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Safety Behavior Increases Obsession-Related Cognitions About the Severity of Threat

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This study investigated whether checking behavior, the most common safety behavior in obsessive–compulsive disorder (OCD), contributes to the development of OCD symptoms. Ninety healthy undergraduates spent a week between a pre- and posttest either actively engaging in clinically representative checking behavior on a daily basis (experimental group, n = 30), monitoring their normal checking behavior (monitor group, n = 30), or received no instructions on checking behavior (control group, n = 30). Cognitions about the severity of threat increased from pre- to posttest in the experimental group, but not in the monitor and control groups. Cognitions about the importance of checking decreased in the monitor group. The results indicate that checking behavior contributes directly to the exacerbation of OCD symptoms. Together with the findings of previous studies, this suggests that safety behavior may be involved in the development of anxiety disorders and OCD. Potential mechanisms of how engaging in safety behavior increases threat perception are discussed.

Keywords: safety behavior; obsessive–compulsive disorder; checking; threat overestimation

Author contributions: both authors contributed equally.

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Safety behavior is common in both anxiety- and obsessive–compulsive-related disorders (American Psychological Association, 2013), and refers to actions aimed at preventing or minimizing a feared outcome (Salkovskis, 1991). Patients with social phobia, for instance, avoid eye contact because they fear rejection, patients with panic disorder quickly sit down when they feel their heart beat rising to avoid a heart attack, and patients with obsessive–compulsive disorder (OCD) frequently check gas stoves, light switches, or electrical outlets, because they fear the catastrophe of their house burning down under their responsibility. Although these behaviors seem useful to patients and provide anxiety relief in the short term, they actually play a pivotal role in the maintenance of pathological anxiety in the long term (Clark, 1999; Salkovskis, Thorpe, Wahl, Wroe, & Forrester, 2003). Most importantly, safety behaviors cause a misattribution of safety, which prevents the acquisition of information that disconfirms inaccurate threat beliefs (Salkovskis, 1991), and divert attentional recourses away from this information (Sloan & Telch, 2002). For instance, in patients with OCD, the nonoccurrence of their house burning down may erroneously be attributed to the repeated checking of the gas stove (i.e., safety behavior).

In addition to their role in the maintenance of symptoms, safety behavior seems to contribute directly to the *exacerbation* and *development* of anxiety and OCD symptoms. To illustrate, individuals with hypochondriasis may increase health anxiety by constantly checking their body (e.g., feeling for lumps, inspecting skin spots; see Abramowitz, Schwartz, & Whiteside, 2002), and patients with checking compulsions paradoxically enhance memory uncertainty by perseverative checking (Boschen &

Vuksanovic, 2007). Recently, Engelhard, van Uijen, van Seters, and Velu (in press) showed that even in healthy individuals, the use of safety behavior leads to threat expectations to objectively safe stimuli. In a conditioning experiment, participants who displayed safety behavior (i.e., they could avoid a potential subsequent shock) to a safety cue (a stimulus that had never been paired with a shock) subsequently had higher threat expectations to this cue than participants who were not given the opportunity to avoid. Thus, safety behavior seems to increase anxiety not only by misattributing safety to the execution of this behavior, but also by directly attributing danger to safe situations.

The possibility that safety behavior exerts a causal influence on anxiety was recently investigated in two studies. First, Deacon and Maack (2008) investigated the effects of safety behavior on the fear of contamination in healthy participants with either high or low levels of contamination fear. After a weeklong baseline period, participants spent 1 week actively engaging in a wide range of contamination-related safety behaviors on a daily basis (e.g., washing and disinfecting hands excessively, trying to avoid touching public door handles), followed by a second weeklong baseline period. Independent of initial levels of contamination fear, participants reported increased contamination anxiety following the safety behavior manipulation. However, because this study lacked a control condition that did not perform any safety behavior, it remained unclear what the effect of the manipulation was. Therefore, in a subsequent study, healthy participants were divided in two groups, a safety behavior group and a monitor/control group (Olatunji, Etzel, Tomarken, Ciesielski, & Deacon, 2011). In between two weeklong baseline periods in which both groups monitored their normal use of safety behaviors, participants in the safety behavior condition were asked to spend 1 week engaging in a large array of health-related safety behaviors on a daily basis, whereas participants in the control condition kept monitoring their usual safety behavior. Results showed that, compared with the control condition, participants in the safety behavior condition reported higher levels of health anxiety, hypochondriacal beliefs, and avoidant responses to health-related behavioral tasks. Thus, even in healthy individuals, the mere act of engaging in health-related safety behaviors for 1 week increased health anxiety.

Although hypochondria was not classified as an anxiety disorder in DSM-IV, and OCD has been separated from the anxiety disorders in DSM-5 (American Psychological Association, 2013), there appears to be quite some overlap between these disorders and anxiety disorders (Deacon & Abramowitz, 2008). Thus, despite the distinct characteristics of the safety behaviors associated with these disorders, the role that safety behaviors may play in the development of OCD and anxiety disorders is expected to be functionally equivalent (Rachman, 2002; Telch & Lancaster, 2012). However, checking behavior, the most commonly observed safety behavior in patients with OCD (i.e., in 80% among those with lifetime OCD; Ruscio, Stein, Chiu, & Kessler, 2010), has unique features that include rigidity and repetitiveness. The present study was therefore conducted to experimentally investigate whether this more rigid and ritualistic safety behavior (i.e., checking) contributes to the development of OCD symptoms.

According to the self-perpetuating mechanism of compulsive checking (Rachman, 2002), the amount of checking behavior a person performs is determined by the sense of responsibility, probability of harm, and anticipated seriousness of the harmful outcome. Conversely, Rachman (2002) predicts that an increase in checking behavior will lead to an increase in the sense of responsibility, probability of harm, anticipated seriousness of the harmful outcome, and, additionally, a decrease in memory confidence. Since previous research has shown that people with OCD symptoms not only use checking behavior in response to their obsessions, but also have the tendency to display more checking behavior in mildly uncertain situations that are unrelated to obsessions (Toffolo, van den Hout, Engelhard, Hooge, & Cath, 2014; Toffolo, van den Hout, Hooge, Engelhard, & Cath, 2013), checking behavior itself may contribute to the development of the disorder. When people are habitually more inclined to use checking behavior, this may not only increase uncertainty levels (e.g., van den Hout & Kindt, 2003), but also have a direct effect on obsessional beliefs such as the perceived likelihood and severity of threat. Therefore, we conducted a study similar to the one by Olatunji et al. (2011), in which participants in the experimental condition engaged in a large number of checking-related safety behaviors for 7 consecutive days, to simulate the natural behavior of patients with checking OCD. Although patients with OCD often repeatedly check the same objects, their rigidity and the repetitiveness of their behavior may also become visible in mere checking rituals. This often involves checking a series of objects in a certain order, every time they leave the house or go to bed, for instance. In the present study we chose to include this last type of checking behavior, because it seemed more plausible that healthy participants would comply to this and be able to incorporate it into their daily life for a period of 1 week.

