequences and then completed the check themselves. Under the low responsibility condition, participants signed a different Responsibility Contract which assigned complete responsibility for the check and its outcome to the experimenter who then completed the check himself, ensuring that this imitative check closely matched that shown by the participant in the baseline check.

All participants were included in both the high responsibility condition and the low responsibility condition. The order of responsibility manipulations was randomly assigned. Before each check, participants were told that there would be a memory test following the check and that they would be asked questions both about the check itself, and about other things which happened during the check. During each check, the experimenter clipped a coloured pen to his collar (either green or purple), coughed (or did not cough) and read out a list of four digits (digits read during the first check were not the same as those read during the second).

After each check, participants were asked about the amount of responsibility and anxiety they felt during the check (manipulation check) and then completed a Memory and Confidence Interview (test data).

The Memory and Confidence Interview was designed to assess memory for both threat-relevant aspects of the check (e.g. 'How many times did you touch the stove?', 'What was the final state of the thermostat?', 'Was the faucet shut off when you began the check?') and for threat-irrelevant aspects of the check (e.g. 'What were the four numbers you heard me say?', 'Did I cough during the check?', 'What colour was the pen clipped to my collar?'). The Interview also assessed participant's confidence in each of their responses on a 0 to 100 scale where 0 represented no confidence at all in their response and 100 represented complete certainty about their response. The Interview began with a description of the differences between memory and confidence in memory and described situations of high confidence in incorrect memories, low confidence in correct memories, high confidence in correct memories and low confidence in incorrect memories. It was important to ensure that this interview could be used for almost any kind of checking behaviour so some flexibility was built-in to accommodate the variety of checking behaviour found in OCD.

One week later, participants came into the lab to watch a videotape of the two checks. After watching each videotaped check, participants completed additional Memory and Confidence Interviews (retest data). Since these data were collected one week after the test data and involved memory for *videotaped* checks, the two retest conditions were taken as conditions of no responsibility (i.e., any adverse consequences of the original check would already have occurred so ratings of responsibility would be somewhat meaningless). Hence, the design includes high and low responsibility conditions (test data), and two no responsibility conditions (retest data).

3. Results

3.1. Manipulation check

Participants reported feeling more responsible during the high responsibility condition (79.1 on a 0–100 scale) than they did during the low responsibility condition (52.7 on a 0–100 scale, where 0 represents not at all responsible and 100 represents completely responsible) and this difference was marginally significant, paired-sampled $t_{(10)}=1.8$, $p<0.10$. Ratings of anxiety (taken on a 0–100 scale) during each check (test data) and during each videotape (retest data) did not significantly differ between the four conditions. Participants' responsibility ratings and anxiety ratings are displayed in Fig. 1.

3.2. Memory

Results from the Memory and Confidence Interview (displayed in Fig. 2) were subjected to a 4×2 within–within repeated measures MANOVA and indicated that overall memory scores did not differ across the different conditions $F_{(3,27)}=0.66$, n.s. That is, all of the participants remembered about the same amount of information, regardless of condition. However, there was a highly significant interaction effect, $F_{(3,27)}=10.09$, $p<0.001$, indicating that the amounts of threat-relevant vs threat-irrelevant information remembered was significantly different across the four different conditions. Planned Dunn–Bonferonni *t*-tests revealed that participants had a tendency to remember more 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) in the high responsibility condition, $t_{(27)}=9.4$, $p<0.001$. A similar, but weaker effect was found in the low responsibility con-

