

PRACTICE DOES *NOT* MAKE PERFECT

The Ironic Effects of Compulsive
Perseveration

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ISBN 978-90-393-6156-6

Cover design and layout: Marlotte Jonker & Karin Giele

Printing: Off Page, www.offpage.nl

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PRACTICE DOES *NOT* MAKE PERFECT

The Ironic Effects of Compulsive Perseveration

Oefening baart *geen* kunst

De ironische effecten van compulsieve perseveratie

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van de
rector magnificus, prof.dr. G.J. van der Zwaan,
ingevolge het besluit van het college voor promoties in het openbaar te verdedigen op
vrijdag 27 juni 2014 des middags te 2.30 uur

door

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geboren op 29 mei 1983 te Goes

Promotoren: Prof.dr. M.A. van den Hout
Prof.dr. I.M. Engelhard

*IMAGINATION IS MORE IMPORTANT THAN KNOWLEDGE.
FOR KNOWLEDGE IS LIMITED, WHEREAS IMAGINATION EMBRACES THE ENTIRE WORLD,
STIMULATING PROGRESS, GIVING BIRTH TO EVOLUTION.
IT IS, STRICTLY SPEAKING, A REAL FACTOR IN SCIENTIFIC RESEARCH.*

-EINSTEIN, COSMIC RELIGION WITH OTHER OPINIONS AND APHORISMS (1931)-

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Check the
stove!!

Door
Locked?

Is the
light off?

Chapter 1

Introduction

INTRODUCTION

In everyday life, many people will be familiar with the experience of sudden doubt after closing the door and walking away: 'Did I lock it?' Some people will walk back and check if it is really locked. A handful of them will check twice, but after these checks, the majority will be sure that their front door is properly locked. However, many patients with obsessive-compulsive disorder (OCD) are not reassured after one or two checks; they still feel doubt. They may continue checking the door for several minutes or more. Some patients with OCD can barely leave the house because their checking rituals are so time-consuming. It is striking that after carrying out this perseverative behavior, patients may experience that their feelings of uncertainty are maintained or have even increased. Research has shown that perseveration itself induces uncertainty. The aim of this thesis is to further elucidate this relationship, by examining the effects of different forms of compulsive perseveration on uncertainty and to test a possible mechanism that could be partly responsible for this phenomenon. In this introductory chapter, a short overview of the history of OCD is described, followed by information about the prevalence and characteristics of the disorder. Then, I will further discuss research findings related to obsessive-compulsive perseveration and uncertainty. The introduction concludes with the research objectives and an overview of the studies of this thesis.

OCD THROUGH HISTORY

One of the first descriptions of a disorder that is reminiscent of current disorders like OCD or Gilles de la Tourette can be found in the 'Malleus Maleficarum' ('The Witch Hammer') (Kramer & Sprenger, 2007). This guidebook was published in 1486 and aimed to help inquisitors with the identification and 'treatment' of witches. Only one treatment was appropriate: Burning the women to death to exorcise the devil. Chapter 10 of this guidebook describes how the devil also can possess men and let them act against their own reason. For example, a sober priest is mentioned who felt the urge to stick his tongue far out of his mouth every time he passed a church (Kramer & Sprenger, p131, 2007). Another well-known example is Shakespeare's Lady Macbeth, who cried out in despair: 'What, will these hands ne'er be clean?', while compulsively washing her hands in an unsuccessful attempt to reveal feelings of guilt and pollution (Shakespeare, 1987).

In the 19th century, French psychiatrist covered clinical phenomena in categories. They described OCD as a form of madness, which was included within the category 'folie raisonnante' (insanity without delusions) (Berrios, 1989). After 1850, OCD shifted from madness or insanity to 'folie avec conscience' (insanity with insight) (Berrios, 1989). Obsessions were gradually separated from delusions and compulsions were separated from impulsions (Alvarenga, Hounie, Mercadante, Miguel, & Conceicao, 2007).

Jean Etienne Dominique Esquirol (1782-1840) observed that his patients had a certain insight in their disease and therefore described it as 'délire partiel' (partial delusions) (Alvarenga et al., 2007). Bénédict Morel (1809-1873) argued that OCD should be classified as a 'disease of the emotions' due to the anxiety that patients experienced (Alvarenga et al., 2007; Berrios, 1989). The current definition of OCD is derived from the psychiatrist Friedrich Otto Westphal (1833-1890), who used the term 'Zwangsvorstellung', which compassed both mental experiences and actions (Alvarenga et al., 2007).

The first extensive study in OCD patients was done by Pierre Janet (1859-1947), who described the development of obsessive-compulsive (OC)- like symptoms in detail in his book 'Les Obsessions et la Psychasthenie' actions (Alvarenga et al., 2007). He argued that a sense of imperfection or incompleteness is the core problem of the disorder (Swinson, Antony, Rachman, & Richter, 2001). He proposed three clinical stages of the illness, in which the presence of compulsions and obsessions arise in the final and most severe stage of the disorder (Berrios, 1989).

The next major effort to understand OCD came from Sigmund Freud (1856 - 1939). He theorized that an obsessive-compulsive character developed as a result of a defense against anal eroticism and parent-child conflicts that were experienced during the anal stage of a child's psychosexual development. Because of a failed repression system, unwanted thoughts enter consciousness causing anxiety. He theorized that some patients develop an 'obsessional neurosis' because of responding maladaptively, for example by carrying out compulsions to neutralize the offending ideas and impulses (Alvarenga et al., 2007).

THE HISTORY OF OCD IN THE DSM

The classification of mental disorders in the first and second edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) were strongly influenced by the

psychoanalytic theory of Freud (Steketee, 2012). What we call OCD today was defined as 'obsessive-compulsive reaction' in the DSM-I (1952) and 'obsessive-compulsive neurosis' in the DSM-II (1968) (Steketee, 2012). With the publication of the DSM-III (1980), etiology theories were removed and syndromes were defined as sets of observable criteria. The definition of OCD, which was classified as an anxiety disorder, only changed slightly in the DSM-III-R (1987), DSM-IV (1994) and DSM-IV-TR (American Psychiatric Association APA, 2000), for example by focusing on clearly defined obsessions and compulsions (Steketee, 2012). An important change has taken place in the DSM-5 (APA, 2013), as OCD has been removed from the chapter on anxiety disorders and placed in a new chapter 'obsessive-compulsive and related disorders'. Another disorder in this chapter is 'hoarding disorder', which is now created as a unique diagnosis and has thus been separated from OCD (APA, 2013).

EPIDEMIOLOGY

OCD affects up to 2.3% of the U.S. population, with a mean age of onset of 19.5 years (Ruscio, Stein, Chiu, & Kessler, 2010). This age of onset seems to be bimodal, with an early and late onset. The first distribution, with a mean of age of 11.1, shows increased frequency of Tourette's syndrome and increased family history of OCD. The second distribution has a mean onset age of 23.5 years and shows elevated prevalence of general anxiety disorder and major depressive disorder (Delorme et al., 2005). The majority of people with an early age of onset are male, with nearly a quarter of males having OCD before the age of 10. No specific gender predominance has been reported in large sample epidemiological studies (Fornaro et al., 2009). A study in a community sample showed that nearly everyone with a lifetime OCD diagnosis also met criteria for co-morbid conditions (90%), like anxiety disorders (75.8%), mood disorders (63.3%), impulse-control disorders (55.9%), and substance use disorders (38.6%) (Ruscio et al., 2010). OCD is (by definition) a debilitating disorder: It is often chronic and in many cases it is associated with serious impairment in work and social functioning and increased suicidality (Torres et al., 2006).

OBSESSIONS

The DSM-IV-TR (APA, 2000) defines obsessions as thoughts, images or impulses that are recurrent and persistent and cause marked anxiety or distress, are time-consuming and/or significantly impair normal functioning of the person. The main

themes of these obsessions are aggression, sex and blasphemy and typically relate to fear of behaving inappropriately or doing harm (e.g., stabbing a child) (Rachman, 1997). British research suggests that around 80% of the general population may experience intrusive, unpleasant and unwanted thoughts similar to those seen in OCD (Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). Rachman and de Silva (1978) suggested that, with respect to their content, these 'normal' intrusions from the general population resemble the 'abnormal' obsessions from OCD patients. They showed that a sample of therapists was not able to correctly identify clinical obsessions from a list of obsessions/intrusions reported by OCD patients and non-patients. However, in a replication study, Rassin and Muris (2006) found that both therapists and students were able to distinguish the content of the two sorts of obsessions beyond chance level. In a second study, undergraduates reported that they experienced significantly more normal than abnormal obsessions (which they chose from a list of clinical and non-clinical obsessions), suggesting that the two kinds of obsessions do differ from each other (Rassin, Cogle, & Muris, 2007). Thus, although these findings suggest that there is at least a subtype of obsessions experienced by OCD patients that is characterized by a more 'bizarre', abnormal content, the content of non-clinical intrusions and clinical obsessions is hard to discriminate, as the themes (e.g., aggression or harm) are highly similar. Where normal and abnormal obsessions show a high overlap in content, they obviously differ with respect to their duration, frequency, intensity and reaction of the person (Rachman & de Silva, 1978).

In his theory of obsessions, Rachman (1997) stated that a misinterpretation of the content of the normal intrusions causes obsessions to develop. Patients with OCD tend to over-evaluate the consequences of an intrusive thought, also known as 'thought action fusion' (TAF) (Shafran, Thordarson, & Rachman, 1996). More specifically, the 'likelihood TAF' refers to the belief that having a thought of a catastrophe increases the likelihood that this catastrophe will actually occur and the 'moral TAF' refers to the belief that having immoral thoughts is as bad as immoral behavior (Rassin, Muris, Schmidt, & Merckelbach, 2000).

Salkovskis, Richards and Forrester (1995) argued that intrusive thoughts induce resistance in patients with OCD: They actively try to suppress these thoughts. Cognitive-behavioral models suggest that suppression of intrusive thoughts ironically increases the frequency of these unwanted thoughts in patients with OCD. This leads to a vicious circle of catastrophic misinterpretations, thought suppression attempts

and increased thought frequency, through which obsessions could develop (Rachman, 1998). Rassin et al. (2000) found that TAF appeared to trigger thought suppression, which in turn predicted OCD symptoms.

Although theorized by Rachman (1998), it is still unclear whether suppression of intrusive thoughts really increases the frequency of these thoughts. A classic experiment by Wegner, Schneider, Carter and White (1987) described the 'white bear effect': When participants suppressed the thought of a white bear, this resulted in more rather than less thoughts of this animal. However, further studies on the effect of thought suppression in patients with OCD and non-clinical controls revealed mixed results: Some studies found an increased frequency of the thoughts, whereas others found no effect or even a decreased frequency of the thoughts. It is therefore still unclear whether or not suppression leads to enhanced thought frequency (for an overview, see Purdon, 2004). In a study by Purdon, Rowa and Antony (2007), 37 patients with OCD registered their thought suppression attempts over three days. Participants reported using neutralizing behavior or strategies in addition to suppression more often than using suppression alone and used thought suppression prior to neutralizing. This last finding suggests that thought suppression may be a first attempt of resistance against an obsession. It is possible that rituals are performed when suppressing has not the desired effect of reducing distress.

COMPULSIONS

Neutralizing rituals, also known as compulsions, are a second strategy in response to the disturbing obsessions that patients with OCD experience. These compulsions are defined as repetitive behaviors (e.g., checking light knobs, ordering books in a bookshelf or prolonged hand washing) that the person feels driven to perform in response to an obsession or according to rules. These compulsions are aimed at preventing or reducing distress or at preventing a catastrophic event. Just like obsessions, compulsions cause marked distress, are time consuming and interfere with the person's normal routine (APA, 2000). The most prevalent type of compulsive perseveration is checking, with a prevalence of around 80% in patients with lifetime OCD (Ruscio et al., 2010). Compulsive behavior does also occur in the general population: Approximately 50% of the general population reported to engage in some compulsive or ritualistic behavior (Muris, Merckelbach, & Clavan, 1997).

Rachman (2002) theorized that compulsive behavior occurs when people believe

that they have an elevated responsibility to prevent harm from occurring. When a patient believes that the probability and seriousness of the feared harm are high, compulsions will increase. However, this does not explain why compulsions are typically repetitive. Their perseverative behavior is reminiscent of a Greek legend in which the Greek gods punished King Sisyphus for his misdeeds in life (Alvarenga et al., 2007). He was forced to push a large, heavy stone up a steep hill. At the end of his long effort, as he nearly reached the top, the stone always rolled down again. This forced Sisyphus to start again, and again, and again, which ended up in an eternity of useless efforts and frustration (Parker, Mills, & Stanton, 2006, p.189). The compulsive perseveration that patients with OCD exhibit is a typical example of such a Sisyphean task: It is a recurring or prolonged action beyond the point where the goal of this activity is reasonably reached (Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011). Thus, one or two checks obviously are not enough for most OCD patients. Apart from objective criteria, patients with OCD seem to use subjective criteria (e.g., washing 'until it feels right') or internal rules (e.g., checking 15 minutes or 25 times) (Wahl, Salkovskis, & Cotter, 2008) as guidance for when to stop their perseverative behavior.

SOMETHING WRONG?

OCD patients with check compulsions are less confident than healthy controls about their memory performance (e.g., Constans, Foa, Franklin, & Mathews, 1995; McNally & Kohlbeck, 1993; Tolin et al., 2001). They seem to engage in checking behavior to obtain more certainty. However, after checking repeatedly, they are still uncertain about whether or not they have locked the door, turned off the coffee machine or closed the window. This suggests that patients with OCD suffer from a general memory deficit (Tallis, 1997). However, the findings on memory dysfunctions in patients with OCD are mixed at best. There are many studies that found memory deficits in patients with OCD (e.g., Dirson, Bouvard, Cottraux, & Martin, 1995; Ecker & Engelkamp, 1995; Rubenstein, Peynircioglu, Chambless, & Pigott, 1993; Savage et al., 2000; Sher, Frost, Kushner, Crews, & Alexander, 1989), but there are just as many studies that found no difference between healthy controls and OCD patients with respect to their objective memory performance (e.g., Christensen, Kim, Dysken, & Maxwell Hoover, 1992; Jelinek, Moritz, Heeren, & Naber, 2006; Kim et al., 2006; Moritz, Kloss, von Eckstaedt, & Jelinek, 2009). Some studies even showed a positive memory bias in patients with

OCD compared to non-clinical controls. For example, Constans et al. (1995) found that recall of last performed behavior was superior in patients with OCD compared to non-clinical controls, but only for actions that elicited anxiety. Radomsky and Rachman (1999) showed that compulsive cleaners had a better memory for contaminated objects compared to anxious and non-anxious controls. Under conditions of high responsibility, Radomsky, Rachman and Hammond (2001) found a memory bias in favor of threat-relevant material in checkers.

Several reviews have been conducted on the range of studies on memory impairment in OCD. Kuelz, Hohagen and Voderholzer (2004) concluded in their systematical review on cognitive impairments in patients with OCD that the results (of 50 studies) are inconsistent, but that OCD seems to be related to visuospatial and verbal memory dysfunction. The results point to a deficit in the ability to efficiently use encoding strategies that are needed to organize information. They suggested that memory problems in OCD are secondary to their impaired executive strategies: Patients, generally, focus too much on irrelevant details during their learning process. In a more recent review, Harkin and Kessler (2011) argued that memory impairments in OCD are secondary to their impairments in executive dysfunction. They propose that executive dysfunctions only impair memory when patients with OCD are confronted with stimuli or situations that are related to their anxious concerns.

What is striking about the memory uncertainty problems of patients with OCD is that they are domain specific. Although patients may display general, mild elevated levels of uncertainty, their uncertainty can be extreme on some domains. They may be uncertain about whether they turned off the lights, but they do not experience difficulty in recalling what they ate for breakfast or which movie they saw yesterday. More specifically, the uncertainty is domain specific for issues that relate to the patients obsessions and/or compulsive activities. For example, patient A is uncertain whether he locked the door properly but feels certain about turning off the stove; while patient B feels pretty confident about locking the door, but displays serious doubts about the stove. Although the findings in memory research are inconclusive, this domain specificity is hard to reconcile with a general memory deficit in patients with OCD (van den Hout & Kindt, 2004).

'I REMEMBER DOING IT, BUT THE MEMORY IS NOT CLEAR SOMEHOW'

The uncertainty that is experienced after repeated checking has a distinct dissociative character. Reed (1985) provided some quotations based on interviews with compulsive checkers about the nature of the experienced uncertainty. These quotations showed that patients reported feelings of unreality and ambivalence after repeated checking, like: 'It's as though the memory is there, but it's not *definite* enough', 'I remember doing it in a way, but it's all fuzzy' or 'Usually I can remember that I've done it, but the memory is not clear somehow' (Reed, 1985; p. 153).

Several studies reported that patients with OCD generally report more dissociative symptoms (Rufer, Fricke, Held, Cremer, & Hand, 2006), defined as disruptions of integrated functions of consciousness, memory, identity or perception of the environment (Watson, Wu, & Cutshall, 2004). For example, Goff, Olin, Jenike, Baer and Buttolph (1992) found that OCD patients scored higher on dissociative symptoms than healthy controls. Furthermore, patients with high dissociation scores had more OCD symptoms than patients with low dissociation scores. Compared to other OCD symptoms, checking is most strongly related to dissociation (Grabe et al., 1999; Rufer et al., 2006, Watson et al., 2004). Moreover, elevated dissociation scores predicted poorer cognitive behavior treatment outcome (Rufer et al., 2005).

Interestingly, several authors reported associations between memory uncertainty and dissociative experiences. For example, the level of dissociation while watching an aversive film is found to be positively correlated with subjective experiences of memory disturbances, but not with objective memory disturbances (Kindt & van den Hout, 2003; Kindt, van den Hout, & Buck, 2005). Merckelbach and Wessel (2000) showed that patients with OCD did not perform worse than healthy controls when they had to remember whether an action was carried out or only imagined. However, the higher patients scored on dissociation, the less confidence they had in their decisions.

PARADOXICAL EFFECTS OF PERSEVERATION

In sum, memory uncertainty motivates patients to check. Despite the absence of obvious memory problems, they still doubt their memory after perseverative checking. The question remains: Why are patients with OCD so uncertain after perseverative checking and what processes are responsible for the dissociative nature

of this experience?

Several authors suggested that repeated checking in itself may not reduce, but paradoxically *increases* memory uncertainty (Rachman, 2002; Salkovskis & Forrester, 2002; Tolin et al., 2001; van den Hout & Kindt, 2003a; 2003b; 2004). This would explain why clinical uncertainty in OCD is so domain specific: Checking undermines memory confidence for issues that are related to the checked event, while confidence in other domains remains intact. Another implication is that if healthy individuals would engage in OC-like checking, they should develop the same type of memory uncertainty displayed by OCD patients.

This is indeed what happens. In a series of studies, van den Hout and Kindt (2003a; 2003b; 2004) instructed healthy participants to engage in a virtual checking task. At the pre-test and the post-test, all participants checked a gas stove and answered questions about vividness and detail of memory and memory confidence for the last gas stove checking trial. In between the pre- and post-test, half of the subjects were allocated to the relevant checking group and the other half to the irrelevant checking group. The relevant checking group engaged in a series of 20 checking trials of the gas stove, while the irrelevant group checked 20 trials of light bulbs. Although memory accuracy remained intact in both groups, vividness and detail of memory as well as memory confidence declined from pre- to post-test in the relevant checking group but not in the irrelevant checking group. Interestingly, during repeated checking, healthy participants experienced the same kind of dissociative ambivalence (e.g., 'I remember doing it in a way, but it's all fuzzy') as reported by patients (van den Hout and Kindt, 2003b; 2004, exp 4). The effects on memory uncertainty were replicated in several other studies. For example, the same effects were found when using a real gas stove instead of a virtual stove (Radomsky, Gilchrist, & Dussault, 2006) and in patients with OCD (Boschen & Vuksanovic, 2007). Furthermore, repeated mental checking induces doubt in memory for previous mental checks (Radomsky & Alcolado, 2010) and subtle confidence-undermining effects of checking can already be observed after 2 to 5 checks (Coles, Radomsky, & Horng, 2006).

While most research on uncertainty in OCD focused on memory distrust, the uncertainty of patients with OCD also relates to other functions, like perception, attention, and language comprehension (Dar, Rish, Hermesh, Taub, & Fux, 2000; Hermans et al., 2008). For example, patients with OCD may be uncertain whether they understand the instruction leaflet of medicines ('Do I properly read that I have to take

two pills in the evening?') or they may doubt if they correctly see that the light is turned off ('Do I see correctly that the switch is turned off, is the light really not on?'). Hermans et al. (2008) studied the effects of repeated checking not only on memory confidence, but also on uncertainty about attention and perception. In contrast to the other studies, the repeated checking task used by Hermans et al. (2008) did not reduce memory confidence in patients with OCD. Moreover, no effects were found on perceptual uncertainty. However, they did find a decrease in confidence in attention in patients with OCD compared to patients with other anxiety disorders and healthy controls. Hermans et al. (2008) used only five checks and thus suggested that this number was probably insufficient to induce reductions in memory confidence. Dek, van den Hout, Giele and Engelhard (2010) investigated the effects of 20 repeated checks on memory, attention and perception. In line with earlier studies (e.g., van den Hout and Kindt, 2003a; 2003b; 2004), they showed that after 20 checks, memory confidence declined. In that study, no effects were found on uncertainty about perception and the effects on attention were not replicated. The results of the study by Dek et al. (2010) suggest that the effects of perseverative checking may be domain specific, i.e., checking only leads to memory distrust and not to attentional or perceptual distrust. Uncertainties about other cognitive functions are also attended by perseveration. The patient who is uncertain about reading the instruction leaflet probably reads the text lines of this instruction dozens of times and the patient that is uncertain about the lights may stare for minutes at the light switch and the light. Possibly, only the cognitive processes that are subject to perseveration are affected. If this is true, then perseverative memory checking leads to memory distrust and not to perceptual distrust, and prolonged fixating on a text line may induce uncertainty about perception, but not about memory. In this way, perseveration may only induce uncertainty about the cognitive operations that are involved.

Van den Hout, Engelhard, de Boer, du Bois and Dek (2008) tested this assumption with respect to the effects of prolonged fixating on perceptual uncertainty. They showed that perseverative staring indeed induced doubt about perception. Healthy participants looked at a gas stove at a pre-test and a post-test for 10 s and answered questions about perceptual uncertainty and general feelings of dissociation. In between the pre-test and the post-test, participants in the experimental condition were instructed to stare for 10 min at the same gas stove, while participants in the control condition stared for 10 min at two light bulbs. Relative to the control

condition, the increase in uncertainty about perception was higher in the experimental condition. Both conditions showed an increase in dissociative feelings. Because 10 min staring is extremely long, in another study the clinical credibility of the staring paradigm was tested by shortening the duration of staring (van den Hout et al., 2009). Participants were asked to look at the gas stove for 2 s during a pre-test and post-test. In between, participants were asked not to look at the stove (control condition) or to stare at it for 7.5 s, 15 s, 30 s or 300 s. Just like the first study, perceptual uncertainty and dissociation were assessed after the pre-test and the post-test. In this study the dissociation questionnaire was adapted to specifically relate to dissociative experiences of visual perception. The results showed that the longer the staring, the stronger the effects on dissociation and uncertainty. This effect occurred fast, around 50% of the maximal increase that was reported after 300 s was already present after 15 s.

Deacon and Maack (2008) instructed students to engage in contamination-related safety behaviors for one week. They were asked to engage in cleaning behavior as much as possible. Examples were disinfecting their hands after coming into contact with several objects, disinfecting telephone receivers, toilet seats, doorknobs etc. After this week, participants showed significant increases in threat overestimation, fear of contamination and emotional and avoidant responses to contamination-related behavioral avoidance tasks. The results of this study suggested that increasing the frequency of cleaning behavior leads to uncertainty about contamination. Although the participants were not instructed to engage in repeated or prolonged cleaning (e.g., prolonged hand-washing), their behavior was more or less perseverative in the sense that it had to be conducted beyond the reasonable point where it added to the goal of the activity (clean hands).

Thus, repeated checking induces uncertainty about memory, perseverative staring induces uncertainty about perception and dissociative experiences and increased cleaning induces doubt about contamination. These effects occur fast: Relatively short intervals of staring (van den Hout et al., 2009) and a low number of checks (Coles et al., 2006) induce uncertainty. It is tempting to speculate that these findings are a special case of an encompassing phenomenon: 'Perseveration → Dissociative uncertainty', in the cognitive function that is involved. Perseveration may be a counter-productive OC-like strategy, which increases dissociative uncertainty and thus may serve to maintain the disorder. Given the findings of the described studies,

the question ensues whether other forms of perseveration, like text repetition, also induce uncertainty. Then, for example, re-reading text lines or repeating sentences would result in more uncertainty about semantics. The second question is whether there is a general mechanism behind this theorized 'perseveration → uncertainty' phenomenon.

OBJECTIVES AND FOCUS

OUTLINE OF THE PRESENT THESIS AND LIMITATIONS

Although much research is done in the field of OCD and cognitive and neuropsychological theories are proliferating, many questions are still unanswered. Like the blind men in the Indian parable 'the blindmen and the elephant', all researchers try to understand the etiology of OCD. In the poem by John Godfrey Saxe (1873) that is based on this story, a group of blind men touches an elephant to learn what it is. However, they all touched another part of it, and therefore came up with different conclusions. For example, the man that felt the tusk concluded that the elephant is like a spear and the blind man that touched the swinging tail argued that the elephant is like a rope. Fortunately, unlike the blind men that resulted in complete disagreement, all lines of research that have been done do contribute to a better understanding of OCD. There are many different theories proposed on the development and maintenance of OCD. Although many aspects and research lines have proved to be important, e.g., high responsibility (Salkovskis et al., 2000) or neuropsychological underpinnings of the OC-behavior, reduction is often inevitable. We are just one of the blind men and focus on one single aspect of the disorder; the maintenance of OCD. More specifically, the aim of this thesis is to get a better understanding of the maintenance of uncertainty after carrying out OC-like perseverative behavior. We had two objectives. The first is to investigate the generality of the 'perseveration → uncertainty' phenomenon. The second objective is to further our understanding of how perseveration breeds uncertainty.

OBJECTIVE 1: GENERALITY

As discussed earlier, research has provided proof of the causal relationship between checking and memory distrust, and staring and perceptual uncertainty. These results seem to be special cases of an encompassing phenomenon: 'Perseveration → uncertainty' and suggests that research should be broadened to

confidence in other cognitive processes. In the current thesis, we further test the effects of perseveration on cognitive distrust in three other domains.

First, **Chapter 2** reports a study in which healthy participants were asked to repeat short sentences. It was examined whether sentence repetition leads to uncertainty about the meaning of the sentence and how fast this effect occurs. It was also explored if effects of repeating sentences are affected by simultaneously looking at the primary object in the repeated sentence (e.g., looking at a mug while saying 'the mug is clean') (Giele, van den Hout, Engelhard & Dek, 2014).

Chapter 3 describes a study in which the effects of 'perseverative reasoning' are tested. Patients with OCD often report that when they are confronted with an innocuous, but disorder-relevant situation, they are uncertain if a catastrophe may follow. Whereas most people quickly conclude that the situation is safe, some patients with OCD may generate lengthy, step-by-step reasoning chains from this neutral situation towards highly improbable catastrophes. We tested whether making perseverative reasoning cascades towards possible harm scenarios induces feelings of uncertainty about a harmful outcome and makes this outcome more credible. We also explored whether making multiple series of reasoning cascades increases these effects. Healthy participants read a neutral situation with an improbable, catastrophic outcome. In a pre-test and post-test, they were asked to rate the credibility of this outcome and feelings of uncertainty. In between, two experimental groups generated respectively one or five series of intermediate steps between the situation and the harmful outcome, while a control group carried out a filler task (Giele et al., 2011).

Chapter 4 presents a study which extended previous research on repeated checking and memory uncertainty by investigating the effects of repeated checking on uncertainty about future threat. Patients do not only check because they are uncertain about their memory, but also because they are uncertain about future catastrophes (Rachman, 2002). Unpredictability of future threat is a causal factor in the development of anxiety disorders (Barlow, 2000). While repeated checking increases uncertainty about memory for past actions, it remains unclear whether repeated checking also increases uncertainty about future threat. This is tested by combining a procedure that is used in discriminative fear-conditioning paradigms with a checking task. Undergraduates checked a virtual stove and virtual light bulbs. The stimulus configuration that the undergraduates used to make discriminations between danger and safety cues was subjected to perseveration (experimental condition) or no

perseveration (control condition) (Giele, van den Hout, Engelhard, Dek, Damstra, & Douma, in press).