As mentioned earlier, contrary to Deacon and Maack (2008), Olatunji et al. (2011) did include a control condition that monitored daily safety behavior. However, as Olatunji et al. (2011) discuss, it is unknown whether merely monitoring one's safety behavior affects behavior and subsequent outcome measures. Prior research suggests that self-monitoring of psychopathological symptoms in treatment decreases anxiety and negative behavior, and increases positive behavior and approach (see Craske & Tsao, 1999). To eliminate the potential influence of safety behavior monitoring, the present study included an additional control condition, in which participants did nothing between the pre- and posttest. Inclusion of a no-monitoring control condition made it possible to isolate the effect of the checking behavior manipulation from potential monitoring effects. Therefore, contrary to Deacon and Maack (2008) and Olatunji et al. (2011), we did not include weeklong baseline periods before and after the checking behavior manipulation, but only used a pre- and posttest. It was hypothesized that compared with the monitor and control groups, participants in the experimental group would show a pre- to posttest increase in OCD-related cognitions about the importance of checking, the perceived likelihood and severity of a catastrophe (i.e., threat overestimation), and general obsessive beliefs about inflated responsibility and exaggerated threat perceptions. Based on previous findings of Deacon and Maack (2008) and Olatunji et al. (2011) it was also expected that these effects would be specific to OCD-related cognitions, and that the manipulation would not affect general anxiety.

Method

PARTICIPANTS

Ninety participants (mean age 22.36, *SD* = 3.39; 73 women) were recruited at Utrecht University and the University of Applied Sciences Utrecht, and randomly assigned to the experimental (n = 30), monitor (n = 30), or control group (n = 30). Individuals with a current psychiatric disorder were excluded from participation. Participants received remuneration or course credit for their participation.

MEASURES

Checking Cognitions Scale (CCS)

Based on the Contamination Cognitions Scale used in a similar study by Deacon and Maack (2008), this questionnaire was developed for the present study to assess the effect of checking behavior on OCD-related cognitions about the importance of checking and the perceived likelihood and severity of threat when one does not check things around the house (see supplemental material 1). It consists of 21 questions about 7 items that are often involved in OCD-related checking behavior, such as the gas stove, windows and doors, and electrical plugs. For each item, participants rate the importance of checking (e.g., "I think that checking if the stove is off before I leave the house or go to bed is . . . "; rated from *not at all important* to *very important*); the likelihood of a dangerous situation happening (e.g., "How likely is it that a dangerous situation will emerge when you do not check if the stove is off before leaving the house or going to bed?" rated from *very unlikely* to *very likely*); and the severity of a dangerous situation happening (e.g., "How severe would the possible consequences be if you do not check if the stove is off before leaving the house or going to bed?"; rated from *Not at all severe* to *Very severe*) on 0–100 visual analogue scales (VAS). The overall CCS score was calculated by averaging ratings across all 21 items (cf. Deacon & Maack, 2008). Even though importance of checking, likelihood of threat, and severity of threat ratings were moderately to highly correlated (see Table 2), subscales were calculated by averaging ratings across the 7 items of each subscale to gain insight in the separate constructs of the CCS. The CCS had excellent internal consistency at both time points (α's = .89 and .93), and high test–retest reliability (r = .87; calculated using the pre- and posttest of the control group). Subscales showed very good internal consistency too, with importance of checking α's = .80 and .88, likelihood of threat α's = .78 and .88, and severity of threat α's = .81 and .86.

Obsessive Beliefs Questionnaire–44 (OBQ-44) Responsibility and Threat Estimation (RT) Scale

A Dutch translation of the 16-item RT subscale of the OBQ-44 (Obsessive Compulsive Cognitions Working Group, 2005) assessed participants' beliefs about preventing harm from happening to oneself or others, beliefs about the consequences of inaction, and responsibility for bad things happening, and was used as a dependent variable. This scale accounts for more variance in OCD-related beliefs than the other belief domains of the OBQ (Obsessive Compulsive Cognitions Working Group, 2005). Participants rate their agreement with each statement on a 7-point Likert scale (e.g., "Harmful events will happen unless I am very careful"; 1 = *disagree very much*, 7 = *agree very much*). Internal consistency was excellent at both time points (α's = .84, and .90).

Obsessive–Compulsive Inventory–Revised (OCI-R)

The Dutch translation (Cordova-Middelbrink, Dek, & Engelbarts, 2007) of the OCI-R (Foa et al., 2002) was used to check for pretest differences in obsessive–

compulsive tendencies. The OCI-R contains 18 items concerning OCD characteristics, each measured on a 4-point Likert scale (e.g., "I check things more often than necessary"; 0 = *not at all*, 4 = *extremely*). The OCI-R has good test–retest reliability and validity in both clinical (Foa et al., 2002) and nonclinical populations (Hajack, Huppert, Simons, & Foa, 2004). Internal consistency was very good (α = .83).

Beck Anxiety Inventory (BAI)

The BAI (Beck, Epstein, Brown, & Steer, 1988) was used to measure effects of the manipulation on general anxiety. It assesses to which extent participants experienced 21 common anxiety symptoms during the past week, rated on 4-point Likert scales (e.g., "heart pounding" or "unsteady"; 0 = *not at all*, 3 = *very much*). It showed excellent internal consistency at both time points (α's = .83 and .88).