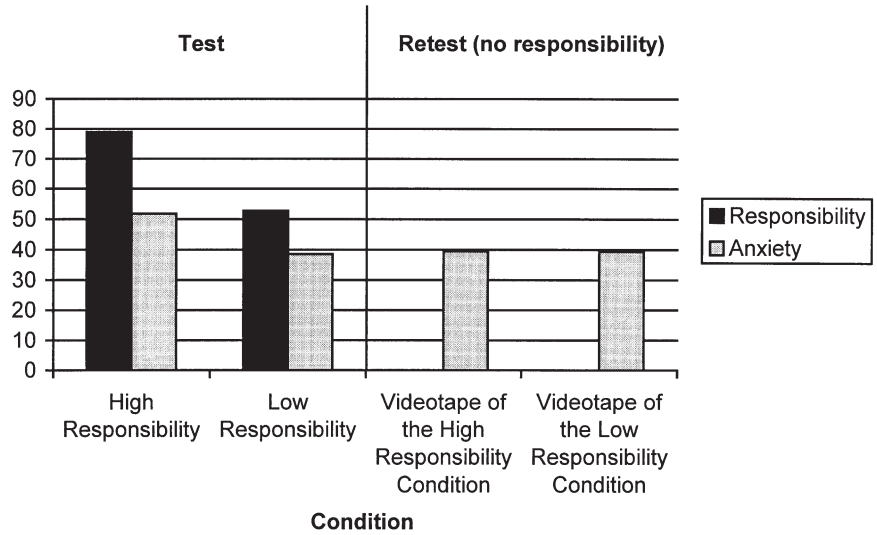

Fig. 1. Manipulation Check: Participants' ratings of perceived responsibility and anxiety (on a 100 point scale) during test conditions of high and low responsibility. Anxiety ratings during retest conditions of 'no responsibility' are shown on the right hand side of the figure.

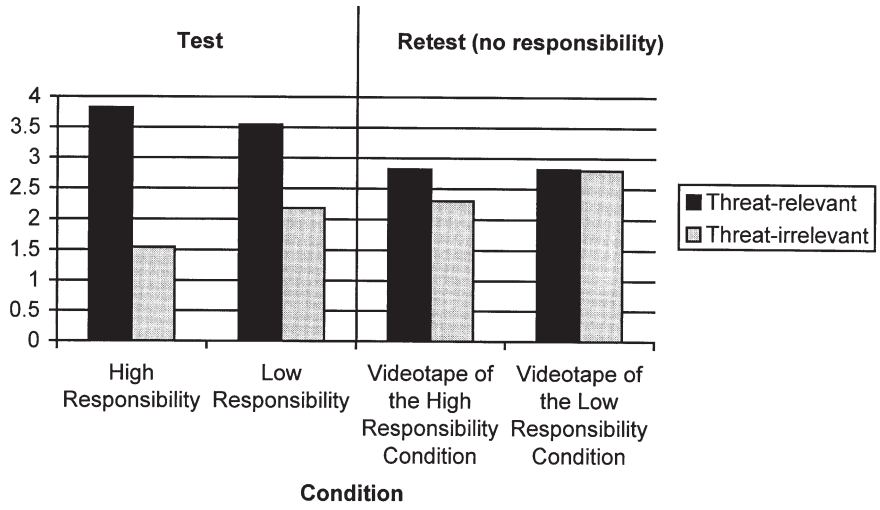

Fig. 2. Memory: Participants' memory scores for threat-relevant and threat-irrelevant information (each is out of 5) from the Memory and Confidence Interview for test conditions of high and low responsibility and for retest conditions of 'no responsibility'. Memory for threat-relevant information exceeds that for threat-irrelevant information. This bias was amplified under conditions of high responsibility.

dition, $t_{(27)}$=5.6, $p<0.01$. At retest (no responsibility), there were no differences between threat-relevant and threat-irrelevant memory for the videotape of the high responsibility condition, $t_{(27)}$=2.1, n.s., and for the videotape of the low responsibility condition, $t_{(27)}$=0.1, n.s.

3.3. Confidence

Confidence scores from the Memory and Confidence Interview are displayed in Fig. 3. A repeated measures ANOVA indicated that participants were significantly less confident about their memory under conditions of high responsibility than they were under conditions of low responsibility (test) or no responsibility (retest), $F_{(3,27)}$=3.23, $P<0.05$.

4. Discussion

As predicted, results from this experiment show that there is a memory bias in compulsive checkers in favour of threat-relevant information (over threat-irrelevant information). Under conditions of high responsibility this bias is amplified. Under conditions of 'no responsibility', no bias is detectable. As responsibility for the outcome of a check decreases, confidence in memory for aspects of the check increases.

