



The impact of compulsive cleaning on confidence in memory and cleanliness[☆]

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ABSTRACT

Recent research has helped elucidate a potentially important mechanism by which repetitive, compulsive behavior leads to memory and perceptual distrust. Although the effects of repeated checking and perseverative staring have been investigated, no research to date has examined the impact of compulsive cleaning on cognitive confidence. This study examined the effect of repeated cleaning in a cohort of 60 non-clinical participants. Two sets of items were used – three different colored bowls, and three different colored plates. Participants either repeatedly cleaned bowls or plates, with the other set serving as a control. A range of variables was also assessed at pre-test and post-test, including the accuracy of memory for which items were cleaned, as well as confidence in memory, and confidence that the items were clean. Results demonstrated that while there was no impact on memory accuracy, participant's memory confidence for the control items improved, while memory confidence for the repeatedly cleaned items did not. There was also no impact of repeated cleaning on confidence in cleanliness of repeatedly cleaned or control items. Results expand on previous research examining repeated behavior and metacognition, and provide initial insights into differences between repeated checking and cleaning.

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1. Introduction

Obsessive Compulsive Disorder (OCD) is an anxiety disorder characterized by obsessions, such as persistent thoughts and images, which cause significant distress or anxiety, and neutralizing compulsions, which are overt or covert acts aimed at alleviating anxiety or discomfort (APA, 2000). OCD has an estimated lifetime prevalence rate of 1.3% (Somers, Goldner, Waraich, & Hsu, 2006). Individuals with OCD face considerable disruption to their social, occupational and relational functioning, and report reduced quality of life across many domains (Eisen et al., 2006; Leon, Portera, & Weissman, 1995; Norberg, Calamari, Cohen, & Riemann, 2008; Olatunji, Cisler, & Tolin, 2007; Riggs, Hiss, & Foa, 1992). OCD has attracted an increasing research interest and output over the past few decades (Boschen, 2008).

1.1. The effect of perseverative behavior on cognitive confidence

Recently, several authors have attempted to enhance the understanding of OCD through examining the cognitive changes that

occur as a result of repeated or prolonged behaviors. The most commonly used methodology for the assessment has been that of van den Hout and Kindt (2003). Using a simulated gas stove, these authors examined the effect of repeated checking on memory confidence and memory accuracy. Non-clinical participants turned on, turned off, and checked a virtual gas stove over 20 trials. Memory accuracy was examined through participants indicating which of six gas burner elements they had checked, while memory confidence was examined by asking participants how confident they were that they correctly recalled which elements were checked. It was found that repeated checking reduced memory confidence, but not memory accuracy. Furthermore, repeated checking reduced the vividness and detail of memory for the checking behavior. van den Hout and Kindt theorized that repeated checking increases familiarity with the checked stimuli and inhibits bottom-up perceptual processing. As the stimulus becomes increasingly familiar, processing resources are assigned to higher level needs, and processing of the familiar stimuli proceeds in an automatic, conceptual manner. The authors propose that reduced perceptual processing produces diminished memory vividness and detail, which in turn reduces confidence in that memory. Overall, it was concluded that repeated checking acts to reduce memory confidence, rather than provide reassurance about a potentially dangerous situation, stimulating further checking behaviors. For an individual with OCD, the repeated checks they perform in search of certainty are ironically impairing their memory confidence, and fueling their doubt.

The original van den Hout study has been followed up by a replication using a real stove top (Radomsky, Gilchrist, & Dussault,

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2006), as well as research examining the effect of different numbers of repetition trials (Coles, Radomsky, & Horng, 2006). Although the majority of the research has investigated the effect of repeated checking using non-clinical samples, the phenomenon has also been observed using a sample of patients with OCD (Boschen & Vuksanovic, 2007).

More recently, researchers have examined other behaviors common to OCD. Van den Hout, Engelhard, de Boer, du Bois, and Dek (2008) noted that individuals with OCD will stare perseveratively at an anxiety provoking object. Accordingly, these authors hypothesized that perseverative staring would reduce perceptual confidence, rather than provide reassurance, similarly to the memory distrust caused by repeated checking. Using a simulated gas stove and a simulated light bulb display, van den Hout et al. examined the effect of perseverative staring on perceptual confidence. For 10 min the experimental group perseveratively stared at the same display that they observed in the pre-test and post-test (e.g., gas stove → gas stove → gas stove), while the control group stared at a different display (e.g., gas stove → light bulbs → gas stove). Results showed that the experimental group reported greater perceptual uncertainty than the control group, suggesting that compulsive staring produces perceptual distrust similar to the memory distrust produced by compulsive checking.