The Checklist

The Checklist was developed as a manipulation check and to inspect pretest differences in checking behavior (see supplemental material 2). The Checklist contains six categories of situations in which people may perform checking behavior, and each category contains several items that could be checked when participants were in that situation (e.g., "checking if the door was locked" or "checking if your laptop was unplugged"). The categories were "Before leaving the house," "Before going to bed," "When being/having been away," "After being in the kitchen," "After using the bathroom/cosmetic appliances," and "Other situations." Respondents noted whether or not they had performed each of the 59 checking behaviors that day by indicating "yes" or "no." A third option, "not applicable (N/A)" was provided in case participants did not have the opportunity that day to perform that particular checking behavior (e.g., if the participant never used a hair dryer). The percentage of "yes" responses of the total number of items that could have been checked (sum of "yes" and "no" responses) was calculated. Test–retest reliability was very good (r = .85; calculated using the pre- and posttest of the control group).

PROCEDURE

Participants were tested individually in a soundproof laboratory room during both sessions. During the first session, participants gave written informed consent after receiving verbal and written instructions about the study. Participants received a package with five questionnaires (CCS, OCI-R, OBQ-44 RT, BAI, and Checklist) and filled these out.

Then the manipulation followed. Participants in the experimental group were given a laminated list with all the checking items of the Checklist in present tense (e.g., "Before leaving the house: Check if the door is locked"). Participants were told that the researcher was interested in to what extent people can engage in *more* checking behavior of everyday objects than they normally do on a daily basis, for 1 week. They were instructed to perform all the checking behavior on the list at every possible opportunity during the upcoming week. They were asked to check every item once more than they would usually do. For instance, if the participant would usually check once whether the door was locked when leaving the house, they were now asked to check this twice. If the participant usually never checked whether the door was locked, they were now asked to check this once. The experimenter went over the list together with the participant to ensure that he or she understood when and how he or she could check each item (e.g., checking the gas stove could involve carefully looking at whether the burners were off or physically touching or turning the knobs). Next, participants were given one Checklist for each day during the week between the first and second laboratory session. They were asked to complete a Checklist at the end of each day before going to bed, and indicate for each item whether they had checked it in the past 24 hours. To increase compliance, participants were asked to set a daily alarm on their phone as a reminder.

The monitor group was told that the researcher was interested in to what extent people usually check everyday objects on a daily basis, for 1 week. They were also handed a Checklist for each day during the week between the first and second laboratory session, and asked to complete one at the end of each day before going to bed. Participants were instructed not to change their behavior in any way, and to "just do what you would normally do and record it on this form every day." The experimenter went over the Checklist together with each participant and asked each to set a daily alarm on his or her phone as a reminder. The control group did not receive any further instructions.

The second session took place approximately 1 week later (6–8 days). Participants in the experimental and monitor group handed in their daily Checklists. All participants again filled out the CCS, OBQ-44 RT, BAI, and Checklist. Additionally, participants in the experimental and monitor group indicated on a 0 (*not at all*) to 100 (*exclusively*) VAS to what extent they had given socially desirable answers when filling out the daily Checklists, and on a 0–100% VAS which percentage of the behavior they had filled out on the daily Checklists they had actually performed. Participants were thoroughly debriefed, and participants

Table 1
Mean (*SD*) Participant Characteristics and Dependent Variables by Condition

		Experimental group (n = 30)	Monitor group (n = 29)	Control group (n = 30)	Total (N = 89)
OCI-R		11.90 (10.14)	8.59 (5.83)	10.90 (6.75)	10.48 (7.85)
Checklist	Pre	29.08 (13.86)	25.53 (15.97)	28.51 (14.66)	27.73 (14.75)
	Post	77.63 (19.06)	18.76 (14.53)	26.56 (15.08)	41.23 (30.88)
CCS	Pre	37.19 (12.14)	31.15 (15.49)	34.72 (13.37)	34.39 (13.78)
	Post	41.31 (16.81)	28.97 (16.08)	34.02 (13.80)	34.83 (16.25)
CCSimp	Pre	50.74 (15.10)	42.13 (18.32)	51.96 (20.79)	48.34 (18.53)
	Post	53.41 (20.36)	36.34 (18.32)	47.73 (22.75)	45.94 (21.55)
CCSlik	Pre	27.50 (12.60)	19.99 (13.99)	22.37 (13.81)	23.32 (13.69)
	Post	30.99 (16.70)	21.14 (15.64)	23.79 (15.53)	25.35 (16.33)
CCSsev	Pre	33.32 (15.49)	31.34 (20.10)	29.82 (15.26)	31.50 (16.92)
	Post	39.53 (18.80)	29.44 (20.20)	31.00 (16.06)	33.37 (18.74)
OBQ-44	Pre	36.57 (10.85)	34.45 (11.71)	35.30 (12.09)	35.45 (11.46)
	Post	36.90 (12.89)	34.21 (12.47)	32.93 (13.07)	34.69 (12.78)
BAI	Pre	9.27 (6.75)	6.83 (5.08)	9.03 (5.11)	8.39 (5.75)
	Post	9.57 (7.96)	4.62 (4.20)	8.13 (5.57)	7.47 (6.41)

Note. OCI-R = Obsessive-Compulsive Inventory–Revised; CCS = Checking Cognitions Scale; CCSimp = CCS importance subscale; CCSlik = CCS likelihood subscale; CCSsev = CCS severity subscale; OBQ-44 = Obsessive Beliefs Questionnaire–44 Responsibility/Threat Estimation Scale; BAI = Beck Anxiety Inventory; Pre = pretest; Post = posttest.

in the experimental group were encouraged to return to their normal frequency of checking behavior. Participants were handed a letter with the researchers' contact information, and asked to contact them in case they had any further questions concerning the study (n = 0). Finally, participants were thanked and paid for their participation.