OBJECTIVE 2: UNDERLYING MECHANISMS

How might the various types of perseveration induce experiences of dissociation and uncertainty? There are several explanations for this phenomenon. After repeated checking, different memory recollections are created for the same event. Possibly, these similar recollections may interfere with each other and induce memory problems. However, although participants in the studies of van den Hout and Kindt (2003a; 2003b) reported more uncertainty about their memory, their actual memory accuracy was not affected. Moreover, several studies even showed that memory accuracy in patients with OCD increased for threat-relevant situations (e.g., Radomsky et al., 2001). Van den Hout and Kindt (2003a; 2003b; 2004) provided an explanation for the repeated checking → memory uncertainty effect. Novel and familiar events are processed at different levels. Unexpected or new input is associated with more data-driven and perceptual processing, whereas familiarity is attributed to enhance conceptually driven processing (Johnston & Hawley, 1994). When OCD patients check repeatedly, this increases familiarity with the act and stimuli. This indicates that after repeated checking, a patient with OCD probably will know that he has checked the gas stove but he will not *remember* the specific details of a single check. Thus, repetition of many similar check events may make it difficult to distinguish among them, but possibly induces an even better memory representation of the whole situation. This difference between 'knowing' and 'remembering' is indeed found in a study by van den Hout and Kindt (2003b); after repeated checking, participants memory recollection of the last check was based on general knowing instead of specific remembering. Possibly, perceptual elements are inhibited and memory for the last check experience becomes less vivid and detailed as a result of repeated checking (van den Hout & Kindt, 2004). This lack of detail and vividness of the recollection may result in less memory certainty.

Dek et al. (2010) argued that, due to OC-like perseveration, the automaticity of this check behavior is increased. Normally, the outcome of daily routines is taken for granted (e.g., locking the door, turning off the lights). However, patients with OCD may not trust these automatic routines and engage in repeated behavior to enhance their certainty. Ironically, after this repeated checking, the behavior and stimulus become

more and more familiar and automatization increases conceptual processing. Thus, the desire to make use of controlled strategies may lead to a vicious circle of checking behavior and memory distrust.

The above explanations of the effects of perseverative checking do not completely cover the effects of non-checking types of perseveration. For example, in the case of prolonged staring, people mistrust their perceptions but are not uncertain about different memory recollections. This second part of the thesis focuses on another explanation: It aims to critically test whether the 'perseveration → uncertainty' phenomenon can be explained in terms of a blocked spreading of activation of related concepts.

Priming studies showed that if a person is presented with a word (e.g., 'chair'), reaction times are faster for recognition of related words (e.g., 'table') compared to unrelated words (e.g., 'horse') (e.g., Meyer & Schvaneveldt, 1971). According to the spreading of activation theory, after a stimulus is perceived, concepts that are semantically related to the perceived stimulus get more accessible (Collins & Loftus, 1975). In this way, spreading of activation may be involved in the perception of meaning.

However, if a stimulus is repeatedly processed in relative isolation, spreading of activation by the stimulus may be inhibited. The semantic satiation hypothesis states that, as a function of repetition, there is a 'fatigue' of underlying mental structures resulting in semantically related concepts becoming less accessible (Pynte, 1991; Sanbonmatsu, Posavac, Vanous, Ho, & Fazio, 2007; Smith, 1984). This semantic satiation effect is found after repeating words. In a study by Smith (1984), participants had to decide whether a target word (e.g., 'apple') belongs to the same category as a previously presented prime word (e.g., 'fruit'). When the prime and the target were related, relatedness decisions became slower when the prime word was repeated for 30 compared to 3 times (Smith, 1984). Thus, after repetition, fruit loses its power to serve as a prime for related words (Smith & Klein, 1990). This satiation effect was also found in a more complicate design by Black (2001). A word was followed by a word pair that was either related or unrelated to this repeated word. Participants had to decide whether the words of the word pair were related (e.g., 'organ-kidney') or unrelated (e.g., 'organ- flower'). When the word pair was related, reaction times were faster when the preceding word was related to this word pair (e.g., 'heart') compared to unrelated (e.g., 'ceiling'). This facilitation effect disappeared when the preceding

word was repeated. The same effect was found for visual representations. Lewis and Ellis (2000) showed 3 or 30 pictures of a famous person. After these pictures, a picture of another famous person was shown that was related or unrelated to the first. Participants were slower in making a relatedness decision after 30 repetitions compared to 3 repetitions.

This satiation effect can also be experienced subjectively. When a word is repeatedly said out loud (e.g., 'coffee, coffee, coffee. ...'), it will not completely lose its meaning; on a general level the meaning of the word is still understood. However, it starts to feel strange and unreal. As mentioned above, the uncertainty after perseveration has a dissociative character. Individuals realize the nature of the perceived stimulus/situation, but report that it feels strange and unreal (van den Hout & Kindt, 2003b; Reed, 1985). The semantic ambiguity that can be experienced after repeating words (the word 'sounds strange') resembles the experiential effects of OC-like perseveration ('I know that I have done it, but somehow it feels strange'). Is it possible that OC-like perseverative behavior, just like repeating words or pictures, blocks spreading of activation of semantically related concepts? Normally, a perceived stimulus activates related concepts and derives its meaning from this context. For example, when someone turns on the light with a light switch, related concepts like a light bulb will become more accessible. Second, the person knows that this switch is a light switch because this is confirmed by the context (e.g., when the position is changed, the light bulb produces light). If perseverative OC-like behavior interferes with the spreading of activation of semantically related concepts, this would reduce access to related objects and affect meaning. The experiential end-point may be feelings of dissociation and uncertainty that patients with OCD experience (van den Hout et al., 2009).

Chapter 5 presents a study that investigated whether perseverative behavior impairs spreading of activation of related items. Healthy participants were instructed to repeat 20 types of OC-like checking operations (e.g., checking an alarm clock) non-perseveratively (2 times) or perseveratively (20 times). Next, a picture was shown and participants decided as quickly as possible whether this picture was semantically related to the checked object. It was expected that, due to spreading of activation, the non-perseverative condition would be faster in their relatedness decisions for related pictures compared to unrelated pictures. Second, it was expected that this spreading of activation effect was inhibited in the perseverative condition, resulting in a smaller

difference in relatedness decisions reaction times for related vs. unrelated pictures (Giele, van den Hout, Engelhard, Dek, Hoogers, & de Wit, 2013).

Chapter 6 consists of two parts. In the first part, patients with OCD and matched controls participated in a perseveration task, that was comparable to the task described in Chapter 5. Since OCD patients report more dissociative experiences than non-clinical controls (e.g., Hand, Rufer, Fricke, Held, & Cremer, 2006), it was tested whether patients with OCD are therefore more sensitive to the 'perseveration → satiation' effect. This was measured objectively, by measuring the speed of relatedness judgments in the OCD group and in the matched non-clinical control group, and subjectively, by comparing ratings of dissociative uncertainty in both groups. Furthermore, it was tested if semantic satiation effects were stronger in the OCD group compared to the non-clinical group and if experiences of dissociative uncertainty were less tolerated by OCD patients. In the second, exploratory part of this chapter we examined whether the dissociative uncertainty that was found after controlled perseveration is also present after 'clinical' perseveration carried out by OCD patients in their own personal environment (Giele, van den Hout, Engelhard, Dek, Toffolo, & Cath, 2014, submitted for publication).

Chapter 7 is a general discussion in which the main findings presented in the empirical chapters 2 to 6 are summarized and combined. Furthermore, critical limitations of the studies, clinical implications and possibilities for future research are presented.

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6 times

CHECK
DOUBLE
CHECK

Check the
stove!!

Door
Locked?

Is the
light on?

It is off

Chapter 2

Paradoxical effects of compulsive perseveration: Sentence repetition causes semantic uncertainty

Published as:

Giele, C. L., van den Hout, M. A., Engelhard, I. M., & Dek, E. C. P. (2014). Paradoxical effects of compulsive perseveration: Sentence repetition causes semantic uncertainty. *Journal of Obsessive-Compulsive and Related Disorders*, 3, 35-38. doi:10.1016/j.jocrd.2013.11.007

ABSTRACT

Many patients with obsessive-compulsive disorder (OCD) perform perseverative checking behavior to reduce uncertainty, but studies have shown that this ironically increases uncertainty. Some patients also tend to perseveratively repeat sentences. The aim of this study was to examine whether sentence repetitions leads to semantic uncertainty and how fast this effect occurs. We also explored if effects of repeating sentences are affected by simultaneously looking at the primary object in the repeated sentence (e.g., looking at a mug while saying 'the mug is clean'). Between a pre- and post-test, 165 students repeated short sentences only once (control conditions), or 5, 10 or 20 times (experimental conditions). In the pre- and post-test, they completed a questionnaire about feelings of uncertainty and dissociation. While repeating the sentence, participants looked at the object that was part of their perseveration (relevant) or looked at a white wall (irrelevant). Results showed that sentence repetition induces semantic uncertainty, which increased with more sentence repetitions, and was the largest after 20 repetitions. This effect was not qualified by looking at the object of perseveration. These and earlier findings suggest different types of OC-like perseveration have detrimental effects and may fruitfully be targeted in psychological treatments of OCD.

INTRODUCTION

A core feature of obsessive-compulsive disorder (OCD) is a persistent and debilitating doubt. This motivates checking to increase certainty, like checking that the iron is unplugged. Compulsions are typically 'perseverative': Checking may go on for minutes or even hours, beyond the point where the goal of the action is reasonably reached (Giele, van den Hout, Engelhard, Dek, Hoogers & de Wit, 2013). Paradoxically, repeated checking itself produces memory uncertainty. For instance, van den Hout and Kindt (2003a; 2003b; 2004) instructed healthy participants to engage in an OC-like checking task that involved repeatedly checking a virtual gas stove. After this perseverative checking, memory accuracy remained intact, but the recollections were less vivid and detailed than a control group and, most importantly, memory confidence had declined. Checking behavior seems to be self-perpetuating: It leads to reduced memory confidence, which in turn motivates more checking (Rachman, 2002). These negative effects of compulsive checking on memory certainty have been replicated with a real gas stove (Ashbaugh & Radomsky, 2007; Radomsky, Gilchrist, & Dussault, 2006), threat-irrelevant stimuli (Dek, van den Hout, Giele, & Engelhard, 2010), and patients with OCD (Boschen & Vuksanovic, 2007).

Nevertheless, the lack of confidence in patients with OCD is not restricted to memory; it also occurs in other cognitive areas, like perception. Patients may visually fixate on an object, and, for example, stare at their hands to determine if they are really clean, or at a light-knob to convince themselves that the light is really off. Healthy participants who stared for 10 min at a gas stove reported uncertainty about their perception (van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008), and the time-effect of visual perseveration is fast - increased uncertainty was already found after 15 s of staring (van den Hout, et al., 2009).

Reasoning may have perseverative features as well. When some patients with OCD find themselves in disorder-relevant situations, they tend to reason in chains of small steps between the current situation and a highly improbable catastrophe, apparently to make sure they do not overlook potential harmful events. Yet research among healthy participants has shown that OC-like step-by-step reasoning from a neutral situation to a catastrophic outcome enhances the credibility of this feared outcome (Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011). Note that a very similar phenomenon was documented by O'Connor and Robillard (1995), who described an 'inferential confusion' between reality and possibility in patients with OCD. It has been

suggested that this is due to a reasoning process in which OCD patients treat obsessions as valid probabilities rather than recognizing the obsession as an imagined possibility (e.g., Aardema, O'Connor, Emmelkamp, Marchand, & Todorov, 2005).

Thus, OC-like perseveration appears to paradoxically promote uncertainty, and this has been found so far with respect to checking and staring. Moreover, reasoning leads to similar paradoxical effects by increasing the credibility of feared catastrophes. Some OCD patients tend to perseveratively repeat sentences ('my hands are clean, my hands are clean' etc). The question ensues whether text repetition also induces uncertainty. Repeating sentences may lead to brief feelings of ambivalence about the meaning of these sentences to the person, a phenomenon called 'semantic satiation' (Pynte, 1991). The spreading of activation theory states that when a person is presented with a stimulus, the concepts most closely connected to that stimulus are activated as well and become more accessible (Collins & Loftus, 1975). This is thought to occur very fast and without awareness (Dehaene et al., 1998), and to contribute to the experience of the meaning of the word. The spreading of activation theory has typically been studied in semantic priming studies. Meyer and Schvaneveldt (1971) presented two strings of letters simultaneously on a computer screen. Participants were instructed to decide as quickly as possible whether the strings were words or non-words. They were faster for pairs of semantically-associated words (e.g., 'bread' and 'butter') than for pairs of unassociated words ('bread' and 'doctor'). However, when a word is repeatedly presented, it appears that the spreading of activation to related words is blocked (Pynte, 1991; Sanbonmatsu, Posavac, Vanous, Ho and Fazio, 2007; Smith, 1984). For example, Smith (1984) instructed participants to repeat the name of a category 3 or 30 times, and then decide as fast as possible whether or not a target exemplar belonged to the repeated category. This decision was slower after 30 compared to 3 repetitions. It is presumed that this is the underlying mechanism of semantic satiation; when a word is repeatedly presented, the accessibility of semantically-related words is disrupted. This satiation effect can be experienced subjectively; after repeating the word 'bread' several times, the word does not completely lose meaning to the person, but starts to sound strange and induces feelings of ambivalence ('I know what it means, but it sounds strange'). Yet, to our knowledge, this subjective semantic ambiguity has never been tested experimentally.

Patients with OCD typically repeat sentences and not words. Therefore, the aim of the current study was to test whether sentence repetition leads to subjective semantic

uncertainty about the meaning of the sentence. Note that patients often look at the object of interest (e.g., a light switch) when they repeat sentences (e.g., 'the light is off, the light is off'). We explored whether the hypothesized effect of sentence repetition on semantic uncertainty is affected by simultaneous looking at the object of perseveration. Since limited amounts of checking and short durations of staring are sufficient to create uncertainty (Coles et al., 2006; van den Hout et al., 2009), we also decided to examine the threshold at which repeating sentences induces uncertainty.

The current study and the majority of the studies that are described are carried out with a non-clinical sample. This is important, as it is hypothesized that perseverative behavior itself serves to increase uncertainty. This implies that when healthy participants engage in OC-like perseveration, they should experience the same type of uncertainty that is experienced by OCD patients.

In sum, the aim of this study was to test if repeating short sentences leads to subjective semantic uncertainty. It was predicted that (a) compared to a control group, sentence repetition increases semantic uncertainty and (b) there is a dose response relationship between semantic uncertainty and number of repetitions. Furthermore, we explored if effects of repeating sentences are affected by simultaneously looking at the object of interest (e.g., looking at a mug while saying 'the mug is clean').

METHOD

PARTICIPANTS

Participants were 165 volunteer undergraduate students from Utrecht University and University of Applied Sciences (103 females; mean age = 21.8 years, $SD = 2.15$). They received course credit or a small financial remuneration for their participation.

DESIGN

The experiment had a $2 \times 4 \times 2$ mixed factorial design. The within-group factor was Time: Participants completed a questionnaire during a pre-test and a post-test. The first between-group factor was Number: Between the pre-test and post-test, participants were asked to say a sentence once (control conditions), or repeat it for 5, 10 or 20 times (experimental conditions). These numbers were based on results of pilot studies. The second between-group factor was Looking: During perseveration, attention was focused on the object of perseveration (a series of books or a mug) or a white wall.

PROCEDURE

Participants were tested in a dimly lit and sound-attenuated room. The distance between the participant's chair and object of perseveration or the white wall was 50 cm. Participants were asked not to move their chair during repetition of the sentence. The experimenter sat behind the participant. Before the experiment started, participants practiced with repeating sentences aloud at the same pace.

First, participants listened to a sound fragment played on the computer, in which a sentence was prompted. They were instructed to recite the sentence and to look at the object of perseveration that was either a row of books or a mug. Half of the participants said aloud 'the mug is clean' and looked at a clean white mug. The other half said 'the books are standing up straight' and looked at a straight row of four books.

Then, in the pre-test, they completed a questionnaire (see below) on the computer. Next, participants in the 20 repetitions conditions performed the sentence repetitions task, participants in the other six conditions started with a filler task on the computer in which they were asked to detect vowels as quickly as possible. The duration of this task was 28.5 s in the control conditions, 22.5 s in the 5 repetitions conditions and 15 s in the 10 repetitions conditions. After the filler task, participants heard the sound fragment again and said the sentence once or 5, 10 or 20 times, depending on the condition. While perseverating, half of the participants looked at the same object as before the pre-test (mug or books) and the other half looked at the white wall (and could not see the object). Instructions stressed the importance of concentrating on the object or white wall without talking or looking away. Finally, during the post-test, participants completed the same questionnaire as in the pre-test. While completing the questionnaire, the object was covered with a cloth.

MEASURES

SEMANTIC UNCERTAINTY

The level of semantic uncertainty was measured with the following four items that were scored on 100 mm Visual Analogue Scales (VAS), ranging from 'never' (uncertain, meaningless, unreal or strange) to 'always'. The first two semantic uncertainty items used in the present study were generated by the authors and based on pilot studies. The last two items were based on earlier research that examined other forms of perseveration (Giele et al., 2013; van den Hout et al., 2008; 2009).

- While saying the sentence, I was uncertain about its meaning
- While saying the sentence, it seemed as if it did not really have a meaning
- While saying the sentence, it sounded unreal
- While saying the sentence, I thought it sounded strange

Cronbach's alpha was .73 at the pre-test and .82 at the post-test, which indicates that the four items tap the same construct. Corrected item-total correlations at both times were $>.3$. The final score was the average of the four items (range = 0-100).

RESULTS

Outliers were changed into $M \pm 2.5 SD$. When the direction of the differences was predicted, one-tailed p values are reported.

OCI-R

After the experimental tasks, participants completed the Obsessive-Compulsive Inventory-Revised (OCI-R), which is a self-report measures of obsessive compulsive features (Foa et al., 2002), and has good psychometric properties (Abramowitz & Deacon, 2006; Huppert et al., 2007). The mean OCI-R score was 12.6 ($SD = 8.2$), which was significantly lower compared to a sample from the general U.S. population ($M = 18.8$, $SD = 11.1$), $t(840) = 6.74$, $p < .001$, and compared to a U.S. sample of OCD patients ($M = 28.0$, $SD = 13.5$), $t(378) = 12.93$, $p < .001$ (Foa et al., 2002).

SEMANTIC UNCERTAINTY

A $2 \times 4 \times 2$ ANOVA was conducted with Time (pre-test; post-test) as within-subjects factors and Repetitions (1; 5; 10 or 20 times) and Looking (relevant; irrelevant) as between-subjects factors and semantic uncertainty as the dependent variable. This revealed a significant main effect of Time, $F(1,157) = 21.61$, $p < .001$, $\eta_p^2 = .12$, and a significant main effect of Repetitions, $F(3,157) = 4.20$, $p = .07$, $\eta_p^2 = .07$. In line with our predictions, there was a significant Time \times Repetitions interaction, $F(3,157) = 11.30$, $p < .001$, $\eta_p^2 = .18$ (Figure 1), indicating that changes in semantic uncertainty from pre- to post-test differed between number of sentence repetitions. Simple main effects analyses showed that semantic uncertainty declined in the control condition, $M_{diff} = 6.43$, $F(1,157) = 5.71$, $p = .009$, $\eta_p^2 = .04$, and increased in the experimental

conditions after 5 repetitions, $M_{\text{diff}} = 7.86$, $F(1,157) = 8.15$, $p = .003$, $\eta_p^2 = .05$, 10 repetitions, $M_{\text{diff}} = 8.81$, $F(1,157) = 9.99$, $p = .001$, $\eta_p^2 = .06$, and 20 repetitions, $M_{\text{diff}} = 15.63$, $F(1,157) = 29.15$, $p < .001$, $\eta_p^2 = .16$. Post-hoc t -tests revealed that the pre- to post-test changes for the control groups differed significantly from the pre- to post-test changes for the experimental conditions, all p s $< .001$, all r s $> .38$. The pre- to post-test increases between 5 and 10 repetitions did not differ significantly, $t(81) = .21$, $p = .42$, $r = .02$, while the difference in pre- to post-test changes after 10 and 20 repetitions reached significance, $t(77) = 1.66$, $p = .05$, $r = .19$. Likewise, the pre- to post-test increases in semantic uncertainty after 5 and 20 sentence repetitions differed significantly, $t(78) = 2$, $p = .02$, $r = .22$.

The main effect of Looking was opposite to the prediction, with the irrelevant looking condition showing more uncertainty than the relevant looking condition, $F(1,157) = 5.76$, $p = .02$, $\eta_p^2 = .04$. The two-way interactions Time \times Looking and Looking \times Repetitions and the three-way interaction Time \times Repetitions \times Looking were not significant, $F(1,157) = 2.87$, $p = .09$, $\eta_p^2 = .02$, $F(3,157) = 2.18$, $p = .09$, $\eta_p^2 = .04$, and $F(3, 157) < 1$, $\eta_p^2 = .001$, respectively.

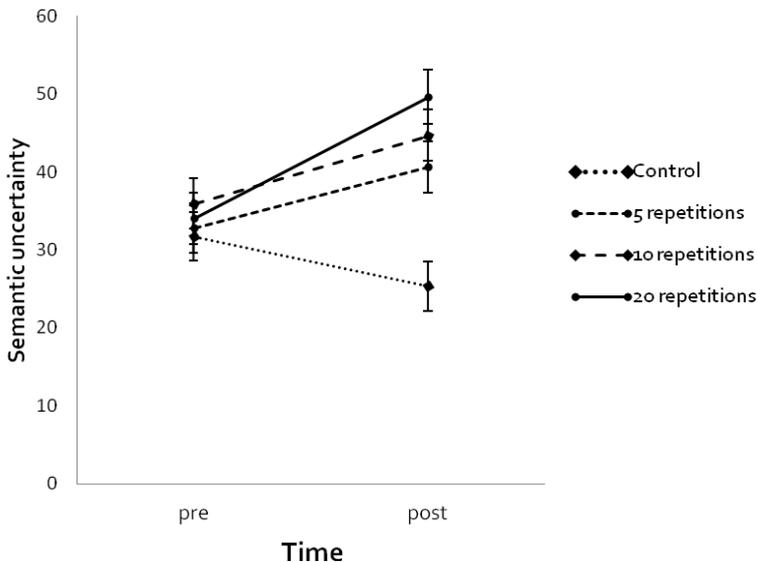


Figure 1. Mean scores on semantic uncertainty before (pre-test) and after (post-test) sentence repetition. Error bars represent standard errors.

DISCUSSION

Results of this study demonstrate that sentence repetition induced semantic uncertainty. This effect occurs relatively fast: After five sentence repetitions. Uncertainty increased with more sentence repetitions; after 20 sentence repetitions the increase in uncertainty was the largest.

The detrimental effects on semantic certainty were not qualified by looking at the object of perseveration. Although it is evident that looking at an object is not the same as staring; the instructions for looking in the current study (concentrating on the object or white wall without looking away) resemble the instructions for staring in the studies of van den Hout et al., (2008; 2009) and therefore, in the current study, prolonged looking had a somewhat perseverative character. The findings of our study suggest that effects of sentence perseveration are not influenced by other cognitive modalities, like prolonged looking. Radomsky and Alcolado (2010) found that repeated physical checking induced memory uncertainty about physical checks but did not affect confidence in memory for mental checking, and vice versa. In line with these findings, Dek et al., (2010) showed that perseverative memory checking leads to memory distrust, but not to attentional or perceptual distrust. The authors suggested that the effects of perseveration may be domain specific; that is, the effects of perseveration may not generalize to other domains but only leads to uncertainty about the cognitive operation that is involved. Likewise, in the current study, sentence repetition induced semantic uncertainty but this effect was not driven by prolonged perception.

Note that the uncertainty during and after compulsive perseveration has a typical dissociative element. When compared to other OCD symptoms, checking is most strongly related to dissociation (Hand, Rufer, Fricke, Held, & Cremer, 2006; Watson, Wu, & Cutshall, 2004). Reed (1985) reported quotations based on interviews with clinical checkers: 'It's as though the memory is there, but it isn't definite enough', or, 'I remember doing it in a way, but it's all fuzzy'. After checking perseveratively, van den Hout and Kindt (2003b) found that healthy participants experienced the same kind of dissociative ambivalence. The study by van den Hout et al. (2009) demonstrated that short intervals of staring also induce dissociative experiences. The current study provides further evidence for the dissociative nature of the subjective uncertainty that results from perseveration; since two of four semantic uncertainty items used in the present study had a dissociative character (e.g., 'while saying the sentence, it sounded

unreal).

The findings of the current study provide another contribution towards a comprehensive model for the 'perseveration → uncertainty' phenomenon, by demonstrating that repeating sentences induces dissociative uncertainty about the meaning of the sentence. This 'perseveration → uncertainty' phenomenon is robust: Repeated checking induces uncertainty about memory (e.g., Boschen & Vuksanovic, 2007), prolonged staring induces uncertainty about perception (e.g., van den Hout et al., 2009), OC-like step-by-step reasoning increases the probability of the feared outcome (Giele et al., 2011) and the present study shows that text repetition induces uncertainty about the meaning of the sentence. This uncertainty about the cognitive operation that is involved has a distinct dissociative character. What is the mechanism linking perseveration to dissociative uncertainty? A possible answer comes from research on spreading of activation and semantic satiation, phenomena hinted to in the introduction.

Recently, Giele et al. (2013) examined whether OC-like motor perseveration induces semantic satiation. Healthy participants were asked to exhibit 20 types of OC-checking behaviors non-perseveratively (2 times) and perseveratively (20 times). Then they decided as quickly as possible whether or not a picture was semantically related to the checked object. The non-perseverative condition showed spreading of activation: Participants were faster in deciding that pictures were related than unrelated. The effect was blocked in the perseverative condition, where reaction times for related and unrelated items were similar. Moreover, perseveration induced dissociative uncertainty.

These findings suggest that perseverative checking blocks spreading of activation and may lead to a loss of meaning of the objects involved in perseveration. This induces a dissociative doubt, 'I know that I've checked the door, but it all feels strange and unreal'. As repeated checking, sentence repetition, prolonged visual fixation and perseverative reasoning all have the same paradoxical effects, it is tempting to speculate that they have the same satiation effects. Future research is clearly warranted here.

Studies on the effects of perseverative behavior on cognitive processes and subjective experiences may help to elucidate the cognitive psychology of OCD. This study adds to the growing body of literature that demonstrates that OC-like perseveration is a counterproductive strategy: It induces a dissociative uncertainty

about the cognitive operation that is involved. Current findings revealed that this phenomenon is also present after text repetition; perseveration of sentences induced semantic uncertainty, which occurs relatively fast (after five sentence repetitions). It seems likely that feelings of unreality and ambivalence have a negative impact on the desired certainty. This way, perseverative behavior, like checking, staring, and text repetition, results in a vicious circle of perseveration and uncertainty.

This study may have an implication for clinical practice. The treatment of OCD with the most empirical support for its efficacy is Exposure and Response Prevention (ERP, National Institute of Mental Health, 2009), which is based on the principle that exposure to stimuli which provoke anxiety, without performing the compulsive rituals that are aimed at reducing that anxiety and preventing negative outcomes, actually decreases anxiety for those stimuli (Abramowitz, Taylor, & McKay, 2009). Possibly, current treatments mainly focus on response prevention of checking and washing motor rituals, like checking gas stoves or washing hands, while perhaps other (subtle) forms of perseverative behavior may easily be overlooked or may seem harmless (e.g., repeating 'the light is off, the light is off'). We suggest that practitioners and OCD patients should be aware that all forms of perseveration could have negative effects and are potential treatment targets.

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12 times

Really?

Ch.
DO
CHECK

Check the
stove!!

Door
Locked?

Is the
light on?

It is off

Is it?

Chapter 3

Obsessive-compulsive-like reasoning makes an unlikely catastrophe more credible

Published as:

Giele, C. L., van den Hout, M. A., Engelhard, I. M., Dek, E. C. P., & Klein Hofmeijer, F. (2011). Obsessive-compulsive-like reasoning makes an unlikely catastrophe more credible. *Journal of Behavior Therapy and Experimental Psychiatry*, 42, 293-297. doi:10.1016/j.jbtep.2010.12.012

ABSTRACT

When obsessive-compulsive (OC) patients are confronted with disorder-relevant situations, they tend to reason in chains of small steps between the current situation and a highly improbable catastrophe. It was hypothesised that this type of 'perseverative reasoning' would increase the subjective likelihood of the feared catastrophe. In an experiment with 63 healthy undergraduates, we tested whether OC-like perseverative reasoning induces feelings of uncertainty about a harmful outcome and makes this outcome more credible. Furthermore, we explored whether making multiple series of events increases these effects. Participants were administered a neutral situation with a catastrophic improbable outcome. In a pre- and post-test, they rated the credibility of this outcome and feelings of uncertainty about the outcome. In between, two experimental groups were instructed to generate respectively one or five series of intermediate steps between the situation and the harmful outcome, while a control group carried out a filler-task. Consistent with the predictions, perseverative reasoning enhanced the credibility of a negative, improbable outcome. However, there were no differences between the two experimental conditions (one or five reasoning chains), and perseverative reasoning did not increase uncertainty about the outcome. The OC-like generation of small steps between an innocuous situation and a negative outcome increases the credibility of a feared outcome, potentially serving to maintain obsessive-compulsive disorder (OCD) problems.

