

The Role of Distinctiveness of Stimulus in Memory Distrust as a Function of Repeated Checking



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SUMMARY

Objective: Recent literature proposes that repeated checking increases familiarity with the material, making recollections less vivid and detailed and promoting distrust in memory. The aim of the current study is to investigate the possible underlying mechanisms of low confidence in memory.

Method: The Padua Inventory-Washington State University Revision (PI-WSUR) was applied in a cohort of university students. Among the students who completed the PI-WSUR, 84 participants were selected and assigned to low Obsessive-Compulsive Symptomatology (OCS) group or high OCS group according to their PI-WSUR scores. An interactive computer animation was developed to test repeated checking behavior. Participants were randomly assigned to two experimental conditions: "Feedback condition" and "no feedback condition". The participants were all asked to carry out checking rituals on a virtual gas ring. However, half of the participants were given feedback indicating that checking activity was successful and complete and half of the participants were not.

Results: While there was no significant difference in terms of memory accuracy, memory detail and memory vividness between feedback condition and no feedback condition, there was a significant difference in terms of memory confidence between two experimental groups.

Discussion: Results are discussed in the light of a different explanation offering that the level of distinctiveness of recollections plays crucial role in memory distrust rather than the explanation of low confidence hypothesis.

Keywords: Obsessive behavior, memory, compulsive behavior, obsessive-compulsive disorder, doubt, distinctiveness.

INTRODUCTION

Numerous studies have found that checking compulsions are the most common symptoms in OCD (Ruscio et al. 2010). These compulsions occur in approximately 80% of patients (Ball et al. 1996, Ruscio et al. 2010). In addition, it is reported that patients with OCD having checking compulsions tend to distrust their memory performance (Brown et al. 1994, Constans et al. 1995, Dar et al. 2000, Ecker and Engelkamp 1995, Hermans et al. 2008, McNally and Kohlbeck 1993)

and it is also reported that they experience uncertainty regarding their cognitive operations (Nedeljkovic and Kyrios 2007)

Checking compulsions are commonly associated with doubt (Rachman 2002). The hypothesis proposed by van den Hout and Kindt (2003a) becomes the most frequently referred explanation for the relationship between doubt and checking. It is suggested that a series of studies have demonstrated that repeated checking itself impairs confidence in memory. The series of studies began with van den Hout and Kindt's study (2003a), which is named as original study in this text

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(Ashbaugh and Radomsky 2007; van den Hout and Kindt 2003a, 2003b, 2004; Radomsky et al. 2006). These studies generally utilized non-clinical samples. In this line of research, participants consistently experienced 20 sets of turning on, turning off and checking trials of gas rings or light bulbs. The condition in which participants operated upon gas rings for 20 times was called relevant checking and the condition in which participants operated upon light bulbs for 20 times was called irrelevant checking. Different combinations of three out of six gas rings or light bulbs were used from trial to trial. In the procedural flow of the experiment, all participants experienced turning on, turning off and checking trials of gas rings at the twenty-first trial. Immediately after the experiment, during the assessment section, participants were given a schematic drawing with six gas rings on a page of paper to show which three lights or gas rings they checked at the very last checking episode by crossing the corresponded circles for gas rings upon this paper. This measure is known as “memory accuracy”. In the original study, there was no significant difference in terms of scores of memory accuracy between the experimental conditions. Moreover, consistently participants in relevant checking were significantly less confident about their answers to the question about memory accuracy than the participants in irrelevant checking condition. This measure was called confidence in memory. Also, participants in relevant checking condition had significantly less vivid and detailed recollections about the question related to their answers for the very last checking episode than the participants in irrelevant checking condition. These were called vividness in memory and detail in memory, respectively. Lastly, when compared with participants in the irrelevant checking condition, participants in the relevant checking condition were significantly less confident in their answer to the question of whether the gas rings were turned off. This measure was referred to as outcome confidence (Ashbaugh and Radomsky 2007; van den Hout and Kindt 2003a, 2003b, 2004, Radomsky et al. 2006) Coles et al. (2006) evaluated the number of trials required to elicit the detrimental effects of repeated checking on cognitive confidence. The authors limited the number of trials to fifteen. It was found that the expected effect of the repetition starts to be developed and arisen between the second and the tenth trial.