Results

RANDOMIZATION AND MANIPULATION CHECKS

One outlier (CCS posttest; control group) was changed into M + 3 SDs (Field, 2009), and one participant in the monitor group was excluded from analyses, because afterwards she reported recently being diagnosed with generalized anxiety disorder. One-way ANOVAs[1] were performed to check for pretest differences among groups. Groups did not differ in obsessive–compulsive tendencies (OCI-R), $F(2, 86) = 1.39$, $p = .26$; or checking behavior (Checklist), $F(2, 86) = 0.48$, $p = .62$ at the pretest, see Table 1. Also, no pretest differences were found on any of the dependent variables, largest $F(2, 86) = 2.54$, $p = .09$. To check whether the manipulation was effective, we examined whether the amount of items participants checked (Checklist) changed from pre- to posttest, and whether the experimental and monitor group differed in scores on the Checklists they filled in each day during the week between the pre- and posttest. Overall, there was a pre- to posttest increase in the amount of items checked, $F(1, 86) = 82.18$, $p < .001$, $\eta_p^2 = .49$; which differed between conditions, $F(2, 86) = 146.58$, $p < .001$, $\eta_p^2 = .77$; see Table 1. The effect of condition was also significant, $F(2, 86) = 42.13$, $p < .001$, $\eta_p^2 = .50$. Planned comparisons showed an increase in the experimental group, $t(29) = 13.42$, $p < .001$, $d = 2.92$; a decrease in the monitor group, $t(28) = 3.49$, $p = .002$, $d = 0.44$; and no change in the control group, $t(29) = 1.30$, $p = .20$. This change in Checklist scores differed between the experimental and monitor group, $t(44.30) = 13.47$, $p < .001$, $d = 3.47$; the experimental and control group, $t(38.66) = 12.89$, $p < .001$, $d = 3.33$; and there was a trend for a difference between the monitor and control group, $t(57) = 1.89$, $p = .05$, $d = 0.51$. On each day during the week between the pre- and the posttest, participants in the experimental group (M = 74.42, SD = 18.34) checked more items than participants in the monitor group (M = 18.24, SD = 13.86), $t(57) = 13.24$, $p < .001$, $d = 3.45$.

No participants were excluded from analyses because of giving socially desirable answers when filling in the daily Checklists. A low percentage of socially desirable answers was reported by participants in both the experimental (M = 22.47%, SD = 24.22) and monitor group (M = 10.31%, SD = 11.84), and they indicated to have performed most of the checking behavior that they had filled in on the daily Checklists (experimental group M = 89.37%, SD = 8.41; monitor group M = 91.34%, SD = 14.70).

[1] For F tests we reported effect size η_p^2, whereby 0.02 indicates a small effect, 0.13 a medium effect, and 0.26 a large effect. For t tests we reported effect size Cohen's d, whereby 0.2 indicates a small effect, 0.5 a medium effect, and 0.8 a large effect.

Table 2
Pearson *r* Correlations Between Questionnaires at the Pretest, *df* = 89

	CCSimp	CCSlik	CCSsev	OCI-R	OCI-Rc	OBQ	BAI	Checklist
CCS	.80**	.86**	.87**	.31*	.26*	.28*	.24*	.52**
CCSimp		.48**	.47**	.26*	.29*	.12	.20	.54**
CCSlik			.77**	.27*	.22*	.28*	.23*	.42**
CCSsev				.26*	.13	.32*	.18	.35*
OCI-R					.56**	.48**	.66**	.30*
OCI-Rc						.22*	.26*	.26*
OBQ-44							.48**	.25*
BAI								.28*

Note. *$p < .05$, **$p < .001$; CCS = Checking Cognitions Scale; CCSimp = CCS importance subscale; CCSlik = CCS likelihood subscale; CCSsev = CCS severity subscale; OCI-R = Obsessive–Compulsive Inventory–Revised; OCI-Rc = Obsessive–Compulsive Inventory–Revised checking subscale; OBQ = Obsessive Beliefs Questionnaire-44 Responsibility/Threat Estimation Scale; BAI = Beck Anxiety Inventory.

MAIN ANALYSES [2]

Table 2 shows that there were moderate to strong significant correlations among most questionnaires at the pretest. Correlations with the OCI-R checking cognitions subscale were added separately as an additional check of the validity of the CCS and Checklist. To test the study hypotheses, a series of 2 (Time: pretest vs. posttest) × 3 (Condition: experimental vs. monitor vs. control) mixed ANOVAs (see footnote 1) were conducted to examine the effect of the safety behavior manipulation on checking cognitions (CCS), obsessive beliefs (OBQ-44 RT), and general anxiety symptoms (BAI).

Checking Cognitions Scale (CCS)

There was no main effect of time, $F(1, 86) = 0.27$, $p = .60$; and a trend of condition, $F(2, 86) = 3.10$, $p = .05$, $\eta_p^2 = .07$. The crucial Time × Condition interaction was significant, $F(2, 86) = 5.62$, $p = .005$, $\eta_p^2 = .12$; see Figure 1. Planned comparisons showed a pre- to posttest increase in the experimental group, $t(29) = 2.40$, $p = .02$, $d = 0.28$; a trend for a decrease in the monitor group, $t(28) = 1.97$, $p = .06$, $d = 0.14$; and no change in the control group, $t(29) = 0.56$, $p = .58$. The change in CCS scores differed between the experimental and monitor group, $t(49.11) = 3.08$, $p = .003$, $d = 0.80$; and the experimental and control group, $t(58) = 2.27$, $p = .03$, $d = 0.59$; but not between the monitor and control group, $t(57) = 0.89$, $p = .38$. Hence, consistent with our hypothesis, performing OCD-related checking behavior for 1 week increased participants' checking-related cognitions.

CCS subscale importance of checking showed a decrease over time, $F(1, 86) = 3.99$, $p = .049$, $\eta_p^2 = .04$; a main effect of condition, $F(2, 86) = 4.01$, $p = .02$, $\eta_p^2 = .09$; and a Time × Condition interaction, $F(2, 86) = 4.52$, $p = .01$, $\eta_p^2 = .10$; see Figure 2, left panel. There was a pre- to posttest decrease in the importance of checking in the monitor group, $t(28) = 3.12$, $p = .004$, $d = 0.32$; a trend for decrease

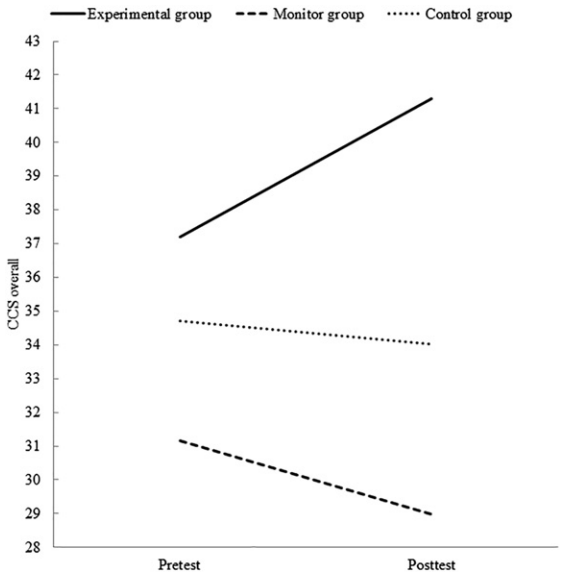

FIGURE 1 Checking Cognitions Scale (CCS) scores at pre- and posttest for each condition.

