



Obsessive–compulsive disorder and the paradoxical effects of perseverative behaviour on experienced uncertainty[☆]

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Abstract

Patients suffering from Obsessive-compulsive disorder (OCD) tend to check repeatedly and after checking episodes they tend to be uncertain about their memory for checked events. It seems plausible that memory distrust motivates checking, but why checking is repeated and why one check is not enough to reassure the patient is uncertain.

To study this, an interactive computer animation displaying light bulbs or gas rings was developed and healthy participants were asked to engage in repeated checking. In five separate experiments we found that repeatedly checking the same class of items resulted in sharp decreases in detail and vividness of memory of the checked events while the accuracy of the memory remained intact. The phenomenological quality of the experienced memory distrust was highly similar to the ambivalence OCD patients tend to report about their memory after checking. Furthermore, there were some indications that repeated checking not only undermines trust in memory, but may also reduce the sense that one acted responsibly.

The experimental preparation may be used as a model for OCD checking. The study suggests that repeated checking is sufficient to cause paradoxical effects on memory trust and that repeated checking is a counterproductive safety strategy.

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1. Introduction

Obsessive–compulsive disorder (OCD) patients tend to have inflated senses of both threat and personal responsibility (Foa, Sacks, Tolin, Prezworski, & Amir, 2002).

[☆]The experimental preparation used in the experiments described can be downloaded from “www.dmkep.unimaas.nl/epp/download.htm”.

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A normal sense of potential threat and personal responsibility is the reason why airplane pilots perform equipment checks before taking off. The inflated senses of threat and responsibility may explain why OCD patients check matters that others leave unchecked. However, OCD checkers check *repeatedly*. Why is one check not enough to satisfy the patient?

It has been proposed (e.g. Tallis, 1995) that OCD checkers suffer from a general memory deficit and that memory distrust after checking is a manifestation of this general deficit (Tallis, 1995). There are many problems with this proposal (e.g. van den Hout & Kindt, 2003a), the most serious perhaps being the fact that clinical memory distrust in OCD is highly domain-specific. Patients can be extremely unsure, for example, about having closed a door, but they are not (or at least far less) unsure about what they had for dinner. Domain specificity appears to be incompatible with the implication of deficit models that memory problems should be manifest on all tasks that require episodic memory.

Recently, several authors suggested that the relation between memory uncertainty and checking might be reciprocal. That is, while memory uncertainty may motivate checking, checking may not reduce, but paradoxically *increase* memory uncertainty (Rachman, 2002; Tolin et al., 2001; Salkovskis & Forrester, 2002; van den Hout & Kindt, 2001; 2003a; 2003b). This would explain why clinical memory uncertainty in OCD is confined to issues that are related to checking: the latter would undermine memory confidence for checked events but leave confidence in other recollections intact.

In four separate experiments we tested a specific account of *how* checking breeds uncertainty (van den Hout & Kindt, 2001, 2003a,b). We started from the assumption that patients may be motivated to check because of inflated senses of threat and personal responsibility (Foa et al., 2002) or, more specifically, because of fear of guilt arising from having acted irresponsibly (Mancini, 2001; Mancini & Gangemi, 2004, this issue). If people repeat and prolong checking, and the degree to which they do so, checking will become a familiar routine. One of the key features of repetition-induced familiarity is that the processing of high-level ‘semantic’ aspects of the experience gets prioritized and that the processing of lower level, perceptual elements gets inhibited (Roediger, 1990; Johnston & Hawley, 1994). As a result, memory for the experience becomes less vivid and detailed. Lack of detail and vividness may not affect actual memory accuracy but it will make the recollection appear less trustworthy. Thus, the counterproductive effect of repeated checking would be an automatization-induced reduction of memory vividness, detail and certainty. If persisting memory uncertainty motivated the repetition of checking, the patient may get trapped in a spiral of mutually reinforcing checking behaviour and memory distrust. Neisser (1981) coined the term ‘repisodic memory’ for memories that are neither episodic nor semantic but that refer to events that have occurred repeatedly. Such memories are often experienced as episodic, but in fact they are not recollections of a single episode but common features of a series of events. Neisser suggests that repisodic memory is trustworthy to the subject. This suggestion (repetition making memory trustworthy) seems at odds with the present position. Still, this contrariety may be more apparent than real. That is, repisodic memory as outlined by Neisser is typically about the gist of a series of events. This is highly

similar to the suggestion that with repetition, the processing higher-order semantic aspects of the events get prioritized. Neisser's account of episodic memory is silent about the issue that is crucial here, namely that repetition makes the memory of the perceptual elements of the last event of the series less vivid, detailed and trustworthy.

