Highlights

- People high in checking concerns reported greater need to avoid looking at threat than neutral objects.

- Visual attention to threat objects was the same in the high and low checking groups.

- In the high checking group greater visual attention to threat was associated with lower post-check certainty.

Visual Attention to Threat During Stove-Checking in People High in Checking Behaviour

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Author notes

Declaration of interest

Given her role as an Editorial Board Member, Christine Purdon had no involvement in the peer-review of this article and had no access to information regarding its peer-review.

Author Statement

Author contributions are as follows: Olivia A. Merritt – Data curation; Formal analysis; Funding

acquisition; Investigation; Project administration; Visualization; Roles/Writing - original draft;

Writing - review & editing; Christine Purdon – Conceptualization; Formal analysis; Funding

acquisition; Methodology; Resources; Supervision; Validation; Writing - review & editing.

Abstract

Leading models of obsessive-compulsive disorder (OCD) state that hypervigilance to threat is a factor in compulsion persistence; however, previous research on attention deployment in OCD is mixed. The current study examines the hypothesized role of strategic avoidance and situational goals through exploring the relationships between visual attention, self-rated need to avoid and need to attend, and post-check certainty. Individuals low (LCC, n=30) and high (HCC, n=29) in checking concerns completed a stove-checking task with a real stove surrounded by threat and neutral items. Eye movements were tracked with a portable eye tracker and participants self-reported their need to attend to and avoid attending to items, as well as their post-check certainty. Although the HCC group reported greater need to avoid attending to threat, visual attention to threat did not differ between groups. Greater visual attention to threat predicted lower post-check certainty in the HCC group, but not the LCC group, and need to avoid threat was not associated with post-check certainty. People high in checking concerns may wish to avoid attending to threat, but have limited success in doing so, and the more they look at threat the less confident they feel. Implications for OCD treatment are discussed.

Keywords: OCD/obsessive-compulsive disorder, checking, attention, avoidance, harm

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Checking compulsions are often characterized by a check-doubt-repeat cycle that is a primary source of impairment and complaint. According to leading models, people with checking compulsions are highly sensitive to threat cues (e.g., proximity of paper towel roll to a stove burner) and information about whether their compulsions have been done properly (e.g., quality of their memory for the check). That is, information relevant to threat is noticed quickly and captures attention, triggering and re-triggering the obsessional concern, doubt, and the subsequent checking compulsion (Rachman, 2002; Salkovskis, 1999). This is consistent with general models of anxiety which identify early engagement with threat, avoidance of threat, and difficulty disengaging from threat as key factors in anxiety (e.g., Armstrong & Olantji, 2012; Cisler & Koster, 2010). Rachman (2002) further observed that the harm about which people are concerned lies in the future and thus there is no terminus for checking behaviour, which leads to its repetition. However, each repetition tarnishes the memory for the previous, fostering further doubt as to whether it has been done effectively. Thus, attentional biases to threat stimuli may evoke checking behaviour and could be a factor in checking persistence, both by refreshing the sense of threat and by evoking repetition that undermines confidence in the check.

A large body of work supports the assertion that repetition degrades memory for the action that has been repeated. For example, in their meta-analysis, van den Hout, van Dis, van Woudenberg, and van de Groep (2019) found a large effect size for the negative impact of repetition on memory confidence. Repetition has also been associated with decreased confidence in attentional processes and sensory perception (e.g., Hermans et al., 2003; 2008) and inducing memory distrust has been found to result in greater checking (Alcolado & Radomsky, 2011). Several studies have examined repetition of compulsions in vivo, finding that greater repetition

of the compulsion was associated with poorer confidence in memory and sensory processes following the check (Bouvard, Fournet, Denis, Acachi, & Purdon, 2020; Bucarelli & Purdon, 2015; Dean & Purdon, 2021).

Given that attentional biases to threat have been implicated in checking persistence, that checking relies heavily on visual impressions (e.g., the status of the stove light, whether an electrical cord is plugged in), and that visually re-checking has been found to degrade confidence in memory for what has been checked, attentional deployment to threat during checking is relevant to understanding the persistence of checking behaviour. It is possible that prolonged and/or frequent visual attention to threat cues undermines confidence in memory, sensory, and cognitive processes.