[2] Exploratively it was examined whether the checking behavior manipulation would have an effect on general checking behavior in an unrelated task. The visual search task of Toffolo et al. (2013) was administered both at pre- and posttest, because this induced and measured checking behavior. In this task participants had to report whether a target was present or absent in a search field (see Toffolo et al., 2013, for details of the task). A 2 (Time) × 2 (Trial type: target-absent vs. target-present trials) × 3 (Condition) mixed ANOVA was performed to compare groups on pre- to posttest changes in search time (checking behavior) in both target-absent and target-present trials. Although overall, participants searched longer in absent than present trials, $F(1, 82) = 572.94$, $p < .001$, $\eta_p^2 = .88$; and there was an overall decrease in search time from pre- to posttest, $F(1, 82) = 14.48$, $p < .001$, $\eta_p^2 = .15$; the crucial interaction effects were not significant, $ps > .26$.

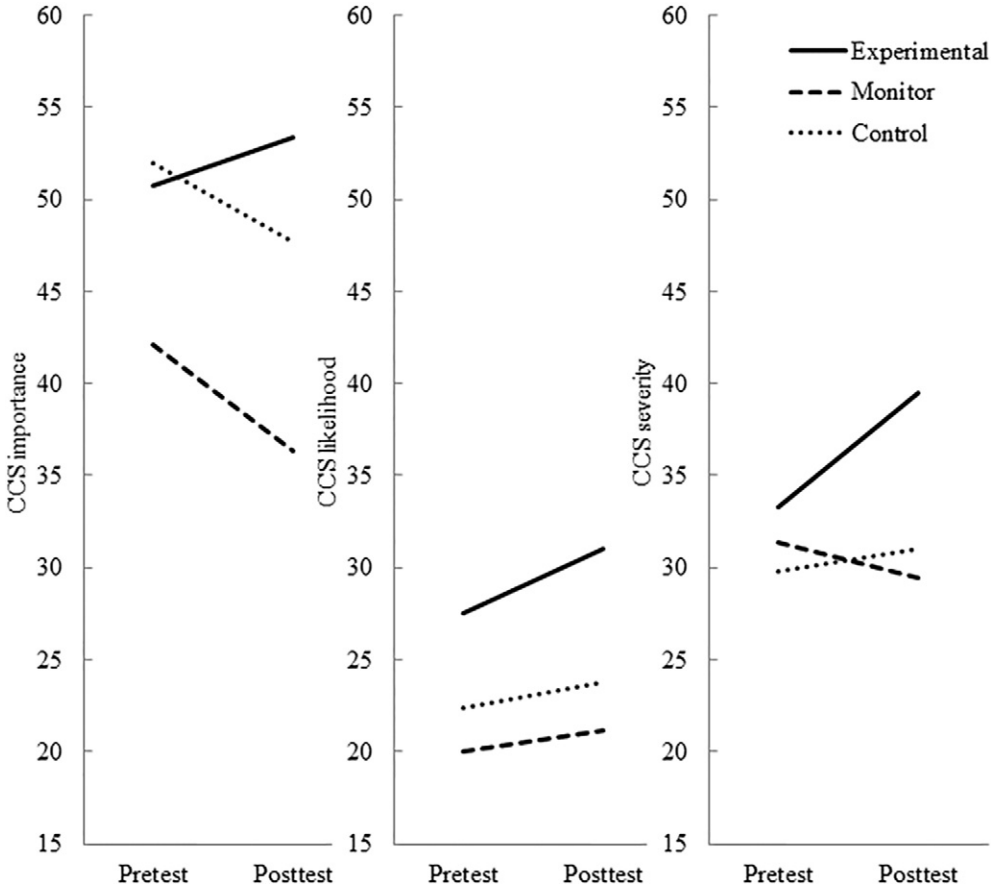

FIGURE 2 Checking Cognitions Scale (CCS) subscales importance of checking (left panel), likelihood of threat (middle panel), and severity of threat (right panel) at pre- and posttest for each condition.

in the control group, $t(29) = 1.95$, $p = .06$, $d = 0.19$; and no change in the experimental group, $t(29) = 1.17$, $p = .25$. The likelihood subscale showed a trend for an increase over time $F(1, 86) = 3.48$, $p = .07$, $\eta_p^2 = .04$; a trend of condition, $F(2, 86) = 3.08$, $p = .05$, $\eta_p^2 = .07$; and no Time × Condition interaction, $F(2, 86) = 0.47$, $p = .63$; see Figure 2, middle panel. On the severity subscale, there was a trend for an increase over time, $F(1, 86) = 3.44$, $p = .07$, $\eta_p^2 = .04$; no main effect of condition, $F(2, 86) = 1.23$, $p = .30$; and a Time × Condition interaction, $F(2, 86) = 5.74$, $p = .005$, $\eta_p^2 = .12$; see Figure 2, right panel. Checking cognitions about the severity of threat increased from pre- to posttest in the experimental group, $t(29) = 2.72$, $p = .01$, $d = 0.36$; but did not change in the monitor, $t(28) = 1.43$, $p = .17$; and control group, $t(29) = 0.92$, $p = .37$.

Obsessive Beliefs Questionnaire-44 (OBQ-44) Responsibility and Threat Estimation (RT) Scale

There were no main effects of time, $F(1, 86) = 0.70$, $p = .41$; and condition, $F(2, 86) = 0.48$, $p = .62$; nor was the Time × Condition interaction significant, $F(2, 86) = 0.83$, $p = .44$. Thus, in contrast with the findings on the CCS and with our expectations, the experimental group did not show a pre- to posttest increase in obsessive beliefs about inflated responsibility and exaggerated threat perceptions compared with the monitor and control groups.