Although perseverative behavior has been demonstrated to impact on cognitive confidence when that behavior involves repeated checking or prolonged staring, other perseverative behaviors have not yet been investigated. The current study examined whether one of the most common compulsive behavior seen in OCD – compulsive cleaning (Ball, Baer, & Otto, 1996) – showed results consistent with this hypothesis. Using a sample of sixty undergraduate students without significant cleaning compulsions, we assessed whether the act of repeatedly cleaning a contaminated plate resulted in deterioration in cognitive confidence variables such as perception, attention, and memory, as well as perception of cleanliness. Based on van den Hout and Kindt's (2003) theory, we hypothesized that repeated cleaning would result in increased familiarity with the cleaned stimuli, which would discourage bottom-up perceptual processing. Consequently, memories for the different cleaning trials would become less vivid and detailed. It was hypothesized that participants will report reduced confidence that the dish most recently cleaned is free from contamination, as the most recent cleaning episode is subject to impaired memory vividness and detail.

Based on the existing research examining compulsive checking and staring, it was expected that memory accuracy would be unimpaired following repeated cleaning with participants correctly identifying the color of the dish most recently cleaned. Participants were expected to report poorer memory vividness and detail, as well as greater distrust in memory for the repeatedly cleaned dish, than for the non-repeatedly cleaned dish. Finally, it was predicted that repeated cleaning would impair participants' confidence in cleanliness, brought about by reduced memory confidence, vividness and detail. Participants were expected to demonstrate their impaired confidence in the cleanliness of the repeatedly cleaned dish in their responses on a questionnaire, by spending longer washing the repeatedly cleaned item than they will the non-repeatedly cleaned item, and by their selection of the non-repeatedly cleaned dish to eat a piece of cake from.

2. Method

2.1. Participants

The sample consisted of 60 undergraduate psychology students, who participated in exchange for partial course credit. There were

6 males and 54 females, with ages ranging from 17 to 51 years ($M = 25.25$, $SD = 9.06$). On the Obsessive Compulsive Inventory, participants scored mean totals of 24.43 ($SD = 19.17$) for distress, and 36.16 ($SD = 23.04$) for frequency, substantially below the mean scores of individuals with OCD. All participants denied any current or previous diagnosis of OCD.

2.2. Materials

Data collection involved a behavioral cleaning task, a number of pen-and-paper questionnaires, and a final behavioral task.

2.2.1. Cleaning task

The cleaning task involved repeatedly contaminating and cleaning plates or bowls, to assess the impact of repeated cleaning on cognitive confidence in attention, memory, perception and cleanliness. Six dishes were used: a red plate, a red bowl, a purple plate, a purple bowl, a green plate and a green bowl. Each trial involved the participant contaminating then cleaning two of the three bowls or plates. This procedure was derived from the repeated checking procedure developed by van den Hout and Kindt (2003).

2.2.2. Memory Accuracy Assessment

Throughout the experiment participants washed red, purple and green dishes, in a random order. The Memory Accuracy Assessment was conducted by questioning participants as to the color of the most recently washed dish.

2.2.3. Confidence Questionnaire (CQ; van den Hout & Kindt, 2003)

Participants indicated on four 100-mm visual analogue scales, their memory confidence, memory vividness, memory detail, and confidence in the cleanliness of the most recently cleaned item.

2.2.4. Obsessive–Compulsive Inventory (OCI; Foa, Kozak, Salkovskis, Coles, & Amir, 1998)

The OCI is a self-report measure of the frequency of OCD symptoms and the resulting level of distress. The 42 items are rated on a five-point Likert scale, and comprise seven subscales: Washing, Checking, Doubting, Ordering, Obsessing, Hoarding, and Mental Neutralizing. The OCI exhibits excellent internal consistency and satisfactory test–retest reliability. The OCI was included to assess the severity of participants' OCD symptoms.

2.2.5. Timed Behavioral Assessment

Using a stop-watch, the experimenter discreetly timed the participants while they washed the three bowls, and then the three plates. A longer time taken to wash the bowls in comparison to the plates was considered an indication of less confidence in the cleanliness of the bowls, and vice versa.