In the first three experiments, we tried to establish whether repeated checking is sufficient to reduce the vividness and detail of the checking, and if, in its wake, memory confidence would be compromised. Furthermore, it was documented whether, apart from subjective memory confidence, actual memory accuracy was affected by repeated checking. The memory effect we were looking for was assumed to be a normal cognitive result from repeated checking and the experiments were therefore carried out with healthy subjects. An interactive computer simulation was made in which participants had to repeatedly check virtual gas rings. In the fourth experiment we determined to what degree the phenomenological experience of memory after experimental checking resembles the subjective experience reported by clinical checkers.

OCD uncertainty not only relates to memory, but also to responsibility. Both during and after safety behaviours patients may worry whether they are acting or have acted in a responsible way. It was hypothesized that the sense of acting/having acted responsibly depends on the feeling that one is acting effortful/has acted effortful. Persevering with behaviours like checking and washing, however, will make the behaviour an automatic routine implying that it requires less effort. Thus, the perseverative nature of OCD safety behaviour may not only undermine memory confidence, but also the feeling of acting/having acted in a responsible way. Testing this assumption was the aim of the fifth experiment.

2. General method

All five experiments were set up in very similar ways. Deviations are described when introducing the pertinent experiment. An interactive computer animation was developed in which participants had to repeatedly check a virtual gas stove (relevant checking; see below) or virtual light bulbs (irrelevant checking; see below).

Participants were tested in a dimly lit and sound-attenuated laboratory room where they sat at a table with a PC. During the experimental task, the experimenter observed the participants through a one-way mirror. The questions to be answered were typed on booklets and were handed out by the experimenter.

The animation started with a training phase during which participants were trained to turn animated gas rings and animated light bulbs on and off. As for the gas stove, the monitor displayed a gas stove with six knobs that corresponded to six gas rings. By moving the cursor with the mouse, participants could turn any particular gas ring on, after which a rather realistic gaslight occurred. The gas rings could be turned on, higher, lower, and off. The six light bulbs were perceptually rather different such that automatization in the irrelevant checking condition would not generalize to the gas stove. The lights could be operated by six sliding panels using the mouse. Turning the gas ring or light bulb off was made somewhat delicate and in about one in five trials, participants made a mistake. Each participant trained

with both light bulbs and gas stoves. Half of the participants started to train with the light bulbs, the other half with the gas rings.

After the training phase, a schematic diagram was shown with circles at the same screen location where participants had previously seen the gas rings. Three of the circles contained a cross and participants were asked, by means of a text line displayed on the monitor, to turn off the gas rings that corresponded with the three crossed circles. They were told that feedback about failures would no longer be given. Next the animated gas stove was presented and participants turned on the three rings. Then a text page occurred asking participants to turn the gas rings off again. The stove was presented again, with the rings still light, and the participants turned the stove off. A text page then occurred asking the participants to check whether the rings had been properly turned off. The rings were checked and the participants rated the questions about checking (see below).

After this pre-test, half of the subjects were allocated to the relevant checking group and the other half to the irrelevant checking group. Participants in the relevant checking group got a series of 20 trials of the type used for the pre-test: (a) an instruction about which three of the six rings to turn on (different combinations from trial to trial), (b) then turning them on, (c) turning them off, and (d) checking whether they were really off. After each trial a text was displayed saying “Next you will be asked to operate a gas stove”. Only after the 20th trial were participants asked, unexpectedly for them, to answer the questions again. Participants in the control group were subjected to 20 corresponding trials of checking light bulbs. After each trial a text said “Next you will be asked to operate light bulbs”. However, after the 20th trial the text said that the object to operate next was the gas stove. After operating the gas stove, participants filled in the booklet with questions about the last checking episode. For all details, see the experimental procedure on www.dmkep.unimaas.nl/epp/download.htm.

The design is given in Fig. 1.

Design

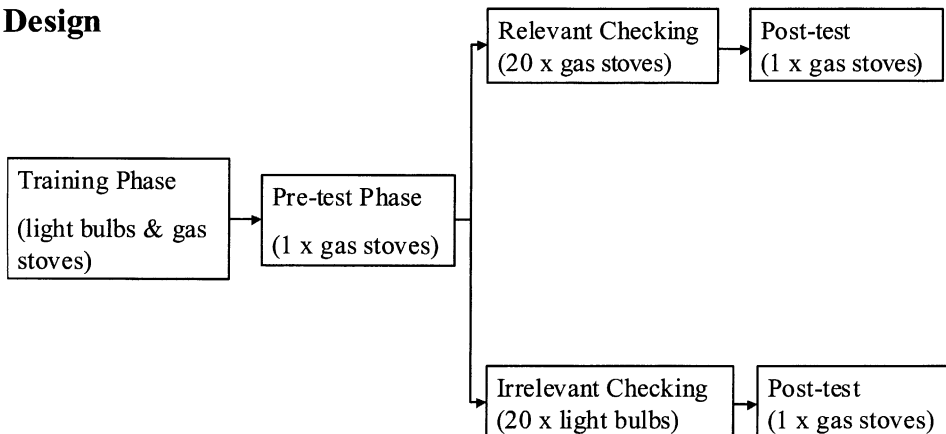


Fig. 1. General design of the experiments 1, 2, 4 and 5. Experiment 3 has the same design but no pre-test.