INTRODUCTION

Many obsessive-compulsive (OC) patients engage in perseverative checking (Tallis, 1995). Prior research has consistently shown that persons suffering from obsessive-compulsive disorder (OCD) tend to distrust their memory performance (e.g., Brown, Kosslyn, Breitner, Baer, & Jenike, 1994; Constans, Foa, Franklin, & Mathews, 1995; Dar, Rish, Hermesh, Taub, & Fux, 2000; Ecker & Engelkamp, 1995; Hermans, Engelen, Grouwels, Joos, Lemmens, & Pieters, 2008; McNally & Kohlbeck, 1993). Patients indicate that their repeated checking is caused by distrust in memory for earlier checks (Reed, 1985).

A series of studies has demonstrated that repeated checking itself corrupts confidence in memory. When healthy individuals engage in OC-like perseverative checking by checking gas stoves for 20 times, confidence in memory about the checking is reduced (Ashbaugh & Radomsky, 2007; Radomsky, Gilchrist, & Dussault, 2006; van den Hout & Kindt, 2003a, 2003b, 2004). Coles, Radomsky, and Horng (2006) found that checking between two and five times is sufficient to create memory distrust. Moreover, the dissociative experiences which are common in OCD patients (Grabe, Goldschmidt, Lehmkuhl, Gänsicke, Spitzer, & Freyberger, 1999; Hand, Rufer, Fricke, Held, & Cremer, 2006; Merckelbach & Wessel, 2000) are reproduced by this repeated experimental checking; healthy participants reported similar dissociation-like experiences of ambivalence (van den Hout & Kindt, 2003b). Interestingly, recently Radomsky and Alcolado (2010) found that repeated *mental* checking also reduces memory confidence for previous mental checks.

Patients with OCD also report uncertainty about cognitive operations, like perception or language comprehension (Nedeljkovic & Kyrios, 2007). They tend to try to control this obsessive uncertainty by other forms of perseverative behavior, like prolonged staring or re-reading a line. Van den Hout, Engelhard, Smeets, Dek, Turksma, and Saric (2009) demonstrated that short intervals of staring (i.e., between 7.5 and 300 s) induced uncertainty about perception and dissociative experiences. The larger part of the observed dissociation and uncertainty after 5 min of staring had already occurred within 30 s, and around 50% of this maximal increase was reported between 7.5 and 15 s.

The results of these studies suggest that the detrimental effects of perseveration on trust in memory and perception may be special cases of the general principle that perseveration may lead to uncertainty about cognitive operations that are involved. In

the present context, 'perseveration' can be fruitfully defined as prolonging or repeating an action beyond the point where the goal of the action is reasonably reached. Interestingly, the reasoning style exhibited by OCD patients has a perseverative flavour as well. Patients often argue in lengthy, piecemeal and inventive ways how highly improbable catastrophes may result from innocuous situations and, more particularly, how they may turn out to be responsible for misfortune due to personal carelessness. A nice clinical illustration is given by Johnson-Laird, Mancini, and Gangemi (2006). They describe a patient who worried that she might have been contaminated with HIV, because she had touched a photograph of an actor who had died of AIDS. She argued that the actor may have contaminated the photographer, who might have contaminated the negative of the photograph; this negative might have contaminated the print of the photograph, the person who printed the newspaper might have been contaminated by the print, and therefore may have contaminated the newspaper printer, and this may have contaminated the newspaper and, finally, the patient herself. It is easy to add examples. One of our patients was worried, because she had put chewing gum on the rails of a Ferris wheel and argued that it could not be ruled out that a young child in another gondola would try to take away the gum, bend over, fall down, and dies, leaving the patient guilty.

Note that people typically take it for granted that memory, perception and thinking are adequate: Even without vivid perceptual memories, individuals trust that they locked the car and that the visual impression that a switch is off corresponds to the physical status of the switch. With regard to thinking, individuals quickly jump to conclusions, e.g., there is no reason to worry about HIV being transmitted via touching photos. Patients with OCD, however, seem to distrust the integrity of these cognitive operations and start to persevere in order to decrease doubt. When it comes to reasoning, patients may distrust the conclusion that the outcome of some state of affairs is safe. This impact of possible danger seems to overrule the impact of reality, i.e. that there is no reason to worry about the situation (Aardema et al., 2009). It seems that, in order to be prepared for threat, they start to generate possible step-by-step scenarios that start with an observed state of events and culminate in a dreaded catastrophe. Given that perseverative checking ironically increases distrust in memory (e.g., Ashbaugh & Radomsky, 2007; van den Hout & Kindt, 2003a, 2003b, 2004) and that prolonged staring induces uncertainty about perception (van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008; van den Hout et al., 2009), one wonders if

this perseverative and OC-like step-by-step reasoning has comparable ironical effects. Does this OC-style of reasoning increase the subjective likelihood and/or severity of negative outcomes?

In a relevant review, Koehler (1991) concluded that explanation or imagination tasks increase confidence in what is explained or imagined. When a hypothesis is temporarily treated as if it is true, its credibility increases. For example, in a study by Ross, Lepper, Strack, and Steinmetz (1977), participants wrote explanations why a given event might happen. When they were informed that the event was a figment, they still found it more likely to occur in a given situation, compared to a control group. However, Koehler (1991) also argued that when a scenario is particularly difficult to imagine, imagination has opposite effects. Sherman, Cialdini, Schwartzman and Reynolds (1985) described how participants, who were asked to imagine that they were infected with a disease with unfamiliar symptoms (e.g., an inflamed liver), gave lower probability ratings compared to a control group who did not imagine the symptoms. Given that the catastrophes that serve as the outcome of OC-reasoning chains are typically highly improbable, the Sherman and colleagues (1985) findings suggest that imagining OC-like catastrophes does not lead to more credibility of these outcomes. Nevertheless, in the Sherman study, participants engaged in *imagining* the symptoms and it is unclear if (OC-like) reasoning towards the outcome that the person is infected with the disease would have led to similar results.

O'Connor and Aardema (2003) argue that obsessive compulsive disordered thinking is characterized by mistaking an imagined possibility for a real probability. In a study by Keen, Brown, and Wheatley (2008), individuals with OCD were given an imaginary scenario that consisted of an ambiguous situation and an end of this scenario. Participants were asked to describe step-by-step how this situation might lead to the outcome of this situation. Next, they rated the subjective probability of the scenario and how worried they were that this scenario would happen. Furthermore, the subjective ease with which scenarios could be simulated was measured. Results showed that participants found it easier to simulate and had higher subjective probabilities for a scenario related to their main obsessive fear than scenarios related to other OCD fears. However, the data are silent about any causal contribution of this reasoning style on probability ratings. Because the authors only measured worry and probability of the OC-like outcome afterwards, it remains unclear if these scores for personal relevant OCD scenarios were already at a higher level before the reasoning

process.

The aim of the present study was to critically test if OC-like step-by-step reasoning from a given situation towards an unlikely harmful outcome induces feelings of uncertainty and increases the subjective probability of that outcome. Furthermore, we explored if generating more than one step-by-step cascade between an innocuous situation and a dreadful outcome, would enhance the expected effects. Healthy participants were asked to read brief scenarios about a harmless situation and an OC-like harmful outcome and to answer questions about the credibility of this outcome and feelings of doubt before *and* after the experimental manipulation. Participants were assigned to one of three groups: The first experimental group generated one series of intermediate steps between the given situation and outcome, the second experimental group generated five such series, with small adaptations in the steps (but always with the same harmful outcome), while the control group carried out a neutral filler-task.

METHOD

PARTICIPANTS

Seventy-one volunteer undergraduate psychology students from Utrecht University participated (45 females; mean age 22, $SD = 3.3$). They were paid a small remuneration.

STIMULUS MATERIAL

Three different situations and OC-like outcomes were constructed which were balanced across the three groups. An example of a situation is: *Imagine that it's Saturday night and you're babysitting your niece of nine months old. You're watching television while she sits on your lap. Your niece starts to cry. Because you want to comfort her, you give her a pacifier, but it accidentally falls on the ground. You wipe it off very carefully and then give it to your niece.* All situations were followed by a different OC-like harmful outcome that was related to the situation. For example: *One day later your niece dies and you feel guilty.*

ASSESSMENTS

Credibility of the outcome

Both at the pre-test and the post-test, participants were asked to indicate how credible they thought it was that the given situation might lead to the given OC-like harmful outcome, by rating a 100 mm Visual Analogue Scale (VAS), running from 'absolutely not credible' to 'very credible'.

Uncertainty about the outcome

Uncertainty was measured with the following four items that were rated on a 100 mm VAS, running from 'totally disagree' to 'totally agree'.

- I know that the outcome is not credible, but somehow I start to doubt about it
- I am very certain that the outcome is not credible
- The outcome is more credible than I expected
- I would be concerned that the given outcome would happen
- I would be relieved when [the subject described in the outcome] would be healthy and well

A reliability analysis was executed to examine whether the five uncertainty items reflected one construct. Cronbach's alpha at the post-test was .64 and all corrected inter-item correlations were above .3, except for item 5 ($r = .05$). When this item was deleted, alpha increased to .74, therefore we decided to measure uncertainty about the outcome only with the first four items. Item two was rescaled because it was phrased in an opposite way. The combined scale was the average score on the four items and ranged from 0 to 100.

DESIGN AND PROCEDURE

Participants were tested in a dimly lit and sound-attenuated laboratory room. First, at pre-test, participants were asked to read a scenario about a certain situation and an OC-like harmful outcome and complete the questionnaires (see 2.3. Assessments). Next, participants were trained in step-wise reasoning. In the first phase of the training, they were taught to make one series of small steps (with a minimum of three and a maximum of six steps) between a neutral situation and a *neutral* possible

outcome of this situation. In the second phase, participants were given another situation and neutral outcome, and they were instructed to make two different series of intermediate steps between this situation and outcome. Participants were encouraged not to make completely different ways of reasoning between this situation and outcome, but to make small adaptations in the steps of the two different series.

After the trainings task, participants were randomly assigned to one of the three different groups which each took about three min. Group 1 was asked to make one series of small steps between a neutral situation and an OC-like harmful outcome, between one or two min. They were instructed to make these steps in their mind, without writing them down. After this, they were asked to do a word-puzzle for the remaining time. Group 2 was asked to generate in their mind five series of steps (with small adaptations) between the situation and an OC-like harmful outcome for three min. Group 3 was asked to do a word-puzzle for three min.

After the post-test, which was identical to the pre-test, groups 1 and 2 were asked to write down their reasoning steps, so that they could later be checked by the experimenters. Finally, group 1 and 3 were asked if they had made reasoning steps while doing the word puzzle, and if so, to write these down.

RESULTS

Eight participants were excluded from the analysis. Four of them incorrectly created reasoning steps that were clearly unrelated to the situation and/or the outcome; the other four made reasoning steps during the filler task. Because the filler task served as a control for reasoning, they were dropped from analyses, yielding a final sample of 63 participants (40 females), with a mean age of 21.5 years ($SD = 2.5$).

CREDIBILITY OF THE OUTCOME

The scores on Credibility of the outcome at pre- and post-test were skewed to the left ($M = 15.3$, $SD = 16.3$, and $M = 28.6$, $SD = 25.3$, respectively), and were log-transformed to normality for analyses. Data were analyzed with a 2×3 ANOVA with Time (pre-test and post-test) as the within-group factor and Group (group 1, 2, or 3) as between-group factor. The data are shown in Figure 1.

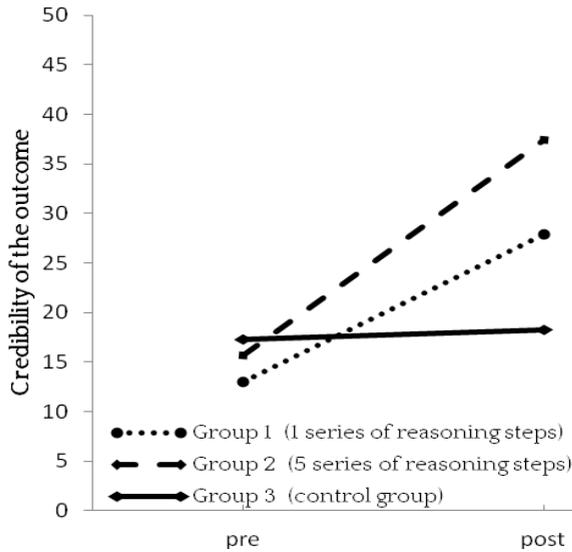


Figure 1. Credibility of the OC-like outcome at pre-test and post-test for the three groups

There was a significant main effect for Time, indicating that, overall, there was an increase in credibility of the outcome from pre-test to post-test, $F(1,60) = 20.81$, $p < .001$, $\eta_p^2 = .26$. The Group effect was not significant, $F(2,60) = .56$, $p = .57$, $\eta_p^2 = .02$. However, the crucial Time \times Group interaction was significant, $F(2,60) = 5.59$, $p = .006$, $\eta_p^2 = .16$, reflecting the fact that pre-to-post increases were higher in the reasoning groups.

Simple main effect analyses were carried out, and revealed that the pre-test to post-test increases were significant in the two reasoning groups, $M_{diff} = .36$, $F(1,60) = 12.44$, $p = .001$, $\eta_p^2 = .17$, for the group which made one series of steps, and $M_{diff} = .46$, $F(1,60) = 22.03$, $p < .001$, $\eta_p^2 = .27$, for the group which made five series of steps), but not in the control group, $M_{diff} = .02$, $F(1,60) = .007$, $p = .94$, $\eta_p^2 < .001$. Thus, only the reasoning groups showed an increase in credibility of the outcome.

Post hoc t-tests revealed that the pre- to post-test changes for the control group differed significantly from the pre- to post-test changes for the two reasoning groups, $t(38) = 2.85$, $p = .004$, $r = .42$, for the group that made one series of steps, $t(40) = 3.35$, $p = .001$, $r = .47$, for the group that made five series of steps. However, more series of reasoning did not contribute to this effect on credibility of the outcome: The pre-test to post-test changes did not differ significantly between the two reasoning groups, $t(42) = .61$, $p = .55$, $r = .09$.

UNCERTAINTY ABOUT THE OUTCOME

An ANOVA showed a significant main effect for Time, $F(1,60) = 5.31$, $p = .025$, $\eta_p^2 = .081$ which reflected the fact that overall, there was an increase in uncertainty from pre-test to post-test. There was neither a significant main effect for Group $F(2,60) = 1.54$, $p = .22$, $\eta_p^2 = .049$, nor a significant Time \times Group interaction, $F(2,60) = .75$, $p = .48$, $\eta_p^2 = .024$.

Fig. 2 suggests that the time-effect is carried mainly by the increases in the experimental groups. Indeed, simple main effect analyses indicated that the pre-test to post-test increase was significant for Group 2 ($M_{diff} = 9.65$, $F(1,60) = 4.96$, $\eta_p^2 = .076$, $p = .03$). However, this effect was not significant for Group 1 ($M_{diff} = 6.69$, $F(1,60) = 2.18$, $\eta_p^2 = .035$, $p = .15$), or Group 3 ($M_{diff} = 1.81$, $F(1,60) = 0.14$, $\eta_p^2 = .002$, $p = .71$).

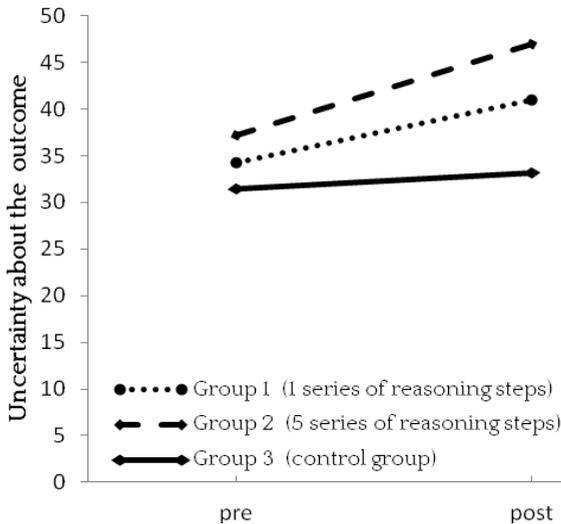


Figure 2. Uncertainty about the OC-like outcome at pre-test and post-test for the three groups

DISCUSSION

The aims of the current study were to examine whether OC-like step-by-step reasoning from a neutral situation towards an improbable catastrophic outcome increases feelings of uncertainty and credibility of the outcome. The results suggest that perseverative reasoning indeed enhanced the credibility of a negative, improbable outcome. Credibility did not increase with more perseverative series; the

effects were similar for participants who made one or five series of reasoning. The effect size of the difference between these experimental groups is small ($r = .09$), (Cohen, 1992). Therefore, it's unlikely that the non-significant effect is due to a power problem. Possibly, the dose-response relationship between the number of reasoning cascades and credibility is not linear, but polynomial or logarithmic, whereby making more series of reasoning does not automatically lead to more credibility of the outcome. The findings are in line with earlier research (Pélessier, O'Connor, & Dupuis, 2009) documenting that participants become less confident about an initial formed conclusion based on given premises after they consider alternative conclusions. Making more reasoning cascades may have comparable effects, that is, new series of events may reduce credibility of an earlier cascade. In spite of a well-grounded explanation for the absence of differences in credibility between the two experimental groups, we suggest that one chain of reasoning may be the threshold for affecting the (in)credibility of an OC-like outcome.

We found an increase in uncertainty between the pre-test and the post-test and further analyses suggest that this effect is mainly carried by the experimental group that made five series of reasoning steps. However, perseverative reasoning did not interact with uncertainty about the outcome; therefore it is hard to draw firm conclusions about differences between conditions.

It seems somewhat odd that perseverative reasoning did not induce more uncertainty about the OC-like outcome, while at the same time the credibility of this improbable outcome increased. One possible explanation may be found in the somewhat unfortunate formulation of the uncertainty items. We expected only small effects of perseverative reasoning on the credibility of the OC-like outcome. Therefore, the statement 'I know that the outcome is not credible, but somehow I start to doubt about it' may be somewhat ambiguous and difficult to answer by participants who found the catastrophe at post-test quite credible. However, when we removed this item and the analyses were rerun (based on items 2-4), they yielded the same results reported for the 4-item scale (with a significant main effect for Time, $F(1,60) = 9.36$, $p = .003$, $\eta_p^2 = .14$, but a non-significant main effect for Condition, $F(2,60) = 1.87$, $p = .16$, $\eta_p^2 = .06$, and most important, a non-significant interaction effect for Condition and Time, $F(2,60) = .81$, $p = .45$, $\eta_p^2 = .026$).

The findings on credibility are inconsistent with the findings of the Sherman et al. (1985) study, which demonstrated that participants who imagined being infected with an unfamiliar disease, underestimated the probability of getting the disease compared to a control group who did not imagine being infected. One might argue that, when someone fails to imagine a feared outcome, this lack of imagination may serve as a source of information, which lends less credibility to the outcome. Koehler (1991) speculates that when a scenario is particularly difficult to imagine, this increased effort could lead to decreased confidence in the outcome. With reasoning, increased effort leads to a better fit between the situation and the outcome. Perhaps step-by-step reasoning towards an improbable outcome makes an outcome more understandable and, therefore, more credible. Further research about imagination and reasoning in OCD and their effects on credibility is warranted.

Johnson-Laird and colleagues (2006) argued that patients with OCD use a dialectical form of reasoning, in which they alternate between searching for examples and counterexamples of the worst case scenario. That is, patients are held to focus on a dangerous catastrophe and try to ensure that there is absolutely no possible way to be at risk. As a consequence, patients paradoxically find possible mechanisms and start to loop between examples and counterexamples of the danger. Comparable to this form of dialectical reasoning is the experimental reasoning task of Aardema, O'Connor, Pélissier, and Lavoie (2009). They confronted OCD patients with a reasoning process that consisted of pieces of possibility of danger and pieces of reality-based information. Aardema et al. (2009) hypothesized that patients with OCD would be more affected by possibility-based information leading to increased uncertainty. Patients with OCD and healthy controls were asked to read an OCD relevant scenario. Following this scenario, they rated the probability that an OC-like outcome (an accident) would happen. Then, participants were provided with reality-based information that no accident had happened and they rated probability again. Next, the participants were given possibility-based information that the accident could have happened and, once again, were asked to rate the probability of the fearful outcome. Each participant was given three pairs of reality-based and possibility-based information. In OCD patients, the outcome probability decreased significantly less than in controls and the impact of possibility-based information was higher in OCD patients than in controls. In our study, we did not assess whether participants, while engaging in step-by-step reasoning, searched for examples and counterexamples of

the OC-like outcome, but it is plausible that the experiment too induced some form of dialectical reasoning. In further research, it would be interesting to gain more insight in the way patients with OCD construct their step-by-step reasoning paths.

This study was performed with a healthy student sample. A possible limitation of this study is that we did not include additional psychometric measures, like measures of obsessionality, dissociation, and imagination. However, the data suggest that the effect of perseverative reasoning on the credibility of unlikely outcomes is a general phenomenon. There is no a priori reason to speculate that the effects of reasoning are different for OCD patients or high scorers on OC-symptoms. For potential future research, it may nevertheless be interesting to investigate the relationship between OC-symptoms and reasoning more closely. OCD patients and/or people who score high on OC-symptoms might be more vulnerable to the effects of reasoning and show even larger increases in credibility, but this awaits future testing.

The study may have some clinical implications. First, it is not uncommon for patients to experience an unexpected situation, quickly generate a catastrophic outcome, and engage in step-by-step reasoning between the two. Explaining that and how step-by-step reasoning in the case of 'OCD-catastrophes' will be counterproductive may be helpful. Second, sometimes the steps between a neutral situation and catastrophic outcome are not well-elaborated by the patient or may appear extremely farfetched to the therapist. Therapists may then try to challenge the imagined scenarios by asking *how* the patient figures that particular transitions may take place (e.g., 'how exactly might HIV be transmitted from the cell phone to the pencil?'). Such therapeutic endeavor may be risky to the extent that it fosters the process that is documented in this paper: It may paradoxically *stimulate* the credibility of the feared catastrophe.

In sum, the OC-like generation of a cascade of events that may take place between a given state of affairs and a negative outcome seems to increase the credibility of the feared outcome. Patients appear to use this reasoning process to make sure they do not overlook potential harmful events. It is assumed that reasoning starts with thoughts about possible danger (Johnson-Laird et al., 2006), and that patients may try to arm themselves against this imagined danger by considering the situation fully. As a result, the patient with OCD starts to make a series of small steps towards this self-created danger. This very strategy, however, has the ironic effect of increasing the belief that the feared event will happen. The attempt to neutralize anxiety through

reasoning is a possible parallel with other forms of perseveration, like checking or staring. The findings suggest that this step-by-step reasoning leads to similar paradoxical effects that are found after prolonged staring (uncertainty about perception) (van den Hout et al., 2008, 2009) or repeated checking (uncertainty about memory) (Ashbaugh & Radomsky, 2007; Boschen & Vuksanovic, 2007; Coles et al., 2006; Dek, van den Hout, Giele, & Engelhard, 2010; Radomsky et al., 2006; van den Hout & Kindt, 2003a, 2003b, 2004). This may make it less obvious that, for example, transmitting HIV by touching pictures is nonsense. The data of this study seems to add to the growing list of studies that reported that the effects of perseverative behavior are in contrast with the intentions of OCD patients; their safety-strategies are counterproductive and lead to a *decrease* instead of an *increase* in confidence about a positive outcome.

ACKNOWLEDGEMENTS

Iris Engelhard was supported with a Vidi Innovational Research grant from the Netherlands Organization for Scientific Research during the time this work was conducted.

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12 times
24

Check the stove!!

Really?
Is it REALLY LOCKED?

Cl. DOU CHE

Door Locked?

Is the light on?

It is off

Is it?

Yes!

Chapter 4

Repeated checking induces
uncertainty about future
threat

In press as:

Giele, C. L., Engelhard, I. M., van den Hout, M. A., Dek, E. C. P., Damstra, M. F., & Douma, E. (in press). Repeated checking induces uncertainty about future threat. *Journal of Experimental Psychopathology*

ABSTRACT

Studies have shown that obsessive-compulsive (OC) -like repeated checking paradoxically increases memory uncertainty. This study tested if checking also induces uncertainty about future threat by impairing the distinction between danger and safety cues. Participants ($n = 54$) engaged in a simulated checking task, in which they completed two series of 19 checking trials. The experimental group checked burners on a stove and the control group checked light bulbs. Participants completed two pre-tests (before the first series of checks) and two post-tests (one after the first series of checks, the other after the second series). In these tests, they first checked the stove and answered questions about memory confidence and accuracy. Then one of two conditioned stimuli (CS; i.e., a circle) was presented. A CS+ replaced a burner that was on, and a CS- replaced a burner that had been switched off. During each CS presentation, participants rated their shock (UCS) expectancy and confidence about UCS occurrence. Next, the CS+ was followed by the UCS. Analyses showed that the first series of checks did not affect memory accuracy and UCS expectancy, but did reduce confidence about memory and about UCS occurrence in the experimental group, relative to the control group. The second series of checks did not lead to these group differences, compared to the first series. The results demonstrate that repeated checking increases uncertainty not only about memory, but also about future threat.

INTRODUCTION

A core feature of obsessive-compulsive disorder (OCD) is persistent and debilitating doubt, often related to issues of overestimation of threat and inflated responsibility, which serves as a motive for compulsive behavior, such as counting in certain patterns or washing hands (OCCWG, 1997). The symptoms are alienating and time-consuming, and cause significant distress and/or disruption in social and occupational functioning (American Psychiatric Association, 2000). OCD has a lifetime prevalence of 2%, and the most common compulsion is checking, with a prevalence of around 80% (Ruscio, Stein, Chiu, & Kessler, 2010). Checking behavior is also common in the general population (Muris, Merkelbach, & Clavan, 1997). Most people will remember certain situations in which they felt responsible and double-checked (e.g., going back home to check whether the door is really locked). However, checking once or twice is not enough for patients with checking OCD. For them, checking is perseverative, and is repeated or continued without serving an apparent purpose (e.g., checking a door that is already locked) (Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011; Giele et al., 2013).

Studies have shown that checkers are less confident than healthy controls with respect to their memory performance (e.g., Constans, Foa, Franklin, & Mathews, 1995; McNally & Kohlbeck, 1993; Tolin et al., 2001). After checking repeatedly, patients remain relatively uncertain about their memory for checked events. Therefore, it has been suggested that checking might have paradoxical effects: Checking may not reduce, but increase memory uncertainty (e.g., Rachman, 2002). This has, indeed, been found (Boschen & Vuksanovic, 2007; Coles, Radomsky, & Horng, 2006; van den Hout & Kindt, 2003a, 2003b, 2004). In a first study by van den Hout and Kindt (2003a), healthy participants engaged in a checking task. In the first and the last trial, participants checked a virtual gas stove. In between these two checking trials, they checked the stove (relevant checking) or light bulbs (irrelevant checking) 18 times. After the first and last trial, questions about memory and meta-memory were assessed. Memory accuracy was similar for both groups, but vividness and detail of the memory as well as memory confidence had declined in the relevant checking group, but not in the irrelevant group. Research with a real instead of virtual stove (Radomsky, Gilchrist, & Dussault, 2006), with threat-irrelevant abstract figures (Dek, van den Hout, Giele, & Engelhard, 2010), and with a clinical sample (Boschen & Vuksanovic, 2007) have resulted in similar findings. Moreover, changes in meta-

memory have been observed after a relatively low number of checks; substantial reductions in memory confidence occurred between 2 and 10 checks (Coles et al., 2006).