2.2.6. Tasty Behavioral Assessment

A piece of cake was placed on a clean bowl and a clean plate that matched those used in the experiment, and the participant was permitted to take one as a thank-you for his/her participation. The participant was not aware that this dish was different from those used in the experiment. The participant's choice of either the plate or the bowl to eat from was recorded as an indication of which of the dishes they considered cleaner. Where the participant declined the cake, they were asked which dish they would take, were they to have one.

2.3. Procedure

Participants completed the tasks individually, in one 60 min session. The pre-test Cleaning Task involved the participant con-

taminating two of the three *plates* by rubbing a raw chicken wing onto each dish in two circular motions. The two plates that were contaminated were randomly selected by the experimenter. The participant was instructed to wash each plate with a sponge in a tub of warm soapy water. Pre-test measures were collected, with participants completing the CQ and the Memory Accuracy Assessment. This procedure was then repeated, with two of the three *bowls* being contaminated then washed. The CQ and the Memory Accuracy Assessment were again completed.

The participant then conducted 20 trials of the Cleaning Task. Half of the participants repeatedly contaminated and cleaned bowls (with plates being used as the control), while the other half of the participants repeatedly contaminated and cleaned plates (using bowls as the control).

In the same manner as the pre-test Cleaning Task, the post-test Cleaning Task involved the contamination and cleaning of two of the three plates, followed by the post-test completion of the CQ and the Memory Accuracy Assessment. Two of the three bowls were then contaminated and cleaned, followed by completion of the CQ, the Memory Accuracy Assessment, and the OCI. The Timed Behavioral Assessment and the Tasty Behavioral Assessment were then conducted.

2.4. Design

The Wilcoxon signed ranks test, a non-parametric analogue of a repeated measures *t*-test (Howell, 2007), was used to determine whether the frequency of accurate memory responses changed from pre-test to post-test for the repeatedly cleaned dish and the non-repeatedly cleaned dish. To examine the effect of repeated cleaning on cognitive confidence, a series of 2×2 repeated measures ANOVAs were conducted using *trial* (pre-test and post-test) and *object* (repeatedly cleaned and non-repeatedly cleaned) as the independent variables, and memory confidence, memory vividness, memory detail, confidence in perception, confidence in attention, and confidence in cleanliness as the dependent variables. To determine whether memory vividness and memory detail would predict memory confidence, a standard multiple regression analysis was conducted with *memory vividness* and *memory detail* as the independent variables and memory confidence as the dependent variable. Results were based on the combined post-test scores for the repeat and non-repeat conditions.

For the Timed Behavioral Assessment, a repeated measures *t*-test was conducted with the independent variable being *object* (repeatedly cleaned and non-repeatedly cleaned), and the dependent variable being time spent washing. For the Tasty Behavioral Assessment, two chi-square analyses were used to look for differences in the number of participants who chose to eat from the repeatedly cleaned compared to the non-repeatedly cleaned dishes, and in the number who chose to eat from the bowl compared to the plate. An a priori alpha level of $<.05$ was used for all analyses.

3. Results

To examine whether repeated cleaning influenced cognitive confidence, a series of statistical analyses were conducted using SPSS. Examination of the variables revealed severe skew on some dependent measures. Unadjusted variables were retained, as log transformations did not alter the results. All other statistical assumptions were met.

3.1. Memory accuracy

It was predicted that memory accuracy would be unimpaired following repeated cleaning. Memory accuracy was examined by questioning participants as to the color of the most recently washed dish, and their response was coded as either correct or incorrect. Results showed that the number of accurate memory responses did not differ between the pre-test and the post-test for the repeatedly cleaned dish ($z = -0.47, p = .64$), or for the non-repeatedly cleaned dish ($z = -1.8, p = .07$). Thus memory accuracy did not change for either the repeat or control condition, from pre-test to post-test. Table 1 presents the means and standard deviations for this analysis.

3.2. Memory confidence

The measure of memory confidence was from the CQ. From this measure, where a higher score indicates greater confidence, a significant *trial* \times *behavior* interaction was found, $F(1, 59) = 4.5, p = .04$, partial $\eta^2 = .07$ (illustrated in Fig. 1). Simple effects analysis revealed that memory confidence significantly increased between the pre-test and post-test for the non-repeatedly cleaned dish, $t(59) = 2.60, p = .01$, Cohen's $d = .68$. Memory confidence did not change between the pre-test and post-test for the repeatedly cleaned dish, $t(59) = .16, p = .81, d = .04$. There was no main effect of *trial* ($F(1, 59) = 2.18, p = .15$, partial $\eta^2 = .04$) or *object* ($F(1, 59) = .08, p = .77$, partial $\eta^2 = .001$).