Few studies have examined attention to threat in people with OCD, and fewer still have examined attentional biases to threat during checking. Armstrong, Olatunji, Sarawgi, and Simmons (2010) found that people high in contamination fears were quicker to orient to fearful faces (i.e., facilitated attention, or, vigilance) and paid more attention over time to disgusted and fearful expressions (i.e., maintenance of attention, or, difficulty disengaging) than those low in contamination fears. Olafsson, Friðriksdottir, Sveinsdottir, and Kristjansson (2019) also found that people high in contamination fears showed vigilance for threat, but not maintenance of attention on threat. Similarly, Armstrong, Sarawgi, & Olatunji (2012) found that those high in contamination fears oriented towards contamination stimuli more often than those low in contamination fears. However, they did not find group differences in attention maintenance over time, and the high contamination fear group made shorter fixations on contamination stimuli than on other types of stimuli.

Cludius, Wenzlaff, Briken, and Wittekind (2019) compared visual attention to images of items people check to neutral images during a passive viewing task in people with checking compulsions. They found evidence for gaze maintenance but not vigilance, although noted that the group with checking compulsions had significant symptom overlap with other subtypes of OCD. Finally, several studies have found no evidence of attention bias to threat in people with OCD (De Mathis et al., 2020; Kyrios & Iob, 1998; Moritz & von Muhlenen, 2008). Thus, existing studies on visual attention to threat in people with OCD have produced mixed findings. However, studies to date have featured a passive viewing task in which participants were simply presented with images while eye movements were tracked. Visual attention may be different during a compulsion, when the stakes of securing an accurate visual image are perceived to be high.

Bucarelli and Purdon (2016) examined visual attention to threat during an in-vivo stove checking task. Participants with the checking subtype of OCD and clinically anxious controls with no comorbid or subclinical OCD boiled a kettle of water in a lab kitchen, turned off the stove, put a pot of dry rice on the burner just used, and then left the kitchen to join the researcher down the hall. Participants wore a portable eye tracker during the stove task. As per Rachman (2002), the authors hypothesized that people with OCD as compared to people with generalized anxiety disorder (GAD) would exhibit greater visual attention to threat objects (paper towels, matches) placed around the stove during the task, and that the more they looked at the stove the less confidence they would have in their subsequent memory for the status of the stove. Neither hypothesis was confirmed. The OCD group checked longer than the anxious control group, but their visual attention to the stove was unrelated to post-task confidence in the stove's status. Furthermore, participants with OCD showed *less* visual attention to the threat items around the

stove than those in the anxious control group. Bucarelli and Purdon speculated that people with

OCD can anticipate obsessive-compulsive traps, and in certain circumstances (e.g., when

someone else is ultimately responsible for harm, in this case the researcher) may feel driven to

avoid looking at threat so as to simplify their memory for the check by not having to mentally

account for the whereabouts and status of the "threat" items, and thus potentially avoid a

prolonged doubt-compulsion-doubt cycle. That is, there may be important contextual factors that

influence visual attention during checking compulsions.

This hypothesis is consistent with evidence that people with OCD are strategic about

reducing the need for compulsions while navigating their environment. Purdon, Rowa and

Antony (2007) found that people with OCD attempted to suppress their obsessions to get rid of

them before the compulsion became necessary. For people with OCD, it may be that cues

relevant to the obsessional concern receive very early attentional capture (as per Rachman) but

once registered, top-down processes direct attentional deployment towards or away from threat,

as guided by situational goals. In Armstrong et al. (2012) people with OCD had shorter fixations

on threat, which could be indicative of a rapid shift away from threat as a means of limiting

exposure.

There is also evidence that visual attention to threat is influenced by situational

motivation to attend to and avoid attending to threat. Nelson, Purdon, Quigley, Carriere, and