In sum, while memory uncertainty provokes checking, repeated checking itself paradoxically increases uncertainty about memory for *past* actions ('what knobs did I check?'). Rachman (2002) suggested that patients feel urged to check, because they try to avoid being held responsible for future catastrophes. Studies have indicated that patients with OCD show a greater intolerance of uncertainty than non-clinical controls (e.g., Carleton et al., 2012; Steketee, Frost & Cohen, 1998; Tolin, Abramowitz, Brigidi & Foa, 2003). Intolerance of uncertainty is defined as the inability to tolerate the possibility that a relatively improbable negative event may occur, and typically relates to uncertainty about future catastrophes (Buhr & Dugas, 2002). For example, patients with OCD who are afraid of spreading disease may not shake hands before washing them repeatedly, and may be upset because they cannot rule out the possibility of future harm. It remains unclear if OC-perseveration also induces doubt about possible *future* threat. This question is important, because unpredictability of future threat is a causal factor in the development of anxiety disorders (Barlow, 2000). A large body of research has shown that organisms prefer predictable aversive events to unpredictable events (Badia, Harsh, & Abbott, 1979; Mineka & Kihlstrom, 1978) and unpredictable danger leads to a more sustained level of anxiety than predictable danger (Grillon, Baas, Lissek, Smith, & Milstein, 2004). Note that when threat can be predicted, then so can safety (i.e., when threat will not occur; Seligman & Binik, 1977). Therefore, unpredictable threat results in a state of chronic anxiety, because danger and safety cannot be distinguished. OCD is accompanied by 'overly anticipating future threats' (Brüne, 2006). Does perseverative checking have paradoxical effects, not only by enhancing uncertainty about memory but also by enhancing uncertainty about future threats, making danger and safety less predictable?

In order to answer this question, we used a variation of a procedure that has been used in discriminative fear-conditioning paradigms (e.g., Lommen, Engelhard, Sijbrandij, van den Hout, & Hermans, 2013). Apart from learning that a conditional stimulus (CS) is a valid predictor of an unconditional positive or negative stimulus (UCS; Davey, 1997; Engelhard, de Jong, van den Hout, & van Overveld, 2009; Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2002), these paradigms include another stimulus (CS-) that is presented in the absence of the UCS. When a negative UCS is

used in a conditional discrimination task, differential conditioning refers to the discrimination between the CS+ that predicts danger (e.g., shock) and the CS- that predicts safety (no shock or the absence of threat).

In this study, participants engaged in a checking task, and were randomly assigned to an experimental group (relevant checking; i.e., of a gas stove) or a control group (irrelevant checking; i.e., light bulbs). Before and after checking, participants checked the gas stove and answered questions about memory accuracy and confidence. Next, they were presented a CS+ or a CS- and rated their shock (UCS) expectancy and confidence about UCS occurrence. Just like earlier studies, we tested whether OC-like relevant checking decreases memory accuracy and confidence. Furthermore, we tested whether repeated relevant checking decreases UCS expectancy and confidence about UCS occurrence.

METHOD

PARTICIPANTS

Participants were 54 students (mean age = 23.07, $SD = 4.42$) from Utrecht University and Utrecht University of Applied Sciences. Exclusion criteria were: 1) a past or current diagnosed psychiatric disorder, 2) epilepsy, 3) a heart condition, 4) use of medication or a drug that may interfere with attention, reaction times, and/or memory, and 5) pregnancy. Students participated voluntarily and signed a written informed consent prior to participation. Afterwards, they received course credit or a financial compensation for participating.

STIMULUS MATERIALS

The task was based on the virtual checking task of van den Hout and Kindt (2003a), which has been used in a series of studies (e.g., van den Hout & Kindt, 2003a, 2003b, 2004; Boschen & Vuksanovic, 2007). It is a computer-based simulated checking task, in which a six-burner stove or a set of six light bulbs can be manipulated.

There were some differences between the current checking task and the original. First, the current task consisted of *two* series of 19 checking trials instead of one. Second, to ensure that the task did not take too long, manipulating the burners and light bulbs was simplified. The electric stove consisted of six rings with six corresponding knobs. Instead of moving the mouse cursor on a rotary knob, we used clicking on the knobs to turn the stove knobs on and off. A single burner was turned

off by clicking three times on the corresponding knob with the left mouse key. After each click, the color of the burner changed from red (on) to white (off). By clicking the right mouse button three times, the burner was turned on. The six light bulbs were turned off and on by clicking three times on the corresponding sliding panels with the left or right mouse key. The color of the lights changed from yellow (on) to white (off); see fig. 1). A third modification was that we added a differential conditional procedure to the checking task. After a checking trial, a CS was presented for 10s. It was a circle that replaced one of the six burners or light bulbs. It served as CS- when it replaced a burner/light bulb that was turned off, and as CS+ when it replaced a burner/light bulb that was *not* turned off. After presenting the CS, a grey screen appeared for 5s. At the same time, the CS+ was always followed by a mild electric shock (UCS) for 5s, delivered via finger electrodes to two fingers of the non-dominant hand. It was adjusted individually to a level that was 'highly annoying but not painful' through a work-up procedure prior to the conditioning task (cf. Orr et al., 2000; Lommen et al., 2013). The CS- was never followed by the UCS.

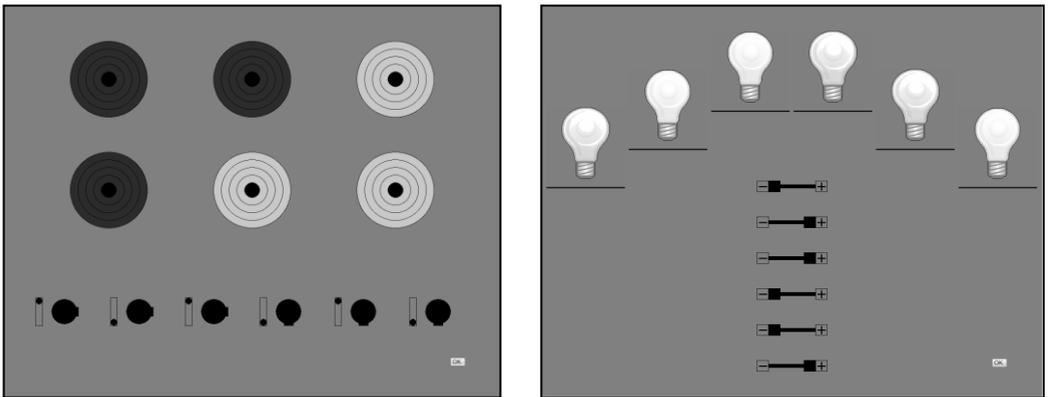


Figure 1. Computer animations of the electric stove and the light bulbs

PROCEDURE

After checking the exclusion criteria, oral and written information was given and written informed consent was obtained. Next, the work-up procedure was used to determine the UCS level.

Practice and acquisition phase

First, participants were shown three crosses for 4 s on the computer screen. Then, the electric stove appeared with six burners, of which three were located on the position of the former crosses. All six burners were on. Participants were instructed to turn off the burners that corresponded with the three crosses and click on the 'ok' button. Next, the stove was shown again and participants were instructed to check the three burners by turning them on and off. The same procedure was practiced with six light bulbs. Then the experimenter explained that after the next checking operation, a screen would be shown with a circle. This circle corresponded with one of the six burners or light bulbs that were shown in the former screen. It was made explicit to all participants that a circle over a burner which was previously 'on' was associated with shock, and a circle over a burner which was previously 'off' was associated with no shock. Thus, only when the circle appeared on the place of a light bulb or burner which was *not* checked, it would be followed by the UCS. It was explicitly mentioned that the circle always concerned the last checking trial.

Next, participants received four practice trials: Two trials with the stove and two trials with light bulbs. One stove trial and one light bulb trial were followed by a CS+ and the UCS and the other two trials were followed by a CS-. Finally, participants practiced with three subsequent trials in which they checked light bulbs. The last trial was followed by a CS-. After the practice phase, the experimenter verified that participants understood the procedure and had learned the CS-UCS relationship.

Pre-tests

During the pre-tests, participants were administered two trials in which they checked the stove. After each trial, they completed a pretest (see Assessments) which consisted of questions about memory accuracy and memory confidence (rated within 10 s), and questions about UCS expectancy and confidence about this (also rated within 10 s). When the CS+ was presented, it was followed by the UCS, and when the CS- was

presented, it was followed by no UCS. Each participant was presented one CS- and one CS+ in random order.

Relevant vs. irrelevant checking

After the pre-tests, half of the participants were allocated to the relevant checking group, and the other half was allocated to the irrelevant¹ checking group. All completed a series of 19 trials; the relevant checking group checked the stove and the irrelevant checking group checked the light bulbs. After the 19th trial of the first and the second series of checks, both groups engaged in one checking trial with the stove and completed a post-test.

Post-tests

The post-tests were administered after the first and second series of 19 checks. The post-tests consisted of the same phases as the pre-tests. After checking the stove, participants completed questions about memory accuracy and memory confidence. Then, a CS+ or CS- was presented with questions about UCS expectancy and confidence about UCS occurrence. The CS+ was followed by the UCS. In one post-test a CS+ was presented and in the other post-test a CS- was presented. The order of the CS+ and CS- was randomized (see fig. II).

¹Checking light bulbs was considered 'irrelevant checking' because it was irrelevant to the stimulus (a stove) used in the pre-tests and post-tests.

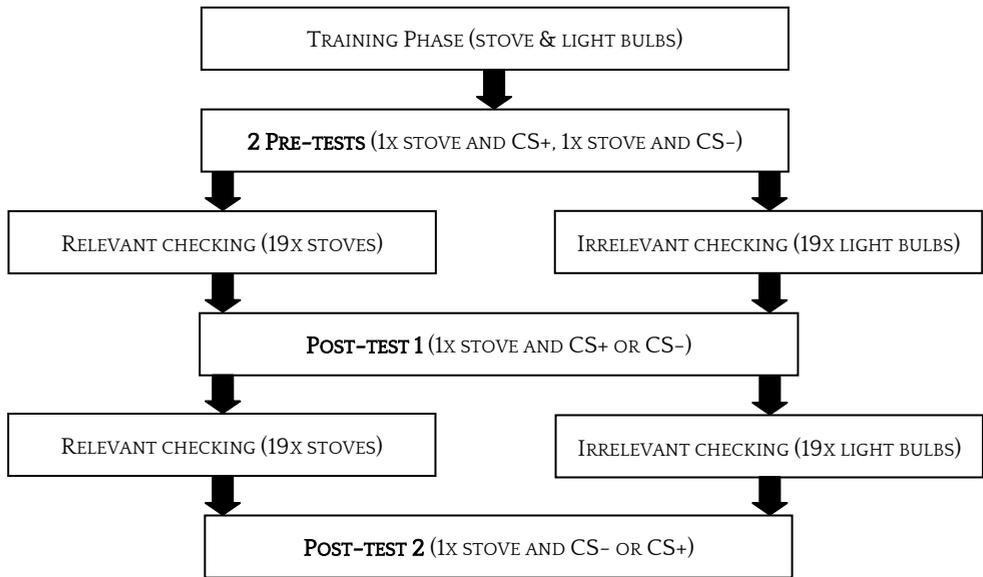


Figure II. Design of the experiment

ASSESSMENTS

Memory accuracy

Participants were shown a schematic representation of the six burners on the screen and were asked to click on the three circles representing the burners they had checked during the last checking episode.

Memory confidence

They were asked to indicate on a Visual Analogue Scale (VAS), ranging from 'absolutely not confident' (0) to 'absolutely confident' (100), how confident they were that their answer was correct.

UCS expectancy

Participants were asked to indicate whether the circle (CS) would be followed by the shock by clicking on 'yes' or 'no'.

Confidence about UCS occurrence

Confidence about the occurrence of the UCS was assessed by asking participants to indicate on a 100 mm VAS, ranging from 'absolutely not confident' (0) to 'absolutely confident' (100), how confident they were that their answer about UCS expectancy was correct.

Subjective aversiveness of the task

Afterwards, participants were asked to indicate on a VAS ranging from 'absolutely not unpleasant' (0) to 'very unpleasant' (100) how they found the task.

RESULTS

Outliers (4.63% of the total responses) were changed to $M \pm 2.5 SD$. A mean pre-test score was calculated for each participant.

MEMORY ACCURACY

In total, 12 mistakes (5.56%) were made at the pre- and post-tests. The number of mistakes in the relevant and irrelevant checking group decreased from pre- to post-tests (see table 1). Thus, memory *accuracy* was not reduced by repeated checking.

Table 1. Number of mistakes made in memory accuracy at pre-tests, post-test 1 and post-test 2

	Pre-tests	Post-test 1	Post-test 2
Relevant checking group	6	1	0
Irrelevant checking group	2	3	0

MEMORY CONFIDENCE

Three participants were excluded from the analysis on memory confidence, because they did not respond within time on the first post-test ($n = 1$) or the second post-test ($n = 2$). This resulted in a sample of 51 participants. Since the assumption of sphericity was violated, $\chi^2(2) = 8.26$, $p < .05$, Greenhouse-Geisser corrected values were used. A repeated measures analysis with Group (Relevant vs. Irrelevant checking) as between-groups variable and Time (pre-test vs. post-test 1 vs. post-test 2) as within-subjects

variable was performed to assess the effect of repeated relevant checking on memory confidence. This 3×2 ANOVA revealed no significant main effects for Time, $F(1.73, 84.62) = 1.8$, $p = .18$, $\eta_p^2 = .04$, or Group, $F(1, 49) = 2.97$, $p = .09$, $\eta_p^2 = .06$. The crucial Time by Condition interaction was significant, $F(1.73, 84.62) = 5.54$, $p = .008$, $\eta_p^2 = .1$, reflecting that the effect of repeated checking on memory confidence differed between conditions (see fig. III).

Simple main effects analyses showed a decrease in memory confidence from the pre-test to post-test 1 in the relevant checking condition, $M_{diff} = 12.75$, $p = .001$, but no change in the irrelevant checking condition, $M_{diff} = 5.1$, $p = .15$. The pre-test to post-test 2 difference in memory confidence was also significant in the relevant checking condition, $M_{diff} = 8.35$, $p = .016$, and was not significant for the irrelevant checking condition, $M_{diff} = 1.41$, $p = .67$. The post-test 1 to post-test 2 differences in memory confidence were not significant for the relevant checking condition, $M_{diff} = 4.4$, $p = .34$, and the irrelevant checking condition, $M_{diff} = 6.51$, $p = .15$.

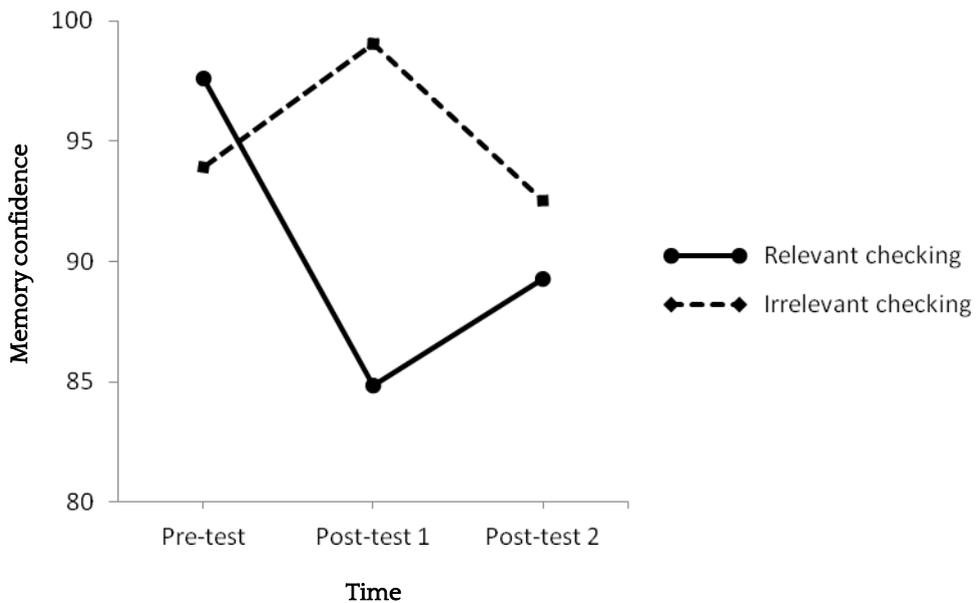


Figure III. Memory confidence before and after relevant/irrelevant checking.

UCS EXPECTANCY

There were four missing values (1.85%) and 23 mistakes (10.65%) during the pre- and post-tests. Table II gives the number of mistakes (i.e., prediction errors) in both conditions at pre-tests and post-tests. Furthermore, participants learned to discriminate the CS+ and CS-. That is, participants expected the UCS in 84.0% of the CS+ trials (of the pre-tests and post-tests), and 5.7% of the CS- trials. This difference was significant, $\chi^2(1) = 128.25, p < 0.001$.

Table II. Number of mistakes (i.e. prediction errors) in UCS expectancy at pre-tests, post-test 1 and post-test 2.

	Pre-tests	Post-test 1	Post-test 2
Relevant checking group (n=26)	1 (and 2 missing values)	4	1
Irrelevant checking group (n=28)	10 (and 2 missing values)	3	4

CONFIDENCE ABOUT UCS OCCURRENCE

Two participants did not respond within the set time on both pre-tests, therefore they were excluded from analysis. This resulted in a sample of 52 participants. A 3×2 ANOVA was conducted with Time (pre-test vs. post-test 1 vs. post-test 2) as within-subjects factor and Group (Relevant vs. Irrelevant checking) as between-subjects factor and confidence in UCS occurrence as dependent variable. Main effects of Time, $F(2,100) < 1, p = .71, \eta_p^2 = .007$, and Group, $F(1,50) = 1.14, p = .29, \eta_p^2 = .02$, were not significant. In line with our predictions, there was a significant Time \times Group interaction, $F(2,100) = 3.99, p = .022, \eta_p^2 = .07$ (fig. IV), indicating that changes in confidence about UCS occurrence differed between the groups. Subsequent simple main effects analysis showed that confidence about UCS occurrence decreased in the relevant checking group from pre-test to post-test 1, $M_{diff} = 7.19, p = .018$, but not in the irrelevant checking group, $M_{diff} = 3.41, p = .24$. The pre-test to post-test 2 differences in confidence were not significant for the relevant checking condition, $M_{diff} = .59, p = .86$, and irrelevant checking condition, $M_{diff} = 1.85, p = .57$. Although figure 4 suggests that confidence about UCS occurrence increased in the relevant checking group from

posttest 1 to posttest 2, this effect was not significant, $M_{diff} = 6.6$, $p = .075$. For the irrelevant checking group, the post-test 1 to post-test 2 change was also not significant, $M_{diff} = 5.26$, $p = .14$.

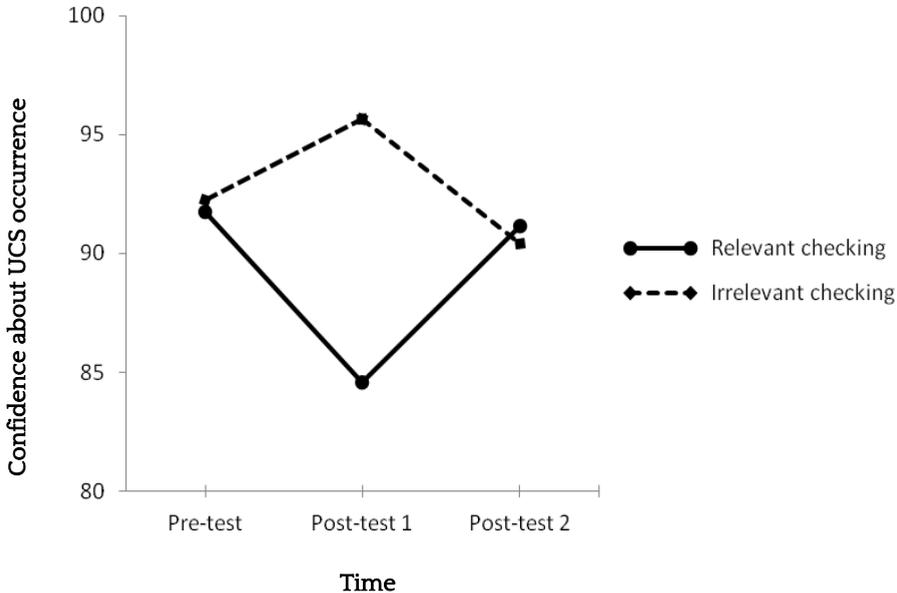


Figure IV. Confidence about UCS occurrence before and after relevant/irrelevant checking

SUBJECTIVE AVERSIVENESS OF THE TASK

Scores on subjective aversiveness of the relevant checking group, $n = 26$, $M = 43.32$, $SD = 29.93$, did not differ from the irrelevant checking group, $n = 28$, $M = 43.97$, $SD = 23.58$, $t(47.51) = .09$, $p = .93$, $d = 0.02$, 95% CI [-14.17, 15.48].

DISCUSSION

Several studies have shown that repeated checking induces uncertainty about past events ('which knobs did I check?'). The present study is the first to examine whether checking also induces uncertainty about *future* threat. Participants learned that a CS+ (circle presented on the place of a burner which was turned on) predicted danger (shock) and that a CS- (circle presented on the place of a burner which was off) predicted safety (no shock). We tested whether repeated checking induced uncertainty about CS+/CS- discriminations, making future safety and danger less

predictable.

The results replicate and extend the earlier findings. Although modifications were made to the original checking task used in earlier research (e.g., Boschen & Vuksanovic, 2007; van den Hout & Kindt, 2003a, 2003b, 2004), similar results were obtained: After one series of 20 checks, repeated relevant checking decreased confidence in memory, but did not affect memory accuracy. There was no further decrease in memory confidence after a new series of 20 checks. Coles and colleagues (2006) demonstrated that memory uncertainty increased when the number of checks increased: Participants completed 0, 2, 5, 10, or 15 checks. The most substantial reductions in memory characteristics occurred after a relatively low number of checking trials; memory confidence was increasingly affected between 2 and 10 checks. The decrease in memory confidence did not differ between the 10 and 15 check conditions. In the current study, participants engaged in a relatively high number of checks. Therefore, the decrease in memory confidence after the second series of checks might be subject to a floor effect.

Furthermore, two series of 20 checks do not equal 40 consecutive checks. Van den Hout and Kindt (2003) have suggested that repeated checking increases familiarity with the checked event and leads to a shift from perceptual to conceptual processing, which results in reduced vividness and detail of the person's recollection of the stimulus, thereby reducing memory confidence. Interestingly, this effect of repeated checking on memory confidence can be attenuated by the use of novel and/or distinctive stimuli, which increase perceptual processing (Boschen, Wilson, & Farrell, 2011). Although we did not change the checked stimulus after the first 20 checks, the automatic processing of the checked stimulus was disrupted by a post-test with new perceptual elements. Therefore, it is possible that participants started with a small increase in perceptual processing at the beginning of the second series of 20 checks. This explanation does not seem to relate well to the phenomena of OCD, because in real life, checking rituals encompass the succession of discrete checking episodes. This (small) disruptive effect of the second post-test on memory confidence would probably not be present anymore after a third post-test with a new checking episode.

Apart from inducing memory uncertainty and relative to the control condition that checked irrelevantly, repeated relevant checking decreased confidence about future threat. After 20 checks, participants were less confident whether or not a CS would be

followed by a mild shock (UCS). Just like repeated checking did not affect memory accuracy, the ability to predict the UCS correctly also remained unaffected by relevant checking. The findings with respect to the second series of 20 checks remained somewhat ambiguous. Confidence about UCS occurrence between the first post-test and the second seemed to increase, although this change was non-significant. There was also no difference in confidence about UCS occurrence between the pre-test and the second post-test. This might be related to the experimental design. After the first series of checks, the post-test was not expected by participants. However, the occurrence of this first post-test may have prepared participants for a new test at the end of the second series, possibly motivating them to remain better focused.

There were no differences between the relevant checking group and the irrelevant checking group with respect to their ratings of subjective aversiveness of the task. This is somewhat surprising, given that unpredictable aversive events are generally more frightening than predictable aversive events (Grillon et al., 2004). However, the aversiveness of the procedure was mainly derived from the occurrence of the shocks, which was identical in the two conditions. This may have obscured any more subtle effects of unpredictability.

The results of the current study demonstrate that repeated checking not only increases uncertainty about memory, but also increases uncertainty about future threat. Patients with OCD try to obtain certainty about the possibility of future aversive events. Repeated checking seems to be counterproductive, because their confidence in the prediction of those threats is reduced by this behavior. As unpredictable danger increases anxiety (Grillon et al., 2008), this may contribute to the maintenance of the disorder.

Although theoretically relevant, the experimental design that is used in the current study differs somewhat from everyday checking by OCD patients. The first difference relates to the actual exposure to the threat. In the current experiment, a small number of harmless electric shocks were given to the participants to be certain that they learned the CS-UCS association. However, patients with OCD (usually) do not experience their feared threat. In future studies, it would be interesting to investigate if the same effect might be obtained with an UCS that has not been presented before. Second, another difference is the disconnection between the checking activity (e.g., checking a gas stove) and threat (shock). The UCS that we used symbolizes the catastrophes that are feared by patients (e.g., fire). However, future studies may

examine if the effects of repeated checking are enhanced when the UCS is idiosyncratic for OCD patients and ecologically connected to the checked event (i.e., fire due to not checking the stove properly).

The third difference relates to the way in which the stimuli were checked. Although checking virtual burners on a screen is not the same as real life checking, the stimuli (i.e., burners and light bulbs) that are checked in the current study are stimuli that are also checked by (some) OCD patients in their daily lives. However, in the current study, every trial, participants checked three different burners (out of six). Moreover, participants turned those burners completely on and off. At first glance, this procedure clearly differs from the checking ritual of OCD patients. Patients may remain focused on the same stimuli to make sure that they are really turned off, closed, switched off, etc. However, some patients report that they are unsure as a result of their repeated checking operations ('maybe I touched the other knobs with my sleeve during the last checking episode'). As a result, they may engage in different types of checking (e.g., checking burners/ lights that were not checked before by turning them on and off). Just like the current study, these different checks may result in different memory recollections.

The hypotheses that were tested imply that uncertainty about memory for past action and future events are normal results of repeated checking. Therefore, the predictions were tested in samples of healthy individuals. Boschen and Vuksanovic (2007) reported that decreases in memory confidence after repeated checking were equal for OCD patients and healthy controls. It remains to be demonstrated whether or not uncertainty about future threat after repeated checking would also be observed in OCD patients. Although this is still an open issue, there are no indications that such differences between OCD patients and controls exist.

In sum, the current study replicates previous work demonstrating that repeated checking increases uncertainty about the cognitive operations involved (e.g., memory for checked events). In addition, it demonstrates that checking behavior also induces uncertainty about future threat: Checking undermines confidence in the ability to discriminate future safety from impending threat. It seems unlikely that repeated checking leads to reduced confidence in general. For example, Dek and colleagues (2010) found that repeated checking reduced confidence in memory, but not in perception or attention. Therefore, reduced confidence in memory and about future threat do not seem secondary to reduced confidence in general.

Note that the aversive shock was administered if a circle (CS) replaced a burner that not turned off in the last trial. The shock was not administered if the circle replaced a burner that was turned off. Participants had to remember whether the burner was turned off or not in order to estimate whether the circle would be followed by a shock. Thus, it is highly plausible that the reduced confidence in UCS expectancy was due to reduced memory confidence induced by repetition. However, crucial to the present findings is that under specific conditions, like the ones created here, reduced memory confidence serves to reduce confidence in the prediction of future events.

Patients with OCD engage in perseverative safety behaviors, like checking, to prevent harm from occurring (Rachman, 2002). When repeated checking increases anxiety by making future danger less predictable, this could increase these safety behaviors. OCD patients may then be trapped in a vicious circle, with repeated checking fuelling problems in telling safety from threat and the other way round. Radomsky, Shafran, Coughtrey and Rachman (2010) and Shafran, Radomsky, Coughtrey and Rachman (2013) suggest to incorporate experimental studies on repeated checking into treatment methods, for example, by using behavioral experiments that let patients experience that repeated checking causes uncertainty. The present findings may serve to underscore why abstaining from perseveration is a crucial element in exposure and response prevention (ERP), the treatment of choice for OCD (Clark, 2004; Rosa-Alcázar, Sánchez-Meca, Gómez-Conesa, & Marín-Martínez, 2008).

ACKNOWLEDGEMENTS

Acknowledgements and thanks to Edwin Dalmaijer for developing the software for the interactive computer simulation that was used in this study.

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Again!
Check
it again!

~~12~~ times
(24)

Really?

Is it
REALLY

Am I sure?

Check the
stove!!

or
Locked?

Is the
light on?

It is off

The light
is OFF

Is it?

Yes!

Chapter 5

Ironic effects of compulsive perseveration

Published as:

Giele, C. L., van den Hout, M. A., Engelhard, I.M., Dek, E. C. P., Hoogers, E. E. P., & Wit, de K. (2013). Ironic effects of compulsive perseveration. *Memory*, *21*, 417-422. doi:10.1080/09658211.2012.

ABSTRACT

Individuals with obsessive-compulsive disorder (OCD) exhibit perseverative behaviors, like checking, to reduce uncertainty, but perseveration paradoxically enhances uncertainty. It is unclear what mechanism might be responsible. We hypothesized that perseverative OC-like behavior produces 'semantic satiation' and interferes with the accessibility of meaning. Healthy participants repeated 20 types of OC-like checking behavior non-perseveratively (2 times) or perseveratively (20 times). Afterwards, they decided as quickly as possible whether a picture was semantically related to the checked object. The non-perseverative condition showed spreading of activation: Judgments were faster for related rather than unrelated objects and pictures. The effect was blocked in the perseverative condition, where reaction times for related and unrelated items were similar. The results suggest that the ironic effects of compulsive perseveration are due to interference with spreading of activation.