Beck Anxiety Inventory (BAI)

There was a main effect of condition, $F(2, 86) = 3.55$, $p = .03$, $\eta_p^2 = .08$; and an overall decrease in BAI scores between pre- and posttest, $F(1, 86) = 4.79$, $p = .03$, $\eta_p^2 = .05$. There was a trend for this to differ among conditions, $F(2, 86) = 2.85$, $p = .06$, $\eta_p^2 = .06$. This pattern of differences among conditions was further investigated with exploratory post hoc tests. These indicated a decrease in the monitor group, $t(28) = 2.78$, $p = .01$, $d = 0.47$; but no change in the experimental, $t(29) = 0.35$, $p = .73$; and control group, $t(29) = 1.68$, $p = .10$, see Table 1. The change in BAI scores differed between the experimental and monitor group, $t(57) = 2.14$, $p = .04$, $d = 0.56$; but not between the experimental and control group, $t(48.58) = 1.19$, $p = .24$; and the monitor and control group, $t(57) = 1.38$,

$p = .18$. This was in line with the expectation that the effect of the checking behavior manipulation would be OCD specific, and thus would not increase general anxiety.

Discussion

Increasing daily checking behavior of everyday objects for 1 week increased overall checking-related cognitions measured with the CCS, which assessed cognitions about the importance of checking and the likelihood and severity of threat (i.e., threat overestimation). Moderate to strong correlations among these constructs of the CCS indicated that they were closely related, and the overall scale showed excellent internal consistency. Nonetheless, to gain insight into how checking behavior influenced the separate constructs, these were also analyzed individually. This showed that, although the data pattern of the experimental group seemed similar for all three constructs, the increase in overall checking-related cognitions was accounted for by an increase in cognitions about the severity of threat. Additionally, cognitions about the importance of checking decreased in the monitor group, but did not change in the experimental and control group. No changes in cognitions about the perceived likelihood of threat were found in any of the groups. There were no changes in general obsessive beliefs about inflated responsibility and exaggerated threat perceptions for any of the conditions. General anxiety decreased from pre- to posttest for all groups.

The finding that increasing one's daily checking behavior exacerbates checking-related cognitions about the severity of threat fits with previous studies showing that engaging in safety behavior increases anxiety and threat beliefs. Engaging in health-related safety behavior increased health anxiety and hypochondriacal beliefs (Olatunji et al., 2011), and cleaning-related safety behavior exacerbated threat perception and contamination anxiety (Deacon & Maack, 2008). Together, these findings suggest that safety behavior contributes directly to the exacerbation of anxiety and OCD symptoms, and may thus be involved in the development of anxiety disorders and OCD.

Engaging in checking behavior did not change participants' general obsessive beliefs about inflated responsibility and exaggerated threat perceptions, measured with the OBQ-44 RT scale. It seems likely that the checking behavior manipulation was not potent enough to influence these beliefs. In comparison with the CCS, which was designed to measure specific checking-related cognitions, the OBQ-44 RT scale addresses more overarching cognitions about responsibility and threat perceptions. This scale appears to be a more stable measure of beliefs that are related to trait anxiety and psychopathology in general, instead of specifically to OCD (Cougle & Lee, 2014; Myers, Fisher, & Wells, 2008; Tolin, Worhunsky, & Maltby, 2006). Considering that the OBQ-44 has low sensitivity to treatment change (Anholt et al., 2010), it seems plausible that general beliefs about inflated responsibility and exaggerated threat perceptions were not affected by increasing checking behavior for 1 week. Perhaps if participants engaged in excessive checking behavior for many weeks, these beliefs would increase.

General anxiety did not increase in any of the groups, which suggests that engaging in checking behavior specifically increased OCD-related checking cognitions. However, it should be noted that some researchers argue that the BAI mainly assesses panic symptomatology rather than anxiety in general (Cox, Cohen, Direnfeld, & Swinson, 1996; Leyfer, Ruberg, & Woodruff-Borden, 2006), even though it continues to be widely used as a measure to assess general anxiety (e.g., Abramowitz, Khandker, Nelson, Deacon, & Rygwall, 2006) and was also administered in the studies of Deacon and Maack (2008) and Olatunji et al. (2011). Future studies could consider using other measures of anxiety such as the State Trait Anxiety Inventory (STAI; Spielberger, 1983) or the Depression, Anxiety, and Stress Scale (DASS; Henry & Crawford, 2005) to further investigate the influence of checking behavior on general anxiety symptoms. The overall decrease in BAI scores seems to be caused by the monitor group. In addition to a decrease in general anxiety, the monitor group showed a pre- to posttest decrease in the amount of items they checked daily, and a decrease in cognitions about the importance of checking. In comparison, the control group did not show any changes. It thus appears that monitoring daily checking behavior decreased the amount of checking behavior participants engaged in, which in turn may have decreased cognitions about the importance of checking and general anxiety. This is in line with previous research, which suggests that self-monitoring causes a decrease in negative behavior and psychopathological symptoms (see Craske & Tsao, 1999). Additionally, when looking at the findings of Olatunji et al. (2011), it seems that monitoring safety behavior might have decreased threat perception and health anxiety, and increased approach behavior in their study as well.

A possible explanation of the present findings comes from recent studies that challenge the idea that compulsions are mainly a response to obsessions to reduce the likelihood that a feared outcome will take place (e.g., Cougle & Lee, 2014; Gillan & Robbins, 2014; Robbins, Gillan, Smith, de Wit, & Ersche, 2012). Based on theories of moral reasoning and cognitive dissonance, it is argued that obsessive

beliefs may be an epiphenomenon of OC symptoms. Moral reasoning is the conscious mental activity of altering information about people and their behavior in order to come to a moral judgment or decision. This is usually a post hoc process, in which one searches for evidence to support an initial intuitive reaction (Haidt, 2007). In addition, cognitive dissonance theory states that individuals are motivated to reduce a conflict that arises when their behavior is not in line with their belief, by altering their belief so that it corresponds with their behavior (Festinger, 1957; Festinger & Carlsmith, 1959). When translating these theories to OCD it was suggested that compulsions create cognitive dissonance (Cougle & Lee, 2014; Gillan & Robbins, 2014). Obsessive thoughts may then arise to resolve the discrepancy between the individuals' cognitions and their otherwise incomprehensible compulsive behaviors. Thus, obsessive beliefs could simply reflect post hoc attempts to justify compulsive urges and behavior ("I am triple checking the electrical outlets and lights around the house, therefore I must be very responsible," or "I am checking the stove repeatedly, therefore it must be highly likely that something very bad will happen otherwise"). Individuals with OCD may thus come to overestimate threat or perceive themselves as having an exaggerated sense of responsibility to explain their compulsive urges and to put their cognitions in line with their behavior. This is in line with recent findings that anxiety patients use their own behavior as information about the safety of a situation (Gangemi, Mancini, & van den Hout, 2012; van den Hout et al., 2014). In the present study it is therefore possible that individuals in the experimental group began to perceive potential threat in the environment as more severe to justify their checking behavior. However, more research is needed to investigate this. The present study only involved checking many objects "once more than typical" in several situations, to create ritualistic behavior similar to checking behavior observed in patients with OCD (i.e., OCD checkers may display a ritual of checking many items once in a particular order before leaving the house, for instance). However, many patients with OCD also perform more repetitive compulsive behavior, such as checking the stove or the light switches many times in a row. Therefore, future research could, for instance, focus on fewer checking tasks to check more often (e.g., the ones that are most frequently used by patients with OCD) to further investigate how compulsive checking behavior influences obsessive cognitions.