These results are consistent with early models of information processing and emotional arousal (Bower, 1981; Kovacs & Beck, 1978), and with previous research on confidence in memory in OCD (Rachman, 1973; Sher et al., 1989), on the impact of responsibility on OCD symptoms (Lopatka & Rachman, 1995; Shafran, 1997), on memory for checking behaviour (Constans et al., 1995) and on memory bias in OCD (Radomsky & Rachman, 1999).

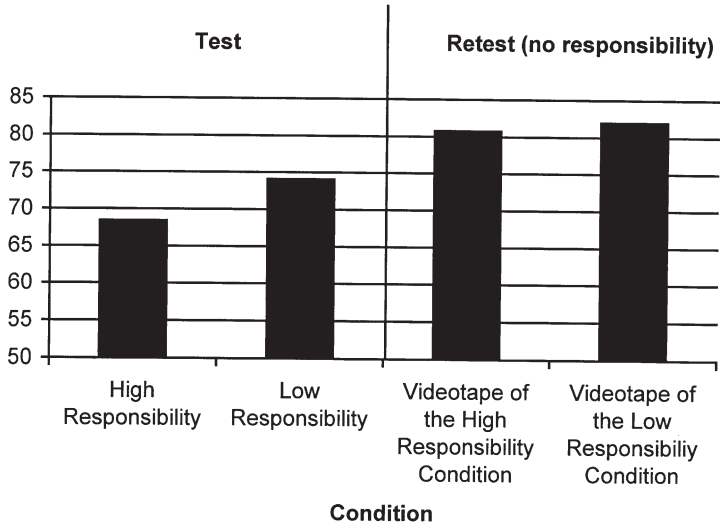

Fig. 3. Confidence: Participants' confidence ratings (out of 100) from the Memory and Confidence Interview for test conditions of high and low responsibility and for retest conditions of 'no responsibility' Test Retest (no responsibility).

In the earlier research by Constans et al. (1995) and Radomsky and Rachman (1999) a positive memory bias was found under conditions of low responsibility. It would be difficult to argue that these two studies had conditions of 'no responsibility' because they both used stimuli which could have been perceived as somewhat threatening in the future (contaminants left on objects, faucets left on, etc.). The present study used situations which could have been perceived as threatening in the future (e.g. stove left on), but also used situations which could not (e.g. videotape of stove left on one week earlier). Some participants even commented that any danger resulting from an 'improper' check as seen on the videotape would have already resulted in disaster long before their return to the laboratory for the retest.

An analysis of data from the confidence portion of the Interview shows that responsibility may have more of an effect on confidence in memory than on general memory itself. That is, under conditions of high perceived responsibility, participants are much less likely to be confident of their (equally correct) memory than under conditions of lower perceived responsibility.

The simplest explanation for these results comes from earlier models of information processing and anxiety (Bower, 1981; Kovacs & Beck, 1978), which predict that increased attentional and memorial resources are allocated to process information relevant to a person's current emotional state. This mechanism is not only intuitive, but is also adaptive (the best time to have immediate access to threat-relevant cues and memories would be during times of immediate threat or danger).

It is possible that reduced confidence partially results from impaired memory for *threat-irrelevant* information. Just as a reduced ability to use contextual information in the elderly results in apparent memory deficits in that population (Mclntyre & Craik, 1987), perhaps reduced access to threat-irrelevant information in OCD results in apparent memory deficits in compulsive checking. That is, compulsive checkers may not have access to the same amount of contextual (threat-irrelevant) information when attempting to recall the outcome of a previous check. It would therefore seem reasonable that their (incomplete) memory is less vivid, producing doubt and reductions

in confidence. If true, this mechanism could account for reduced elaboration of encoded information without producing a general memory deficit. The results of this study do not provide support for either a general memory deficit or for neuropsychological memory deficits in association with compulsive checking.

Patient reports of *poor memory* in OCD likely result from *poor confidence* in memory. These beliefs are unlikely to be self-correcting because of our difficulty separating accuracy from confidence in thinking about our own memories, (If you're not sure that you are remembering something correctly, it may be because you can't remember it (accuracy), or it could be because you lack certainty (confidence) in your memory.)