INTRODUCTION

People with obsessive-compulsive disorder (OCD) experience recurrent, persistent and debilitating obsessive thoughts, images or impulses (obsessions) that typically relate to harm (e.g., spreading disease). Patients try to prevent or neutralize negative outcomes with perseverative rituals, known as compulsions (e.g., repetitive checking, hand washing). OCD ranks among the most disabling psychiatric conditions affecting about 2% of the general population (Ruscio, Stein, Chiu, & Kessler, 2010). Treatments are available, but many patients do not respond optimally (Fisher & Wells, 2005).

One of the most puzzling aspects of OCD is the perseverative nature of compulsions; why are they prolonged or repeated (e.g., checking the gas knob 10 times) beyond the point where their goal is reasonably reached (e.g., Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011)? Perseveration is thought to result from uncertainty (e.g., 'is the gas knob really off?'; Rachman, 2002), but controlled studies show that OC-like repetition, paradoxically, *increases* uncertainty. Van den Hout and Kindt (2003a, 2003b, 2004) have shown in a series of studies that compulsive checking enhances memory uncertainty. Undergraduate participants engaged in repeatedly checking a gas stove. After 20 trials of checking, memory vividness, memory detail and confidence in memory declined compared to a control group. These results are reproduced in several labs (e.g., Coles, Radomsky, & Horng, 2006; Dek, van den Hout, Giele, & Engelhard, 2010; Radomsky, Gilchrist, & Dussault, 2006), also with a clinical sample of OCD patients (Boschen & Vuksanovic, 2007). Moreover, after prolonged, visually fixating on objects ('Is the knob I see really off?'), uncertainty about perception is induced (van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008; van den Hout, Engelhard, Smeets, Dek, Turksma, & Saric, 2009). Several studies have found a clear link between OCD and dissociative symptoms (e.g. Grabe et al. 1999; Hand, Rufer, Fricke, Held, & Cremer, 2006; Merckelbach & Wessel, 2000). Interestingly, patients with OCD indicate that the uncertainty induced by perseveration has a 'dissociative' flavor to it, 'I know that I have done it, but the memory is not clear somehow' and 'I remember doing it in a way, but it's all fuzzy' (Reed, 1985). This dissociative nature of clinical checking also occurs when healthy individuals copy obsessive-compulsive (OC) -like checking or staring (van den Hout et al., 2009).

The studies described above showed that different forms of perseverative behavior lead to uncertainty. However, it is still unclear what the mechanism behind

this effect is and the crucial question remains: *How* does perseveration breed dissociative uncertainty? Findings on inhibition of 'spreading of activation' may be relevant. When a stimulus is processed, semantically-related concepts become more accessible (Collins & Loftus, 1975). This priming effect has been mainly studied with words; target words that are semantically related to a prime word are more easily recognized than unrelated target words (Smith, 1984). For example, in two studies by Meyer and Schvaneveldt (1971), participants were presented two strings of letters which were words or non-words. The words were semantically related (e.g., 'bread' and 'butter') or non-related (e.g., 'bread' and 'doctor'). In the first study, they were instructed to decide whether both strings were words ('yes') or non-words ('no'). In the second experiment, participants had to respond 'same' if the strings of letters were both words or non-words and 'different' when they were not. The 'yes' responses from study 1 and the 'same' responses from study 2 were faster for pairs of related words than for pairs of unrelated words.

However, there is no reason to assume that the spreading of activation phenomenon is confined to words. For example, handling a coffee machine will make the concept of a coffee cup more accessible. If a stimulus is *repeatedly* processed, spreading of activation may be disrupted. When a word is repeatedly presented, the accessibility of semantically related words is diminished (Smith, 1984; Pynte, 1991). Smith (1984) instructed participants to overtly repeat a category word (e.g., 'fruit') for 3 or 30 times. Then they decided whether another word (e.g., 'apple' or 'robin') was a member of this category. After 30 repetitions, participants were slower in making relatedness judgments. Likewise, Sanbonmatsu, Posavac, Vanous, Ho, and Fazio (2007) found that the priming of words (e.g., 'bombs') towards attitudinal words (e.g., 'horrible') was diminished after repeating the prime word. The loss of semantics is subjectively noticeable: After repeating the word 'milk' 20 times, its meaning is still understood, but the word feels strange. Such 'semantic satiation' also occurs for visual representations. Lewis and Ellis (2000) showed 3 or 30 pictures of a famous person. Afterwards, a picture of another famous person was shown, and participants had to decide whether this person was related to the first. Relatedness decisions were significantly slower after 30 repetitions than after 3 repetitions.

There is a parallel between these alienating effects of repeating words or images and the dissociative nature of OC-like uncertainty after perseverative behavior. The 'repetition-induced semantic satiation effect' may explain how OC-like perseveration

breeds dissociative uncertainty. Perseverative OC-like behavior (like checking) may interfere with spreading of activation of semantic related concepts, thereby reducing access to the meaning of that behavior. If so, exhibiting OC-like perseveration should reduce recognition of stimuli related to that behavior. This may result in the ambivalent uncertainty experienced by OCD patients (e.g., 'I can see the switch is off, but it feels fuzzy and unreal').

The aim of this study was to examine whether semantic satiation might be an underlying mechanism through which perseveration causes dissociative uncertainty, and to extend the literature about semantic satiation from repeated words or images to behavior. Participants exhibited OC-checking behaviors non-perseveratively (2 times) and perseveratively (20 times). Then they decided whether or not a picture was semantically related to the checked object. If the accessibility of meaning diminishes, (a) this decision should be delayed from 2 to 20 checks. Furthermore, we expected that (b) due to spreading of activation, the non-perseverative condition would be faster in recognizing pictures that are related to the checked object than in recognizing unrelated pictures, and (c) due to semantic satiation, the perseverative condition would show a smaller difference between recognizing related and unrelated pictures.

METHOD

PARTICIPANTS

Thirty-eight undergraduate psychology students from Utrecht University participated (mean age 22.5, $SD = 3.2$, 28 females). They received a small remuneration.

DESIGN AND PROCEDURE

The participants were tested in a dimly lit and sound-attenuated room. Twenty instruction clips were recorded by the experimenters. In these clips, 20 different check-operations with different objects were shown. The operations were all derived from OCD cases; they mainly involved checking (e.g., checking a coffee machine or a wallet) and sometimes related to symmetry (e.g., putting two pencils in a 90 degree angle). The duration of the clips was between 5 and 7 seconds and each clip showed one check with one single object. The same objects that were used in the instruction clips were presented to the participants. After watching an instruction clip, participants imitated the behavior, at the same speed, with the object on the desk.

Operations were repeated until a tone (250 ms) was presented. Participants then stopped the action and looked at the computer screen with a black background, which showed a white fixation-cross (1800 ms) followed by the word 'related?' (200 ms), presented in white font. Next, in the middle of the screen a picture (e.g., coffee cup) was presented and participants said as quickly as possible whether the picture was related ('yes') or unrelated ('no') to the operation. Speed of relatedness judgments was measured with a head microphone. Participants had to respond within 5 s, otherwise it was recorded as a non-response. After the response, the picture disappeared. After each trial, a new object was placed on the desk and a new instruction clip was shown. There were three practice trials before the experiment started.

In half of the experimental trials the action was repeated twice and in the other half it was repeated 20 times. Half of the pictures were related to the checked object, half were unrelated. The order of the trials was randomized. This resulted in a within-group design with a 2 (repetition 2 vs. 20 times) \times 2 (picture related vs. unrelated) matrix with 5 trials for each of the conditions.

RESULTS

One participant made only incorrect responses in one of the conditions and was therefore excluded from analysis. From all responses, 6.2% were erroneous: The relatedness response was wrong or the response took longer than 5 s. The average non-recording rate was 8.2%, mainly due to the vocal response being too quiet. These trials were excluded from the analysis.

A 2 \times 2 ANOVA was carried out with Repetitions (2 vs. 20) and Relatedness (related object and picture vs. unrelated object and picture) as within-group factors. Four outliers were corrected. The hypothesis specified directional relationships, therefore the main effect of Repetition and the interaction between Repetitions \times Relatedness were tested one-tailed.

Overall, relatedness judgments were faster for related trials compared to unrelated trials (see Fig. I), which was reflected in a significant main effect for Relatedness, $F(1,36) = 9.09$, $p = .005$, $\eta_p^2 = .2$. The hypothesis that relatedness judgments should be delayed from 2 to 20 checks implies there would be a significant main effect of Repetitions. Indeed this is what was observed; responses were slower after 20 repetitions than after 2 repetitions, $F(1,36) = 13.75$, $p < .001$, $\eta_p^2 = .28$. The crucial Repetitions \times

Relatedness interaction was also significant, $F(1,36) = 3.60$, $p = .03$, $\eta_p^2 = .09$. Congruent with our hypothesis, a paired t-test showed that after 2 repetitions, participants were faster for related objects and pictures, compared to unrelated trials, $t(36) = 3.36$, $p = .001$, Cohen's $d = .45$. We expected that due to semantic satiation, this difference would not be significant in the 20 repetitions condition. This was the case, $t(36) = .95$, $p = .17$, Cohen's $d = 0.11$. For related pictures and objects, a paired t-test showed that participants were slower after 20 repetitions than after 2 repetitions, $t(36) = 3.54$, $p < .001$; Cohen's $d = 0.46$. For unrelated trials, this increase between 2 and 20 checks was non-significant, $t(36) = 1.12$, $p = .14$, Cohen's $d = 0.1$.

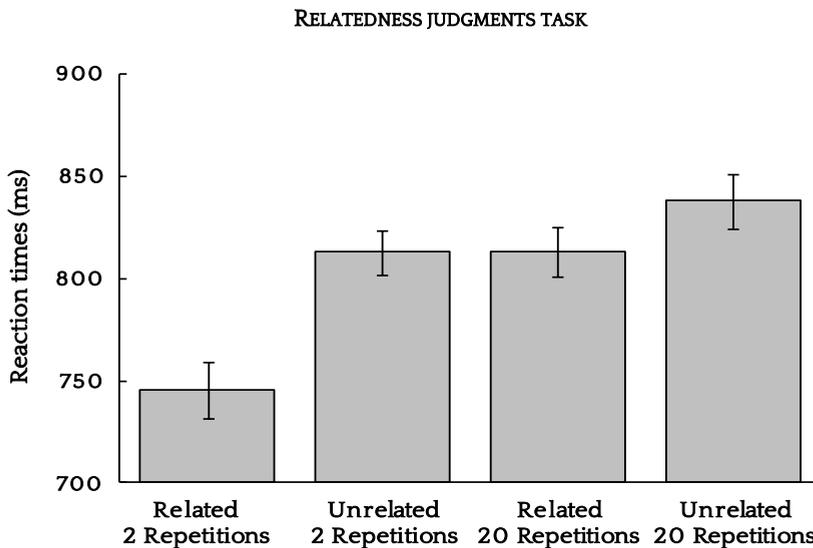


Figure 1. Reaction times (ms) for the relatedness judgments task (related vs. unrelated) after repeating the action 2 vs. 20 times: Means and SEM

DISCUSSION

We hypothesized that perseverative OC-like behavior produces semantic satiation and interferes with the accessibility of meaning. This study followed the design from Lewis and Ellis (2000, Experiment 3), who showed that the repeated presentation of faces results in slower relatedness judgments. The current study extends these findings to repeated behavior: It took longer to decide whether a checked object and

picture were related after 20 checking repetitions than after 2 repetitions. In addition, after 2 repetitions, judgments were faster for related rather than for unrelated pictures, but this spreading of activation effect was blocked as a consequence of repetition; reaction times for related and unrelated items were similar after 20 repetitions.

It seems unlikely that fatigue or distraction explains the slower reaction times after 20 repetitions, because reaction times would then have increased for related as well as unrelated trials for participants who perseverated 20 times. Yet, this was not the case: Reaction times increased specifically between checking 2 and 20 times when the object and picture were related, not when they were unrelated. Moreover, if participants would get tired because of the repetitive checking, they should slow down over the course of the 20 trials. However, they were faster in trials 16-20 ($M = 740$ ms) than in trials 1-5 ($M = 868$ ms).

Our results are based on findings observed in the laboratory. Of course, there are differences between checking in the lab and checking behaviors of OCD patients. For example, unlike the externally induced checks performed in the lab, patients with OCD are internally driven: They check to reduce uncertainty. However, in this study we were interested in the effects of repetitive checking as such, without interference of other processes.

On clinical grounds, we speculated that OC-like perseveration backfires and increases rather than decreases doubt (Rachman, 2002), and this has been repeatedly confirmed experimentally (Boschen & Vuksanovic, 2007; van den Hout and Kindt, 2003a; 2003b; Radomsky et al., 2006)¹. The current study suggests *how* compulsive perseveration may breed doubt: It interferes with spreading of semantic activation rendering the meaning of objects involved in perseveration less accessible.

One may wonder if habituation (i.e., a decreasing behavioral response that results from repeated stimulation; Rankin et al., 2009) is theoretically equivalent to semantic satiation. At first glance, habituation and semantic satiation seem to be identical processes. However, the dissociative experiences that occur after repeated checking are not typical for habituation. It is tempting to speculate that semantic satiation represents some kind of 'over-habituation', but a comprehensive conceptual analysis of the differences between semantic satiation and habituation is beyond the scope of the present paper.

The findings of the current study add to the rationale for Exposure and Response

Prevention (ERP), the treatment of choice for OCD (National Institute of Mental Health, 2009). Although patients may know that their perseverative behavior is dysfunctional, it may be helpful to explain the theory of semantic satiation to them in order for them to understand *why* their perseverative behavior is a counterproductive strategy. Furthermore, OCD patients may appraise dissociative feelings during perseveration falsely. Patients may think that such feelings mean that they are forgetful, going crazy, or are flawed in some other way, rather than understanding that such feelings are normal consequences of engaging in repetitive behavior. Understanding this may reduce anxiety and motivate them to abstain from ritualizing.

The findings on semantic satiation may also have implications outside of clinical contexts. For example, warning signals that are repeatedly shown to smokers or car drivers may lose the ability to activate semantically related concepts, thereby reducing their impact.

In sum, carrying out compulsive perseveration slowed down relatedness judgments, which suggests that access to the meaning of stimuli was reduced, and that compulsive perseveration undermines the accessibility of meaning. These findings suggest that the doubt and distrust experienced by OCD patients during and after perseveration may be the experiential end point of perseveration-induced blocking of spreading of activation.

Footnote

¹Previous studies on perseveration used subjective measures to study uncertainty and dissociation (e.g. van den Hout et al., 2009). Extrapolating from other studies, we predicted that the OC-like perseverative behavior that was carried out in this study induced such feelings. However, to avoid that other measurements interfered with the task we did not include questionnaires about 'dissociative uncertainty'. Therefore, we conducted a short separate study in which we asked 20 participants to check one object non-perseveratively (2 times; $n = 10$) or perseveratively (20 times; $n = 10$). Every participant was randomly assigned to one of the two conditions and all perseverated with a different object, so that all 20 check-operations that were used in the current study were carried out.

Dissociative uncertainty was measured with the following three items, which were scored on 100 mm Visual Analogue Scales (0 = totally disagree, 100 = totally agree).

- While I [performed the check]* it seemed unreal, as if I was dreaming
- While [performing the check]* it seemed as though I was looking through fog, as if [the object]* was further away/ unclear
- When I [performed the check]* I started to feel strange, as if [the object]* was not clear somehow

*The specific operation or object was described in the brackets, which was different for each of the participants.

The first two items were based on items of the Clinician-Administered Dissociative State Scale (CADSS; Bremner et al., 1998) and adapted to relate to dissociation about the object and the check-operation which was carried out. The third item was generated by the authors.

A one-way ANOVA showed that participants who perseverated for 20 times scored significantly higher ($M = 45.1$, $SD = 19.7$) on dissociative uncertainty than participants who repeated the act two times ($M = 12.6$, $SD = 16.2$), $F(1,19) = 16.18$; $p = .001$.

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Again!

Check

AGAIN!

100% ?

12 time

(24)

it

REALLY

Am I sure?

Check the stove!!

or Locked?

Is the light on?

It is off

The light

is off, it is off!
OFF... OFF...

Is it?

Yes!

Chapter 6

The effects of perseveration in obsessive- compulsive disorder

Submitted as:

Giele, C. L., van den Hout, M. A., Engelhard, I. M., Dek, E. C. P., Toffolo, M. B. J., & Cath, D. C. (2014). *The effects of perseveration in obsessive-compulsive disorder*.

ABSTRACT

Obsessive compulsive (OC)-like perseveration paradoxically increases feelings of uncertainty. We studied whether the underlying mechanism between perseveration and uncertainty is a reduced accessibility of meaning ('semantic satiation'). In the first part, OCD patients (n = 24) and matched non-clinical controls (n = 24) were asked to repeat words 2 (non-perseveration) or 20 times (perseveration). They decided whether this word was related to another target word. In contrast to an earlier study with healthy participants (Giele et al., 2013), speed of relatedness judgements was not affected by perseveration; in both groups reaction times were similar after 2 compared to 20 repetitions. We also tested whether repeating words induced more feelings of dissociative uncertainty and whether these feelings were more present and/or less tolerated in patients with OCD compared to controls. Both groups reported more dissociative uncertainty after perseveration compared to non-perseveration, which was higher in OCD patients. The groups did not differ with respect to their intolerance of these feelings. The second part of the study aimed to determine the effects of real-life perseveration on dissociative uncertainty in a smaller subsample of the OCD group (n = 9). Patients reported more dissociative uncertainty after 'clinical' perseveration compared to non-perseveration. Although the mechanism behind 'perseveration → uncertainty' is still unclear, results suggest that the effects of perseveration are counterproductive.

INTRODUCTION

Obsessive-compulsive disorder (OCD) is a debilitating mental disorder with an estimated prevalence rate of 2% (Ruscio, Stein, Chiu, & Kessler, 2010). It is characterized by the presence of anxiety provoking thoughts, impulses, or images that are recurrent and persistent. Most patients carry out compulsive behaviors in response to these obsessions, which are aimed at preventing negative outcomes and/or reducing the associated anxiety. These symptoms can be distressing and time-consuming and result in lower quality of life (Olatunji, Cisler, & Tolin, 2007).

The most prevalent type of compulsive perseveration is checking, e.g., whether the house is properly locked (Ruscio et al., 2010). In a descriptive study, patients reported that they check repeatedly because they distrust memory for earlier checks (Reed, 1985). Checking does not seem to be related to objective memory failures, but may be motivated by the wish to reduce uncertainty (Rachman, 2002). It has been argued that compulsions have the opposite effect, and that, paradoxically, OCD perseveration *increases* uncertainty.

This has been demonstrated in several studies. When students were instructed to repeatedly check a gas stove, their confidence in memory, as well as memory vividness and detail declined compared to a control group. Perseverative checking had no effect on memory accuracy (van den Hout & Kindt, 2003a; 2003b; 2004). However, uncertainty in OCD is not limited to memory distrust; patients are also uncertain about other cognitive operations (Nedeljkovic & Kyrios, 2007). For example, patients may distrust their perception that the electrical switch is off or whether they understand a written line. These uncertainties are also associated with perseveration; patients may stare for minutes at a light switch or they may read a text line dozens of times. Such other forms of perseverative behavior have the same paradoxical effects as repeated checking. Prolonged, visually fixating on objects induces uncertainty about perception (van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008; van den Hout et al., 2009), repeated OC-like washing increases uncertainty about contamination (Deacon & Maack, 2008), repeating sentences induces uncertainty about their meaning (Giele, van den Hout, Engelhard, & Dek, 2014) and perseverative reasoning towards an obsessive-compulsive (OC)-like catastrophe increases the probability of this feared outcome (Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011). The results of these studies on the counterproductive effects of perseverative checking, staring, text repetition, washing and reasoning might be special cases of a

more general principle; that is, perseveration may lead to uncertainty about the cognitive operation that is involved (Giele, van den Hout, Engelhard, Dek, Hoogers, & de Wit, 2013).

The uncertainty that is experienced after perseveration has a distinct dissociative character ('I know that I have done it, but the memory is not clear somehow', 'I remember doing it in a way, but it's all fuzzy', Reed, 1985). Individuals understand the nature of the perceived stimulus, but report that it feels strange and unreal. Interestingly, these dissociative experiences were also found in non-clinical participants: after repeated experimental checking (van den Hout & Kindt, 2003b; expt. 4), perseverative staring (Hout et al., 2008; 2009), and text repetitions (Giele et al., 2014). Why does perseverative behavior induce uncertainty, and why is this uncertainty dissociative? Derealisation during perseveration represents a disturbance in perception of *meaning*. This phenomenon is reminiscent of findings on spreading of activation and semantic satiation.

The spreading of activation theory proposes that when a person is presented with a concept, this will prime concepts semantically related to it, which means that their retrieval will be more rapid than the retrieval of unrelated concepts (Collins & Loftus, 1975). So, for example, if a person is presented the prime word 'banana', he or she will be faster in recognizing the target word 'apple', than the word 'dog' (Meyer & Schvaneveldt, 1971). Neely (1976) tested this by asking participants to indicate as quickly as possible whether a target word was an existing or a non-existing word. The prime was a semantically-related word, a semantically-unrelated word, or a non-word. Results indicated that, participants responses were faster when the prime and target were semantically-related than when the prime was semantically unrelated or a non-word.

However, when a word is *repeatedly* said out loud (e.g., 'bread, bread, bread'), its meaning is affected and facilitation of recognizing related words decreases (Pynte, 1991). According to the semantic satiation hypothesis, as a function of repetition, there is a 'fatigue' of underlying mental structures resulting in semantically-related concepts becoming less accessible (Pynte, 1991; Sanbonmatsu, Posavac, Vanous, Ho, & Fazio, 2007; Smith, 1984; Smith and Klein, 1990). Smith (1984) demonstrated this with a category membership task in which participants had to decide whether a target word (e.g., apple) belonged to the same category as a previously presented prime word (e.g., fruit). This prime word was repeated for 3 or 30 times. When the prime and target

were related, speed of making member decisions was affected by repetition. That is, when the target was a member of the repeated category (e.g., apple – fruit), decision times increased after 30 repetitions, whereas no effect was observed with non-member targets. Thus, after repetition, 'fruit' lost the power to serve as a prime for related words (Smith, 1984; Smith & Klein, 1990). Lewis and Ellis (2000) extended the semantic satiation research by examining this phenomenon with visual representations. They showed 3 or 30 pictures of a famous person. Next, a picture of another famous person was shown. Participants were slower in deciding whether this second person was related to the first person after 30 repetitions compared to 3 repetitions.

Thus, perseveration of words and images blocks spreading of activation. The experience that a word feels strange after repetition (e.g., 'milk, milk, milk') seems to be comparable to the dissociative feelings that patients report after repeated checking or staring. If repeated checking also blocks spreading of activation of semantically related concepts, then this may explain how OC-like perseveration breeds dissociative uncertainty. Repeatedly checking a light switch may block spreading of activation to semantic related concepts, like a lamp, and thereby reduces access to the meaning of that behavior. And when the meaning of checking a light switch is less accessible, this may result in a dissociative experience of uncertainty (e.g., 'I know that the switch is off, but it feels fuzzy and unreal').

To examine the relevance of 'blocked spreading of activation' induced by repetition to the understanding of OCD, Giele et al. (2013) used a relatedness decision task to test whether there were satiation effects after executing perseverative *motor behavior*. Healthy participants exhibited 20 types of OC-checking behaviors. After 2 or 20 repetitions of the same check-operation, they heard a tone and were shown a picture. Participants said as quickly as possible whether this picture was semantically related (e.g., a coffee cup) or unrelated (e.g., a pencil) to the check-operation (e.g., checking a coffee machine). After 2 repetitions, participants were faster in their relatedness decisions when the picture and checked object were related than when they were unrelated. This spreading of activation effect was blocked after 20 repetitions: Participants' responses to related and unrelated pictures were equally fast. Moreover, participants who perseverated 20 times scored significantly higher on dissociative uncertainty than participants who repeated the act twice (Giele et al., 2013).

The results of the study described above suggest that the ironic effects of compulsive perseveration are due to interference with spreading of activation. Carrying out compulsive perseveration slowed down relatedness judgments, which suggests that access to the meaning of related stimuli was reduced. This may induce the dissociative doubt that is experienced by OCD patients. Note that this perseveration/satiation study was carried out in non-clinical individuals. Compared to non-clinical controls, OCD patients report more dissociative experiences (Goff, Olin, Jenike, Baer & Buttolph, 1992), and the question arises whether patients with OCD, compared to healthy controls are more sensitive to the 'perseveration→satiation' effect described above. The current study aimed to answer this question, and consisted of two parts.

In the first part, OCD patients and matched controls participated in a perseveration task that was comparable to the described experiment with healthy controls (Giele et al., 2013). We hypothesized that (1) in both the OCD group and a matched non-clinical control group, relatedness judgments would slow down and (2) dissociative uncertainty would be higher in the perseverative condition, compared to the non-perseverative condition. Furthermore, we hypothesized that the impact of perseveration for OCD patients compared to non-clinical controls would be higher (3) on reaction times and (4) subjective ratings of dissociative uncertainty. Constans, Foa, Franklin and Matthews (1995) reported that OCD patients and controls did not differ in the level of reported vividness of memories, but OCD patients stated that they *desired* more vivid memories than controls. This discrepancy between actual and desired quality of memory suggests an *intolerance* of uncertainty. Several studies have found indications that OCD patients indeed experience more intolerance of uncertainty than non-clinical controls (e.g., Steketee, Frost & Cohen, 1998). For example, a study by Tolin, Abramowitz, Brigidi, and Foa (2003) revealed that OC checkers showed greater intolerance of uncertainty than OC non-checkers or non-anxious controls. Therefore, we also explored whether, (5) regardless of perseveration, the dissociative uncertainty caused by perseveration was tolerated less by OCD patients compared to non-clinical controls.

As noted above, several studies have reported that OCD patients in general report more dissociative symptoms (Rufer, Fricke, Held, Cremer, & Hand, 2006). Interestingly, compared to other OCD symptoms, checking is most strongly related to dissociation (Rufer et al., 2006; Watson, Wu & Cutshall, 2004). Moreover, elevated

dissociation scores predicted poorer CBT outcome (Rufer et al., 2005). These studies investigated dissociation as a *trait*, a relatively stable characteristic of OCD patients which indicates that their integrated functions of consciousness, memory, identity or perception of the environment are disrupted (Watson et al., 2004). Perseveration which is induced under controlled laboratory conditions provokes dissociative uncertainty. This suggests that 'clinical' perseveration performed by patients with OCD is attended by *state* dissociation. On-the-spot research is an important addition to the present laboratory studies. The second part of the study aimed to determine the effects of real-life perseverative behavior on dissociative uncertainty in patients with OCD. We expected that the same dissociative uncertainty that is found in healthy individuals after experimenter-induced perseveration (Giele et al., 2013) is present after 'clinical' perseveration carried out by OCD patients in their own environment (e.g., at home).

PART 1

METHOD

PARTICIPANTS

OCD patients were recruited from the Altrecht Academic Anxiety centre (AAA) mental health centre (ambulant care) and the Vincent van Gogh Centrum Angst- en Dwangstoornissen (VVG-CAD) mental health centre (inpatient care). Patients were assessed the OCD module of the Dutch version (van Groenestijn, Akkerhuis, Kupka, Schneider, & Nolen, 1999) of the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996) and were included when they had a DSM-IV diagnosis of OCD. This OCD module was administered by a psychologist under the supervision of the first author. Two patients were excluded from analysis because they were in partial remission.

Patients were excluded from this study if they were insufficiently proficient in the Dutch language, if they were addicted to alcohol or drugs, or if they suffered from symptoms from the psychotic spectrum. Healthy controls were recruited through advertisements. They were age, sex and education matched to the patients with OCD included in the study. Controls were excluded when they had OCD or any other current psychiatric disorder, including alcohol and drug abuse, or were non-fluent in Dutch.

The final sample consisted of 24 patients ($M = 34.33$ years, $SD = 9.09$, 16 females)

with a primary OCD diagnosis and 24 age/sex/education matched non-clinical controls ($M = 34.29$ years, $SD = 13.26$, 16 females) who received a small remuneration in return for their participation. The highest educational level was determined using a 3 point scale (1: primary education, low-level vocational training & intermediate general vocational training/ 2: intermediate professional vocational training & college-bound high school/ 3: college & university), which did not differ between the OCD patients ($M = 2.29$, $SD = .75$) and non-clinical controls ($M = 2.46$, $SD = .72$). Participants gave oral and written informed consent. The study was approved by the Medical Research Ethics Committee (MREC) of the University Medical Center (UMC) Utrecht.