3. Experiment 1

3.1. Participants

Thirty-nine college students (mean age 24; 27 females) volunteered to participate.

3.2. Assessments

1. *Memory accuracy*: Both at pre-test and at post-test participants were given a page with a schematic drawing of the six gas rings on the gas stove and they were asked to indicate, by crossing three of the six circles corresponding to the six gas rings, which rings they actually checked during the last checking episode.
2. *Vividness, detail and confidence in memory*: Participants were asked to indicate the vividness and detail of their recollection of the last checking operation on two 100-mm VAS's running from "not vivid" to "extremely vivid" and from "not detailed" to "extremely detailed". Confidence in checking was assessed by asking participants to indicate on a VAS ranging from "0" (absolutely not confident) to "100" (absolutely confident) how confident they were that the answer to the question about which rings had been checked (see 1, above) was correct.
3. *Outcome confidence*: On a 100-mm VAS participants were asked to indicate how confident they were that now all the gas stoves were really off, i.e. the outcome of checking.
4. *Interpretation of the task*: The experiment was not introduced as a memory task, but pilot observations showed that some participants rightly guessed at the beginning of the experiment that memory was being tested. An open question, at post-test, asked participants what they believed the aim of the experiment to be. This allowed the experimenters later to split the sample into participants who did and who did not believe that the experiment was about memory. Furthermore, at both the pre-test and the post-test participants were asked to indicate on a 100-mm VAS how important it was for them to check accurately.

3.3. Results

Memory accuracy: The number of participants in both conditions that had accurate recollections at pre-test and post-test is given in [Table 1](#)

Clearly, relevant checking did not make memory less accurate.

Vividness, detail and confidence in memory: Findings are given in [Fig. 2](#).

Data were tested with a two-way ANOVA comparing Time (pre-test vs. post-test) and Group (relevant checking vs. irrelevant checking) with the former factor being a within-subject measure. For all three dependent variables, there were significant effects of Time (all F 's > 18; $df = 1,37$; all p 's < 0.001) Likewise, for all three variables the Group effect was significant (all F 's > 8; $df = 1,37$; all p 's < 0.001). Most pertinent to the hypothesis under review, for both vividness, detail and memory confidence there were significant Time X Group interactions (all F 's > 6; $df = 1,37$;

Table 1

Memory accuracy (proportion of participants making no mistakes) in experiment 1

	Pre-test	Post-test
Relevant checking	$n = 17/19$	$n = 17/19$
Irrelevant checking	$n = 20/20$	$n = 18/20$

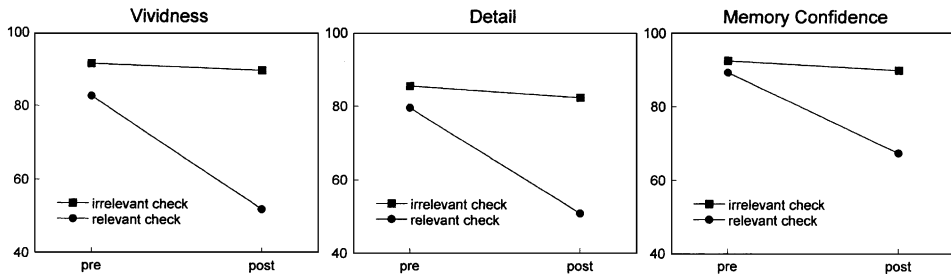


Fig. 2. Vividness, detail and memory confidence before and after relevant/irrelevant checking in experiment 1.

all p 's < 0.02). Thus, compared to irrelevant checking, relevant checking produced significant reductions in vividness and detail of the memory about the last check. While accuracy of memory was unaffected by relevant checking (see Table 1), the latter undermined the *confidence* in the accuracy of the memory (see Fig. 2).

Outcome confidence: Scores on outcome-confidence were unaffected by relevant checking and remained around 75 in both groups. Neither the Group effect, nor the Time effect, nor the Time X Group interaction approached significance (all F 's < 1.5; $df = 1,37$; all p 's > 0.2). Thus, while participants became less confident in their memory about the checking (see Fig. 2), they remained confident that the gas stoves were really off.

3.4. Discussion of experiment 1

In line with the hypothesis, repeated relevant checking produced reductions in vividness and detail of recollection while memory confidence eroded. However, neither memory accuracy nor outcome confidence was affected. Experiment 2 was partly intended to shed light on the combination of reduced confidence in memory and unaltered confidence in outcome.