Smilek (2015) presented participants with threat and neutral image pairs under calm and anxious

mood inductions while their eye movements were tracked. After this free viewing task

participants were presented with a random subset of 10 of the threat images they had seen during

the task and rated their motivation to look at the threatening images and motivation to avoid

looking at the threatening images ("How motivated were you to look towards/away from

image"). Four groups of participants were identified: those high in motivation to look towards threat and low in motivation to look away from threat ("engagers"), those high in motivation to look away and low in motivation to look towards ("avoiders"), those low in motivation to both look towards and away ("indifferent") and those high in motivation to both look towards and away ("ambivalent"). They found that the avoiders looked at neutral images more than threat images, the engagers looked at threat more than neutral, and the ambivalent uniquely showed early engagement, with greater likelihood of first fixation on threat, followed by no bias, and the indifferent group showed no biases. The ambivalent group were higher in trait anxiety than the avoider and indifferent groups. Xu, Rowe, and Purdon (2021) tracked eye movements of participants high in spider fear while they completed an attentionally demanding task with a live tarantula in a terrarium with a dislodged lid in ready view. At 12 random points during the task participants were asked to rate how motivated they were to look at the spider and how motivated they were to avoid looking at the spider. They found the same association between motivation and viewing patterns as in Nelson et al. (2015). Furthermore, whereas the indifferent, engagers, and avoiders groups showed a reduction in spider fear to pre-baseline levels, the ambivalent group did not, and their mood state post-task was more negative.

Taken together these data suggest that situational goals influence visual attention to threat, and that visual attention to threat in turn influences emotional responses to threat. Difference in individual goals may help explain the mixed findings in the attention in OCD literature. Bucarelli and Purdon (2016) speculated that people with OCD may have been strategic about where they looked during the stove checking task, deliberately avoiding threat items so as to avoid being locked into a fraught and time-consuming check-doubt-check pattern, as well as anticipated doubt and fear about the stove they might experience after they have left the

environment. Such defensive avoidance might be quite driven, perceived in the moment as a strong desire or need.

The purpose of the current study was to extend Bucarelli and Purdon's (2016) findings by assessing the extent to which participants high and low in checking concerns felt the need to attend to and to avoid attending to threat and neutral stimuli during a stove-checking task. We were also interested in whether perceived need to look at and avoid looking at threat items would be reflected in actual viewing patterns (that is, do people exhibit attentional control or do they have difficulty disengaging). Finally, we were interested in whether self-reported need to attend to threat and visual attention to threat during the check had any impact on post-check certainty. To this end, people high and low in checking concerns underwent the same stove checking task as in Bucarelli & Purdon (2016) while their eye movements were tracked. In addition, participants rated their need to attend to and to avoid attending to each of the threat and neutral items immediately following the stove-checking task. Based on Bucarelli and Purdon (2016) we predicted that: (1) those high in checking concerns would report greater need to avoid looking at threat cues than those low in checking concerns, (2) greater need to avoid threat would be associated with reduced visual attention to threat, and (3) less visual attention to threat would predict greater post-check certainty in the HCC group; and, (4), greater need to avoid threat would predict greater post-check certainty in the HCC group.

Methods

Participants

Participants were recruited from a research pool of undergraduate students at a Canadian university and were reimbursed with partial course credit. Participants who scored within one unit of the top and bottom quartiles of the "Responsibility" scale of the Dimensional Obsessive

Compulsive Scale (DOCS; Abramowitz et al., 2010), which assesses concerns about causing

harm and checking behaviour, were selected for the study. The final sample consisted of 30

people low on this scale, who were considered to have low checking behaviour and concerns

(LCC group; score of 0-2 on this subscale; $mean_{responsibility}$= .73, $SD_{responsibility}$=.87; $mean_{DOCStotal}$=

6.4, $SD_{DOCStotal}$=6.54) and 29 people high on this scale, considered to have high checking

concerns (HCC group; score of 8 or higher on this subscale; $mean_{responsibility}$= 10.93,

$SD_{responsibility}$=2.63; $mean_{DOCStotal}$= 32.36, $SD_{DOCStotal}$=11.08). The mean HCC DOCS score in our

sample is in the same general range as has been found in people with a formal diagnosis of OCD

(Thibodeau et al., 2015). Given that the lab component of the study required intensive resources,

we took the decision to sample at the high and low ends of the scale rather than using the DOCS

as a continuous predictor.

The cultural makeup of the sample was 29% East Asian, 29% White, 19% South Asian,

10% Southeast Asian, with less than 5% of the sample identifying as African American, Middle

Eastern, or "Other". Both the HCC and LCC group were majority female (69% and 73%,

respectively). There were no differences between the HCC (*M*= 20.37, *SD*= 1.950) and LCC (*M*=

20.35, *SD*= 1.623) groups on age, $t(43)$= -.042, p= .967, gender identity ($\chi^2(2)$= 2.146, p= .342),

sex assigned at birth ($\chi^2(1)$= .005, p= .942), or ethnicity ($\chi^2(7)$= 6.860, p= .444).