PROCEDURE

Participants were tested in a dimly lit and quiet room where they sat at a table with a PC and a response box. Instructions were partly presented on the computer screen and were partly explained by the experimenter. The experimenter was present in the same room during the whole task, in order to be able to explain any obscurities or answer questions if necessary. First, participants received information about the study and filled out the informed consent. Then, they filled out the questionnaires (OCI-R, Y-BOCS, BDI-II and BAI). Next, participants started with the perseveration task (see *Materials and Design*), which started with a training phase. After the training phase, participants started with the experiment, which consisted of 60 trials. Participants were asked to fill out questionnaires about dissociative uncertainty and intolerance of these feelings after both the first and second trial (Time 1), and after both the 59th and 60th (Time 2) trial of the experiment. The reason to administer the questionnaires at these trials and not throughout the experiment was to reduce effects of repeated testing (e.g., answers to later questions being motivated by a wish to remain consistent with earlier answers). At the end of the last trial, participants were asked to fill in the PDEQ. The duration of the total experiment was approximately 50 minutes.

MATERIALS AND DESIGN

The perseveration task that was used in this study is based on the relatedness decision task of Giele and colleagues (2013). Instead of repeating motor behavior, participants in the current study repeated neutral words. Before the experimental phase, a training phase was conducted in order to train participants in repeating words and making relatedness decisions. Participants practiced repeating a neutral prime word aloud at

the same pace. They were shown a white fixation cross (1000 ms) and subsequently a neutral word (2000 ms). The pace at which they had to repeat this word was indicated by the appearance of a white circle in the middle of a black screen. This circle was repeatedly shown for 250 ms with an interval of 350 ms. They had to repeat this word, until a short tone was presented. Participants then stopped repeating the word and had to look at the computer screen which showed a white fixation cross (1800 ms) on a black background. Next, in the middle of the screen a target word was presented and participants were instructed to indicate as quickly and accurately as possible whether this word was related or unrelated to the word they just repeated by pressing the blue (related) or yellow (unrelated) knob of a response box. After a response, the word disappeared. Then, a new word was presented on the screen and the same procedure started again.

For half of the participants, the blue (related) knob was located on the left side and the yellow (unrelated) knob on the right side of the response box, for the other half, this was reversed. During the entire experiment, participants had to keep their left hand on the left knob and their right hand on the right knob to be able to respond as quickly as possible. Their reaction times were automatically recorded by the response box. Participants had to respond within 5 s, otherwise their response was recorded as a non-response.

During the training phase, participants received feedback from the experimenter about their accuracy. The first practice trial consisted of only repeating words, from the second to the 10th trial, participants practiced with both repeating words and making relatedness decisions. In the first five practice trials, the pace to repeat the word was indicated by showing the white circle. In the last five practice trials, participants were instructed to try to repeat the word at the same pace that was practiced in the previous trials, but now the circle was not shown (just like in the experimental phase). The number of word repetitions differed between practice trials.

The experimental phase consisted of 60 trials. In each trial a new neutral prime word was repeated, but the number of required word repetitions and the presentation of related versus unrelated words differed between trials. Four conditions were created, with 15 trials of each condition, so that for half of the 60 trials the prime word was repeated 2 times (non-perseveration) and in the other half the prime word was repeated 20 times (perseveration). Furthermore, in half of the 60 trials a related target word was shown, in the other half a non-related target word was

shown. This resulted in the conditions: Related/2 repetitions; Unrelated/2 repetitions; Related/20 repetitions and Unrelated/20 repetitions. The order of presentation of the conditions was pseudo-randomized over trials. To control for time effects (with respect to the dissociative uncertainty questionnaire), the randomization was created in such a way that on Time 1 (trial 1 and 2) participants had to repeat one word 2 times and another word 20 times (or vice versa), and on Time 2 (trial 59 and 60) one word 2 times and one word 20 times (or vice versa). In sum, the experiment had a mixed factorial design with three independent variables: Perseveration (perseveration/non perseveration), Relatedness (words related/words unrelated) and Group (OCD patients/ non-clinical controls).

The 60 prime and 60 target words were matched between the four conditions on number of syllables, on Dutch word frequency (based on the database 'SUBTLEX-NL' which consists of 44 million words from film and television subtitles in the Dutch language; Keuleers, Brysbaert, & New, 2010) and on strength of association between the cue and the target. This strength of association was based on the Dutch Word Association Database (www.kuleuven.be/semlab/interface/index.php), in which the probability ratings of the most frequent responses (target words) to 8995 cue words can be found.

MEASURES

Clinical characteristics

Participants completed two self-report measures of obsessive-compulsive symptoms: The Obsessive-Compulsive Inventory-Revised (OCI-R, Foa et al., 2002), and the self-rated version of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS, Goodman et al., 1989). Participants also completed the Beck Depression Inventory-II (BDI-II, Beck, Steer, & Brown, 1996), which measures levels of symptoms of depression, and the Beck Anxiety Inventory (BAI, Beck, Epstein, Brown, & Steer, 1988; Beck & Steer, 1991), which measures severity of anxiety symptoms. Compared to the non-clinical group, OCD patients scored significantly higher on all measures, see Table 1.

Table 1. Descriptive statistics of the clinical characteristics

	OCD		Non-clinical		<i>df</i>	<i>t</i> (<i>p</i>)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Y-BOCS	18.63	7.14	1.75	2.82	29.98	10.77 (<.001)
OCI-R	22.5	11.87	6.29	4.75	30.18	6.21 (<.001)
BDI-II	22.96	12.1	6.21	6.26	34.47	6.02 (<.001)
BAI	19.67	10.87	5.5	4.65	31.16	5.87 (<.001)

Dissociative uncertainty

The level of dissociative uncertainty in the relatedness decisions task was measured with the following three items, scored on a 9-point Likert scale (1 = totally disagree, 5 = not agree, not disagree, 9 = totally agree).

- While I was saying the word [WORD]* aloud, it became unreal, as if I was dreaming.
- While I was saying the word [WORD]* aloud, this word started to sound strange; different than I would normally expect.
- When I was saying the word [WORD]* aloud, I started to feel strange, as if the word [WORD]* was not clear somehow.

*The neutral word that was repeated aloud was mentioned in the brackets (e.g., 'fork'), this word was different for each of the trials

The first and the second item are based on items of the Clinician-Administered Dissociative State Scale (CADSS; Bremner et al., 1998) and were adapted to the present task. The third item was used in the study of Giele and colleagues (2013) and was also adapted to the present task. A reliability analysis suggests that the three items reflect one construct; at Time 1, Cronbach's alpha after 2 repetitions was .93 and after 20 repetitions it was .90. The combined scale was the average score of these three items.

Intolerance of dissociative uncertainty

The level of intolerance was measured when participants experienced a certain level of dissociative uncertainty. Therefore, participants were asked to score intolerance of dissociative uncertainty only when they scored 6 or higher on the related item which measured dissociative uncertainty (e.g., they had to score item 1b when they scored 6 or higher on the Likert scale of item 1a). Irrespectively of perseveration, a mean score of all intolerance items that were scored after the first, second, 59th and 60th trial was calculated. The level of intolerance of dissociative uncertainty was measured with the following three items, scored on three 100 mm Visual Analogue Scales (0 = not unpleasant, 100 = very unpleasant).

- These experiences of unreality were ..
- This strange sound was ...
- These strange feelings were ...

Dissociative Experiences

Dissociative symptoms were measured with the Dutch version of the Peritraumatic Dissociation Experience Questionnaire (PDEQ; Engelhard, van den Hout, Kindt, Arntz, & Schouten, 2003). This is a 10-item self-report inventory (scored on five point Likert scales ranging from 1 = absolutely untrue to 5 = absolutely true) used to assess dissociation, with well-established psychometric properties (Marmar, Metzler, & Otte, 2004). Participants were asked to rate the items of this questionnaire with respect to dissociative experiences that they might have experienced during and directly after the experiment.

RESULTS

RELATEDNESS DECISION TASK

In this task, the speed of relatedness judgments was measured after repeating words 2 or 20 times. Median values were used to minimize outlier effects, which were log-transformed to normality. From all responses, 3.33% (96 responses) were wrong and 0.28% (8 responses) took longer than 5s and were removed from analysis. Furthermore, 19 responses (0.66%) were removed because of procedural errors. Finally, 4 responses (0.14%) were removed because more than 50% of the participants responded incorrectly on this cue-target combination.

A $2 \times 2 \times 2$ ANOVA was carried out with Perseveration (2 vs. 20) and Relatedness (related cue and target word vs. unrelated cue and target word) as within-group factors and Group (OCD patients vs. non-clinical control) as between-group factor. It was predicted that participants would be faster in making relatedness judgments for related words compared to unrelated words. This was reflected in a significant main effect for Relatedness, $F(1,46) = 10.68$, $p = .002$, $\eta_p^2 = .19$ (see figure 2). Overall, OCD patients were somewhat slower in making related judgments than non-clinical controls; which was reflected in a non-significant trend effect for Group, $F(1,46) = 3.72$, $p = .06$, $\eta_p^2 = .08$. However, there was no delay in making relatedness judgments from 2 to 20 repetitions; the main effect for Perseveration was non-significant, $F(1,46) = .59$, $p = .45$, $\eta_p^2 = .01$. Also, all two way interactions (Perseveration \times Relatedness, Perseveration \times Group and Relatedness \times Group) and the crucial three-way interaction (Perseveration \times Relatedness \times Group) were non-significant, all F 's < 1 , all $\eta_p^2 < .02$ (see fig. 1).

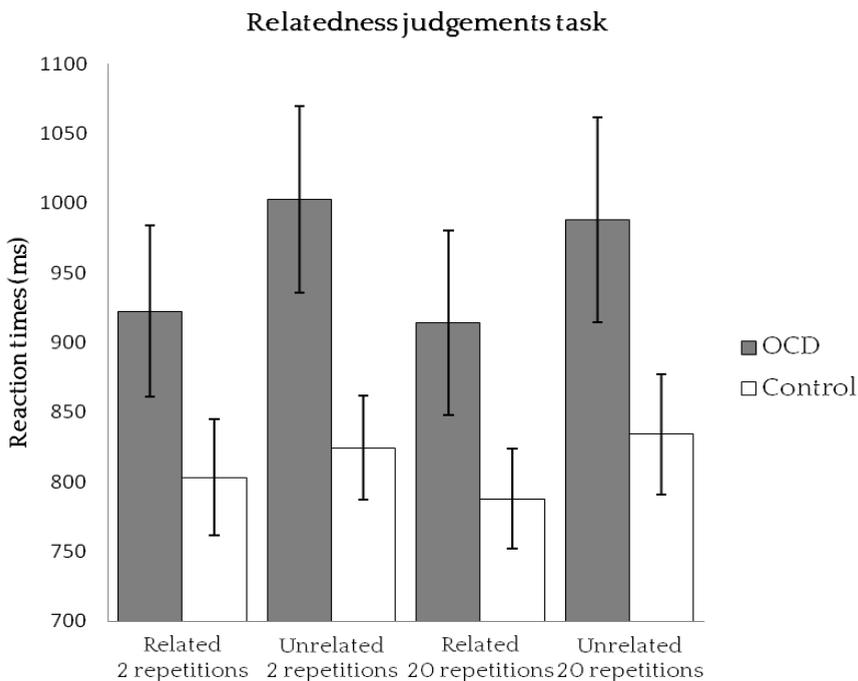


Figure 1. Reaction times (ms) for the relatedness judgements task (related vs. unrelated) for OCD patients and non-clinical controls after 2 vs. 20 word repetitions. Error bars represent standard errors

DISSOCIATIVE UNCERTAINTY

A $2 \times 2 \times 2$ mixed ANOVA with Perseveration (perseveration/non perseveration) and Time (Time 1/ Time 2) as within-groups variables and Group (OCD patients/ non-clinical controls) as between-groups variable was performed to assess the effect of repeating words on dissociative uncertainty.

The main effect for Perseveration was significant, $F(1,46) = 43.87, p < .001, \eta_p^2 = .49$, and was qualified by the crucial Perseveration \times Group interaction, $F(1,46) = 3.57, p = .03, \eta_p^2 = .07$ (one tailed), which reflected that the effect of repeating words on dissociative uncertainty was stronger for OCD patients compared to non-clinical controls (see fig. 2). There were no significant main effects for Time, $F(1,46) < 1, \eta_p^2 = .002$, or Group, $F(1,46) = 3.08, p = .09, \eta_p^2 = .06$.

Simple main effects analysis showed that the increase in dissociative uncertainty from 2 to 20 repetitions was significant for both OCD patients, $M_{\text{diff}} = -1.8, F(1,46) = 36.24, p < .001, \eta_p^2 = .44$, and non-clinical controls, $M_{\text{diff}} = -1, F(1,46) = 11.2, p = .002, \eta_p^2 = .2$.

The Time \times Group interaction showed a non-significant trend, $F(1,46) = 3.63, p = .06, \eta_p^2 = .07$, reflecting an overall increase in dissociative uncertainty between Time 1, $M = 2.41, SD = 1.28$, and Time 2, $M = 2.85, SD = 2.13$, for the non-clinical control group, and a decrease in uncertainty between Time 1, $M = 3.69, SD = 2.16$, and Time 2, $M = 3.38, SD = 1.92$, for patients with OCD. However, simple main effects analysis showed that these difference in dissociative uncertainty between Time 1 & Time 2 were non-significant for non-clinical controls, $M_{\text{diff}} = -.44, F(1,46) = 2.5, p = .12, \eta_p^2 = .03$ and OCD patients, $M_{\text{diff}} = .31, F(1,46) = 1.24, p = .27, \eta_p^2 = .03$. Finally, neither the two-way interaction Time \times Perseveration nor the three-way interaction Time \times Perseveration \times Group were significant, both F 's < 1 .

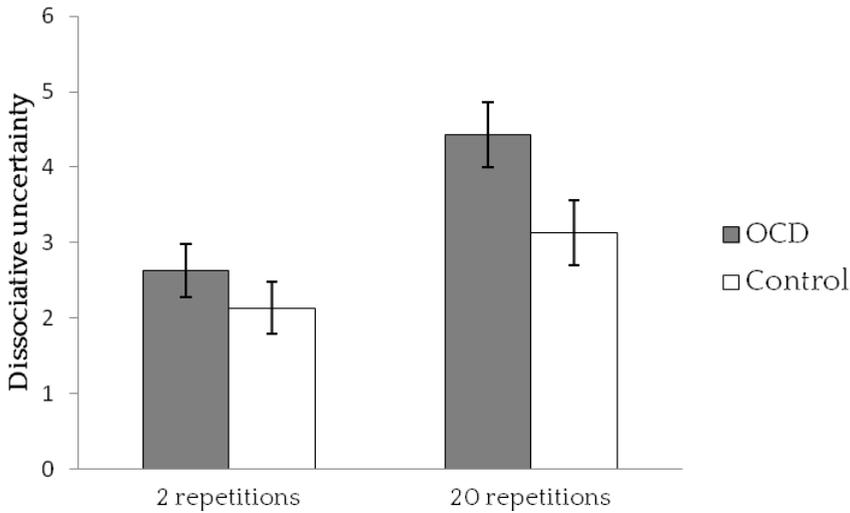


Figure 2. Mean scores on dissociative uncertainty after 2 and 20 word repetitions. Error bars represent standard errors

INTOLERANCE OF DISSOCIATIVE UNCERTAINTY

An exploratory analysis was conducted to test whether dissociative uncertainty would induce more intolerance in OCD patients compared to non-clinical controls. Fifteen OCD patients and 11 non-clinical controls had at least one rating on intolerance of uncertainty and were included in the analysis. Since the scores on intolerance of uncertainty were not normally distributed in the OCD patient group, a non-parametric analysis was carried out. Mann-Whitney U test revealed that the mean score on intolerance of dissociative uncertainty of OCD patients ($M = 44.38$, $SD = 21.39$) did not significantly differ from the mean score of non-clinical controls ($M = 31.39$, $SD = 26.51$), $Z = -1.43$, $p = .15$.

DISSOCIATIVE EXPERIENCES

OCD patients scored significantly higher on the PDEQ, $M = 2.13$, $SD = .79$, than non-clinical controls, $M = 1.54$, $SD = .58$, $t(46) = 2.99$, $p = .004$. This indicates that they experienced more dissociative experiences during and directly after the experiment.

DISCUSSION

The results of part I showed that a spreading of activation effect was found: participants were faster in making relatedness judgments when the repeated word and the target word on the screen were related, compared to unrelated word combinations. However, contrary to our hypothesis, there was no effect of repetition, as spreading of activation was not disrupted after 20 word repetitions. Overall, patients with OCD were slower in making relatedness judgments than non-clinical controls. This could probably be explained by higher levels of symptoms of depression in the OCD group.

Although word repetition did not blocked spreading of activation, repeating words induced dissociative uncertainty; both groups of participants scored significantly higher on dissociative uncertainty after 20 word-repetitions compared to 2 word-repetitions. As hypothesized, this effect was stronger in OCD patients than in non-clinical controls. Furthermore, patients with OCD reported more dissociative experiences during and after the experiment compared to non-clinical controls, as indicated by a higher score on the PDEQ. No significant difference was found between patients with OCD and non-clinical controls with respect to their intolerance of dissociative uncertainty.

In the second exploratory part of this study we examined whether the dissociative uncertainty that was found after controlled perseveration (e.g., part I of this study) is also present after (clinical) perseveration carried out by OCD patients in their own personal environment. Each patient selected an idiosyncratic perseverative behavior. We hypothesized that OCD patients would report more dissociative uncertainty after carrying out this perseverative behavior compared to moments when they did not engage in repeated behavior.

PART II

METHOD

PARTICIPANTS

The OCD participants of part I were asked in a semi-structured interview if they engaged in compulsive behavior in their own environment (e.g., at home). Six patients were excluded because they mainly reported obsessions. Next, it was explored whether these compulsions were perseverative. This meant that they engaged in prolonged (e.g., staring a light switch) and/or repeated behavior (e.g., checking the gas

stove) or engaged in a sequential series of different compulsive behaviors (e.g., before leaving the house, checking the doors, windows, taps, coffee machine, etc. in a pre-established order/routine). Three patients were excluded because they reported compulsions which were not perseverative (e.g., performing a check only once or twice). Furthermore, one patient was excluded because the perseverative behavior was very infrequent and therefore unpredictable. Finally, one patient could not participate because she did not have a mobile phone, which was necessary to participate.

One patient engaged only in part II of this study (and not in part I). This resulted in 14 OCD patients that participated in the second part of this study. Four of them did not return the questionnaires and one patient was excluded from analysis because she completed the questionnaire at other moments than instructed. Finally, a small sample of nine OCD patients ($M = 35.67$ years, $SD = 7.18$, 8 females) was included in the analysis.

PROCEDURE

In accordance with the patient, one idiosyncratic perseverative behavior or one series of different compulsions was individually selected. It was determined when, where and how long patients normally carried out this specific repeated behavior (e.g., before going to work; checking the lights and doors for +/- 15 min). Next, for the perseveration condition, three moments during an upcoming period of seven days were selected when the patient expected that he or she would engage in this repeated behavior. Participants were instructed to immediately fill in the questionnaire on dissociative feelings (Measures) after finishing their perseverative behavior on these three pre-selected moments. To check if participants actually engaged in perseverative behavior during the designated time period, participants were asked to indicate this on the questionnaire.

In the same week, for the non-perseveration (control) condition, a minimum of five episodes were pre-selected in which participants indicated that they most likely would *not* engage in compulsive behavior (e.g., on Tuesday, watching television between 20.00 pm and 23.00 pm). During those episodes, five random moments (max. one per episode) were selected by the experimenter in which participants received a text message on their mobile phone. This text message instructed them to complete the dissociative uncertainty questionnaire (control condition). Patients were

also asked whether they engaged in compulsive behavior during that specific (control) time period. Since we expected that it would be highly probable that participants would, unintentionally, engage in perseverative behavior during the control moments, participants were instructed to fill out this questionnaire five times (compared to three times in the perseverative condition) in order to obtain sufficient control data. The questions referred to a time period that was of the same length as the time period that was needed to execute compulsions in the perseverative condition. For example, if a patient checked his/her gas stove every morning for 15 min, after receiving the text message for the control measurement, the patient indicated how much dissociative uncertainty he/she had experienced during the last 15 min.

DESIGN

The home-task had a within-subjects design with Perseveration (perseveration/non-perseveration) as the independent variable. Participants completed the same questionnaire about dissociative uncertainty directly after performing perseverative behavior (perseveration condition), and after moments when they did not perform perseverative behavior (non-perseveration condition).

MEASURES

Clinical characteristics

The sample of nine OCD patients scored respectively 21.22 ($SD = 8.56$) on the OCI-R, 22.11 ($SD = 7.22$) on the Y-BOCS, 19.67 ($SD = 12.23$) on the BDI-II and 16.67 ($SD = 9.43$) on the BAI.

Dissociative uncertainty at home

Dissociative uncertainty at home was measured with the following three items, which were scored on a 9-point Likert scale (1 = totally disagree, 5 = not agree, not disagree, 9 = totally agree), and were also used in the study by Giele and colleagues (2013).

- During the last [xx]* minutes there were moments when things seemed unreal, as if I was dreaming
- During the last [xx]* minutes I experienced moments when it seemed as though I was looking through fog, as if everything was further away/ unclear

- During the last [xx]* minutes there were moments when I started to feel strange, as if it was not clear somehow

*The specific time duration was determined for each patient individually (depending on the duration of the compulsive behavior that was reported in the interview).

The first two items were based on items of the Clinician-Administered Dissociative State Scale (CADSS, Bremner et al., 1998) and adapted to relate to dissociation during a specific time period. The third item was generated by the authors and was also used in the first part of this study.

RESULTS

CLINICAL CHARACTERISTICS

The mean onset of obsessive-compulsive symptoms was 20.56 years ($SD = 12.3$) (year of onset was missing for one participant). The perseverative compulsions or rituals that were selected had a mean duration of 16.8 minutes ($SD = 14.3$). The perseverative behaviors were: 1) checking the house when leaving (e.g., checking lamps, plugs and sockets), 2) checking and staring at the shower tap, 3) repeatedly cleaning the kitchen table and worktop, 4) checking e-mails (repeatedly reading the text and email address), 5) repeatedly washing the face, 6) checking if the windows are closed and electrical devices are turned off, 7) repeatedly checking a series of objects in the house for traces of a (non-existent) lover of the partner (e.g., checking the bed, towels, bottles, closet, etc.), 8) cleaning and ordering objects and putting things right (symmetry) and 9) cleaning herself after arriving home (e.g., repeated and prolonged hear and hand washing).

DISSOCIATIVE UNCERTAINTY AT HOME

In the perseverative condition, one patient reported on one questionnaire that she did not engage in perseverative behavior during the whole time period. Six patients reported that they engaged in perseverative behavior during one or more control moments. These questionnaires were excluded from analysis. One participant did not complete the questionnaires at two control moments and one participant did not complete one questionnaire after perseveration. For each condition, mean scores per participant were calculated for the remaining questionnaires (≥ 2 per participant).

Since the scores on dissociative uncertainty were not normally distributed in the non-perseveration condition, a non-parametric analysis was carried out. Wilcoxon Signed Ranks Tests revealed that dissociative uncertainty was significantly higher after perseveration, $M = 4.45$, $SD = .83$, compared to non-perseveration, $M = 1.5$, $SD = .5$, $Z = -2.20$, $p = .014$ (one-tailed).

DISCUSSION

Although a relatively low number of OCD patients participated in the second part of this study, the results suggest that 'clinical' perseveration induced dissociative uncertainty. OCD patients reported more dissociative uncertainty after perseveration compared to control moments in which they did not engage in perseverative behavior in their own environment.

GENERAL DISCUSSION

In the first part of this study we hypothesized that compulsively repeating words would induce semantic satiation. First, we expected that this semantic satiation effect would be objectively observed, reflected by delayed relatedness judgments from 2 to 20 word repetitions. Second, we predicted that the experiential end point of this satiation effect would be reflected by an increase in experienced dissociative uncertainty from 2 to 20 word repetitions. Furthermore, we theorized that semantic satiation effects were stronger in the OCD group compared to the non-clinical group and that experiences of dissociative uncertainty were less tolerated by OCD patients.

No effects were found on objective measures. Participants' speed of making relatedness judgments in favor of related word combinations (vs. unrelated combinations) was not disrupted after perseveration. These findings are in contrast with the study by Giele and colleagues (2013), who found that after 2 repetitions, healthy participants were faster in their relatedness judgments when the checked object and the picture were related rather than unrelated, and this spreading of activation effect was blocked after 20 repetitions, where reaction times were similar.

With respect to the subjective experience of dissociative uncertainty, the hypothesis was confirmed; dissociative uncertainty increased after repeating words. This finding adds to the evidence provided by former studies which demonstrated that perseveration is a dysfunctional strategy to reduce doubt (e.g., van den Hout & Kindt, 2003a). Interestingly, the impact of perseveration was stronger in OCD patients

compared to controls: Patients with OCD showed a higher increase in dissociative uncertainty from 2 to 20 word repetitions. Furthermore, after the experiment, both groups scored above the suggested cut-off score for clinically significant levels of state dissociation on the PDEQ questionnaire (Marmar, Weiss, Metzler, & Delucchi, 1996). OCD patients experienced significantly more dissociative symptoms after the experiment than non-clinical controls. Their mean score of 2.13 is just below the score of civilians (2.30) that were recently (within 2 weeks earlier) exposed to a traumatic event (Sijbrandij et al., 2012). Thus, patients with OCD reported a higher level of *state* dissociation than non-clinical controls. As noted in the introduction, OCD patients report more dissociative symptoms in general (Goff et al., 1992). Perhaps our findings can partly explain these elevated scores on *trait* dissociation. It is possible that patients with OCD report more symptoms on dissociative questionnaires, because they actually experience dissociative feelings during and after their, frequent, execution of perseverative behavior.

Although the mean score on intolerance of dissociative uncertainty appeared to be higher for patients with OCD than for non-clinical controls, this difference was not significant. However, this analysis of intolerance of dissociative uncertainty should be considered highly exploratory due to several methodological limitations. First, intolerance of uncertainty was only measured if participants experienced a certain level of dissociative uncertainty. Therefore, only slightly over half of the participants were included in the analysis, suggesting a lack of power. Second, mean scores were based on different amounts of scores; some participants only scored one item, whereas others filled in nine items. This resulted in a somewhat unbalanced design.

Thus, the current study showed that patients report more dissociative uncertainty after perseveration than controls, and that both groups did not differ with respect to their intolerance of these uncertainty feelings. It is tempting to speculate that patients with OCD are trapped in a vicious circle of checking and uncertainty because the impact of perseveration is stronger. Although the results on intolerance of uncertainty should be interpreted with caution, it is possible that OCD patients do not engage in more perseveration because they experience a higher intolerance of their uncertainty feelings, but because they experience more dissociative uncertainty *in itself*. However, as mentioned in the introduction, several studies have found that OCD patients report more (general) feelings of intolerance of uncertainty than controls (e.g., Holaway, Heimberg, & Coles, 2006; Steketee et al., 1998; Tolin et al., 2003). It remains unclear

whether a state of dissociative uncertainty during and directly after perseveration is less tolerated by patients with OCD. This awaits future research.

One major difference between the study of Giele and colleagues (2013) and the current study is the stimulus material. In the study of Giele et al. (2013) participants repeated different forms of OC related motor behavior (e.g., physically checking a coffee machine) as opposed to the verbal perseveration of neutral words in the current study. Since previous studies have demonstrated that different forms of perseveration (e.g., checking, prolonged staring or repeating sentences) induce dissociative uncertainty (van den Hout & Kindt, 2004; van den Hout et al., 2008; 2009), and different forms of perseveration (e.g., repeating words, pictures or behavior) result in semantic satiation (Giele et al., 2013; Lewis & Ellis, 2000; Pynte, 1991; Smith, 1984), in the current study it appeared not necessary that participants engaged in repeating *motor* behavior (like checking). To limit the inconvenience for patients, in the present study participants had to repeat neutral words (perseveratively or non-perseveratively) rather than motor behavior. On the one hand, one could argue that it is therefore unclear whether the differences in the results of the current study and the earlier study (Giele et al., 2013) are due to differences in form (words vs. motor behavior) and/or valence (neutral vs. OC-related) of the perseveration task. Possibly, only OC-related motor behavior is sensitive to the effects of perseveration. On the other hand, several studies unrelated to OCD research have shown that repeating neutral words induces a blocked spreading of activation of semantically related words (e.g., Sanbonmatsu et al., 2007; Smith, 1984; Pynte, 1991). Moreover, the effects of OC-like perseveration in the study by Giele and colleagues (2013) were tested in non-clinical students, thus the checking operations that were performed had no idiosyncratic meaning for the participants.

