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Check, check, double check: Investigating memory deterioration within multiple sessions of repeated checking

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ABSTRACT

Background and objectives: Extensive research has shown that repeated checking causes memory distrust. Therefore, it has been suggested that people may subsequently get into a vicious cycle of decreased memory confidence and increased checking behavior, which may play a role in the maintenance and development of OCD. This study investigated in two experiments how repeated checking influences memory distrust over multiple checking episodes.
Methods: In experiment 1, 70 healthy undergraduates performed two sessions of a virtual checking task with a 30 min break in between. In experiment 2, 41 healthy undergraduates performed two sessions of the checking task on a real kitchen stove and sink.
Results: Results of experiment 1 showed that memory confidence for checking the stove decreased after repeated checking in session 1, and remained low in session 2, but memory vividness and detail decreased in both sessions and recovered in between. In experiment 2, all three meta-memory ratings for checking the stove decreased after repeated checking in both sessions, but recovered in between.
Limitations: Future research may include patients with OCD. To further investigate the development of memory distrust over time, more checking episodes may be included and the time between sessions may be increased. Although replication is needed, the findings of experiment 2 seem more informative.
Conclusions: Repeated checking may decrease memory vividness and detail (and, in turn, presumably also decrease memory confidence) each time this counterproductive strategy is used, which may have implications for using this paradigm as a behavioral experiment in cognitive-behavioral therapy.

1. Introduction

Obsessive-compulsive disorder (OCD) is characterized by intrusive, frightening thoughts (obsessions; e.g., “did I stab my partner while doing the dishes?”) to which patients respond with repetitive behavior (compulsions; e.g., checking the knives and scissors in the house or calling their partner to ensure he or she is alive) to suppress these unwanted thoughts and prevent misfortunes from happening (American Psychiatric Association, 2013). Repeated checking is one of the most common compulsions in OCD (Ruscio, Stein, Chiu, & Kessler, 2010), and these compulsions often constitute the major problem in the disorder (Rachman, 2002).

To explain why and when checking behavior becomes compulsive, Rachman (2002) proposed a self-perpetuating mechanism. He hypothesized that the interaction between an increased sense of responsibility, the perceived probability of harm and the anticipated seriousness of harm makes people engage in preventative checking behavior. However, because patients feel they can never be completely sure that a perceived threat has been adequately removed and because checking behavior may paradoxically inflate feelings of responsibility and memory uncertainty, this behavior will persist.

The idea that repeated checking is a counterproductive strategy that actually increases memory uncertainty has been investigated extensively over the past decade (e.g., Ashbaugh & Radomsky, 2007; Boschen & Vuksanovic, 2007; Coles, Radomsky, & Horng, 2006; Dek, Van den Hout, Giele, & Engelhard, 2010; Dek, van den Hout, Engelhard, Giele, & Cath, 2015; Linkovski, Kalanthroff, Henik, & Anholt, 2013; Radomsky & Alcolado, 2010; Radomsky, Dugas, Alcolado, & Lavoie, 2014; Radomsky, Gilchrist, & Dussault, 2006; Van den Hout & Kindt, 2003, 2004). In these studies,

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patients with OCD or healthy participants were asked to perform an OC-like checking task. Participants were instructed to turn on, turn off, and check a virtual or real life stove multiple times, and asked to rate their memory and meta-memory of their last check directly after the first and final checking trial. Results consistently indicated that after repeatedly checking the same stimulus, memory confidence, vividness and detail of the last check decreased remarkably. Interestingly, however, memory accuracy generally remained intact after repeated checking; it was often not affected (e.g., Dek et al., 2010; Linkovski et al., 2013; Van den Hout & Kindt, 2003, 2004), or displayed a small, likely unremarkable, decrease that was much smaller than the decrease in meta-memory ratings (Boschen & Vuksanovic, 2007; Coles et al., 2006; Radomsky, Gilchrist et al., 2006; Radomsky & Alcolado, 2010; Radomsky et al., 2014). Thus, although checking is intended to increase certainty, it ironically decreases it. In turn, decreased memory confidence may promote continued and/or renewed checking, which may lead to *even less* memory confidence, and so on (Alcolado & Radomsky, 2011; Radomsky, Gilchrist et al., 2006). It therefore has been hypothesized that people may get into a vicious cycle of decreased confidence and increased checking behavior, which may play a role in the maintenance and development of OCD (Nedeljkovic & Kyrios, 2007).