Our findings provide further insight into the role of checking behavior in the maintenance and development of OCD. The finding that increased checking behavior causes an increase in OCD-related cognitions about the severity of threat fits with Rachman's (2002) self-perpetuating mechanism of compulsive checking. It was recently found that people with OCD have the tendency to engage in more checking behavior in mildly uncertain situations (Toffolo et al., 2013, 2014). This may thus not only increase uncertainty levels (van den Hout & Kindt, 2003) but also directly increase threat beliefs. Because these results were obtained in a sample of healthy subjects, it seems plausible that precompulsive (i.e., normal) episodes of checking contribute to the development of compulsive checking by increasing uncertainty and perceived threat (Rachman, 2002).

A possible limitation of the study is that the main findings were measured with a self-constructed and therefore nonvalidated questionnaire (the CCS). The checking behavior manipulation and manipulation check (i.e., the items of the Checklist) were created for the present study as well. However, both lists were developed by the authors who have clinical and research expertise with OCD and anxiety disorders, and in close collaboration with a highly experienced clinical psychologist. The questions were based on cognitions frequently reported by patients with OCD in the clinical practice. Reliability of both measures was good: the CCS and Checklist showed good test–retest reliability, and the CCS and its subscales had very high internal consistency. Moderate to strong correlations between the CCS, CCS subscales, Checklist, and validated scales (the OCI-R, OCI-R checking subscale, OBQ-44 RT, and BAI) suggest that the self-constructed measures are valid. Finally, a comparable self-constructed CCS was used by Deacon & Maack (2008), and they also devised their own safety behavior manipulation, as did Olatunji et al. (2011). However, future research is necessary to validate the self-constructed measures that were used in this study. A final limitation is that participants in the experimental group may have guessed the hypothesis and acted accordingly. However, posttest inquiry about the goal of the experiment did not reveal an expectancy bias.

In conclusion, checking behavior appears to increase OCD-related cognitions about the severity of threat, which, together with results from previous studies, suggests that safety behavior contributes directly to the exacerbation of anxiety and OCD symptoms, and may thus be involved in the development of anxiety disorders and OCD. Although future research should further examine the underlying mechanisms of how safety behavior increases threat perception (e.g., cognitive dissonance theory in relation to OCD; Cougle & Lee, 2014; Gillan & Robbins, 2014) and behavior as

information (Gangemi et al., 2012; van den Hout et al., 2014), it seems possible that normal episodes of checking increase perceived threat and uncertainty, and in that way contribute to the development of compulsive checking.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.beth.2015.04.001.

References

Abramowitz, J. S., Khandker, M., Nelson, C. A., Deacon, B. J., & Rygwall, R. (2006). The role of cognitive factors in the pathogenesis of obsessive–compulsive symptoms: A prospective study. *Behaviour Research and Therapy*, *44*, 1361–1374. http://dx.doi.org/10.1016/j.brat.2005.09.011

Abramowitz, J. S., Schwartz, S. A., & Whiteside, S. P. (2002). A contemporary conceptual model of hypochondriasis. *Mayo Clinic Proceedings*, *77*, 1323–1330.

American Psychological Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Anholt, G. A., van Oppen, P., Cath, D. C., Emmelkamp, P. M., Smit, J. H., & van Balkom, A. J. (2010). Sensitivity to change of the Obsessive Beliefs Questionnaire. *Clinical Psychology and Psychotherapy*, *17*, 154–159. http://dx.doi.org/10.1002/cpp.641

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*, *56*, 893–897.

Boschen, M. J., & Vuksanovic, D. (2007). Deteriorating memory confidence, responsibility perceptions and repeated checking: Comparisons in OCD and control samples. *Behaviour Research and Therapy*, *45*, 2098–2109. http://dx.doi.org/10.1016/j.brat.2007.03.009

Clark, D. M. (1999). Anxiety disorders: Why they persist and how to treat them. *Behaviour Research and Therapy*, *37*, S5–S27.

Cordova-Middelbrink, J. A., Dek, E. C. P., & Engelbarts, M. M. B. (2007). *Automatisering bij subklinische obsessief-compulsieve stoornis* [Automatic processes in subclinical obsessive compulsive disorder]. (Unpublished master's thesis). Utrecht University, Utrecht, Netherlands.

Cougle, J. R., & Lee, H. (2014). Pathological and non-pathological features of obsessive–compulsive disorder: Revisiting basic assumptions of cognitive models. *Journal of Obsessive–Compulsive and Related Disorders*, *3*, 12–20. http://dx.doi.org/10.1016/j.jocrd.2013.11.002

Cox, B. J., Cohen, E., Direnfeld, D. M., & Swinson, R. P. (1996). Does the Beck Anxiety Inventory measure anything beyond panic attack symptoms? *Behavior Research and Therapy*, *34*, 949–954. http://dx.doi.org/10.1016/S0005-7967(96)00037-X

Craske, M. G. C., & Tsao, J. C. I. (1999). Self-monitoring with panic and anxiety disorders. *Psychological Assessment*, *11*, 466–479.

Deacon, B., & Abramowitz, J. S. (2008). Is hypochondriasis related to obsessive–compulsive disorder, panic disorder, or both? An empirical evaluation. *Journal of Cognitive Psychotherapy*, *22*, 115–127. http://dx.doi.org/10.1891/0889-8391.22.2.115

Deacon, B., & Maack, D. J. (2008). The effects of safety behaviors on the fear of contamination: An experimental investigation. *Behaviour Research and Therapy*, *46*, 537–547. http://dx.doi.org/10.1016/j.brat.2008.01.010

Engelhard, I. M., van Uijen, S. L., van Seters, N., & Velu, N. (in press). The effects of safety behavior directed towards a safety cue on perceptions of threat. Behavior Therapy.