4. Experiment 2

4.1. Introduction

Experiment 2 was largely a replication of experiment 1, but there were two differences that related to the persistence of outcome confidence after irrelevant

checking. First, perhaps a peculiarity of the training procedure might have been responsible. This had to do with the feedback given during the training phase. This procedural aspect proved irrelevant and is not discussed here (see van den Hout & Kindt, 2003a; experiment 2). Secondly, the combination of reduced vividness/detail/memory confidence on the one hand and intact outcome confidence on the other seemed reminiscent of the ‘memory-know’ distinction. Declarative memory may be based on “general knowing” that something was the case, or on “remembering” that something was the case (Tulving, 1985). Perhaps the outcome confidence remained unchanged in the relevant checking group but perhaps its source shifted remembering to knowing. One of our (M.K.) patients remarked that his deepest wish was to have a video recording of his entire life so that he could check whether or not particular actions were performed like having made love with a particular woman who was pregnant. Leaving aside the probability that this hypothetical video would become subject to doubt and checking, this and other clinical observations suggest that, when it comes to possible past indications of future harm, OCD patients may favour “remembering” over “knowing”. In the present experiment, participants were asked, at pre-test and post-test, to what degree their outcome confidence was based on remembering or on knowing. It was predicted that, compared to the control group, in the relevant checking group scores would go up on knowing and go down on remembering.

4.2. Participants

There were 40 participants, 33 female, with a mean age of 21 years.

4.3. Assessments

Assessments were identical to experiment 1. However, two VASs on memory source used for outcome confidence were added. One related to knowing (“a general sense that I have properly checked”), the other to remembering (“concrete memories”).

4.4. Results

Memory accuracy: The number of participants that had accurate memories about which rings they checked is given in Table 2.

Relevant checking did not affect memory accuracy.

Vividness, detail and memory confidence: Data are given in Fig. 3.

The patterns in Fig. 3 are comparable to those of Fig. 2 and so were the statistics. For all three dependent measures, Time effects were significant (all F 's > 4.5; $df=1,38$; all p 's < 0.05), Group effects were significant (all F 's > 6; $df=1,38$; all p 's < 0.05) and, most importantly, the Time \times Group effects were significant (all F 's > 11; $df=1,38$; all p 's < 0.005).

Outcome confidence: In the relevant checking group, outcome confidence was 74 at pre-test and 77 at post-test. In the irrelevant checking group scores went from 67 to

Table 2

Memory accuracy (proportion of participants making no mistakes) in experiment 2

	Pre-test	Post-test
Relevant checking	16/20	15/20
Irrelevant checking	10/20	15/20

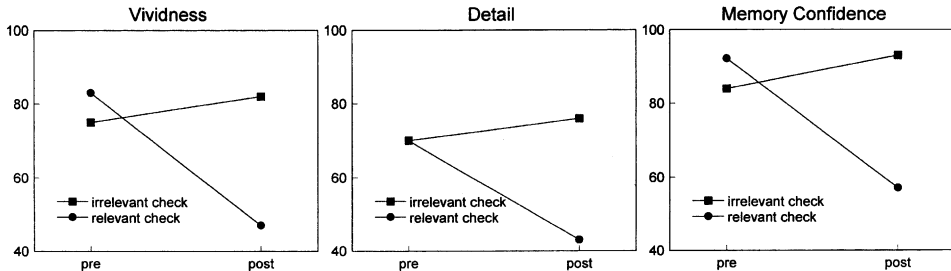


Fig. 3. Vividness, detail and memory confidence before and after relevant/irrelevant checking in experiment 2.

81. While there was a Time effect ($F(1,38) = 5.8; p < 0.05$), neither the Group nor the Group \times Time interaction was significant (all F 's < 2.2 $df = 1,38$). Most importantly, again there was no reduction in outcome confidence in the relevant checking group. As for "remembering" there were no effects for Group or Time (F 's < 1.8 ; $df = 1,38$). In line with the prediction, there was a reduction in the relevant checking group while no such effect was seen in the irrelevant checking group, resulting in a significant Time \times group interaction ($F = 7.8$; $df = 1,38$; $p < 0.01$). On "knowing", however, the Time effect, the Group effect and the Time \times Group effect remained non-significant (all F 's < 3.7 ; $df = 1,38$).

4.5. Discussion of experiment 2

Findings from experiment 1 were replicated. Memory accuracy remained unaffected by repeated checking but confidence in that memory was compromised. Likewise, vividness and detail of memory went down. Confidence in the outcome of checking remained intact. There were some indications that this related to a shift from remembering to knowing. In the experimental group, scores on remembering went down. However, scores on knowing did not. Assessing the 'remember vs. know' source of memory using two separate VASs is unconventional. Typically, participants are asked, on one forced-choice item, whether they used either remembering, or knowing as a source for declarative memory. This more conventional measure is used in experiment 4 (see below).

