



## Perseveration causes automatization of checking behavior in obsessive-compulsive disorder



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### ABSTRACT

Repeated checking leads to reductions in meta-memory (i.e., memory confidence, vividness and detail), and automatization of checking behavior (Dek, van den Hout, Giele, & Engelhard, 2014, 2015). Dek et al. (2014) suggested that this is caused by increased familiarity with the checked stimuli. They predicted that defamiliarization of checking by modifying the perceptual characteristics of stimuli would cause de-automatization and attenuate the negative meta-memory effects of re-checking. However, their results were inconclusive. The present study investigated whether repeated checking leads to automatization of checking behavior, and if defamiliarization indeed leads to de-automatization and attenuation of meta-memory effects in patients with OCD and healthy controls. Participants performed a checking task, in which they activated, deactivated and checked threat-irrelevant stimuli. During a pre- and post-test checking trial, check duration was recorded and a reaction time task was simultaneously administered as dual-task to assess automatization. After the pre- and post-test checking trial, meta-memory was rated. Results showed that relevant checking led to automatization of checking behavior on the RT measure, and negative meta-memory effects for patients and controls. Defamiliarization led to de-automatization measured with the RT task, but did not attenuate the negative meta-memory effects of repeated checking. Clinical implications are discussed.

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### 1. Introduction

Most patients with obsessive-compulsive disorder (OCD) perform perseverative behavior like checking, washing, or counting. Eighty percent of patients engage in checking, making it the most prevalent type of compulsive behavior (Ruscio, Stein, Chiu, & Kessler, 2010). Patients with OCD tend to distrust their memory for earlier checks (Rachman, 2002; Reed, 1985), and are less confident about their memory than healthy controls (Hermans, Martens, De Cort, Pieters, & Eelen, 2003; MacDonald, Antony, MacLeod, & Richter, 1997). There is no robust evidence that patients with OCD have a general memory deficit. Some studies did find general memory dysfunction (e.g., Joel et al. 2005; Kathmann, Rupertseider, Hauke, & Zaudig, 2005; Savage et al. 2000), but others did not (e.g., Jelinek, Moritz, Heeren, & Naber, 2006; Moritz, Kloss, von

Eckstaedt, & Jelinek, 2009; Radomsky & Rachman, 1999). Although checking seems to be a coping strategy to reduce uncertainty, many studies have demonstrated that *repeated* checking is, paradoxically, counterproductive.

van den Hout and Kindt (2003a, 2003b, 2004) were the first to experimentally demonstrate the ironic effects of perseveration. They asked participants to perform checks in a computer task. Participants had to activate, deactivate, and check gas rings by turning knobs on a virtual gas stove. At a pre- and post-test, memory accuracy was assessed, and participants rated their memory confidence, vividness, and detail. Between the pre- and post-test, half of the participants performed 20 checks on the same stimuli used in the pre- and post-test ('relevant checking'), whereas the other half performed checks on different stimuli ('irrelevant checking'). Results showed that repeated relevant checking did not affect memory accuracy, but reduced memory confidence, vividness, and detail. These results have been replicated using a real-life kitchen instead of a computer task (Radomsky, Gilchrist, & Dussault, 2006), with threat-irrelevant stimuli (Dek, van den

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Hout, Engelhard, & Giele, 2010), and with mental instead of physical checking (Radomsky & Alcolado, 2010). The negative effects of repeated checking appear relatively fast: after 2–5 checks (Coles, Radomsky, & Horng, 2006). Furthermore, the effects of repeated checking are not bound to cognitions about the present: repeated checking induces uncertainty about the ability to discriminate between future threat and safety (Giele, van den Hout, Engelhard, Dek, Damstra, et al., 2015). Compared to healthy controls, patients with OCD show similar reductions on the meta-memory ratings after repeated checking (Radomsky, Dugas, Alcolado, & Lavoie, 2014), even though they have lower confidence in memory overall (Boschen & Vuksanovic, 2007).

van den Hout and Kindt (2003a) proposed that repeated checking increases familiarity with the checked stimuli. Familiarity leads to inhibition of processing of perceptual elements of checked stimuli, and prioritizes their semantic aspects (Johnston & Hawley, 1994; Roediger, 1990). It decreases vividness and detail of recollections, which undermines confidence in memory (van den Hout & Kindt, 2003a). This switch from perceptual to conceptual processing could be the underlying mechanism of the paradoxical perseveration phenomenon. Extrapolating from this work, Dek et al. (2014) proposed that the paradoxical effects of perseveration might be the result of automatization of the checking procedure.