Festinger, L. (1957). *A theory of cognitive dissonance*. Evanston, IL: Row Peterson.

Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *Journal of Abnormal Social Psychology*, *58*, 203–210. http://dx.doi.org/10.1037/h0041593

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London, UK: Sage.

Foa, E. D., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcek, R., & Salkovskis, P. M. (2002). The Obsessive–Compulsive Inventory: The development and validation of a short version. *Psychological Assessment*, *14*, 485–496. http://dx.doi.org/10.1037/1040-3590.14.4.485

Gangemi, A., Mancini, F., & van den Hout, M. (2012). Behavior as information: "If I avoid, then there must be a danger." *Journal of Behavior Therapy and Experimental Psychiatry*, *43*, 1032–1038. http://dx.doi.org/10.1016/j.jbtep.2012.04.005

Gillan, C. M., & Robbins, T. W. (2014). Goal-directed learning and obsessive–compulsive disorder. *Philosophical Transactions of the Royal Society B*, *369*(1655). http://dx.doi.org/10.1098/rstb.2013.0475

Haidt, J. (2007). The new synthesis in moral psychology. *Science*, *316*, 998–1002. http://dx.doi.org/10.1126/science.1137651

Hajack, G., Huppert, J. D., Simons, R. F., & Foa, E. B. (2004). Psychometric properties of the OCI-R in a college sample. *Behaviour Research and Therapy*, *42*, 115–123. http://dx.doi.org/10.1016/j.brat.2003.08.002

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*, 227–239. http://dx.doi.org/10.1348/014466505X29657

Leyfer, O. T., Ruberg, J. L., & Woodruff-Borden, J. (2006). Examination of the utility of the Beck Anxiety Inventory and its factors as a screener for anxiety disorders. *Journal of Anxiety Disorders*, *20*, 444–458. http://dx.doi.org/10.1016/j.janxdis.2005.05.004

Myers, S. G., Fisher, P. L., & Wells, A. (2008). Belief domains of the Obsessive Beliefs Questionnaire–44 (OBQ-44) and their specific relationship with obsessive–compulsive symptoms. *Journal of Anxiety Disorders*, *22*, 475–484. http://dx.doi.org/10.1016/j.janxdis.2007.03.012

Obsessive Compulsive Cognitions Working Group. (2005). Psychometric validation of the Obsessive Belief Questionnaire and interpretation of Intrusions Inventory–Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*, 1527–1542. http://dx.doi.org/10.1016/j.brat.2004.07.010

Olatunji, B. O., Etzel, E. N., Tomarken, A. J., Ciesielski, B. G., & Deacon, B. (2011). The effects of safety behaviors on health anxiety: An experimental investigation. *Behaviour Research and Therapy*, *49*, 719–728. http://dx.doi.org/10.1016/j.brat.2011.07.008

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*, 625–639.

Robbins, T. W., Gillan, C. M., Smith, D. G., de Wit, S., & Ersche, K. D. (2012). Neurocognitive endophenotypes of impulsivity and compulsivity: Towards dimensional psychiatry. *Trends in Cognitive Sciences*, *16*, 81–91. http://dx.doi.org/10.1016/j.tics.2011.11.009

Ruscio, A. M., Stein, D. J., Chiu, W. T., & Kessler, R. C. (2010). The epidemiology of obsessive–compulsive disorder in the National Comorbidity Survey Replication. *Molecular Psychiatry*, *15*, 53–63. http://dx.doi.org/10.1038/mp.2008.94

Salkovskis, P. M. (1991). The importance of behaviour in the maintenance of anxiety and panic: A cognitive account. *Behavioural Psychotherapy*, *19*, 6–19.

Salkovskis, P. M., Thorpe, S. J., Wahl, K., Wroe, A. L., & Forrester, E. (2003). Neutralizing increases discomfort associated with obsessional thoughts: An experimental study with obsessional patients. *Journal of Abnormal Psychology*, *112*, 709–715. http://dx.doi.org/10.1037/0021-843X.112.3.709

Sloan, T., & Telch, M. J. (2002). The effects of safety-seeking behavior and guided threat reappraisal on fear reduction during exposure: An experimental investigation. *Behaviour Research and Therapy*, *40*, 235–251.

Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory*. Consulting Palo Alto, CA: Psychologists Press.

Telch, M. J., & Lancaster, C. L. (2012). Is there room for safety behaviors in exposure therapy for anxiety disorders? In P. Neudeck, & H. U. Wittchek (Eds.), *Exposure therapy: Rethinking the model—refining the method* (pp. 313–334). New York, NY: Springer. http://dx.doi.org/10.1007/978-1-4614-3342-2_18

Toffolo, M. B. J., van den Hout, M. A., Engelhard, I. M., Hooge, I. T. C., & Cath, D. C. (2014). Uncertainty, checking, and intolerance of uncertainty in subclinical obsessive compulsive disorder: An extended replication. *Journal of Obsessive–Compulsive and Related Disorders*, *3*, 338–344. http://dx.doi.org/10.1016/j.jocrd.2014.08.004

Toffolo, M. B. J., van den Hout, M. A., Hooge, I. T. C., Engelhard, I. M., & Cath, D. C. (2013). Mild uncertainty promotes checking behavior in subclinical obsessive–compulsive disorder. *Clinical Psychological Science*, *1*, 103–109. http://dx.doi.org/10.1177/2167702612472487

Tolin, D. F., Worhunsky, P., & Maltby, N. (2006). Are "obsessive" beliefs specific to OCD?: A comparison across anxiety disorders. *Behaviour Research and Therapy*, *44*, 469–480. http://dx.doi.org/10.1016/j.brat.2005.03.007

Van den Hout, M., Gangemi, A., Mancini, F., Engelhard, I. M., Rijkeboer, M. M., van Dams, M., & Klugkist, I. (2014). Behavior as information about threat in anxiety disorders: A comparison of patients with anxiety disorders and non-anxious controls. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*, 489–495. http://dx.doi.org/10.1016/j.jbtep.2014.07.002

Van den Hout, M., & Kindt, M. (2003). Repeated checking causes memory distrust. *Behaviour Research and Therapy*, *41*, 301–316. http://dx.doi.org/10.1016/S0005-7967(02)00012-8

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