3.3. Memory vividness and memory detail

For memory vividness and memory detail a higher score indicates greater levels of these constructs. Regarding memory vividness, there was no main effect of *trial* ($F(1, 58) = .16, p = .69$, partial $\eta^2 = .003$) or *object* ($F(1, 58) = .01, p = .92$, partial $\eta^2 \leq .001$). As shown in Fig. 1, the *trial* \times *object* interaction was not significant ($F(1, 58) = .62, p = .44$, partial $\eta^2 = .01$). Similarly for memory detail, there was no main effect of *trial* ($F(1, 59) = 1.22, p = .27$, partial $\eta^2 = .02$), or *object* ($F(1, 59) = .04, p = .85$, partial $\eta^2 = .001$), and the *trial* \times *object* interaction, depicted in Fig. 1, was not significant ($F(1, 59) = 2.03, p = .16$, partial $\eta^2 = .03$). This suggests that memory vividness and memory detail did not differ between the repeatedly cleaned dish and the non-repeatedly cleaned dish, did not change between the pre-test and post-test, and were not differentially affected by repeated and non-repeated cleaning from pre-test to post-test.

Table 1

Means, standard deviations and frequency of accurate memory responses for repeat and non-repeat conditions, at pre-test and post-test.

Condition	Mean	Standard deviation	Frequency	
			Accurate responses (%)	Inaccurate responses (%)
Pre-test repeat	1.23	.43	46 (76.7)	14 (23.3)
Pre-test non-repeat	1.30	.46	42 (70.0)	18 (30.0)
Post-test repeat	1.20	.40	48 (80.0)	12 (20.0)
Post-test non-repeat	1.15	.36	51 (85.0)	9 (15.0)

Note: 1 = accurate memory response; 2 = inaccurate memory response.