One methodological limitation should be mentioned. There were used 60 word-combinations of a repeated prime word and an associated target word (e.g., 'apple - pear') in the task. Half of the repeated words were randomly assigned to a target word of another combination (e.g., 'apple - ink'). Thus, if a person repeated the word 'soap' and this was followed by the target word 'pear' (unrelated), the word 'apple' would always be followed by a non-related word (e.g., 'ink') because the related target word 'pear' was already used in an earlier trial. Hypothetically, participants were able to predict in some trials if the target word would be related or unrelated to the repeated word. In practice, however, it is very difficult to remember all those word

combinations and possibly only a minority of the participants 'detected' this rule. Therefore it seems plausible that this only had a minor effect on the outcome of this study.

In sum, the results only showed subjective effects due to perseveration: Repeating words induced feelings of dissociative uncertainty. This study found no indications that semantic satiation might be the underlying mechanism of the 'perseveration → dissociative uncertainty' cascade. Possibly, the study of Giele and colleagues (2013) in which perseveration did lead to blocked spreading of activation represented a chance finding. Another possibility might be that the blocked spreading of activation that was found in that particular study is another effect of perseveration which, however, is not specifically related to dissociative uncertainty. Further research is necessary to elucidate the specific mechanisms underlying the detrimental effects of perseveration.

The second part of this study showed that OCD patients who engaged in 'clinical' perseverative behavior reported more dissociative uncertainty compared to moments in which they were not perseverating. These findings underscore the notion that the effects of perseveration on dissociative uncertainty are clinically relevant. However, the number of participants who engaged in perseverative behavior was very low. Furthermore, it is worth mentioning that 2 out of 9 participants in the second part of the study reported no dissociative uncertainty at all after carrying out their perseverative behavior (mean score of 1). Possibly, dissociative uncertainty is not experienced at all by a subgroup of OCD patients. A next step would be to elucidate the relevance of the current findings for the general population of patients with OCD. In future research, it would be therefore be valuable to explore the percentage of OCD patients that engage in perseverative behavior and experience feelings of dissociative uncertainty.

With the current study we aimed to gain more insight in the 'perseveration → dissociative uncertainty' phenomenon by testing the effects of perseveration in a clinical sample. Moreover, it was proposed to make a further step in understanding the possible mechanisms by which OCD is maintained; how compulsive perseveration leads to a vicious circle of doubt and dissociation. Although the mechanism through which perseveration induces uncertainty is still unclear, the findings of this study add to the growing list of studies that provided proof for the detrimental effects of compulsive perseveration. This effect is not restricted to a laboratory setting; 'clinical' perseveration induces the same feelings of ambivalence. These findings may add to

the theoretical rationale for current treatments in OCD, like Exposure and Response Prevention (e.g., Franklin, Abramowitz, Kozak, Levitt, & Foa, 2000). In this therapy, patients are confronted with anxiety-evoking stimuli, while refraining from compulsive behavior. Because patients are often unwilling and afraid to refrain from their compulsive behavior, psycho-education about the negative effects (i.e., increase of OC symptoms like dissociative uncertainty) may provide additional motivation for patients to quit their compulsive behavior.

ACKNOWLEDGMENTS

The authors thank the participants for their time and effort and Paula Verholt and Marloes Eidhof for their help in the data collection.

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Again!

Check

AGAIN!

100% ?

No...

1/2 time

24

Ch. Day

REALLY

Am I sure?

Check the stove!!

or Locked?

Do I smell gas?

Is the light on?

It is off

The light is off, it is off!
OFF... OFF...

Is it?

Yes!

IS IT?

Chapter 7

General discussion

GENERAL DISCUSSION

The aim of this dissertation was to better understand the maintenance of uncertainty after carrying out obsessive compulsive (OC)-like perseverative behavior. In this final part of the thesis, the results will be discussed following the two main objectives that were presented in the introduction. Earlier studies found that different forms of perseveration induce uncertainty. The first aim was to investigate the *generality* of this 'perseveration → uncertainty' phenomenon. In this chapter, the main findings of chapter 2, 3 & 4 with respect to this first objective will be summarized and the implications of these findings will be discussed. The second aim of this thesis was to investigate *how* perseveration breeds uncertainty. In chapter 5 & 6 an explanation for this phenomenon is tested. A summary of these chapters and the implications that follow from these findings will be provided. Next, limitations as well as clinical implications will be discussed. Finally, some concluding remarks and suggestions with respect to future research will be given.

OBJECTIVE 1: GENERALITY

SUMMARY AND IMPLICATIONS OF THE FINDINGS

Former studies showed that repeated checking induces uncertainty about memory (e.g., Dek, van den Hout, Giele, & Engelhard, 2010; Radomsky, Gilchrist, & Dussault, 2006; van den Hout & Kindt, 2003a; 2003b; 2004), prolonged staring increases dissociative feelings and uncertainty about perception (van den Hout, Engelhard, de Boer, du Bois and Dek, 2008; van den Hout et al., 2009) and compulsive washing induces uncertainty about contamination (Deacon & Maack, 2008). It is possible that these studies are examples of a more encompassing phenomenon; i.e., that all forms of perseveration induce uncertainty about the cognitive function that is involved.

Chapter 2 describes a study that tested whether these uncertainty effects also extend to language perseveration (Giele, van den Hout, Engelhard, & Dek, 2014). We examined whether sentence repetitions induced dissociative uncertainty about the meaning of the sentence. Furthermore, we tested how fast this effect occurs and if it was affected by simultaneously looking at the primary object in the repeated sentence (e.g., looking at a mug while saying 'the mug is clean'). Sentence repetition induced semantic uncertainty and this effect increased with more sentence repetitions. There were significant increases after 5, 10 and 20 repetitions, and the effects on semantic uncertainty were the largest after 20 repetitions. The uncertainty effects were not

qualified by looking at the object of perseveration. The results of chapter 2 suggest that the 'perseveration → uncertainty' phenomenon is also present after text repetition; perseveration of sentences induces semantic uncertainty. Former studies have shown that the effects of perseverative checking and staring occur relatively fast. Memory confidence was significantly reduced after 10 checks (Coles, Radomsky, & Horng, 2006) and perceptual uncertainty was already present after 15 seconds of staring (van den Hout et al., 2009). Chapter 2 shows that the effects of repeating sentences also appear rather quickly; after 5 sentence repetitions there was a significant increase in semantic uncertainty. The semantic uncertainty that results from perseveration has a dissociative character; two of four semantic uncertainty items used in the study that is described in chapter 2 were related to dissociation (e.g., 'while saying the sentence, it sounded unreal'). Furthermore, other cognitive modalities, like prolonged looking, did not influence semantic uncertainty. This last finding supports the results of earlier studies that suggested that the effects of perseveration are rather domain specific. Dek et al. (2010) showed that repeated checking leads to uncertainty about memory but not to uncertainty about attention or perception. Likewise, Radomsky and Alcolado (2010) described that repeated physical checking induced memory uncertainty about physical checks but not about mental checks, and the other way round.

Some patients with OCD exhibited a reasoning style that has perseverative features as well. To make sure that they do not overlook potential harmful outcomes, patients often tend to reason in long chains of small steps from a current neutral situation towards (improbable) catastrophes. The aim of **chapter 3** was to examine whether this step-by-step 'perseverative reasoning', performed by healthy individuals, would increase uncertainty about a dreadful outcome and makes this outcome more credible (Giele, van den Hout, Engelhard, Dek, & Klein Hofmeijer, 2011). Participants in the experimental conditions engaged in perseverative reasoning; the first experimental condition created a step-by-step cascade between a given situation and outcome and the second experimental group generated five such cascades, with small adaptations in the steps (but always with the same harmful outcome). Participants in the control group performed a neutral filler task. Perseverative reasoning towards a harmful outcome enhanced the credibility of this outcome. The credibility of the outcome did not increase with making more series of reasoning steps; the effects were similar for participants in the two experimental conditions (one or five reasoning

chains). Contrary to our expectations, feelings of uncertainty about the outcome increased both in the control group and the experimental groups; perseverative reasoning did not contribute to this effect.

The results of chapter 3 are somewhat difficult to interpret within the context of the 'perseveration → uncertainty' theory. Although perseverative reasoning increased the credibility of a harmful outcome, uncertainty about this outcome was not increased. These results are not entirely compatible with each other; it sounds fairly implausible that a catastrophe that is experienced as quite credible does not induce feelings of uncertainty. We have no clear explanation for the absence of a reasoning-induced uncertainty effect. In the discussion section of chapter 3 (Giele et al., 2011), it was suggested that the formulation of the uncertainty questions raised problems. 'I know that the outcome is not credible, but somehow I start to doubt about it' was difficult to answer by participants who rated the catastrophe as quite credible after perseverative reasoning. Although the findings of chapter 3 are somewhat different from the results of other perseveration studies, it is evident that OC-like reasoning is a counterproductive strategy that has the same paradoxical effects as checking, staring and text repetition. Patients with OCD want to be absolutely sure that nothing endangers themselves (or others). They focus on highly improbable catastrophes and treat these outcomes as if they are realistic (Johnson-Laird, Mancini, & Gangemi, 2006). Next, patients with OCD engage in perseverative reasoning, which is aimed at increasing safety, by making small steps from an innocuous situation towards those catastrophes. This strategy, however, has opposite effects; perseverative reasoning serves to exacerbate the very problems that it is supposed to reduce by increasing the credibility of this feared outcome.

Several studies have shown that perseveration reduces confidence about *past* (e.g., memory; van den Hout & Kindt, 2003a) or *present* affairs (e.g., perception; van den Hout et al., 2009). The reasoning study that is described in chapter 3 hints to the paradoxical effects of perseveration on the credibility of *future* catastrophes, although the imagined catastrophes could also have taken place in the past. **Chapter 4** further investigates this issue, by testing whether repeated checking not only increases uncertainty about memory, but also increases uncertainty about future threat (Giele, Engelhard, van den Hout, Dek, Damstra, & Douma, in press). Participants learned that a CS+ was followed by a shock (UCS) and that a CS- was not followed by a shock (no UCS). This CS+/CS- discrimination was subjected to perseverative checking

(experimental group) or no perseverative checking (control group). Participants engaged in two series of 20 checks. At the beginning of the experiment and after each series of checks, questionnaires about memory and UCS expectancy were assessed. We expected that confidence in memory and confidence about whether or not a CS would be followed by a UCS would both decline after the first and second series of checks. Furthermore, it was predicted that memory accuracy and UCS expectancy would not be affected by repeated checking.

After the first series of 20 checks, the hypotheses were confirmed: Confidence in memory and UCS occurrence reduced and memory accuracy and UCS expectancy remained intact. However, after the second series of checks there was *no further* decrease in confidence about memory or UCS occurrence. Memory confidence after two series of checks was still significantly lower compared to the level at the beginning of the experiment. Possibly, reductions in memory characteristics occur after a relatively low number of checks. Indeed, Coles et al. (2006) showed that the 'checking → memory uncertainty' effect is a rapid occurring phenomenon. After 10 checks, memory confidence was significantly reduced. However, the decline in memory confidence did not differ between 10 and 15 checks. Thus, the absence of a further decrease in memory confidence after the second series of 20 checks was possibly due to a floor effect. There was a non-significant increase in UCS confidence during the second series of checks. Therefore, at the end of the second series of checks, the level of confidence in UCS occurrence did not differ anymore from the level at the beginning of the experiment. We have no clear explanation for this. After the first series of checks, the questionnaires were unexpected. Possibly, participants foresaw that they would receive the same questionnaires at the end of the second series of checks and were therefore more vigilant.

The findings after two series of checks remain ambiguous and a conclusive explanation is lacking. However, the results after the first series of checks are more straightforward and have some clear implications. First, it replicates previous findings that showed that repeated checking increases uncertainty about memory. Second, it extends earlier research by showing that checking also induces uncertainty about future threat: The confidence in the ability to discriminate future safety from impending threat was impaired. Patients with OCD engage in perseveration to prevent future harm from occurring (Rachman, 2002). The results of chapter 4 suggest that perseveration is a dysfunctional strategy for this aim. Repeated checking undermines

trust in the predictability of future danger or safety. Unpredictable threat leads to a more sustained level of anxiety than predictable danger (Grillon, Baas, Lissek, Smith, & Milstein, 2004). Since unpredictability of future danger is a causal factor in the development of anxiety disorders (Barlow, 2000), perseverative behavior could increase and maintain OCD symptoms.

To conclude, although some unexpected findings were reported, the studies of chapter 2, 3 and 4 add to the growing list of studies that showed that the effects of compulsive perseveration are very paradoxical (e.g., Boschen, & Vuksanovic, 2007; Coles et al., 2006; Radomsky, Gilchrist, & Dussault, 2006; van den Hout & Kindt, 2003a; 2003b; 2004). Patients with OCD try to obtain more certainty by carrying out perseverative behavior. However, the results of their safety strategies are in sharp contrast with the intentions of the OCD patients. Perseveration is a counterproductive strategy and leads to a decrease instead of an increase in confidence about the cognitive functions that are involved.

OBJECTIVE 2: UNDERLYING MECHANISMS

SUMMARY AND IMPLICATIONS OF THE FINDINGS

The second part of the thesis aimed to critically test whether the 'perseveration → uncertainty' phenomenon can be explained in terms of a blocked spreading of activation of related concepts. If perseverative checking blocks spreading of activation, this might lead to a loss of experienced meaning of the objects involved in perseveration. This may induce the dissociative doubt, 'I know that I've checked the door, but it all feels strange and unreal' that patients with OCD experience (Reed, 1985).

Chapter 5 describes a study that examined whether perseverative OC-like behavior produces semantic satiation. Healthy participants engaged in a relatedness decision task (Giele, van den Hout, Engelhard, Dek, Hoogers, & de Wit, 2013). They repeated 20 types of OC-checking behaviors non-perseveratively (2 times) or perseveratively (20 times). After 2 or 20 repetitions of the same check-operation, they decided as quickly as possible whether a presented picture was semantically related (e.g., a coffee cup) or semantically unrelated (e.g., a pencil) to the check-operation (e.g., checking a coffee machine). The results showed that participants were slower in deciding whether the checked object and picture were related after 20 repetitions compared to 2 repetitions. Furthermore, after non-perseveration, participants were

faster in their relatedness decisions for related than for unrelated objects and pictures. This spreading of activation effect was blocked after 20 repetitions; the speed of relatedness decisions for related and unrelated objects and pictures were equal. A separate study that is described in chapter 5 showed that the OC-like perseverative behavior that was carried out in this study induced subjective feelings of dissociative uncertainty. The results of chapter 5 suggest that compulsive perseveration blocks the accessibility of meaning of semantically related concepts. The doubt that is experienced by OCD patients may be induced by this blocked spreading of activation.

The study that is described in chapter 5 was carried out in non-clinical individuals. As OCD patients report more dissociative experiences than non-clinical controls (Rufer, Fricke, Held, Cremer, & Hand, 2006), it is possible that OCD patients, compared to healthy controls, are more prone to the effects of perseveration. Therefore, **chapter 6** further examined these satiation effects of perseveration in patients with OCD (Giele, van den Hout, Engelhard, Dek, Toffolo, & Cath, 2014, submitted for publication). In the first part of the study, OCD patients and matched non-clinical controls participated in a task that was comparable to the task in chapter 5. However, participants repeated words instead of behavior. They repeated words 2 (non-perseveration) or 20 times (perseveration). When another word was presented on the screen, participants decided as quickly as possible whether this word was related to the repeated word. The results showed that participants were faster in their relatedness decisions for related than for unrelated words. Contrary to the findings of chapter 5, this effect was not blocked after 20 word repetitions; reaction times were similar after 20 repetitions compared to 2 repetitions. As expected, dissociative uncertainty was higher in the perseveration condition compared to the non-perseveration condition. This effect was stronger in OCD patients; they reported higher rates of dissociative uncertainty after perseveration compared to controls. Exploratory analysis revealed no significant differences between both groups with respect to their intolerance of these feelings. The second part of the study that is described in chapter 6 explored whether the same dissociative uncertainty that is found after controlled perseveration was present after 'real-life' clinical perseveration, carried out by OCD patients in their own environment. An idiosyncratic perseverative behavior was selected for each patient. Although the number of participants that participated in this second part of the study was very low (n=9), the results suggested that patients reported more dissociative uncertainty after clinical perseveration

compared to control moments in which they were not perseverating.

In sum, chapter 5 and 6 tested whether perseveration induced semantic satiation. First, we hypothesized that the effects of semantic satiation were *objectively* observed, as indicated by slowed relatedness decisions after perseveration. It was expected that the spreading of activation of related concepts that is normally observed would be blocked after OC-like perseveration. Second, we predicted that the experiential end point of this satiation effect would be *subjectively* reported, reflected by an increase in experienced dissociative uncertainty after perseveration compared to no perseveration. The results with respect to these two dependent variables should be discussed further.

With respect to the objective measures of semantic satiation, mixed results have been obtained in chapter 5 and 6. In chapter 5, perseveration impaired speed of relatedness decisions. However, we did not replicate this finding in the study described in chapter 6. In chapter 6, participants repeated neutral words instead of OCD relevant behavior (like chapter 5). However, it is highly unlikely that the use of different stimulus material explains the discrepancy in the results of chapter 5 and 6. A series of studies within the field of priming and un-priming have shown that perseveration of words induces semantic satiation (e.g., Black, 2001; Sanbonmatsu, Posavac, Vanous, Ho, & Fazio, 2007; Pynte, 1991; Smith, 1984; Smith & Klein 1990). The same was found for visual representations (Lewis and Ellis, 2000). This suggests that the study in chapter 6 may contain some methodological shortcomings we are not aware of. Another possibility is that the blocked spreading of activation that was found in chapter 5 is a coincidental finding *or* another effect of perseveration which, however, is not specifically related to dissociative uncertainty.

Just like earlier studies, the findings of chapter 5 & 6 showed that perseveration induced dissociative uncertainty, and these effects were also observed when OCD patients carried out clinical perseveration in their own environment. Furthermore, the results of chapter 6 demonstrated that patients with OCD, compared to controls, displayed more dissociative (*state*) symptoms (as measured by the PDEQ-R) after the entire perseveration task. Earlier studies have shown that OCD patients score higher on dissociative *trait* symptoms than non-clinical controls (Goff, Olin, Jenike, Baer, & Buttolph, 1992). These symptoms were defined as 'disrupted integrated functions of consciousness, memory, identity or perception of the environment' (Watson, Wu, & Cutshall, 2004). Perhaps patients with OCD report more symptoms on dissociative

questionnaires, because they actually experience dissociative feelings during and after their, frequent, execution of perseverative behavior. Finally, chapter 6 extended the findings on 'perseveration → uncertainty', by showing that OCD patients reported a higher level of dissociative uncertainty after perseveration than non-clinical controls. Possibly, because the impact of perseveration is stronger, patients with OCD are more easily trapped in a vicious circle of checking and uncertainty.

LIMITATIONS

Some limitations need to be discussed. The first limitation relates to the definition of 'perseverative reasoning'. It is obvious that sentence repetition (chapter 2) and repeated checking (chapter 4) are perseverative; both are behaviors that are highly repetitive. To put the concept 'perseverative reasoning' under the same umbrella as the other perseveration studies might need further explanation. OC-like reasoning is not perseverative in the sense that people are repeating the same act over and over again. Note however, that we defined perseveration as behavior that is prolonged beyond the point where the goal of the action is reasonably reached (Giele et al., 2011). Normally, daily routines are carried out automatically. Individuals trust their cognitive functions and assume that the outcome of routine information processing is safe. For example, people trust their memory about turning off the stove, they have no doubts about their language comprehension while reading the prescription of a medicine, they are confident about their perception when looking at a lamp that is switched off, et cetera. The same applies for reasoning; when confronted with an innocuous situation, people jump to the conclusion that the outcome of that particular situation is safe and they trust the jump. The reasoning style that patients with OCD exhibit has the same perseverative characteristics as repeated checking or prolonged staring. When confronted with an OCD-relevant situation, patients with OCD are not so convinced about an innocuous outcome and start to create far-fetched reasoning cascades. However, the goal of the action is overshoot; this type of reasoning paradoxically increases the belief that a feared outcome can happen.

A second limitation relates to the type of uncertainty that is measured after repeated checking (chapter 4). We hypothesized that perseveration leads to dissociative uncertainty *about the cognitive function that is involved*. Van den Hout et al. (2009) demonstrated that when participants engaged in prolonged staring, they became uncertain about their perception. In chapter 2, the same effects were found

with respect to language; sentence repetition induced semantic uncertainty. The study described in chapter 4 tested whether repeated checking induced uncertainty about memory and future threat. Thus, strictly speaking, we did not test whether repeated checking induced uncertainty about the cognitive operation *itself*. In other words, participants' feelings about the check-operation (e.g., 'am I checking this correctly?') were not measured. However, in clinical practice and in relation to checking, patients with OCD mostly complain about their memory. They report that they have great difficulty trusting their memory for earlier checks. These feelings of doubt occur afterwards or within the same checking task. This lack of confidence motivates them to check repeatedly (Rachman, 2002). Nevertheless, it is very plausible that checking also undermines trust in the check operation. In a separate study that is described in chapter 5 (as a footnote), the results showed that engaging in perseverative check-operations increased dissociative uncertainty. Note that the items emphasized the dissociative experiences that were induced by perseveration (e.g., 'while checking the coffee machine, it seemed unreal, as if I was dreaming'). We did not measure whether people were uncertain about their checking performance.

This brings us to the third limitation: The conceptualization of 'dissociative uncertainty'. Van den Hout et al., (2009) first mentioned the term 'dissociative uncertainty', although the authors assessed and analyzed dissociation and uncertainty separately. They found that the time course of effects after 7.5, 15, 30 and 300 seconds of staring were highly similar for both dependent variables (see also the dose – response relationship of dissociation and uncertainty in figure 1 of van den Hout et al., 2009). This is not surprising, when taking a closer look at the items that were used in that study. They measured dissociation with items like 'The gas stove seemed unreal or dreamlike' and uncertainty with items like 'It was as though I saw it, but it wasn't definite enough'. It is unclear whether dissociation and uncertainty really measure different constructs. It might be argued that feelings of uncertainty result from the dissociative experiences that are induced by a blocked spreading of activation of semantically related concepts (chapter 5). However, it seems somewhat artificial to untangle the two concepts. Clinically, it appears that the uncertainty of OCD patients has a dissociative component (Grabe et al., 1999; Rufer et al., 2006). Patients report things like 'I remember doing it in a way, but it's all fuzzy' (Reed, 1985). Thus, although the term 'dissociative uncertainty' is chosen somewhat ad hoc, it probably makes most sense to combine both concepts into one construct. Consequently, with dissociative

uncertainty we refer to a condition that is characterized by feelings of uncertainty and dissociation. Nevertheless, it would be desirable to investigate the 'dissociation – uncertainty' link more closely and to develop better validated outcome measures.

A final limitation pertains to the research samples that were used. It is inaccurate to draw firm conclusions about OCD patients from the studies described in chapter 2, 3, 4 and 5 that investigate the effects of perseveration in healthy (young) participants. However, we are interested in the effects of perseveration as such, without interferences of other processes. It was hypothesized that the uncertainty that is induced by perseveration is a general phenomenon. This implies that when healthy participants engage in OC-like perseveration, they should experience the same sort of uncertainty that is experienced by patients with OCD. Boschen and Vuksanovic (2007) compared the effects of repeated checking in patients with OCD and non-clinical controls. Participants completed a series of 20 checking trials and rated questions about memory confidence after trial 1, 5, 10, 15 and 20. They demonstrated that, overall, patients with OCD showed less confidence in their memory than non-clinical controls. Yet the *decline* in memory confidence was broadly the same for both groups. In chapter 6 we showed that OCD patients overall reported more dissociative uncertainty than non-clinical controls. However, contrary to the findings of Boschen and Vuksanovic (2007), we found that perseveration induced higher levels of dissociative uncertainty in OCD patients compared to non-clinical controls. Thus, OCD patients might be more vulnerable to the effects of perseveration. More specifically, the detrimental effects of sentence repetition, reasoning and checking possibly might have been somewhat stronger if we used a clinical population instead of healthy participants.

CLINICAL IMPLICATIONS

As mentioned above, almost all studies of the current thesis were conducted in lab settings with non-clinical persons. Nevertheless, the results do seem to have some implications for clinical practice. The treatment for OCD with the most empirical support is cognitive-behavioral therapy involving exposure and response (ritual) prevention (ERP) (e.g., Fals-Stewart, Marks, & Schafer, 1993; Franklin, Abramowitz, Kozak, Levitt, & Foa, 2000; Lindsay, Crino, & Andrews, 1997). ERP entails systematic, repeated, and prolonged exposure to stimuli which provoke anxiety while patients are refrained from performing compulsive behavior. The aim of this therapy is that

patients with OCD experience and learn that compulsions and avoidance behavior are unnecessary to prevent harm. Eventually, patients with OCD will experience that their anxiety for those stimuli diminishes over time through this process of extinction (Abramowitz, Taylor, & McKay, 2009). The results of the present thesis may provide another rationale for the working mechanism of ERP. We showed that perseveration induced dissociative uncertainty. When patients are motivated to quit their compulsive perseverations, this counteracts the ironical effects of this behavior. In other words, during ERP, their feelings of uncertainty may not only reduce because of extinction processes, but also because the detrimental effects of perseveration are blocked.

ERP requires significant effort by OCD patients. They are often unwilling and anxious to quit their compulsive behavior, which makes many of them refuse to engage in ERP therapy or drop out at an early stage (Maltby & Tolin, 2005). In addition to the psycho-education that is given in ERP, it may be helpful to explain to patients that their perseverative behavior is not only useless, but even has adverse effects. We underscore the suggestion of Radomsky, Shafran, Coughtrey and Rachman (2010) and Shafran, Radomsky, Coughtrey and Rachman (2013) to incorporate experiments on perseverative compulsions into treatment methods. For example, using behavioral experiments that make patients experience that repeated checking induces uncertainty can improve their outcome with respect to ERP. Furthermore, patients with OCD may interpret their dissociative feelings during perseveration as signs of cognitive distortions. They may be afraid that something is wrong with them or that they go insane. If they understand that feelings of dissociative uncertainty are normal consequences of engaging in compulsive behavior, this may reduce anxiety and increase their motivation to refrain from perseveration.

CONCLUSIONS AND FUTURE DIRECTIONS

The current thesis proposed 1) to investigate the generality of the 'perseveration → uncertainty' phenomenon and 2) to make a further step in understanding the possible mechanisms by which OCD is maintained; how compulsive perseveration leads to a vicious circle of doubt and dissociation. With respect to the first objective, the results suggest that the 'perseveration → uncertainty' phenomenon is generalizable to a variety of perseverative conditions that decrease confidence about the cognitive functions that are involved. This contributes to a self-perpetuating cycle that sustains

compulsive checking. A first step for future research would be to develop better validated outcome measures to assess feelings of uncertainty and dissociation. A problem with current validated state scales, for example the Clinician Administered Dissociative States Scale (CADSS, Bremner et al., 1998), is that they consist of too many items to be quickly assessed during or after the perseverative behavior. Second, they do not measure dissociation and/or uncertainty that is directly related to the perseverative behavior that is performed. It would be useful to develop short validated questionnaires that measure dissociation and uncertainty on-the-spot. A second step would be to investigate the relationship between dissociation and uncertainty. Is it true that the uncertainty that is experienced after perseveration always goes hand in hand with feelings of dissociation? It is unclear whether there is a causal relationship between dissociation and uncertainty. However, as noted above, it might be very difficult to separate both constructs.

With respect to the second objective, i.e., testing a mechanism by which perseveration induces uncertainty, the results are inconclusive. Chapter 5 found indications that the ironic effects of perseveration are due to a blocked spreading of activation, however, the study in chapter 6 did not replicate these results. It is therefore still unclear if semantic satiation is the driving mechanism behind 'perseveration → uncertainty.' Further research needs to be conducted in this area. It would be preferable to develop an experimental design in which subjective feelings of dissociative uncertainty and objective effects of a blocked spreading of activation are measured simultaneously in the same perseveration task. Then it would be possible to do a correlational analysis to study the relationship between the two.

Another avenue for future research is to focus on other mechanisms by which perseveration induces uncertainty. As already mentioned, patients with OCD are not satisfied with the degree of certainty that is obtained after carrying out automatic routines. They engage in perseverative behavior by the wish to replace their automatic routines by controlled strategies (Dek et al., 2010). However, this repetition ironically may increase the automaticity of the behavior and makes recollections of this behavior less vivid and detailed (van den Hout & Kindt, 2004). A promising direction for future research would be to focus on these automaticity processes in OCD.