Dek et al. (2014) suggested that practice (i.e., the repetitive act of checking), as well as increased familiarity with the stimuli and the act of checking itself, lead to automatization of checking behavior. To investigate automatization, they focused on efficiency, which is a feature of automaticity that pertains to the extent of demands on attentional resources (Bargh, 1994). Because efficiency can be studied with dual task paradigms (McNally, 1995; Teachman, Joormann, Steinman, & Gotlib, 2012), Dek and colleagues modified the checking task into a dual task by combining it with a secondary reaction time (RT) task in the pre-test and post-test. That is, while participants completed a checking trial in the pre-test and post-test, they also completed the RT task by responding as quickly as possible to tones. Automatization was operationalized as more efficient (faster) performance of the checking procedure and on the RT task at the post-test. Indeed, compared to irrelevant checking, repeated relevant checking led to automatization of the checking procedure (check durations at the post-test were shorter). Because the pre-to-post-test reductions in RT on the secondary task did not differ between the conditions, replication was required in order to make definite inferences about automatization of checking behavior. Subsequently, Dek, van den Hout, Giele, and Engelhard (2015) conducted two replication experiments, and found that relevant checking, compared to irrelevant checking, reduced check duration and RTs which indicates automatization of checking behavior. In sum, repeated checking leads to automatization in non-clinical samples.

Dek et al. (2014) also tested if defamiliarization leads to de-automatization of the checking procedure. Stimulus familiarization is reached by prolonged contact with that specific stimulus. In contrast, defamiliarization is achieved by modifying perceptual characteristics of the stimulus. De-automatization was operationalized as less efficient (slower) performance on the checking task and the RT task at the post-test, compared to the relevant checking condition. Dek et al. (2014) also predicted that defamiliarization (by modifying the background color of the stimuli at the post-test) would reduce the negative effects of repeated checking on meta-memory. This was not found, and the authors suggested that the modification procedure may have been too weak. In a similar experiment, Boschen, Wilson, and Farrell (2011) changed the perceptual characteristics of the stimuli themselves every five checks. They found that repeated checking of perceptually altered

stimuli attenuates the negative effects of repeated checking on memory confidence, vividness, and detail. In a recent study, Dek et al. (2015) altered the color of the stimuli and knobs instead of the background color ('moderate defamiliarization'), and increased the amount of color alterations of the stimuli ('strong defamiliarization'). They demonstrated that moderate defamiliarization resulted in partial de-automatization: defamiliarization reduced efficiency on the secondary RT task, but not check durations. However, it also did not attenuate meta-memory ratings. An unexpected finding was that strong defamiliarization did not lead to de-automatization, but did reduce the drops in memory confidence and vividness after repeated checking. In sum, results on the effects of defamiliarization on de-automatization and attenuation of the meta-memory effects of re-checking are inconclusive.

Patients with OCD typically have a tendency to exert control over their daily-life automatic routines. They "attempt to monitor closely and take control over processes that would otherwise operate in automatic and well-practiced ways" (Salkovskis, 1998, p. 40). Therefore, automatization on the checking/RT task may develop differently (more slowly) for OCD patients than for healthy controls. An experimental study that used a flanker task demonstrated that individuals scoring high on obsessive compulsive symptoms are more reluctant to shift from focused to parallel processing strategies (Soref, Dar, Argov, & Meiran, 2008).

The first objective of this study was to replicate the paradoxical perseveration phenomenon in a sample of patients with OCD. The second objective was to investigate whether checking behavior automates more slowly in patients with OCD than in healthy controls. We hypothesized that (1) repeated relevant checking leads to reductions in memory confidence, vividness, and detail in patients with OCD and healthy controls, and that (2) compared to healthy controls, the degree of automatization after repeated relevant checking is smaller for patients (reflected by less steep reductions in check duration and RTs from pre-test to post-test). The third objective was to explore the effects of defamiliarization in patients with OCD compared to healthy controls. Because we had no strong predictions about this effect, we explored whether (3) patients with OCD differ from healthy controls in the way that defamiliarization leads to de-automatization (reflected by different reductions in check duration and RT), and (4) OCD patients differ from non-clinical controls in their meta-memory ratings after defamiliarization. Research on the effects of perseverative behavior is extensive. However, few studies have focused on the origin of these effects. This research could provide more insight about the way repeated checking affects memory confidence and whether automatization is an underlying mechanism in a clinical sample, which would have implications for treatment.

## 2. Method

### 2.1. Participants

Patients with OCD were recruited from the Altrecht Academic Anxiety center (AAA; ambulant care) and the Vincent van Gogh Center for Anxiety and Obsessive-Compulsive Disorders (VVGi-CAD; inpatient care). We included patients who had a DSM-IV diagnosis of OCD using the Dutch version of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I: First, Spitzer, Gibbon, & Williams, 1996; van Groenestijn, Akkerhuis, Kupka, Schneider, & Nolen, 1999). The SCID-I was administered by the first author or a psychologist under her supervision. We excluded patients if they used benzodiazepines on a regular basis, were addicted to alcohol and/or drugs, suffered from symptoms from the psychotic spectrum, were insufficiently proficient in the Dutch language, or suffered from color blindness. For the healthy controls

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