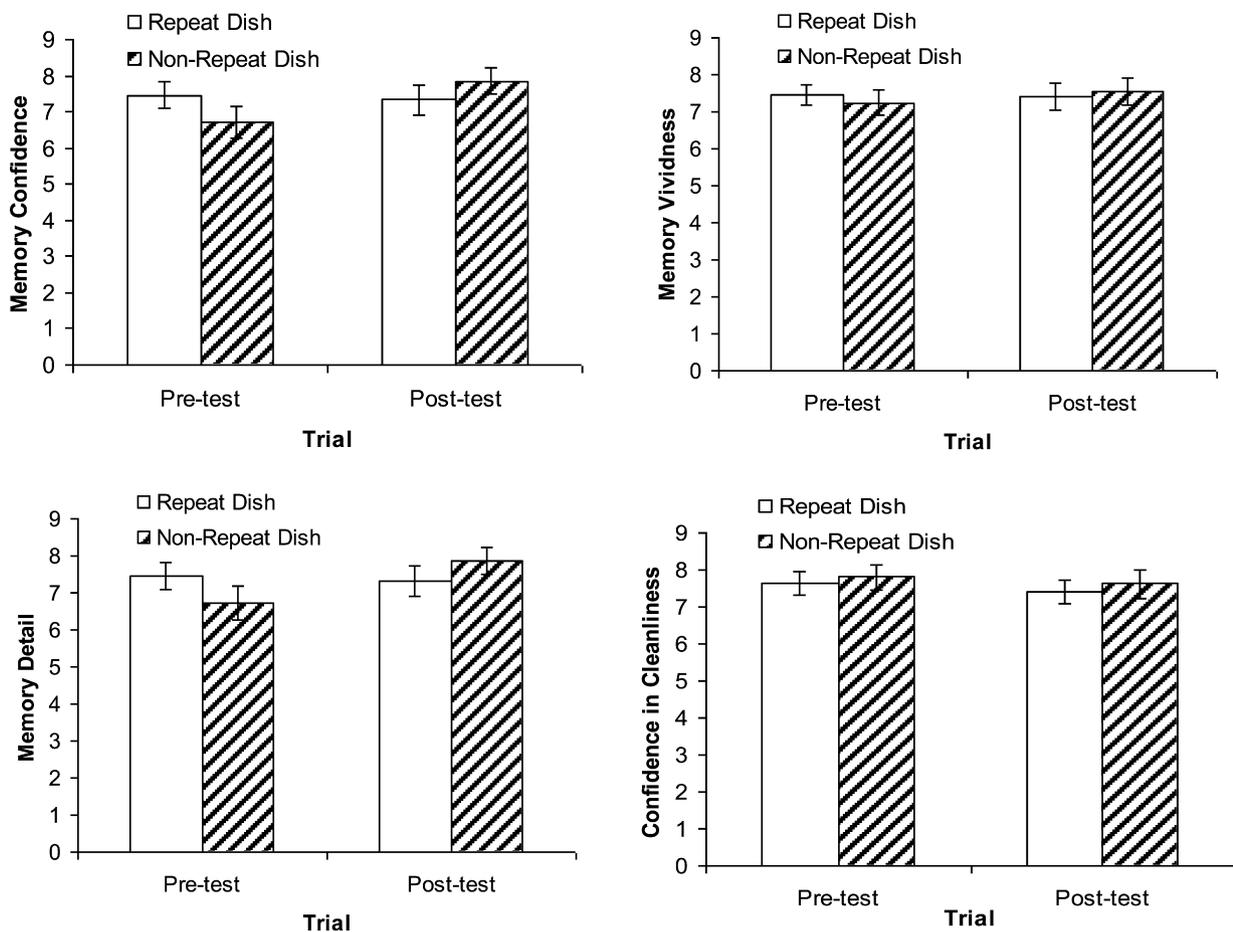


Fig. 1. Mean (+SE) for memory confidence, memory vividness, memory detail, and confidence in cleanliness for repeat and non-repeat conditions, at pre-test and post-test.

3.4. Memory vividness, memory detail, and memory confidence

As memory vividness and detail are strongly correlated constructs ($r = .93$), multicollinearity is problematic. It could be argued that it is unnecessary to include both memory vividness and memory detail in the regression analysis; however the current study included both constructs for the purpose of replicating previous findings.

Memory vividness and detail accounted for 62.3% of the variance in memory confidence (adjusted $R^2 = .61$, $F(2, 54) = 44.6$, $p \leq .01$). Memory detail was found to provide a significant, unique contribution to the explanation of memory confidence ($p = .01$). Memory vividness did not make a significant unique contribution ($p = .42$), once memory detail was taken into account. Greater memory vividness ($\beta = .19$, $sr^2 = .07$) and memory detail ($\beta = .61$, $sr^2 = .22$) were associated with better memory confidence.

3.5. Confidence in cleanliness

Concerning confidence in cleanliness, a higher score indicates greater confidence. There were no main effects of *trial* ($F(1, 59) = .51$, $p = .48$, partial $\eta^2 = .01$), or *object* ($F(1, 59) = 1.24$, $p = .27$, partial $\eta^2 = .02$), and the *trial* \times *object* interaction, illustrated in Fig. 1, was not significant ($F(1, 59) = .04$, $p = .84$, partial $\eta^2 = .001$). This indicates that confidence in cleanliness did not differ between the repeatedly cleaned dish and the non-repeatedly cleaned dish, did not change between the pre-test and post-test, and was not differentially affected by repeated and non-repeated cleaning from pre-test to post-test.

The Timed Behavioral Assessment was expected to show that at post-test, participants would spend longer washing the repeatedly cleaned dish than they would the non-repeatedly cleaned dish, indicating less confidence in the cleanliness of the repeatedly cleaned dish. There was no significant difference between the repeatedly cleaned dish ($M = 36.63$ s, $CI_{95\%} = 30.79\text{--}42.46$) and the non-repeatedly cleaned dish ($M = 35.07$ s, $CI_{95\%} = 30.13\text{--}40.01$) in time spent washing, $t(59) = 1.98$, $p = .17$, $d = .07$.

The Tasty Behavioral Assessment was expected to demonstrate impaired confidence in the cleanliness of the repeatedly cleaned dish, in contrast to the non-repeatedly cleaned dish, by participants' selection of the non-repeatedly cleaned dish from which to eat a piece of cake. Participants were not more likely to select the non-repeatedly cleaned dish ($n = 29$) than a repeatedly cleaned dish ($n = 31$), demonstrated by equivalent selection of repeated and non-repeated dishes from which to eat a piece of cake, $\chi^2(1, N = 60) = .07$, $p = .80$. It was also found that participants were more likely to select the plate ($n = 51$) than the bowl ($n = 9$) to eat from, regardless of whether this dish was repeatedly or non-repeatedly cleaned. This was demonstrated by participants' selection of the plate at a level significantly greater than chance, $\chi^2(1, N = 60) = 29.1$, $p < .01$.