These results were replicated in studies that involved only mental checks (Radomsky and Alcolado 2010), studies examining the effects of short intervals of staring at something upon confidence (van den Hout et al. 2008), studies using repeated object exposure without physical control (Medway and Jones 2013), and studies using real gas rings instead of virtual rings (Radomsky et al. 2006) Moreover, Boschen and Vuksanovic (2007) repeated this paradigm in a sample of participants having checking compulsions rather than in a sample of participants from nonclinical sample. Designs used in

all studies were almost same with the design in the original study of van den Hout and Kindt (2003a). In the assessment section of these studies, participants were given a schematic drawing with six gas rings on a page of paper and were asked to indicate which three gas rings they had checked during the last checking episode by marking the corresponding circles for gas rings upon this paper. Consistently, it was called “memory accuracy”. In general, there was no significant difference in memory accuracy between the experimental conditions. However, participants in relevant checking were significantly less confident about their answers to the question about memory accuracy when compared with the participants in irrelevant checking condition. Also, participants in relevant checking condition reported significantly less vivid and less detailed recollections regarding their answers for the very last checking episode when compared with the participants assigned to the irrelevant checking condition.

The most recent explanation related to reduced confidence and increased doubt in the face of repeated checking is of van den Hout and Kindt’s (2003a) study. It is accepted as being a valid explanation in the context of low confidence hypothesis. This hypothesis argued that checking increases familiarity with the checked material. Then, increased familiarity resulted in decreased vividness and detail and consequently reduced memory confidence. Meanwhile, it is asserted that increased familiarity favors conceptual processing and simultaneously hinders the perceptual processing. In other words, the authors propose that as repeated checking continues, encoding of participants shifts from perceptual processing to semantic processing (Tulving 1985). Therefore, according to the mentioned hypothesis, participants in the last checking episode shifted from specific remembering to general knowing (van den Hout and Kindt 2004, Johnston and Hawley 1994, Tulving 1985). This line of reasoning suggests that vividness and detail in memory are reduced and therefore, memory confidence is reduced (van den Hout and Kindt 2004).

Regarding the reduction of doubt, in a rare study, Tallis (1993) used image formation as a mediator in his three patients with OCD. After giving exposure and response prevention technique, Tallis provided figures 10, 8, 6, 4 and 2 cm in height. Using these figures as mediators, Tallis asked his participants to associate their checking activity with these figures. When the patients felt the urge to check, he asked them to remind themselves that their activity was completed successfully by imagining the figure. In a 25 trial period, the training was finished and the results of this study were fascinating. At the 6-month follow-up, participants maintained all treatment gains and there was no subjective report of doubt thereafter among three participants. These figures are accepted as distinctive stimuli in the encoding process and it is thought to “stand out” in memory. In another study aiming at reducing doubt, by experimentally manipulating the distinctiveness

and novelty of a stimulus and by prohibiting the shift from perceptual processing to conceptual processing, Boschen et al. (2011) aimed at having increment in memory confidence (in other words having smaller reductions in memory confidence) in the manipulated condition when compared with the conditions in which no manipulations were conducted. Regarding the manipulated condition, the authors used two conditions of original study and an additional condition named by perceptual change. In this condition, the background color of the stimulus (that is, gas ring) was changed in every 5 control. This was the only difference between perceptual change condition and relevant checking condition. In perceptual change condition, participants' memory confidence was significantly improved when compared to the participants' scores of memory confidence in relevant checking condition. However, when conditions were compared, vividness in memory and detail in memory did not differ significantly. It was suggested that this finding appears to weaken the ground of classical explanation. Because this explanation argued that the cause of decrement in cognitive confidence was the decrement in vividness of memory and detail in memory. However, this mentioned dissociation in terms of memory confidence and vividness and detail in memory amongst the conditions in Boschen et al. (2011) study is thought to be crucial and this differential finding is seen significant for the current study's methodology. That is, it is thought that the relationship amongst these meta-memorial variables would not be in the way of classical explanation. These authors conducted additional regression analyses in order to support the classical explanation by pointing out the contribution of the scores of memory vividness and detail in memory to the scores of memory confidence. Regarding this aim, explained variance of memory confidence via memory vividness and memory detail was found to be % 57.6. However, the scores in the mentioned regression analysis were entered into the analysis without taking into account the experimental manipulation. Therefore, differences amongst the conditions were went unnoticed (Boschen et al. 2011).