In sum, this dissertation has shown that the paradoxical effects of perseverative behavior are not limited to the domain of memory or perception, but also occur in relation to text comprehension, reasoning and future threat. Furthermore, we made a

first attempt to unravel the underlying mechanisms and shed some light on how this might be related to a blocked spreading of activation of semantically related concepts. However, at this stage, we have to conclude that more research on the working mechanisms behind the 'perseveration → dissociative uncertainty' phenomenon is needed. It is a *cliché, but true* nonetheless, the more research that is done, the more questions are raised. Fortunately, this creates plenty of room for new and exciting studies that can further our understanding in the maintenance of OCD.

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Nederlandse samenvatting
(Dutch summary)

NEDERLANDSE SAMENVATTING

Iedereen heeft het weleens meegemaakt. Je loopt de deur uit en na een paar passen slaat plots de twijfel toe: Heb ik de deur wel op slot gedaan? Wellicht loop je nog een keer terug om dit te controleren. Sommige mensen doen dit misschien twee keer, maar daarna zal de meerderheid vrij zeker zijn dat de deur goed op slot zit. Patiënten met een obsessief-compulsieve stoornis (OCS) zijn echter niet gerustgesteld na één of twee checks, zij blijven twijfelen en controleren. Sommige patiënten met OCS kunnen het huis nauwelijks meer verlaten omdat de dwangmatige rituelen zoveel tijd kosten. Opvallend is, dat na het uitvoeren van dit 'perseveratieve' gedrag patiënten ervaren dat gevoelens van onzekerheid nog steeds aanwezig zijn of zelfs zijn toegenomen. OCS is een chronische stoornis en wordt gekenmerkt door obsessies en compulsies. Obsessies zijn terugkerende en persisterende gedachten, beelden of impulsen die worden beleefd als opgedrongen of misplaatst. In reactie op deze dwanggedachten (of in navolging van bepaalde regels) voelen veel patiënten zich gedwongen om compulsieve handelingen uit te voeren. Voorbeelden van compulsies zijn het controleren van het gasfornuis, het controleren van lichtknoppen, het ordenen van boeken of het langdurig wassen van de handen. Met deze compulsies wordt getracht lijden te verminderen ofwel geprobeerd te voorkomen dat een gevreesde catastrofe zal optreden. Het compulsieve gedrag is typisch perseveratief; het is herhalend of voortdurend gedrag voorbij het punt dat het doel van de activiteit redelijkerwijs is bereikt. Patiënten met OCS vertonen checkgedrag met als doel meer zekerheid te verkrijgen. Ondanks de ogenschijnlijke afwezigheid van geheugenproblemen is het opvallend dat patiënten na veelvuldig checken nog steeds onzekerheid vertonen. Deze onzekerheid heeft een typisch dissociatief karakter. Patiënten met OCS zeggen dingen als 'Ik herinner me wel dat ik het gedaan heb, maar het is allemaal vaag' of 'Gewoonlijk kan ik me herinneren dat ik het gedaan heb, maar mijn herinnering is op de één of andere manier niet helder' (Reed, 1985; p. 153).

Van den Hout en Kindt (2003a; 2003b; 2004) hebben bij gezonde participanten aangetoond dat herhaaldelijk checken niet zorgt voor een toename in geheugenzekerheid, maar op ironische wijze leidt tot een *afname* in geheugenzekerheid. Deze bevindingen zijn meerdere malen gerepliceerd (bijvoorbeeld met een echt gasfornuis en bij patiënten met OCS). Patiënten zijn echter niet alleen onzeker over het geheugen, maar ook over andere cognitieve functies, zoals perceptie, aandacht en taalbegrip. Zo kunnen patiënten met OCS onzeker zijn

over hun tekstbegrip (lees ik nu goed in deze bijsluiters dat ik iedere ochtend twee pillen moet innemen?), of ze twijfelen of hun waarneming wel correct is (zie ik goed dat ik de schakelaar heb uitgezet, is die lamp echt niet aan het branden?). Deze onzekerheden kunnen eveneens leiden tot perseveratief gedrag. Een patiënt met OCS die onzeker is over de tekst in de bijsluiters zal dit vermoedelijk meerdere keren herlezen en de patiënt die niet zeker is of de verlichting is uitgeschakeld zal langdurig staren naar de lamp en de lichtschakelaar. Wellicht leiden deze vormen van perseveratie ook tot onzekerheid, maar dan steeds over de cognitieve functie welke onderwerp is van het perseveratieve gedrag. Dit zou verklaren waarom de onzekerheid bij patiënten zo domeinspecifiek is. Checken ondermijnt dan de geheugenzekerheid voor zaken die gerelateerd zijn aan de check, terwijl het vertrouwen in andere domeinen (bijvoorbeeld perceptie) intact blijft. Langdurig staren naar een lichtschakelaar zou op deze wijze juist leiden tot onzekerheid over de perceptie en niet tot onzekerheid over het geheugen.

Van den Hout, Engelhard, de Boer, du Bois en Dek (2008) hebben aangetoond dat perseveratief staren leidt tot onzekerheid over de perceptie. In een vervolgstudie is aangetoond dat hoe langer participanten staarden naar een gasfornuis, des te sterker de toename van dissociatieve gevoelens en onzekerheid over de perceptie was. Een onderzoek van Deacon en Maack (2008) liet zien dat het uitvoeren van zoveel mogelijk schoonmaakgedrag in één week onder andere leidde tot een significante toename in overschatting van gevaar en angst voor besmetting. Hoewel participanten niet werd verzocht om specifiek perseveratief gedrag te vertonen, had dit veiligheidsgedrag wel degelijk perseveratieve kenmerken; het moest worden uitgevoerd voorbij het punt dat het doel van de actie redelijkerwijs is bereikt.

Samengevat, herhaaldelijk checken leidt tot onzekerheid over het geheugen, perseveratief staren leidt tot dissociatie en onzekerheid over de perceptie en schoonmaakgedrag leidt tot onzekerheid over besmetting. Deze effecten treden snel op; korte perioden van staren en het uitvoeren van enkele checks leiden tot al tot een toename in onzekerheid. Mogelijk zijn deze bevindingen speciale gevallen van een meer algemeen fenomeen; namelijk dat perseveratie leidt tot onzekerheid over de cognitieve functie die erbij is betrokken. Perseveratie om onzekerheid te verminderen zou dan een algemene contra-productieve strategie zijn die de stoornis juist in stand zal houden.

DOEL VAN DEZE DISSERTATIE

Het eerste doel van deze dissertatie was om te onderzoeken in hoeverre de effecten van perseveratie te generaliseren zijn naar andere cognitieve processen dan welke tot nu toe zijn onderzocht (bijv. geheugen en perceptie). Het tweede doel was om beter te begrijpen hoe de onzekerheid toeneemt en blijft voortbestaan na het uitvoeren van obsessief-compulsief perseveratief gedrag. Met andere woorden, is er een algemeen mechanisme wat dit 'perseveratie → onzekerheid' fenomeen verklaard?

Hoofdstuk 2 beschrijft een studie bij gezonde participanten waarin is getest of onzekerheid ook optreedt na het herhalen van taal. Meer specifiek hebben we onderzocht of het herhalen van zinnen leidt tot onzekerheid over de betekenis van de zin. Daarnaast is getest hoe snel dit effect optrad en of het werd beïnvloed door het gelijktijdig kijken naar het object van de zin (bijv. kijken naar een mok en zeggen: 'De mok is schoon'). Het opzeggen van een zin leidde al na 5 herhalingen tot semantische onzekerheid en dit effect nam toe met meer herhalingen. Het maakte daarbij niet uit of de participant keek naar het object van de perseveratie of niet. De resultaten van hoofdstuk 2 suggereren dat het 'perseveratie → onzekerheid' fenomeen ook aanwezig is na het herhalen van tekst. De semantische onzekerheid die optrad na perseveratie had een duidelijk dissociatief karakter; twee van de vier items die werden gebruikt om onzekerheid te meten waren gerelateerd aan dissociatie (e.g., 'terwijl ik de zin herhaalde, klonk deze onwerkelijk').

De redeneerstijl van patiënten met OCS vertoont ook perseveratieve kenmerken. Om te voorkomen dat er geen potentiële catastrofes over het hoofd worden gezien, kunnen sommige patiënten met OCS lange ketens van redenatiestapjes maken van een huidige neutrale situatie naar een onwaarschijnlijke catastrofe. Zo gaf een patiënte met OCS aan dat ze bang was om schuldig te zijn aan onverantwoordelijk gedrag. Ze had tijdens een uitje in een pretpark een stukje kauwgom op een reuzenrad geplakt. Ze beargumenteerde dat het mogelijk was dat een klein kind in een ander stoeltje het stukje kauwgom zou zien. Dit kindje zou vervolgens kunnen proberen het stukje kauwgom te pakken. Dan zou het kindje mogelijk naar voren leunen, waarbij het kind te ver over de reling zou hangen. Dan zou het kind vervolgens kunnen vallen en overlijden. In **hoofdstuk 3** is onderzocht, bij gezonde participanten, of deze stapsgewijze, perseveratieve manier van redeneren leidt tot een stijging in geloofwaardigheid van een beangstigende, maar onwaarschijnlijke uitkomst. Daarnaast is getoetst of de onzekerheid over deze catastrofe zou toenemen. De

resultaten lieten zien dat perseveratief redeneren vanuit een gegeven situatie naar een catastrofale uitkomst leidde tot een stijging van de geloofwaardigheid van deze uitkomst. De geloofwaardigheid van de uitkomst nam niet verder toe wanneer participanten meer verschillende series van redeneerstappen maakten tussen de gegeven situatie en de catastrofe. Tegengesteld aan de verwachtingen leidde perseveratief redeneren niet tot een significante toename in onzekerheid over de uitkomst. Mogelijk was dit te wijten aan de formulering van de onzekerheidstellingen. Bijvoorbeeld de stelling 'Ik weet dat de uitkomst niet geloofwaardig is, maar op de één of andere manier ga ik twijfelen' is moeilijk te beantwoorden voor participanten die de uitkomst na het perseveratief redeneren behoorlijk geloofwaardig vonden.

In **hoofdstuk 4** is onderzocht of herhaaldelijk checken niet enkel de onzekerheid over het geheugen vergroot, maar ook leidt tot onzekerheid over toekomstig gevaar. Gezonde participanten leerden dat een gevaar-cue (CS+, cirkel op de plaats van een eerder vertoonde brandende gaspit) werd gevolgd door een schok (UCS) en dat een veiligheid-cue (CS-, cirkel op de plaats van een gaspit die uit stond) nooit werd gevolgd door een schok. Dit maken van onderscheid tussen een veiligheid-cue en een gevaar-cue was onderwerp van een herhaaldelijke checkprocedure. Participanten in de experimentele groep controleerden twee keer achter elkaar 20 maal gaspitten. Participanten in de controlegroep voerden tweemaal 20 irrelevante checks van lampen uit. Na de eerste serie van 20 checks waren participanten in beide groepen accuraat in het voorspellen van de UCS en ook de accuraatheid van het geheugen bleef intact. Er trad echter in de experimentele groep in vergelijking met de controlegroep een significante daling in geheugenzekerheid op. Daarnaast waren participanten in de experimentele groep na de aanbieder van een CS ook meer onzeker of er wel of niet een UCS zou volgen. Na de tweede serie van checks was er echter geen verdere daling in zekerheid over het geheugen of over het optreden van de UCS te zien, de reden hiervan is niet duidelijk. Een mogelijke verklaring is dat er sprake was van een zogenaamd vloereffect; wellicht kon de onzekerheid niet verder dalen na een volgende serie van 20 checks.

Patiënten met OCS vertonen perseveratief gedrag om gevaar te voorkomen. Deze studie laat zien dat dit een disfunctionele strategie is; herhaaldelijk checken leidt niet alleen tot minder vertrouwen in het geheugen, maar ook tot onzekerheid over toekomstig gevaar. Aangezien onvoorspelbaarheid van toekomstig gevaar een mogelijke causale factor is in de ontwikkeling van angststoornissen (Barlow, 2000),

zou perseveratief gedrag op deze wijze kunnen zorgen voor een toename en instandhouding van OCS symptomen.

Samengevat; de studies van hoofdstuk 2, 3 en 4 laten evenals eerdere studies zien dat de effecten van compulsieve perseveratie zeer paradoxaal zijn. Patiënten met OCS proberen meer zekerheid te verkrijgen door perseveratief gedrag uit te voeren. Het resultaat van deze veiligheidsstrategieën staat echter in schril contrast met de intentie van de patiënten. Perseveratie is een contraproductieve strategie en leidt tot een afname in plaats van een toename in vertrouwen in de cognitieve functies die erbij betrokken zijn.

ONDERLIGGENDE MECHANISMEN

In het tweede deel van dit proefschrift is onderzocht op welke wijze perseveratie leidt tot onzekerheid. Priming studies laten zien dat wanneer een persoon een woord te zien krijgt, deze persoon vervolgens sneller zal reageren op gerelateerde woorden (bijv. 'tafel') dan op niet-gerelateerde woorden (bijv. 'paard'). Volgens de theorie van 'spreading of activation' worden na waarneming van een stimulus semantisch gerelateerde concepten meer toegankelijk. Als deze stimulus echter herhaaldelijk wordt aangeboden, kan het 'spreading of activation' effect worden geblokkeerd. Dit satiatie effect is gevonden na het herhalen van woorden. Wanneer participanten een prime woord (bijv. 'fruit') 30 maal hardop moesten herhalen, waren ze trager in beslissen of een gerelateerd woord (bijv. 'appel') tot dezelfde categorie behoorde dan wanneer de prime driemaal werd herhaald. Hetzelfde effect is gevonden voor visuele representaties. Na het vertonen van 30 afbeeldingen van een beroemdheid werden mensen langzamer in het beslissen of een andere beroemde persoon gerelateerd was aan deze beroemdheid dan wanneer er maar drie foto's werden vertoond. Dit satiatie effect kan ook subjectief worden waargenomen. Wanneer een woord herhaaldelijk hardop wordt uitgesproken (bijv. 'melk, melk, melk.. '), zal het niet volledig zijn betekenis verliezen, maar toch vreemd en gek gaan klinken. Zoals hierboven beschreven heeft de onzekerheid die door patiënten met OCS ervaren wordt na perseveratie een typisch dissociatief karakter. Patiënten begrijpen nog steeds wat de stimulus of de situatie betekent, maar rapporteren tegelijkertijd dat het gek en onwerkelijk aanvoelt. De semantische ambiguïteit die ervaren kan worden na het herhalen van woorden lijkt op dit onwerkelijke gevoel van patiënten met OCS. Mogelijk treedt een blokkade van 'spreading of activation' niet alleen op na het

herhalen van woorden of afbeeldingen. Wellicht worden semantisch gerelateerde concepten ook geblokkeerd na het uitvoeren van perseveratief gedragingen zoals patiënten met OCS vertonen. Dit zou kunnen leiden tot een verminderde betekenis van objecten die gerelateerd zijn aan de perseveratie, met als gevolg de dissociatieve twijfel ('ik weet wel dat ik de deur heb gecontroleerd, maar het voelt vreemd en onwerkelijk') die patiënten met OCS ervaren. Het doel van de laatste twee hoofdstukken was om te onderzoeken of het 'perseveratie → onzekerheid' fenomeen uitgelegd kan worden in termen van een geblokkeerde 'spreading of activation' van gerelateerde concepten.

In **hoofdstuk 5** is onderzocht of perseveratief obsessief-compulsief gedrag leidt tot semantische satiatie. Participanten kregen de opdracht om 20 verschillende checkhandelingen uit te voeren (bijv. controleren van een koffiezetapparaat). De helft van deze handelingen moest 20 keer worden uitgevoerd (perseveratieve conditie), de andere helft werd slechts tweemaal uitgevoerd (niet-perseveratieve conditie). Na 2 of 20 checks werd een afbeelding vertoond (bijv. een koffiekop) en participanten moesten zo snel mogelijk beslissen of de uitgevoerde check wel of niet gerelateerd was aan deze vertoonde afbeelding. Resultaten laten zien dat participanten langzamer zijn in het beoordelen of een gecheckt object en een afbeelding gerelateerd zijn na 20 checks dan na 2 checks. Na 2 checks waren participanten sneller in het beoordelen van een gerelateerde afbeelding dan in het beoordelen van een niet-gerelateerde afbeelding. Dit priming effect was verdwenen na 20 herhalingen; participanten waren dan even snel in het beoordelen van gerelateerde en niet-gerelateerde objecten en afbeeldingen. Een aparte studie die is beschreven in hoofdstuk 5 laat tevens zien dat het uitgevoerde perseveratieve gedrag leidt tot subjectieve gevoelens van dissociatieve onzekerheid. De resultaten suggereren dat compulsieve perseveratie de toegankelijkheid van gerelateerde concepten blokkeert. De twijfel die wordt ervaren door patiënten met OCS wordt mogelijk geïnduceerd door de geblokkeerde 'spreading of activation'.

In **hoofdstuk 6** zijn deze satiatie-effecten verder onderzocht bij patiënten met OCS. In het eerste gedeelte van de studie namen participanten deel aan een taak die deels vergelijkbaar was met de taak die is beschreven in hoofdstuk 5. In deze taak herhaalden participanten echter geen checkhandelingen maar woorden. Een groep patiënten met OCS en een niet-klinische controlegroep herhaalden deze woorden 2 (niet-perseveratief) of 20 keer (perseveratief), totdat een woord verscheen op het

scherm. Participanten moesten dan zo snel mogelijk beslissen of het herhaalde woord wel of niet gerelateerd was aan dit gepresenteerde woord. De resultaten lieten zien dat participanten sneller zijn in deze beslissing voor gerelateerde woorden dan voor niet-gerelateerde woorden. Tegengesteld aan de bevindingen van de studie in hoofdstuk 5, werd dit effect niet geblokkeerd na 20 woord-herhalingen, de gevonden reactietijden waren gelijk na 2 en 20 herhalingen. Met betrekking tot de subjectieve maten werd er wel een verschil gevonden. De score op dissociatieve onzekerheid was hoger in de perseveratieve conditie in vergelijking tot de niet-perseveratieve conditie. Dit effect was sterker in de groep met OCS patiënten; de gemiddelde score op dissociatieve onzekerheid na perseveratie was in deze groep significant hoger dan in de controlegroep. Exploratieve analyses vertoonden geen significante verschillen tussen beide groepen met betrekking tot de intolerantie van deze dissociatieve onzekerheid. In het tweede deel van de studie die is beschreven in hoofdstuk 6 is onderzocht of dezelfde dissociatieve onzekerheid die is gevonden na gecontroleerde perseveratie ook aanwezig is na klinische perseveratie, zoals uitgevoerd door patiënten met OCS in hun eigen dagelijkse omgeving. Ook al hebben er slechts weinig participanten deelgenomen aan dit tweede deel van de studie (n=9), de resultaten lijken te suggereren dat patiënten meer dissociatieve onzekerheid rapporteerden na klinische perseveratie dan na controlemomenten waarop ze geen perseveratief gedrag uitvoerden.

CONCLUSIES EN VERDERE AANBEVELINGEN

Het doel van het onderzoek wat beschreven is in dit proefschrift is tweeledig. Als eerste werd onderzocht of het 'perseveratie → onzekerheid' fenomeen dat is gevonden in eerdere studies te generaliseren is naar andere cognitieve processen. Ook al is er geen effect op onzekerheid gevonden na het perseveratief redeneren, de resultaten van de studies uit dit proefschrift laten zien dat verscheidene perseveratieve gedragingen contraproductief zijn. Het herhalen van zinnen leidt tot semantische onzekerheid en perseveratief redeneren leidt tot een stijging in geloofwaardigheid van een negatieve uitkomst. Tot slot leidt herhaaldelijk controleren niet alleen tot geheugenonzekerheid, maar ook tot onzekerheid over de voorspelbaarheid van toekomstig gevaar of veiligheid. Op deze wijze leiden deze perseveratieve gedragingen mogelijk tot een zichzelf in stand houdend mechanisme waarbij de onzekerheid motiveert tot het uitvoeren van meer compulsief gedrag. In

hoofdstuk 6 is gevonden dat perseveratie leidt tot een hogere stijging van dissociatieve onzekerheid in patiënten met OCS dan in een gezonde controlegroep. Mogelijk zijn patiënten met OCS meer gevoelig voor de effecten van perseveratie en belanden zij op deze wijze sneller in een vicieuze cirkel van toegenomen checkgedrag en onzekerheid. Verder laat dit hoofdstuk zien dat dissociatieve onzekerheid mogelijk ook optreedt na het uitvoeren van klinische perseveratie in de eigen omgeving.

Ten tweede is onderzocht of semantische satiatie een mogelijk verklarend mechanisme zou kunnen zijn voor het 'perseveratie → onzekerheid' fenomeen. De bevindingen van hoofdstuk 5 en 6 zijn hierover niet eenduidig. In hoofdstuk 5 zijn aanwijzingen gevonden dat de ironische effecten van perseveratie te wijten zijn aan een blokkade van 'spreading of activation' van gerelateerde concepten. Deze bevindingen zijn echter niet gerepliceerd in hoofdstuk 6. Het is daarom nog niet duidelijk of semantische satiatie het drijvende mechanisme is achter het 'perseveratie → onzekerheid' fenomeen. Het zou de voorkeur verdienen om een vervolgstudie uit te voeren waarin dissociatieve onzekerheid en de objectieve effecten van een geblokkeerde 'spreading of activation' gemeten worden in dezelfde perseveratie taak. Op deze wijze zou het mogelijk zijn om te kijken of een stijging in dissociatieve onzekerheid na perseveratie samenhangt met een afname in 'spreading of activation'. Verder vervolgonderzoek zou zich ook kunnen richten op het toetsen van andere verklaringsmodellen, bijvoorbeeld door te kijken naar automatiseringsprocessen die optreden ten gevolge van perseveratie.

Een andere mogelijke richting voor vervolgonderzoek zou het verder ontwikkelen van korte gevalideerde vragenlijsten zijn, zodat dissociatie en onzekerheid zoveel mogelijk 'on the spot' gemeten kunnen worden. In dit proefschrift is gekozen voor de term 'dissociatieve onzekerheid', aangezien beide begrippen niet eenvoudig van elkaar te onderscheiden zijn. Het zou echter interessant zijn om de relatie tussen beide te onderzoeken.

Bijna alle studies in deze thesis zijn uitgevoerd in een laboratoriumsetting met een niet-klinische populatie. De resultaten hebben wellicht toch enige implicaties voor de klinische praktijk. De OCS behandeling met de meeste empirische ondersteuning is cognitieve gedragstherapie met exposure en responsepreventie (ERP) (Fals-Stewart, Marks, & Schafer, 1993). In ERP worden patiënten met OCS blootgesteld aan de door hen gevreesde stimuli terwijl het compulsieve gedrag niet mag worden uitgevoerd. Op deze wijze ervaren en leren patiënten dat het uitvoeren van compulsies en

vermijdingsgedrag niet nodig zijn om gevaar te voorkomen. De angst voor de gevreesde stimuli zal door middel van extinctie (uitdoving) verdwijnen. Mogelijk laten de bevindingen van de huidige studie een andere rationale zien voor het werkingsmechanisme achter ERP. Wanneer patiënten worden gemotiveerd om te stoppen met hun compulsieve gedragingen, zorgt dit ervoor dat de ironische effecten van dit gedrag worden geblokkeerd. Met andere woorden, ERP zorgt wellicht niet alleen voor een reductie van onzekerheid door middel van het extinctieproces, maar ook doordat het 'perseveratie → onzekerheid' proces wordt geblokkeerd. Psycho-educatie waarin wordt uitgelegd dat perseveratief gedrag niet alleen nutteloos is, maar zelfs negatieve effecten heeft (meer onzekerheid en dissociatieve gevoelens), kan wellicht helpen om patiënten te motiveren om met dit gedrag te stoppen. Daarnaast interpreteren patiënten met OCS hun dissociatieve gevoelens mogelijk als een teken van een cognitieve afwijking. Wellicht denken ze hierdoor dat er iets mis met ze is of dat ze gek aan het worden zijn. Wanneer ze begrijpen dat deze gevoelens een normale consequentie zijn van het uitvoeren van compulsief gedrag, kan dit wellicht de angst reduceren.

Kortom, deze dissertatie laat zien dat de paradoxale effecten van perseveratie niet beperkt zijn tot geheugen en perceptie, maar ook optreden in relatie tot andere domeinen. Verder hebben we een eerste stap gezet in het ontrafelen van het onderliggende mechanisme van het 'perseveratie → onzekerheid' fenomeen.

Curriculum Vitae

CURRICULUM VITAE



Catharina Louisa (Karin) Giele was born on May 29, 1983 in Kloetinge, a village in the Dutch province of Zeeland. In 2001, she graduated from secondary school (VWO) at the Buys Ballot College in Goes. She started her study Psychology at Utrecht University. In 2008, she obtained her Master's degree (cum laude) in Clinical and Health Psychology. Driven by curiosity, it is no surprise that Karin got involved in experimental research.

Therefore, she started her PhD 'Perseveration in Obsessive Compulsive Disorder' at the same university, under supervision of Prof. dr. Marcel van den Hout and Prof. dr. Iris Engelhard. Apart from doing research, she is also interested in clinical practice. Therefore, she started an internship as a therapist at the Ambulatorium of Utrecht University and the VGct traject for cognitive behavioural therapist. She currently works as a lecturer at the Department of Clinical and Health Psychology at Utrecht University.

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MANUSCRIPTS SUBMITTED

- Giele, C. L.**, van den Hout, M. A., Engelhard, I. M., Dek, E. C. P., Toffolo, M. B. J., & Cath, D. C. (2014). *The effects of perseveration in obsessive-compulsive disorder*. Manuscript submitted for publication
- Dek, E. C. P., van den Hout, M. A., **Giele, C. L.**, & Engelhard, I. M. (2014). *Automatization and familiarity in repeated checking*. Manuscript submitted for publication

AWARDS

Poster Award at the 2011 Annual Congress of Vereniging voor Gedragstherapie en Cognitieve Therapie (VGCT najaarscongres) [Dutch Association of Behavioural therapy and Cognitive Therapy] with poster Giele, van den Hout, Engelhard, Dek, Hoogers & de Wit, The ironic effects of compulsive perseveration.

Honourable mention for poster presentation at the 2010 Annual Congress of Vereniging voor Gedragstherapie en Cognitieve Therapie (VGCT najaarscongres) [Dutch Association of Behavioural therapy and Cognitive Therapy] with poster Giele, van den Hout, Engelhard, Dek, Klein Hofmeijer, Obsessive compulsive-like reasoning makes an unlikely outcome more credible.

SELECTION OF PRESENTATIONS

- Giele, C. L.**, van den Hout, M. A. & Engelhard, I. M. (2013, September). The effects of perseveration in OCD on semantic satiation and dissociative doubt. In C. L. Giele & M. B. J. Toffolo. New research developments in the psychological understanding of OCD. Oral presentation at the annual congress of European Association for Behavioural and Cognitive Therapies (EABCT), Marrakech, Morocco.
- Giele, C. L.**, van den Hout, M. A., Engelhard, I. M., Dek, E. C. P. (2013, March). The ironic effects of compulsive perseveration. Oral presentation at the PhD candidates Day of postgraduate school for research and education Experimental Psychopathology (EPP), Utrecht, The Netherlands.
- Dek, E. C. P., **Giele, C. L.**, & van den Hout, M. A. (2011, September). Does de-familiarization reduce the confidence undermining effects of OCD-like checking? In R. Dar. Exploring Obsessive-Compulsive Doubt: New Experimental Studies. Oral presentation at the annual congress of European Association for Behavioural and Cognitive Therapies (EABCT), Reykjavik, Iceland.
- Giele, C. L.**, Dek, E. C. P., van den Hout, M. A., & Engelhard, I. M. (2011, September). OCD-like reasoning makes an unlikely catastrophe more credible. In R. Dar. Exploring Obsessive-Compulsive Doubt: New Experimental Studies. Oral presentation at the annual congress of European Association for Behavioural and Cognitive Therapies (EABCT), Reykjavik, Iceland.
- Giele, C. L.**, van den Hout, M. A., Dek, E. C. P., & Engelhard, I. M. (2011, September). How compulsions breed doubt: Obsessive compulsive-like (motor) perseveration blocks spreading of semantic activation. In F. Meeten. Mechanisms of perseveration in psychopathology. Oral presentation at the annual congress of European Association for Behavioural and Cognitive Therapies (EABCT), Reykjavik, Iceland.
- Dek, E. C. P., **Giele, C. L.**, & van den Hout, M. A. (2010, June). Domain Specificity of Uncertainty Caused by OCD-like Perseveration. In A. S. Radomsky. Check the Details Again and Again: Information Processing Research in Compulsive Checking and OCD. Oral presentation at the World Congress of Behavioral and Cognitive Therapies (WCBCT), Boston MA, USA.