4. Discussion

The current research aimed to extend previous research by determining whether the cognitive distrust that occurs following compulsive checking and staring also occurs following compulsive cleaning. Results showed some consistencies with previous findings, but also some noteworthy differences.

4.1. Memory and memory confidence

Consistent with predictions and with much of the compulsive checking research (e.g., Radomsky et al., 2006; Radomsky, Rachman, & Hammond, 2001; van den Hout & Kindt, 2003), repeated cleaning was not found to impair memory accuracy. This result supports the conclusion that continued cleaning behavior observed in individuals with OCD is unlikely to be the result of a failure to recall a previous cleaning action.

Based on the theory proposed by van den Hout and Kindt (2003), it was predicted that participants would report greater memory distrust for the repeatedly cleaned dish than for the non-repeatedly cleaned dish, due to increased familiarity of the cleaned stimuli, and reduced bottom-up perceptual processing. In compulsive cleaning there were discrepancies after repeated cleaning between objects that were repeatedly cleaned and those that were not. The discrepancy, however, was somewhat different to that observed in the compulsive checking research. The repeatedly cleaned objects did not show an increase in confidence that was observed for the objects that were not cleaned repeatedly. Results of the current study partially support the theory proposed by van den Hout and Kindt, and support the prediction that repeatedly behavior has an impact on memory confidence.

In contrast with our prediction, and with the repeated checking research, the measure of memory confidence from the CQ showed an increase in memory confidence at post-test for the non-repeat condition, and no change in memory confidence for the repeat condition. For this post-test measure participants were able to overcome the impaired perceptual processing and avoid reductions in memory confidence. These results may be a consequence of the questions used in the measure of memory confidence. The measure of memory confidence asked participants the color of the most recently cleaned dish, then asked participants how confident they were that they correctly remembered the color of the last dish. For this measure, participants were cued to focus on a concrete, salient attribute (i.e., the color of the dish). The non-repeatedly cleaned dish, while visually similar, was slightly different from the repeatedly cleaned dish (i.e., a bowl versus a plate). By cueing participants to focus on a salient dimension of the last cleaning trial (i.e., the color of the last dish), participants may have been better able to differentiate the non-repeated dish from the repeated dishes, strengthening participants' memory confidence. In contrast, the repeatedly cleaned dish underwent 20 similar cleaning trials. Cueing participants to focus on a salient attribute from the last cleaning trial were not sufficient to isolate this cleaning trial and differentiate it from previous trials. Consequently, a salient memory cue did not improve participants' memory confidence for the repeatedly cleaned dish, but instead prevented a decline in confidence.

Our findings suggest that in compulsive cleaning, repetition inhibits increasing memory confidence, somewhat similarly to repeated checking. Importantly, the memory distrust that results from repeated cleaning may generalize to visually similar objects. These findings have relevance to the clinical presentation of OCD: the fear of contamination that persists despite repeated cleaning may be due to this reduction in memory confidence. It was also found that cueing the individual to focus on a concrete, salient dimension of the last cleaning trial can prevent a decline in memory confidence following repeated cleaning, and can enhance memory confidence following one or two cleaning behaviors.

4.2. Memory vividness, memory detail and memory confidence

Consistent with van den Hout and Kindt's (2003) model, the current study found that poorer memory vividness and detail predicted poorer memory confidence. Only memory detail made a

unique contribution to the explanation of memory confidence, this is not surprising however, as memory vividness and memory detail are strongly correlated constructs. Contrary to the results of the compulsive checking research (e.g., Boschen & Vuksanovic, 2007; van den Hout & Kindt, 2003), repeated cleaning was not found to reduce memory vividness or memory detail. According to van den Hout and Kindt, and consistent with a number of studies, it is the reduced memory vividness and detail that leads to impaired memory confidence for repeated checking behaviors (Boschen & Vuksanovic, 2007; Coles et al., 2006). It appears that results of the current study differ from the repeated checking research, as repeated cleaning did not significantly reduce memory vividness and detail, and declines in these components were predicted to be the cause of declines in memory confidence. This may indicate that repeated cleaning differs in some ways from repeated checking. It is proposed that there may be additional elements of memory that are influential in compulsive cleaning, as declines in one measure of memory confidence were evident despite no reductions in memory vividness and detail.