Moreover, Horowitz (1983; cited in Hodes 1994) proposed that mental images are transformed into words or another type of representation; therefore sensory vividness is *naturally* reduced (Horowitz, 1983; cited in Hodes, 1994). Otherwise, reduced vividness is also accepted as a natural consequence of repeated checking (Moritz et al. 2006). These arguments are thought to be consistent with both the data of the study by Boschen et al. (2011) and the original study and its variations. That is, as time passes vividness and detail of the recollections naturally decay.

Thus, it is thought that there emerges the need for explaining decrement in memory confidence in the face of repeated checking via a different explanation - distinctiveness of the stimulus of the recollection- instead of the view in classical

explanation. In the current study, a paradigm articulating a distinctive stimulus which is similar to the stimulus used by Tallis with the procedure of van den Hout and Kindt's study (2003a). It is thought that if participants are given a positive feedback about their checking episodes doubt would be reduced without having an effect upon the variables of detail in memory and vividness of memory.

Aim

In this respect, the primary aim of the current study is to examine the mechanisms of compulsive checking. Another aim is to inspect the effects of giving feedback upon the memory (memory accuracy) and meta-memory (memory confidence, memory vividness and detail in memory) variables.

Hypotheses

It is hypothesized that after repeated checking participants in feedback condition would have significantly greater scores on memory confidence for the last checking episode than participants in no feedback condition. Furthermore, it is also hypothesized that after repeated checking participants in feedback condition would have significantly greater scores on confidence throughout the experiment than participants in no feedback condition. Moreover, it is hypothesized that after repeated checking participants in high OCS group would have significantly greater scores on both memory confidence for the last checking episode and confidence throughout the experiment than participants in low OCS group. However, it is hypothesized for the memorial variables that there would be no interaction effect between group condition and feedback condition. Regarding memory accuracy, it is hypothesized for the last checking episode that there would be no main effect of either group condition or feedback condition.

METHOD

Participants

Participants were selected and participated in the current study via a two-stage procedure. First, all participants were given Padua Inventory-Washington State University Revision (PI-WSUR) and Demographic Information Form (DIF) to determine the level of obsessive-compulsive symptomatology. Participants were 397 undergraduate students from various departments at the Middle East Technical University (METU) and they were contacted in a face to face manner in the time course of March and May 2007. Participants were rewarded with a bonus credit for their coursework. 16 students were excluded from the analysis because they reported that they were currently using psychiatric medications such as antidepressant, anxiolytic and/or antipsychotic drugs. The final analysis included 381 students. The mean age of the 381

students was 20.57 years (SD= 2.50) and age range was 17 to 44 years. 60.89 % of the participants were female.

All participants were provided informed consent prior to participation in the study. After analyzing the data, the mean for PI-WSUR was 30.04 (SD= 17.21). For identifying the groups as “low OCS group” and “high OCS group”, half standard deviation around the mean score of PI-WSUR was partialled out. This value of half standard deviation was specified in order to increase the power of the study by reaching more participants. Therefore, 104 Participants scored half standard deviation above the mean of the PI-WSUR scores were assigned to the “high OCS group” (whose scores were 39 and above) and 137 participants scored half standard deviation below the mean of the PI-WSUR scores were assigned to the “low OCS group” (whose scores were 21 and below). According to their PI-WSUR scores, eighty-five students selected via e-mail participated in the experimental phase of the study. The mean age of participants was 21.36 years (SD= 2.32) and the range was 17 and 28 years. 64 participants (76.2%) were female.

MATERIALS

Demographic information form (DIF)

DIF was administered in order to have information about age, gender, education level of participants and whether they were having psychotropic medication and/or psychological intervention.

Padua Inventory-Washington State University Revision (PI-WSUR)

The PI-WSUR assesses the frequency and severity of obsessions and compulsions (Burns et al. 1996). On the 39 items of the PI-WSUR, scores range from 0 (not at all) to 4 (very much). Five subscales of PI-WSUR are Obsessional Thoughts of Harm to Self/Others Subscale with 7 items, Obsessional Impulses of Harm to Self/Others Subscale with 9 items, Contamination Obsessions and Washing Compulsions Subscale with 10 items, Checking Compulsions Subscale with 10 items, and Dressing/Grooming Compulsions Subscale with 3 items (Jonsdottir and Smari, 2000). The PI-WSUR has acceptable reliability ($\alpha = 0.92$; Burns et al. 1996; cited in Cohen and Calamari, 2004), and good test-retest reliability ($\alpha = 0.72$) (Jacobi et al. 2006).