In experiments 1 and 2 all subjects were given a training phase including gas rings after which an assessment of memory was made. Then, subjects in the irrelevant

checking condition were made to check light bulbs. At trial 20 the control group was presented with the gas rings again. Possibly, this may have reminded them of the earlier sequence of gas-rings being followed by a memory assessment. Combination and the anticipation of a new memory assessment after the gas rings may have motivated them to be extra alert. Experiment 3 was carried out to critically test if this potential artefact was responsible for the findings of experiments 1 and 2. In experiment 3 no pre-test was given to secure that the control group would not anticipate a memory assessment after the last trial.

5. Experiment 3

5.1. Introduction

The aim of the experiment was to replicate experiments 1 and 2, but from the design given in Fig. 1, the pre-test was left out.

5.2. Participants

There were 23 females and 17 males (mean age 20 years).

5.3. Assessment

Assessments were identical to those of experiment 1. However, there were no pre-tests after the training phase.

5.4. Results

Memory accuracy: After relevant checking, 12 of the 20 participants were accurate while after irrelevant checking 14 of the 20 participants were accurate. Thus, relevant checking did not affect memory accuracy.

Vividness, detail and memory confidence: Data are given in Fig. 4. After relevant checking, scores were significantly lower than after irrelevant checking (all t 's > 3.0 ; $df = 18$; all p 's < 0.005).

Outcome confidence: Mean outcome confidence in the experimental group was 52 and this was not statistically different from the mean score (50) in the control group.

5.5. Discussion of experiment 3

All findings from experiments 1 and 2 were replicated. On vividness, detail and memory confidence, the magnitude of the between group differences at post-test were comparable to the magnitude of the post-test differences observed earlier, indicating that previous findings were not spurious results from memory assessments at pre-test.

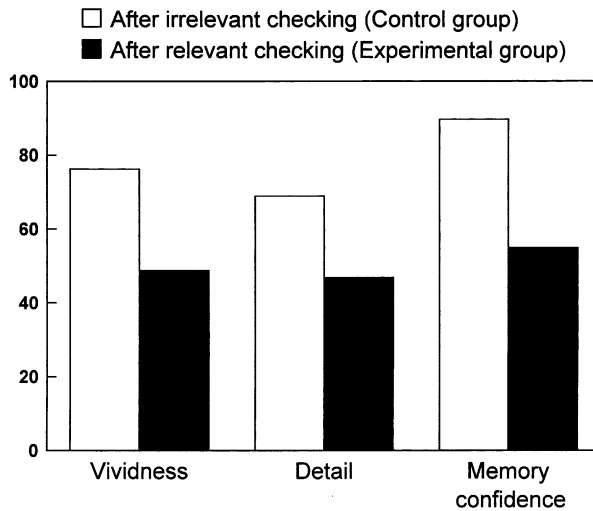


Fig. 4. Vividness, detail and memory confidence after relevant/irrelevant checking in experiment 3.

In all three experiments relevant checking made participants distrust their memory about the last check, but confidence in the outcome of checking remained intact. Experiment 4 was designed to explain this dissociation between confidence in outcome and confidence in memory.

6. Experiment 4

6.1. Introduction

Lampinen, Faries, Menschatz, and Toglia (2000) proved that familiar actions are remembered in ‘knowing’ sense, while the memory of unfamiliar actions has the flavour of ‘remembering’. Possibly the observed reduction of vividness/detail and memory confidence reflects a reduction of ‘remembering’. Outcome confidence may have remained unaffected, but the *source* of outcome confidence may have shifted in the experimental group (from ‘remember’ to ‘know’) while it may have not shifted in the control group. In experiment 2 this hypothesis was tested, but the assessment of the ‘remember–know’ issue was rather unconventional. The first aim of the present study was to investigate the remember–know issue again, but now using the usual assessment strategy.

After checking, OCD patients experience uncertainty about the checking episode. Reed (1985) interviewed clinical checkers and their responses suggest that the uncertainty was an *ambivalence* of a peculiar nature. “It’s as though the memory is there, but is not *definite* enough”, “Usually I can remember that I’ve done it, but the memory is not clear somehow” and “I remember doing it in a way, but it’s all fuzzy”.

Thus, after *clinical* checking, there may be some general knowing that the checking was performed but the recollection seems to be experienced as blurred, indefinite and vague. This seems rather reminiscent of the effects of *experimental* checking. Intact outcome confidence may reflect the general realization that the checking was performed according to the rules, but the reduced memory confidence, vividness and detail may mirror indefiniteness, vagueness and fuzziness that patients experience. Experiment 4 investigated the similarity between the phenomenological nature of memory uncertainty after experimental vs. clinical perseverative checking.

6.2. Participants

Forty undergraduates (mean age 20 years; 37 females) participated.

6.3. Procedure and assessments

For the procedure, see experiments 1 and 2. Memory accuracy, vividness, detail and confidence in memory as well as outcome confidence were assessed as in experiments 1–3; before and after the experiment. Two new assessments were added.