Procedure

Participants were given an overview of the study and provided informed consent. They

then completed the DOCS along with three other self-report questionnaires unrelated to the

current study. Upon completion of these measures, participants were fitted with the eye tracker

(see *Materials*) and calibration was completed. If calibration could not be completed, participants

completed the study as if it were calibrated so we could collect data on need to attend to threat.

Once the eye tracker set-up was complete, participants were given an overview of the checking task using the functional stove.

The study was conducted in a kitchenette that features a café table and chairs and two counters with upper and lower wooden cupboards. There is a functioning electric 4-burner stove in the middle of one counter and a functioning double sink and bar fridge in the opposite counter. Participants were instructed to use the back right burner to boil a kettle that contained a pre-measured amount of water. Four threat items (a roll of paper towels on a vertical rack, a container of wooden matches, a paper basket with blank recipe cards, and wooden spoons in a glass cannister) and four neutral items (a metal canister with pasta noodles, a metal tin with metal cooking utensils, a glass saltshaker, and a stack of mugs to the right of the stove) were situated around the stove (see *Figure 1*). Once the water came to boil, as indicated by its whistle, they were asked to remove the kettle from the stove, place it on a trivet to the right of the stove, make sure the stove was off, place a prepared pot of dry rice onto the burner they had just used, and then remove the eye tracker and join the researcher in another room down the hall, closing the door behind them. The latter introduced the real possibility that if the stove burner was still on when the participant left, a fire could potentially occur. After the instructions for the stove task were given, participants had the opportunity to ask questions and the researcher demonstrated use of the stove by turning all burners on. The researcher then left the kitchen, closing the door behind her. Participants were left to turn off the three unused burners and complete the stove task. After participants completed this task and left the kitchen, they completed the post-check rating scales (see *Materials*).

Figure 1. Stove set up.

Materials

OCD Symptoms

The Dimensional Obsessive-Compulsive Scale (DOCS; Abramowitz et al., 2010) is a 20-item, self-report measure used to assess OCD symptoms and severity. It consists of 4 subscales: Concerns about Germs and Contamination; Concerns about being Responsible for Harm, Injury, or Bad Luck ("Responsibility subscale"); Unacceptable Thoughts; and Concerns about Symmetry, Completeness, and the Need for Things to be "Just Right". Each subscale consists of 5 items evaluating time spent on OCD concerns, avoidance of triggers, distress, impairment, and mental control over these concerns. Internal consistency is excellent, with Cronbach's alphas

ranging from .86-.94 for the Responsibility subscale, and .90-.93 for the total score. The DOCS

has demonstrated good convergent and discriminative validity (Abramowitz et al., 2010). In the

current study, the subscale had excellent reliability (a_{total}= .934; $a_{responsibility}$= .907).

Need to Attend and Need to Avoid

After the stove checking task, participants rated their need to attend to and avoid

attending to the four neutral (e.g., ceramic cups) and four threat objects (e.g., paper towels on a

rack) placed around the stove (see Procedure) during the time they awaited the kettle coming to a

boil (pre-check) and after it had boiled (during check). For each object participants were asked

"to what extent did you feel the need to pay attention to [object]?" and "to what extent did you

feel the need to avoid paying attention to [object]?", on a 1-10 scale (1 being 'no need' and 10

being 'great need'). This wording was meant to reflect the driven quality of defensive avoidance.

Ratings were summed across objects to create composite scores for need to attend to neutral,

need to attend to threat, need to avoid neutral, and need to avoid threat during the pre-check and

check phases. The ratings during each phase were highly correlated (rs ranging from .556-.726),

so pre-check and check scores were aggregated scores by summing ratings from each phase.

Reliability of ratings were acceptable to excellent ($a_{attention,neutral}$= .754; $a_{attention,threat}$= .829;

$a_{avoidance,neutral}$= .934; $a_{avoidance,threat}$= .901).