Turkish adaptation of the PI-WSUR was completed by Yorulmaz et al. (2006). It is stated that this scale and subscales shows the score of internal consistency in the student sample is .93 and its internal consistency in the patient sample is .95. Also, it has a test-retest reliability of .86 (Yorulmaz et al. 2006). Moreover, the reliability of the scale in the current study is $\alpha = 0.92$.

A Computer Animation Program for Assessing Compulsive Checking

A computer animation program was used to test compulsive checking behavior. This program was a modification of the animation used in the study by van den Hout and Kindt (2003a). Modification was made with the permission of van den Hout via the e-mail. Participants check virtual gas rings in this animation. It is aimed to examine the effects of repeated checking upon memory and meta-memory of participants.

Procedure

Subjects were randomly assigned to the four conditions in the experiment: (a) high OCS group given feedback (n= 21), (b) high OCS group given no feedback (n= 21), (c) low OCS group given feedback (n= 21), (d) low OCS group given no feedback (n= 21) When the PI-WSUR score of the feedback condition and no feedback condition has been compared with independent t-test in order to make sure that whether these groups were differentiated based upon the PI-WSUR scores. In the high OCS group, the scores of the participants in feedback condition were not significantly different than participants in no feedback condition ($t(40) = -.30, p > .05$). As similar, in the low OCS group, the scores of the participants in feedback condition were not significantly different than participants in no feedback condition ($t(40) = -.30, p > .05$). Moreover, PI-WSUR scores of the high and low OCS group has been compared with independent t-test in order to make sure that whether these groups were differentiated based upon the PI-WSUR scores. According to the results, participants in high OCS group significantly had greater scores than participants in the low OCS group ($t(82) = 20.811, p < 0.001$).

Each participant took the test individually at the Social Sciences Building at METU. The experiment lasts approximately 15-20 minutes. All experiments were completed over a period of three months.

The animation in the present study was constructed with two essential modifications upon the original animation. The first modification was related to the specification of the number of trials. Regarding this, based upon the study of Coles et al. (2006), the number of trails was limited to fifteen trials. After giving informed consent, participants were given instructions regarding how to complete their tasks in the experiment. The experiment had two sections: training section and main section. In the training section, primarily 6 gas rings and 6 associated gas knobs appeared on the computer screen. Participants were informed about how the gas rings were turned on and turned off using the cursor. When participants turned the gas knob on, they saw on the computer screen the flame around the matched gas ring. When they turned the gas ring off, the flame around the associated gas ring on the screen was simultaneously extinguished. Information was added to the

instructions stating that even if participants were not seeing flame on the screen the gas ring might be open. Then, participants were asked to turn the gas rings on and off at the end of the training section. This additional information was the justification for asking the participants to check the gas rings by turning them on and off. At the end of the experiments the participants were all debriefed about the invalidity of this additional information.

During the main section of the experiment, the participants were told that this experiment consisted of trials and that each trial had three phases. First, they were asked to look at a display screen including six circles, three of which were black and the other three were white. It was stated that this screen would disappear after four seconds. On the next screen, they asked to turn on the gas rings indicated by the “black” circles. Second, they were asked to turn off these gas rings. Finally, they were asked to check whether three gas rings were really off by turning the knobs on an off again. The experiment consisted of 15 trials. Different combinations of three out of six gas rings were used from trial to trial and these combinations were counterbalanced except the combination of last trial. It was kept constant for all four conditions.

The second modification to the original protocol was the addition of feedback. Participants in the feedback condition were given with a total of 6 feedbacks throughout 15 trials. Of these 6 feedbacks, 5 were randomly assigned throughout the first 14 trials. However, all participants in feedback condition were given feedback in the last trial. Participants in feedback condition were introduced about the feedback via the instructions in the training phase. Participants were told that they would be given feedback only after some trials, not after every trial. After checking operation was complete, they were told that they would see red circles in the very place of black circles of the display screen. Also, whenever they saw red circles, they were asked to remind themselves that they turned the requested gas rings off completely and successfully. Feedback consisted of two definite explanations. The first one was that the participants had turned off the gas rings completely. The second one was that these gas rings were the gas rings which the computer animation had asked them to turn on and off. The first one was about turning off the gas rings completely and the second one was about merely the places of the gas rings. However, there was no definite information about the trials in which the participants did not have feedback. In these trials, participants were either successful or unsuccessful in turning off the gas rings. Besides, mentioned instruction was given both orally by the experimenter and in literal representation of the computer screen. In the preliminary examination of the clarity of the instructions, when feedback was only provided in the literal form, participants had difficulty in understanding the content of the feedback. For this reason,

the instructions were conveyed to all participants in both oral and literal form in the training phase.