Remember-know: After shortly explaining the remember-know distinction (for details, see van den Hout & Kindt, 2003b) participants were asked whether their response to the question on outcome confidence was based on either remembering or on knowing. The question was only asked at post-test, to prevent answers being influenced by attempts to appear consistent.

Phenomenological validity: The three quotations provided by Reed (see introduction) were provided to participants who indicated the degree to which they endorsed the items on VASs. To enhance the semantic specificity of this test of phenomenological validity, two versions of the quotations were provided: the original versions and semantically twisted versions. The *original* versions read: “It is though the memory is there, but it isn’t definite enough”; “I remember doing it in a way, but it’s all fuzzy” and “I can remember that I’ve done it. But the memory isn’t clear somehow”. The *twisted* versions were: “It is as though the memory isn’t there, but it is *definite* enough”; “I don’t remember doing it, but in a way it’s all clear” and “I can’t remember that I’ve done it, but the memory is clear somehow”. For each participant, scores on the original quotations were averaged as were the scores on the twisted quotations.

6.4. Results

Memory accuracy: Data are given in Table 3.

Relevant checking again did not affect memory accuracy.

Vividness, detail and memory confidence: Averaged findings are given in Fig. 5.

In contrast to experiments 1–3, the Group effects on all three variables were non-significant (all F 's < 3.8; $df = 1,38$; all p 's > 0.05). Meanwhile, all Time effects were significant (all F 's > 7.3; $df = 1,38$; all p 's < 0.01) and so were the three crucial Time \times Group interactions (all F 's > 4.4; $df = 1,38$; all p 's < 0.05).

Table 3

Memory accuracy (proportion of participants making no mistakes) in experiment 4

	Pre-test	Post-test
Relevant checking	17/20	18/20
Irrelevant checking	18/20	17/20

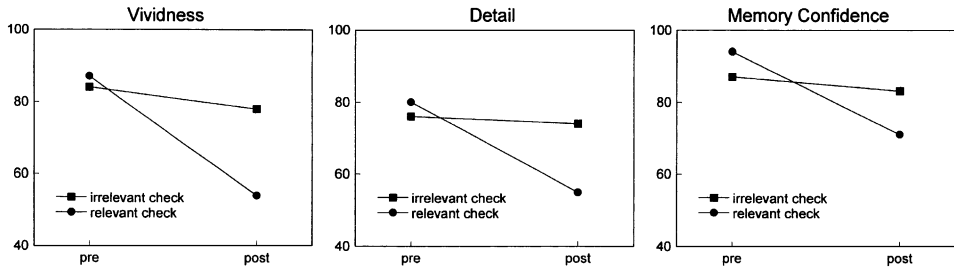


Fig. 5. Vividness, detail and memory confidence before and after relevant/irrelevant checking in experiment 4.

Outcome confidence: In line with experiments 1–3, neither the Time effect, nor the Group effect nor the Time \times Group interaction approached significance; scores in both groups remained about 55.

Remembering vs. knowing as a source of outcome confidence: The proportion of participants in the experimental group who ticked “knowing” instead of remembering was 11/20 while in the control group this proportion was 2/20. This difference was significant ($\chi^2(1) = 4.9; p < 0.05$).

Phenomenological validity: Fig. 6 shows the average scores.

For the twisted versions of the quotations, the Time effect, Group effect and the Time \times Group interaction were all non-significant (all F 's < 0.6 ; $df = 1,38$). On the original versions, however, not only the Time and Group effects, but also the crucial Time \times Group effect were significant (all F 's > 5 ; $df = 1,38; p < 0.05$).

6.5. Discussion of experiment 4

Earlier findings on vividness, detail and trustworthiness of memory were replicated. Using the more usual measure of the remember/know distinction, in the experimental group more participants reported that their post-test outcome confidence was based on knowing (as opposed to remembering) than in the control group. The phenomenological nature of the memory uncertainty after experimental (relevant) checking seemed similar to the memory ambivalence expressed by clinical checkers. This adds to the validity of the present experimental paradigm as a model for memory uncertainty after checking. Apart from memory effects, OCD-like perseveration may also serve to *directly* decrease the feeling that one is acting/has

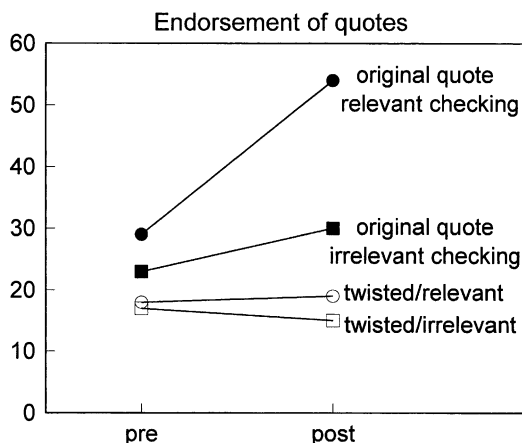


Fig. 6. Relevant checking (but not irrelevant checking) made participants endorse original quotes (but not twisted quotes) from OCD checkers about the subjective experience of memory doubt after checking.

acted responsibly. This might help to explain why patients are not only uncertain after the safety behaviour, but also *whilst* performing it (see general introduction). In experiment 5, the experiments 1, 2 and 4 were repeated while questions were added about perceived effort invested and about perceived responsibility. Relative to irrelevant checking, relevant checking was predicted to result in a decrease of perceived effort and of perceived responsibility.