A closer look at the behaviors involved in checking and cleaning compulsions reveals an important difference that may explain why memory vividness and detail were found to decline following repeated checking, but not repeated cleaning. Checking compulsions typically involve behaviors, such as looking at light switches, stovetops, and locks on doors to ensure they are really switched off or locked (Rachman, 2002). Patients have a concrete object to focus on (i.e., a light switch), and it is the memory of that object that they come to distrust. In contrast, patients with cleaning compulsions often do not have a visible target for their fears. While they can look at their hands or their dishes to inspect for bacteria, ultimately what they are looking for may be microscopic, and invisible. As for checking compulsions, recalling whether the light switch is off pertains to visual aspects of memory; the patient attempts to recall whether the light switch they saw was set to off. In contrast, compulsive cleaning may relate to behavioral aspects of memory. It may not be whether they recall seeing bacteria (as such organisms are microscopic), but whether they trust their memory regarding the cleaning action, for example, a person may doubt whether they scrubbed a particular dish hard enough. It may be that repeated cleaning impairs confidence in behavioral-based memory to a greater extent than it does visual-based memory. This may explain why memory vividness and memory detail, which seem to relate to visual aspects of memory, did not decline, while memory confidence was still affected by repeated cleaning. While behavior-based and visual-based memory have been examined in OCD (e.g., Ecker & Engelkamp, 1995; Tallis, Pratt, & Jamani, 1999), no research has examined how these types of memory may be differentially affected by checking and cleaning.

4.3. Confidence in cleanliness

Based on van den Hout and Kindt's (2003) model, it was proposed that repeated cleaning would increase familiarity with the cleaned items, and discourage bottom-up perceptual processing. Consequently, memories for the different cleaning trials were expected to merge together, become less vivid and detailed, and result in reduced confidence that the dish most recently washed is free from contamination. Against prediction, participants did not report reduced confidence in the cleanliness of the repeatedly cleaned dish, did not spend longer time washing the repeatedly cleaned dish, and did not preferentially select the non-repeatedly cleaned dish to eat from. Overall, neither the self-report measure nor the behavioral measures found a decline in confidence in the cleanliness of the repeatedly clean dish.

In the repeated checking study conducted by van den Hout and Kindt (2003), participants were asked to rate their confidence in

memory for the checking trial, and their confidence in the outcome of the checking trial. Memory confidence referred to how certain participants were that they accurately recalled which stove elements they had checked, while confidence in outcome referred to how certain the participants were that the stove was actually off. While participants did show significant declines in memory confidence (they doubted whether they accurately recalled which of the stove elements they had checked), they did not show reduced confidence in the outcome (they remained confident that the stove was actually off). This result is analogous to the findings of the current study, where confidence in memory and attention were found to decline following repeated cleaning, while the outcome of the cleaning trial – the participant's confidence in the cleanliness of the dish – did not decline. Applying van den Hout and Kindt's explanation to repeated cleaning, it is theorised that repeated cleaning produced familiarity with the cleaned stimuli, which discouraged bottom-up perceptual processing. As the cleaning trial was processed in a top-down, conceptual manner, it is not possible for participants to recall the perceptual elements of the cleaning trial, as they were not encoded. Thus, the decision as to whether the dish is actually clean can only be based on a probability criterion; participants decide whether it is likely that the dish is clean, rather than recalling the cleaning behavior and critically assessing the cleanliness of the dish.

Prior research has shown that the repeated checking paradigm has a comparable effect on healthy and OCD samples, with OCD patients displaying stronger effects (Boschen & Vuksanovic, 2007; Hermans et al., 2008). Thus the results uncovered through the use of this paradigm may provide understanding of the cognitive processes that contribute to OCD. However, the ineffectiveness of this paradigm to elicit impaired confidence in the outcome of the cleaning trial (i.e., impaired confidence in the cleanliness of the repeatedly cleaned dish) may reflect a difference between healthy and OCD samples. Using the probability criterion, healthy participants tended to judge the dish as likely to be clean. However, the magnified uncertainty experienced by an individual with OCD may compel them to judge the dish as unlikely to be clean. While the paradigm developed by van den Hout and Kindt is valuable in examining the processes that may contribute to OCD, failure to produce reduced confidence in the outcome of cleaning or checking may reflect the point where a healthy sample no longer mirrors an OCD sample.