Immediately after the experiment during the assessment section, participants were given a schematic drawing with six gas rings on a page of paper and were asked to indicate which three of them they had checked at the very last checking episode by crossing the corresponded circles for gas rings upon this paper. This assessment was called memory accuracy. Moreover, participants were asked to indicate these variables on a 100-mm Visual Analog Scale in which 0 means not detailed, not vivid, and absolutely not confident; and 100 means extremely detailed, extremely vivid and absolutely confident about the answers related to the crosses that they put on the schematic drawing. These were called detail in memory, memory vividness, and memory confidence, respectively. Lastly, participants were asked to indicate how confident they were about all gas stoves were really off on the question of “how confident are you that now all the gas stoves are really off throughout the experiment?”. This variable was measured on 100-mm Visual Analog Scales which 0 means not confident and which 100 means that extremely confident. This parameter was called confidence throughout the experiment.

RESULTS

A series of statistical assumption were evaluated. One case was identified as a univariate outlier and deleted. Chi-square analyses were conducted to assess differences in memory accuracy in the very last trial of the experiment. For other dependent variables, the data were analyzed using 2 (group condition: high OCS group vs. low OCS group) X 2 (feedback condition: feedback vs. no feedback) between subjects ANOVA separately.

The results of variance analyses

The 2x2 between subjects ANOVA applied to analyze differences in memory confidence. The results showed that there was *only* a main effect of feedback condition ($F(1, 80) = 6.22$, $p < .05$, $\eta^2 = .072$). Participants in feedback condition was found to have greater ($M = 81.90$) memory confidence scores than the participants in no feedback condition ($M = 65.29$). However, group main effect and interaction effect were not statistically significant. A 2x2 between subjects ANOVA was conducted to evaluate differences in the level of detail of the recollections. According to the results, there was not a significant main effect of group, feedback condition, and an interaction effect. A 2x2 between subjects ANOVA was conducted to evaluate differences in the vividness of the recollections. Results showed that there was not a significant main effect of group, feedback condition, and an interaction effect. A 2 X 2 between subjects ANOVA was conducted to evaluate differences in confidence throughout the experiment. Results

Table 1. Descriptive Statistics for Meta-memory Variables

Dependent Variables	Feedback Condition	Mean	SD	N
Memory Confidence (last trial)	Feedback	81.90	27.54	42
	No Feedback	65.29	33.06	42
Memory vividness (last trial)	Feedback	78.17	26.95	42
	No feedback	67.67	30.22	42
Detail in memory (last trial)	Feedback	76.19	25.89	42
	No feedback	65.40	29.85	42
Memory Confidence throughout the experiment	Feedback	87.45	11.93	42
	No feedback	79.24	22.39	42

N= number of participants SD=standard deviation

showed that there was not a significant main effect of group. The *only* significant difference was found for the main effect of feedback condition on confidence throughout the experiment ($F(1, 80) = 4.37, p < .05, \eta^2 = .052$). Participants in feedback condition was found to have greater ($M = 87.45$) scores of confidence throughout the experiment than the participants in no feedback condition ($M = 79.24$). However, there was not a significant interaction effect for the analysis.

The results of chi-square analyses

A chi-square analysis was conducted to examine differences in memory accuracy. While 17.9% of the participants gave inaccurate answers, 82.1% of the participants gave accurate answers ($\chi^2(1, N=84) = 6.57, p < .01$). According to the further analyses, participants in high OCS group gave significantly more accurate than inaccurate answers ($\chi^2(1, N=42) = 30.86, p < .001$) and similarly participants in low OCS group gave significantly more accurate answers than inaccurate ones ($\chi^2(1, N=42) = 7.71, p < .01$). Upon these results, related to the first hypothesis concerning the memory accuracy, it is found that when only accurate answers are taken, answers of participants in low OCS group and in high OCS group were not differentiated significantly ($\chi^2(1, N=84) = 1.17, p > .05$) in terms of memory accuracy (See Table 2).