Post-Check Certainty

Post-check confidence in the status of the stove was assessed as in Bucarelli and Purdon

(2016). Participants were instructed to "imagine the status of the stove right now…" and then

were asked "how certain are you that the check has been done properly?", and "how certain are

you that harm has been prevented?". Responses were registered by making a mark on a 125mm

line anchored by "Not at all certain" and "100% certain". As in Bucarelli and Purdon (2016),

scores from these two items were added to make up the "certainty" scale (*Spearman-Brown coefficient= .779*).

Portable Eye Tracker

A SensoMotoric Instruments (SMI) iViewX[TM] HED Portable Eye Tracker was used to track eye movements. As in Bucarelli and Purdon (2016), prior to beginning the task the eye tracker was calibrated using 5-point calibration. The eye tracker is mounted on a bicycle helmet and comprises an outward-facing camera that produces person-perspective video, and an inward-facing eye monitor that is tracks the participant's right pupil. These two outputs are combined to generate video footage with a superimposed crosshair that indicates participants' attention. The video was coded using SMI BeGaze[TM] Version 2.5 software to generate eye tracking indices. Participants whose eye tracking ratios were below 50% (e.g., the tracker could not track the eye for half of the time or more) were deemed unreliable and excluded from analyses. The eye tracker could lose calibration if participants touched the camera, jostled the helmet, made sudden head movements, looked straight down, were wearing heavy eye make up, were wearing glasses, or if the contrast between the pupil and the iris was not great enough for the eye tracker to accurately detect and track the pupil movements.

Results

Analyses were conducted using SPSS, version 24 (IBM Corp., 2016). Prior to analyses, data were examined for outliers within groups. Outliers were defined as data points three standard deviations or further from the group mean and discontinuous from the distribution. Outliers were replaced with the second most extreme data point in that group (Kwak & Kim, 2017). The number of outliers adjusted for each variable is as follows (if the variable is not listed, there were no identified outliers): avoidance motivation for threat (*n*= 1), attention

motivation for threat (*n*= 2), post-check certainty (*n*= 2). Skew and kurtosis for these variables were within acceptable limits (Kline, 1998).