Recent research showed that patients with OCD generally already tend to be more inclined to use checking behavior than people with no OC tendencies, independently of their obsessions. Jaafari et al. (2013) showed, for instance, that patients with OCD perform more checking behavior than healthy controls in a basic image-comparison task (comparing two images that were projected simultaneously and indicating whether they were identical or not). More specifically, OCD checkers were found to use more checking behavior in a virtual-reality task in which they could freely check multiple items in a virtual house (Kim et al., 2012), and in a delayed matching to samples task (comparing two images that were projected with a delay in between and indicating whether they were identical or not; Clair et al., 2013), compared with OCD non-checkers and healthy controls. Additionally, two recent studies indicated that people who are vulnerable for the development of OCD (people with high OC tendencies) responded with more checking behavior to mildly uncertain situations, as opposed to people with low OC tendencies (Toffolo, van den Hout, Hooge, Engelhard, & Cath, 2013; Toffolo, van den Hout, Engelhard, Hooge, & Cath, 2014). Therefore, even though it is still unknown what comes first (the tendency to use more checking behavior in general or OCD), it seems plausible that when people who are vulnerable for OCD in general use more checking, this may have the same paradoxical effect on memory confidence. This may subsequently lead to the vicious cycle of increased checking behavior and memory distrust, eventually contributing to the development of new OC symptoms.

When investigating this vicious cycle, it became clear that memory confidence reliably declines over the course of one checking episode (e.g., Radomsky, Gilchrist et al., 2006; Van den Hout & Kindt, 2003, 2004). But what is the time course of this decreased confidence? Does checking induced memory distrust disappear once the checking episode is terminated? Or does distrust remain and promote renewed checking behavior, which further decreases memory confidence over time? Since those struggling with compulsive checking problems in OCD often repeatedly check the same objects, it is important to investigate whether memory confidence further deteriorates after multiple series/bouts of repeated checking. Therefore, the present study investigated this by conducting two experiments that used a modified version of the original OC-like checking task (Van den Hout & Kindt, 2003), similar to the one used by Boschen and Vuksanovic (2007). In each experiment, participants performed two bouts of the checking task with a 30 min break in between. It was expected that during the first session of repeated checking, memory confidence, vividness and detail of checking the stove (relevant measures in experiment 1 and 2) would decrease; and that these lower levels of memory confidence, vividness and detail would persist and continue to decrease during the second checking session of the stove. No effects were expected during either of the two checking sessions for memory confidence, vividness, or detail of checking lights (experiment 1; irrelevant measure) or a sink (experiment 2; irrelevant measure). Finally, memory accuracy for checking the stove and the lights/sink was not expected to be affected during the task, or only show a very small decrease.

1.1. Experiment 1

In experiment 1, healthy undergraduates completed a modified version of the *virtual* gas stove task (Van den Hout & Kindt, 2003; Boschen & Vuksanovic, 2007), with two repeated checking sessions separated by a 30 min break. In this within-subjects design all participants repeatedly checked the stove and had "relevant" (stove) and "irrelevant" (lights) pre- and post-tests in each checking session (see Procedure). Because of the irrelevant pre- and post-tests we could control for possible findings to be attributable to the passage of time and did not need to include a separate control group that engaged in irrelevant checking.

For half of the participants memory and meta-memory measures for checking of both the stove and lights were assessed before (pre-test) and after (post-test) the two checking series of the gas rings. However, to rule out possible outcome expectancy effects of the measures in the first session (people's meta-memory ratings noticeably going down, which could influence people's belief about the nature of the experiment) on the measures in the second session (people may anticipate second memory assessments before and after repeated checking), the other half of the participants did not receive a post-test after repeated checking in the first session.

2. Method

2.1. Participants

Seventy undergraduate students (age, $M = 21.81$, $SD = 2.84$; 47 females) from Utrecht University and University of Applied Sciences Utrecht participated in this experiment and were given a small remuneration or course credits for their participation. Participants reported to be in good health and had a mean score of 15.71 ($SD = 9.18$) on OC tendencies, measured with the Obsessive-Compulsive Inventory Revised (OCI-R; Foa et al., 2002). This closely resembled average OC tendencies present in other non-clinical samples as found in a meta-analysis of 55 studies (weighted $M = 14.9$, $SD = 11.3$; see Appendix A of Abramowitz et al., 2014).

2.2. Material

2.2.1. Virtual checking task

The virtual checking task (cf. Van den Hout & Kindt, 2003) assesses the effects of repeated checking on memory and meta-memory ratings and involves operating gas rings on a virtual stove and operating dimmer switches on a set of virtual light bulbs. The present task was modified from its original form for the purposes of this experiment (see "Procedure" for details).

2.2.2. Memory and meta-memory ratings

Memory accuracy, confidence, vividness and detail were