Specifically, when taking the feedback condition into account, results of analysis of chi-square indicated that participants gave more accurate answers than inaccurate answers ($\chi^2(1, N=84) = 3.98, p < .05$). While 17.9% of the participants gave inaccurate answers, 82.1% of the participants gave accurate answers to the question about memory accuracy. Furthermore, in order to examine whether the accuracy of the answers varied as a function of feedback condition, another chi-square analysis was performed. It was found that analysis showed that participants in feedback condition gave significantly more accurate than inaccurate answers ($\chi^2(1, N=42) = 27.52, p < .001$) and in the same way that participants in no feedback condition gave significantly more accurate answers than inaccurate ones ($\chi^2(1, N=42) = 9.52, p < .01$).

Table 2. Cross-tabulation for Group and Memory Accuracy

Group	Memory Accuracy		N
	Inaccurate	Accurate	
High OCS Group	3 (3.6%)	39 (46.4%)	42
Low OCS Group	12 (14.3%)	30 (35.7%)	42
Total	15 (17.9%)	69 (82.1%)	84

N= number of participants OCS= obsessive-compulsive symptomatology

Table 3. Cross-tabulation for Feedback Condition and Memory Accuracy

Feedback Condition	Memory Accuracy		N
	Inaccurate	Accurate	
Feedback	4 (4.8%)	38 (45.2%)	42
No Feedback	11 (13.1%)	31 (36.9%)	42
Total	15 (17.9%)	69 (82.1%)	84

N = number of participants

01). Moreover, related to our second hypothesis regarding memory accuracy, when only the accurate answers are taken, the results show that answers of participants in feedback condition and participants in no feedback condition were not differentiated significantly ($\chi^2(1, N=84) = 0.71, p > .05$) in terms of memory accuracy (See Table 3).

DISCUSSION

In this chapter, the main findings of the current study are summarized and evaluations of these findings are proposed. Next, contributions and future suggestions of the present study shall be asserted. Finally, the limitations of the current study will be discussed.

Regarding the low confidence hypothesis, after repeated checking it is found that whereas memory is intact, memory confidence is reduced. Throughout the text, it is tried to shed the light on this specific phenomenon. The results of the current study revealed that amongst the variables of

meta-memory, main effect of feedback condition was the only significant effect for confidence level of participants regarding the very last checking episode. Similarly, main effect of feedback condition was the only significant effect for confidence level of participants throughout the experiment. In the memory accuracy level, there was no significant differentiation either amongst low OCS group and high OCS group or amongst feedback condition and no feedback condition in terms of main effect of feedback or group. Besides, there was no significant interaction effect between feedback condition and group condition for all variables in this study. Therefore, all hypotheses were confirmed regarding memory vividness, detail in memory and memory accuracy. For memory confidence for the very last checking episode and memory confidence throughout the experiment, all hypotheses except the main effect regarding the group condition were confirmed. Examining the variables of meta-memory for the very last checking episode, feedback seemed to make a difference in memory confidence but had no effect on detail in memory or memory vividness. Moreover, Horowitz (1983; cited in Hodes 1994) proposes as mentioned in the introduction part that mental images are transformed into words or another type of representation; therefore sensory vividness is *naturally* reduced (Moritz et al. 2006). This finding is thought to be crucial for the series of studies in the literature began by the original study because the classical explanation offers that when detail in memory and vividness are reduced the memory confidence is also reduced. However, findings in the current study suggest that a reduction in detail in memory and memory vividness does not necessarily coincide with a reduction in memory confidence. These findings are contrary to the classical explanation. Furthermore, this finding is consistent with the finding of Boschen et al. (2011). That is, it was found in their study that decrement in scores of memory confidence of participants in the perceptual change condition was significantly attenuated when compared with the scores of participants in other condition, in which perceptual change manipulation was not implemented. Yet, when all three conditions (a condition which is similar to relevant checking condition of original study, a condition which is similar to irrelevant checking condition and perceptual change condition) were compared, it was found that the scores of participants in terms of memory vividness and detail in memory were not significantly different from each other.