4.4. Implications

Findings of this research have implications for the experience of individuals with OCD, as well as for the treatment of OCD. The current findings indicate that as an individual with OCD repeatedly cleans an item, he/she becomes increasingly familiar with that item, and experiences memory and attentional distrust as a consequence of reduced perceptual processing. This cognitive distrust can spread to visually similar objects and perhaps other areas of the home, creating a compulsion to clean a continually expanding array of objects or areas. This process may contribute to the way in which OCD develops into an overwhelmingly disruptive disorder. Furthermore, the generalization of memory and attentional distrust across different objects may explain how perceptions of contamination can spread across objects and rooms without physical contact.

Previous authors have suggested that interventions aimed at increasing the vividness and detail of memory may assist in reducing compulsive behaviors (Tallis, 1993). Similarly, findings of the current study suggest that cueing an individual to focus on a concrete, salient dimension of the last cleaning trial may prevent the decline in memory confidence following repeated cleaning behavior, and can enhance memory confidence when only one or two cleaning behaviors have been performed. Interventions which cue

a salient dimension could isolate the memory for the cleaning behavior, and enhance the vividness and detail of that memory. This would enable the individual to assess the effectiveness of the cleaning behavior without impaired memory confidence influencing their judgment. Further examination of this finding may prove helpful for improving treatment effectiveness.

4.5. Limitations

Results of this study must be considered in light of a few limitations. First, the frequency distributions of some variables showed ceiling effects. This problem could be circumvented in future through the use of measures with greater variability, for example by using measures based on more than one item, as used in the current study. Additionally, use of behavior-based questions (e.g., "How willing would you be to eat off this dish right away?") as well as the metacognitive questions used previously may provide more variability. The second limitation is that all subjects completed a series of tasks in a standard order. As a result, the post-test scores for the non-repeated dish may have been positively influenced as participants may have anticipated the non-repeat dish post-test following the repeat dish post-test. For all except one measure (the memory confidence measure from the CQ) the post-test score for the non-repeat dish was not found to be more positive than the post-test score for the repeat dish. Thus this limitation does not appear to have substantially influenced the results. In future, the effects of this problem can be reduced through counterbalancing the order of the pre-tests and the post-tests. A third consideration is that females were over-represented in our sample compared to the general population, or population of OCD sufferers, which may affect generalizability of our results.

The reader should be alert to a number of elements in our protocol that were different from the original repeated checking studies by van den Hout and Kindt (2003). Our method had participants attempt to remember two out of a set of three dishes, while the van den Hout and Kindt (2003) study had their participants select from three out of six gas burners. We only asked participants to identify the color and not the color and type of the dishes. Each of these variations may have made the memory and memory confidence task easier than in previous studies.

Finally, although statistically significant, our effects were weaker than those observed in previous studies. Our method does not allow us to differentiate whether differences between our results and previous checking studies are the result of differences in method, or differences between repeated cleaning and checking.

4.6. Future research

This study is the first to examine the effect of repeated cleaning on confidence in memory and cleanliness, therefore the findings require replication. Additionally, researchers need to determine whether the generalization of distrust also occurs following other compulsive behaviors, such as repeated checking.

It was theorised that repeated cleaning would impair memory vividness and detail, and consequently produce reduced memory confidence. However, the current research found that repeated cleaning reduced confidence in memory, without a decline in memory vividness and detail. It was therefore proposed that while memory vividness and memory detail are important factors in predicting memory confidence following repeated cleaning, there are other elements, possibly related to behavior-based memory, that are also important in determining memory confidence. Future research is needed to examine the impact that repeated cleaning has on behavioral-based components of memory.

5. Conclusions

The current findings extend previous research by establishing that the distrust in memory caused by repeated checking and staring also occurs following repeated cleaning. Fear of contamination in individuals with OCD appears to persist because repeated cleaning paradoxically produces distrust in memory and attention, stimulating continued cleaning. Importantly, this study supports the conclusion that cueing participants to focus on a salient component of the last cleaning trial can prevent a decline in memory confidence. Overall, these findings provide greater understanding of the cognitive processes that underlie compulsive cleaning behaviors in OCD.

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