7. Experiment 5

7.1. Introduction

Experiment 5 was aimed to test the prediction formulated at the end of the discussion of experiment 4.

7.2. Participants

There were 2 male and 38 female volunteers participating. The mean age was 30 years ($SD = 13$).

7.3. Procedure and assessments

For the procedure, see experiments 1, 2 and 4. Memory accuracy, vividness and detail of memory and memory confidence were assessed in the way described above. VAS items were added about perceived effort (did you attend, put effort in, do your

best, could have done better and tried to put effort in). Furthermore, one VAS was added about perceived responsibility.

7.4. Results

Memory accuracy: Data are given in Table 4.

Again, relevant checking did not disrupt actual memory accuracy.

Vividness, detail and memory confidence: Scores are given in Fig. 7.

Findings were similar to those of the earlier experiments. All crucial Time \times Group interactions were significant (all F 's $>$ 4.3; $df = 1,38$; all p 's $<$ 0.05).

Perceived effort and perceived responsibility: Factor analysis on the pre-test data revealed that all items loaded on one common factor explaining 58% of the variance. Based on the pre-scores of both groups, scores were z -transformed. Findings are given in Fig. 8.

As for perceived effort, there was neither a Group, nor a Time effect, but the Time \times Group interaction was significant ($F = 3.77$; $df = 1,38$; $p = 0.03$, one-tailed). Perceived responsibility showed the same pattern. There were no Time or Group effects, but the Time \times Group interaction was significant ($F = 3.4$; $df = 1,38$; $p = 0.04$, one-tailed).

7.5. Discussion of experiment 5

Findings on vividness, detail and memory confidence were replicated. A comparable pattern was observed on perceived effort and perceived responsibility (see Fig. 9). The pattern was predicted and therefore a one-tailed test was used but

Table 4
Memory accuracy (proportion of participants making no mistakes) in experiment 5

	Pre-test	Post-test
Relevant checking	18/20	15/20
Irrelevant checking	14/20	16/20

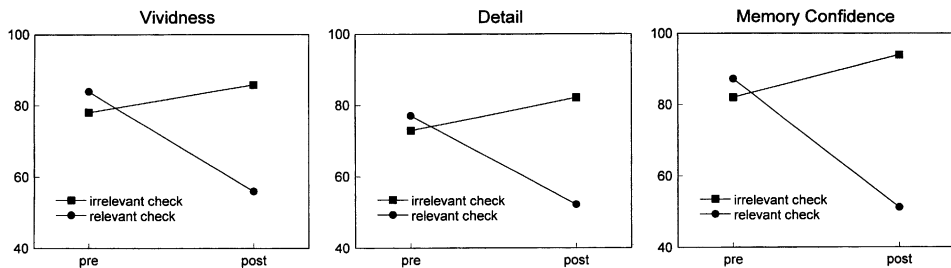


Fig. 7. Vividness, detail and memory confidence before and after relevant/irrelevant checking in experiment 5.

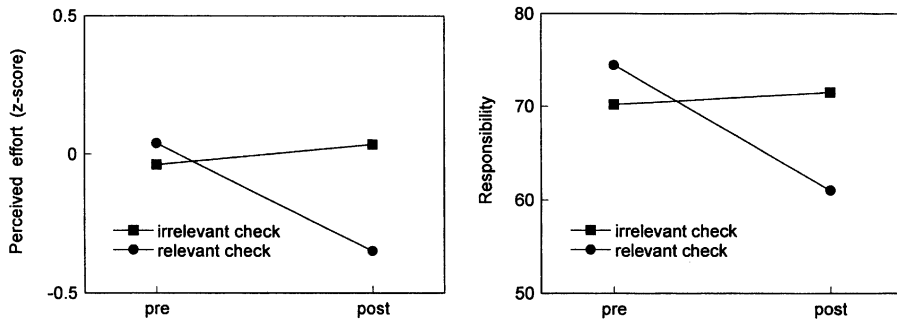


Fig. 8. Perceived effort and perceived responsibility after relevant and irrelevant checking.

the magnitude of the effort/responsibility effects was smaller than the memory effects.