Giving feedback appeared to be beneficial for memory confidence and confidence throughout the experiment but not for detail in memory and memory vividness. How did giving feedback improve memory confidence and confidence throughout the experiment? A new hypothesis may be necessary to address this question.

Rather than interpreting reduced confidence as the result of decreased memory vividness and detail in memory, it is

suggested that memory confidence would be viewed as a meta-memorial variable which is evaluated via the distinctiveness of recollections of the checked stimulus. The nature of mental representations is thought to be examined in order to discuss the distinctiveness of the stimuli. In philosophy of mind, cognitive psychology, neuroscience, and cognitive science mental representation is simply defined as a hypothetical internal cognitive symbol that represents external reality (Smith 1996). According to the dialectical logic of consciousness, it is argued that what is clear is qualified by what is unclear, what is seen is defined by what is not. It is proposed that the seen is partially defined by the surrounding unseen. Each concept is always established with its opposite. For instance, “present” and “absent” always go hand in hand like “right” and “wrong”; “dirty” and “clean”; “day” and “night”, etc. (O’Connor and Aardema 2005). Putting this in another way, binary opposition rooted in Saussurean structuralist theory in which each unit is defined in reciprocal determination with another term. The relation between those two terms is not contradictory but *complementary* (Levi-Strauss 1955).

Taking binary oppositions into account, the reduction of doubt and improvement of confidence seem to be closely linked to the extent of human mind’s ability to distinguish opposite categories like open-closed, day-night, present-absent, etc. It is suggested that the more these categories are interpenetrated the more doubt increases and confidence decreases. Conversely, the more these opposite categories are balanced in the mind the more one makes a decision easily and has less difficulty in feeling certain about this decision. It is suggested that giving feedback might make participants in feedback condition more confident about the very last checking episode and also more confident about all trials than participants in no feedback condition by making trials much more distinct from each other and by hindering participants perceive the trials blurry. It is suggested that when participants saw the feedback, they made an inference that this trial was completed successfully. Similarly, when they did not see the feedback, they also made an inference that it was impossible to say something about this specific trial. Therefore, participants in feedback condition guarded these boundaries more readily than participants in no feedback condition. It is also argued that the more boundary was guarded the more confidence was increased.

In this line of reasoning, in terms of semantic and visual information, it is suggested that distinctive representations are crucial to human mental system (Cooper and Schacter 1992). When literature of cognitive psychology is examined, it is suggested that distinctiveness may lead to increased retrievability (Bunting 2006). Goldstone (1994; cited in Preminger et al. 2007) found that learning to categorize results and gaining the ability to discriminate amongst categories results in better memory. Conversely, it is also argued that a sequence of

correlated memory patterns may collapse into a single *unified* representation (Blumenfeld et al. 2006; cited in Preminger et al. 2007) All things considered, increased similarity amongst experiences caused by repetition or another mechanism may affect the human mind negatively.

Moreover, there are numerous studies in the clinical psychology literature pointing out the difficulty in categorizing in OCD patients. For instance, there is a study stating that control participants differentiate situations whether they merit concern or not better than individuals with OCD (Foa et al. 2001). Besides, people with OCD show more doubt about the correctness of their decisions (Frost and Shows 1993). It is proposed that beliefs about the need for certainty may lead to those kinds of difficulties (Obsessive Compulsive Cognitions Working Group (OCCWG) 1997). The results appear to imply that persons with OCD have difficulty in discriminating and sorting situations (and experiences) they face. Reed's model (1985) focuses upon the very concept of categorization. This model asserts that when people have difficulty in constructing (and integrating) their experiences they have a tendency to compensate this situation by over-structuring their experiences. For instance, doubt, indecision, rumination, and particular compulsions like checking rituals are the outcome of difficulty in categorizing experiences (1985; cited in Taylor 2005). Besides, reminding Reed's model in mind, it is asserted in the context of checking and doubt that patients with OCD report that they have a desire for having higher levels of vividness in their memory to trust their memories completely (Constans et al. 1995). Along with the proposal of the present study, checking is understood as a counter-productive coping strategy in order for making memory episodes more distinct from each other (Moritz et al. 2006). In the long run this strategy is thought to blur the distinct stimuli by increasing the similarity throughout the checking rituals (Tolin et al. 2001). When this cumulated literature is examined, trials in no feedback condition, which were already similar to each other, were thought to become much more similar to each other alongside the experiment. With repetition, similarity between trials was accepted to be increased and distinctiveness was thought to be decreased. Therefore, participants' representations about checking episodes were thought to become unified. That is, the concept of unified representation refers to the decrement in level of distinctiveness of boundaries in concepts amongst binary oppositions. Also, feedback usage appeared to prevent the possible increment in similarity over trials and to make these mental representations more distinct. Therefore, it seemed to enable participants to behave uniquely towards each trial instead of behaving in a unified manner. Finally, by this captured distinctiveness, participants in feedback condition reported significantly greater scores for memory confidence and confidence throughout the experiment than the participants no feedback condition.