Two concerns about this experiment are its low sample size and marginally significant manipulation check. We acknowledge that a larger sample would have been desirable, however, given the size of the effect demonstrated, and the completely within-subjects design of the study, there was sufficient power to analyse the results. We were unable to achieve the same degree of responsibility shift that Lopatka and Rachman (1995) reported, although the inclusion of two 'no responsibility' conditions, the fact that results are consistent with predictions, and the impact of the low sample size on the power to detect the manipulation (not to detect the main effects), make the marginally significant manipulation check more acceptable. In the Lopatka and Rachman (1995) study, considerable time and effort was spent on negotiating a shift in the participants' often rigid sense of responsibility. In the current study, no more than five minutes was devoted to any of the responsibility contracts.

The results, if replicated in a larger sample, would suggest the utility of treatment strategies which focus more on improving confidence in memory and on reducing perceived responsibility for events, than for specifically targeting and compensating for mnestic and related deficits. Monitoring memory accuracy may prove helpful in changing patients' beliefs that their memories are poor. The results of this experiment also provide additional support for the use of ecologically valid experimental paradigms in studies of information processing and emotional arousal. We suggest that the use of words as stimuli is unlikely to be fruitful in research of this type. Similarly, the use of standardised neuropsychological tests which do not account for the possibility of good memory performance in the context of poor confidence, and which make no allowance for the personal significance of the material to be remembered, are unlikely to provide an accurate reflection of neuropsychological functioning in OCD.

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References

American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders.* (4th ed). Washington, DC: American Psychiatric Press.

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

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129–148.

Constans, J. I., Foa, E. B., Franklin, M. E., & Mathews, A. (1995). Memory for actual and imagined events in OC checkers. *Behaviour Research & Therapy*, *33*, 571–665.

DiNardo, P. A., Brown, T. A., & Barlow, D. H. (1994). *Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV).* New York: Phobia and Anxiety Disorders Clinic.

Freud, S. (1909). Notes upon a case of obsessional neurosis (the 'rat man'). In A. Richards, *The penguin Freud library: case histories II*. UK: Penguin.

Graf, P., & Mandler, G. (1984). Activation makes words more accessible, but not necessarily more retrievable. *Journal of Verbal Learning and Verbal Behavior*, *23*, 553–568.

Kovacs, M., & Beck, A. T. (1978). Maladaptive cognitive structures in depression. *American Journal of Psychiatry*, *135*, 525–533.

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

Mathews, A. (1997). Information processing biases in emotional disorders. In D. M. Clark, & C. G. Fairburn, *Science and practice of cognitive behavioural therapy*. Oxford: Oxford University Press.

Mclntyre, J. S., & Craik, F. I. M. (1987). Age differences in memory for item and source information. *Canadian Journal of Psychology*, *41*, 175–192.

Mogg, K., Mathews, A., & Weinman, J. (1987). Memory bias in clinical anxiety. *Journal of Abnormal Psychology*, *96*, 94–98.

Rachman, S. (1973). Some similarities and differences between obsessional ruminations and morbid preoccupations. *Canadian Psychiatric Association Journal*, *18*, 71–73.

Rachman, S. (1998). *Anxiety.* East Sussex, UK: Psychology Press.

Rachman, S., & Hodgson, R. (1980). *Obsessions and compulsions.* Englewood Cliffs, NJ: Prentice Hall.

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

Radomsky, A.S., Rachman, S., & Hammond, D. (1999) Memory, confidence and responsibility in compulsive checking. Paper presented at the Association for the Advancement of Behavior Therapy Conference, November, Toronto.

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

Shafran, R. (1997). The manipulation of responsibility in obsessive-compulsive disorder. *British Journal of Clinical Psychology*, *36*, 397–408.

Shafran, R. (1995). An investigation into the cognitive-behavioural model of obsessive-compulsive disorder: can this be reconciled with a neurological deficit model? Doctoral dissertation, University of London.

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 & Therapy*, *27*, 65–70.

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

Tallis, F. (1993). Doubt reduction using distinctive stimuli as a treatment for compulsive checking: An exploratory investigation. *Clinical Psychology and Psychotherapy*, *1*, 43–52.

Watts, F. N. (1995). An information-processing approach to compulsive checking. *Clinical Psychology and Psychotherapy*, *2*, 69–77.

Williams, J. M. G., Watts, F., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and the emotional disorders.* Chichester: John Wiley and Sons.