8. General discussion

Repeated compulsive-like checking reliably produced reductions in the vividness, detail and trustworthiness of memory but left memory accuracy unaffected. The effects were similar to the experience of memory distrust after clinical checking. Repeated checking reduced the feeling of doing ones best and of acting responsibly. The preparation seems to provide an experimental model of obsessive uncertainty after repeated checking. Uncertainty and compulsive perseveration are closely linked. The findings indicate that *carrying out perseverative behaviour is sufficient to create OCD-like uncertainty*.

The present ideas and data allow for speculations about obsessive uncertainty *during* checking, about *non-perseveration-related uncertainty in OCD and the transition from non-clinical to clinical uncertainty* and about the *termination* of the uncertainty—checking loop. Finally some *clinical considerations* can be formulated.

Patients are not only unsure after checking but sometimes also *during* checking. This uncertainty is obviously not a memory phenomenon. Clinically it may impress as uncertainty about perceptions (“Am I really closing this window now?”). The present paper, however, suggests that it may reflect doubt about whether they are acting in a truly responsible way. It seems that repeated checking serves to make the checking less effort-demanding, and this may make patients feel, already during the compulsion, that they are behaving less responsibly than intended.

Several studies suggest that, even on tests of non-perseveration-related issues like general knowledge/semantic memory, OCD patients are somewhat less certain than others (Dar, 2004, this issue). This non-domain-specific uncertainty is relatively mild: it is not the reason why OCD patients tend to seek help; scores tend to fall within the normal range and the magnitude of the patient-control differences are incomparably much lower than for patient-control difference regarding uncertainty about, for

example, having really closed the door. How to reconcile this general/mild uncertainty of OCDs with their domain-specific/intense uncertainty? A most parsimonious explanation may be that OCD patients' general and non-clinical uncertainty is a stable trait reflecting the upper tail of a normal distribution. The transition between general/mild and specific/extreme uncertainty may be marked by the occurrence of perseverative safety behaviour. As soon as perseveration is used to combat uncertainty about any specific issue, uncertainty may reach clinical proportions. General uncertainty may thus constitute an etiological risk factor and the pathogenesis of OCD may paradoxically reside in the occurrence of counterproductive safety strategies.

If compulsive rituals are manifestations of a positive loop, how do they become time-limited? In the absence of a natural ending of the safety act, arbitrary stop-rules should have to be made up and this is what typically happens. A prominent example is counting the repetitive acts until a specific number is reached. Asked why a specific number of repetitions is satisfactory while others are not, many patients maintain that, for example, the number 3 or 7 has a special hedonic 'feel good' quality to it and that this is why they check 3 or 7 times. Possibly here too the relation between experience and (perseverative) behaviour is mutually reinforcing: if stopping the bothersome ritual after counting to, for example, 3 produces relief, evaluative conditioning may give the number 3 a positive hedonic flavour. The hypothesis that the 'number magic', frequently observed in OCD, results from the use of an arbitrary number in the completion of perseveration is currently being tested by the second author (M.K.).

As for the clinical aspects, it seems that for patients who develop negative higher order beliefs about checking-related uncertainty (e.g. 'my doubtfulness means I'm unusually irresponsible or that I'm getting insane'), it may be helpful to understand that their uncertainty is a normal effect of checking. It follows from the present perspective that changing the perceptual nature of the checking context should have powerful effects. Indeed, many patients show a remarkable loss of uncertainty/checking problems during holidays and during the first days of admission to an in-patient ward where one of the authors used to work (van den Hout, Emmelkamp, Kraaykamp, & Griez, 1988). Meanwhile, effects induced by context change appear to be short-lived, presumably because as soon (little) checking re-occurs, uncertainty may be reinforced, spiralling to the full-blown OCD.

Exposure and response prevention is a relatively effective treatment for OCD patients. With most other anxiety disorders exposure/behavioural experiments can be framed as tests of whether the fear-eliciting cue (a) really predicts some mishappening (b), but a problem with treating OCD is that patients tend not to believe that the disaster (b) *will* happen, but that it *might* happen. Note that deterministic propositions (if a, then b) can be falsified by the observation of a/not-b, while a/not-b does not refute probabilistic propositions (if a, maybe b). Judging from patients' common reservations about the implications of behaviour experiments ("but still, it *might* happen that the house will explode if I don't check the gas"), they tend to have a good feel for this logical problem. Perhaps response prevention/behavioural experiments do not teach the patient that the omitting safety behaviour

is not followed by an external disaster. Rather, acknowledging that ultimate certainty about future safety cannot be reached, uncertainty can be *tolerated*¹. The present data may help the patient realize that if you want to feel comfortable about common safety actions like turning the gas off, it is best *not* to engage in perseveration.

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¹To the degree that patients fear that after omitting safety behaviour uncertainty will escalate to intolerable levels, response prevention of course does provide disconfirming evidence: distress after response prevention tends to wane over time.