Moreover, numerous studies point out that reassurance seeking behaviors increase the OCD symptoms and also they are thought to cause these symptoms to be chronic (Kobori and Salkovskis 2013). In this respect, whether giving feedback reinforces the participants' reassurance seeking behavior merits further discussion. However, participants in the current study are from "normal" population rather than being patients with OCD. When severity of symptoms is taken into account, mechanism(s) of reassurance seeking behavior might be differential in nature. When severity is low, feedback (for instance, saying that "the control is complete") may provide a distinction between two categories (two categories constructed by two possible states: gas knob is open or gas knob is closed) and thus consolidate the confidence in the decision. Regarding the current study, it could be asserted that giving feedback facilitates the construction of binary oppositions in a balanced manner. In this way, it is suggested that feedback makes mental representations much more distinct from each other. Therefore, it seems to improve the memory confidence. When symptoms are severe (that is, if the boundary between two categories is blurred), the absence of reassurance seems to have enough power to make a distinction between two categories (gas knobs are open or closed) and therefore to have a chance to improve confidence. This practice is similar to the treatment of exposure and response prevention. By this manner, patients with OCD appear to have balanced binary oppositions. In summary, instead of thinking that giving reassurance is definitely beneficial or harmful, it is thought that contextual thinking may be more functional.

Clinical application of this theory may include evaluating whether mental representations are unified and whether binary oppositions are balanced. This could be part of the agenda discussed periodically between patient and therapist. A metric for quantifying these phenomena would be useful for determining the severity of disorder, adherence to therapy, and prognosis in OCD.

Limitations of The Study and Further Suggestions

The target population is non-clinical student sample. Therefore, generalization of the results to the clinical population is difficult. Moreover, the experimenter was present in the experiment room for clarification of the instructions but was seated outside of the participants' visual field. It was thought to be another limitation for the reliability of the animation. Besides, regarding the insignificant results of the group main effect and interaction effects in the present study, selection criteria of half standard deviation above and below the mean seems to be inadequate for dividing the groups as high and low OCS groups that there does not emerge any significant effect. As mentioned earlier, need for reassurance seeking is common in OC symptomatology and it might increase the severity of OC symptoms. (Kobori and Salkovskis 2013) In the present study, feedback might have given participants a

kind of reassurance and therefore influenced their performance. On the other hand, because there is no additional assessment the long-term effects of feedback cannot be determined definitely.

Furthermore, the dependent variable of outcome confidence of the original study was not evaluated in the current study. Instead, the question about “whether the gas rings were off throughout the study” was asked. Addressing this methodological deficiency may allow for broader inferences.

When this study is compared with the original study and the study by Boschen et al. (2011)’s study which finds increment in confidence level, the present study is evaluated as being more valid in terms of ecological validity because perceptual environment of a person performing ritual is not changed instantly at the twentieth trial or in every five trials. These experimental settings are thought to be inadequate in reflecting the patients’ everyday life. Future research may include a clinical population. Also, suggested alternative explanation would be examined and implemented in terms of whether it would be valid for the series of studies since 2003. In addition to using gas rings, neutral materials like light bulbs could also be used in the computer animation. Moreover, in the feedback condition, participants were given feedbacks six times out of fifteen trials. The amount and format of the feedback could be varied. Visual and auditory memories have different mechanisms and different experimental formats may have differential effects upon memory. For instance, participants could also say out loud the meaning of the feedback. Evaluating the efficiency mechanisms of these different formats could contribute to the process of psychotherapy.

Furthermore, participants could be asked to indicate how they used the feedback and to specify if they generated a clue for later remembering. Also, a relatively doubt-inductory feedback would be added to the procedure of the study that the hypothesis would be tested in a better way. All these methodological variations are thought to enrich the data.

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