Hypothesis 1: Need to attend and avoid attending to threat

The outcomes of the following analyses were identical whether ratings of need to attend to/avoid attending to threat objects were combined across time phases (pre-check and during check) or kept separate. We predicted that those in the HCC group would report greater need to avoid threat stimuli than those in the LCC group. A repeated measures ANOVA was conducted, with need to attend/avoid ratings and neutral/threat stimuli as within-participants * rs and group as a between-participants factor. The interaction of all three factors was significant, $F(1, 56)=4.57$, $p=.037$, partial $\eta=.075$. In the LCC group, need to attend did not vary according to threat status, and overall ratings were lower than the HCC group. In the HCC group, need to attend was higher for neutral items than threat items, whereas need to avoid was higher for threat items than neutral items. *T*-tests showed a significant difference between the HCC group (*M*= 17.190, *SD*= 17.075) and LCC group (*M*= 8.900, *SD*=4.180) on need to avoid threat stimuli, $t(31)= -2.542$, $p= .016$, $d= 0.684$ (Levene's was significant; thus, this *t* value is for equal variances not assumed). The HCC group also showed a trend towards greater motivation to avoid the neutral items as well, $t(31.798)= -1.970$, $p= .058$, $d= 0.530$. There were no group differences on self-rated need to attend to threat or neutral items, *p*s > .133. See *Figure 2* for these data. These results support our hypothesis that those with checking concerns would show higher need to avoid looking at threat items than those without checking concerns.
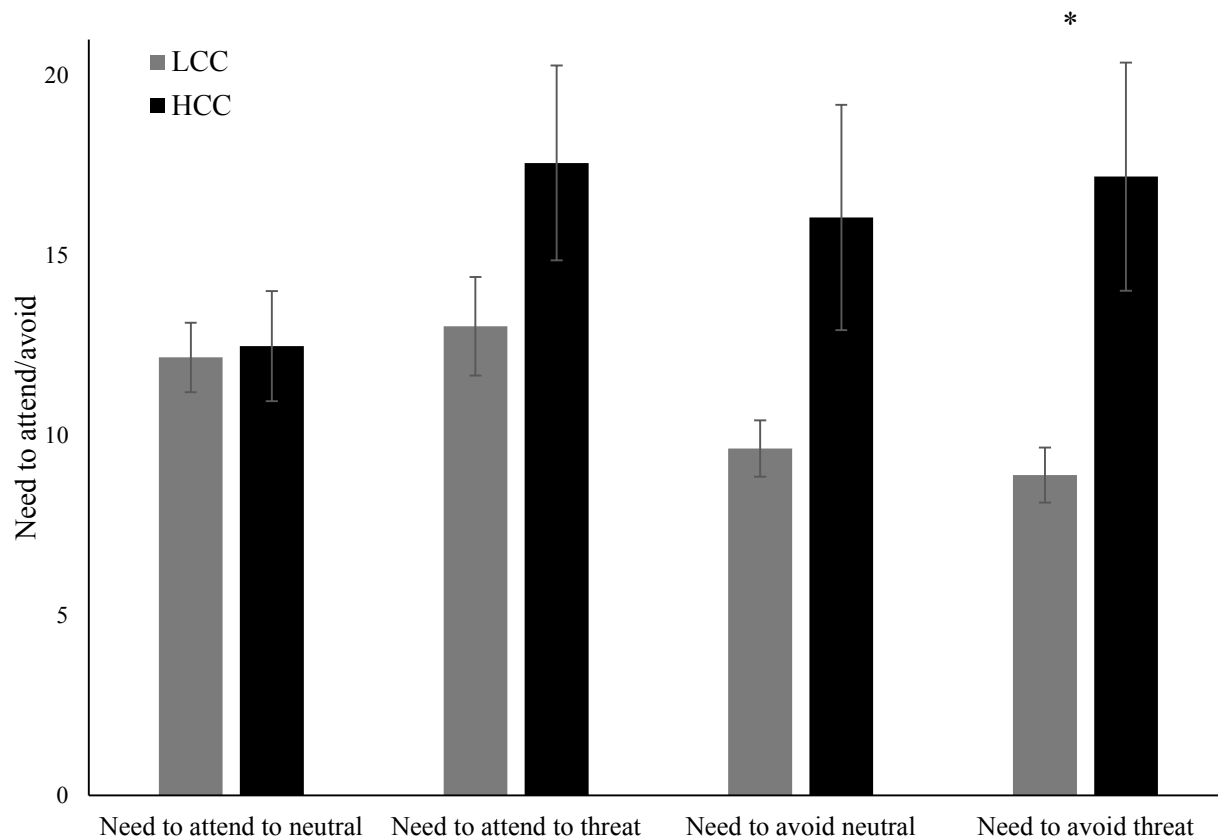
Figure 2. Mean need to attend to and to avoid attending to neutral and threat stimuli across

groups. Error bars (±) represent standard error of the mean. LCC=low checking concerns group;

HCC= high checking concerns group. * Difference between groups is significant, *p*=.016.

Hypothesis 2: Visual attention to threat

We predicted that need to avoid threat would be associated with less visual attention to

threat across groups. Thus, we planned to analyze the correlation between need to avoid threat

and eye tracking indices of attention to threat in the whole sample. Regarding attention indices,

data from 7 HCC and 10 LCC were discarded due to either an inability to calibrate the eye

tracker or loss of calibration during the task. The final sample included in this analysis consisted

of 42 participants (22 HCC, 20 LCC). Eye tracking indices used for this study included duration

of fixations ("fixation time") and number of fixations ("fixation count"). Checking time varied

across participants, so these variables were expressed as proportions (number of fixations on

threat was equal to number of fixations on threat divided by total number of fixations; fixation

time was the time spent on threat divided by total time).

When the sample as a whole was analyzed, need to avoid threat was not related to either

fixation count on threat ($r(42)$= .243, p= .122) nor fixation time on threat ($r(42)$= .222, p= .157).

Given this, exploratory analyses examined the correlation between need to attend/avoid threat

and visual attention to threat within each group. The correlations are presented in *Table 1*. In

both groups, need to attend to threat had a significant positive correlation with fixation time and

fixation count. However, need to avoid attending to threat was not correlated with fixation time

or count in either group.

Table 1. Correlations of need to attend/avoid threat and visual attention indices

	Need to attend to threat	Need to avoid threat	Fixation time on threat	Fixation count on threat
Need to attend to threat	-	.284	.610*	.708**
Need to avoid threat	.111	-	.314	.321
Fixation time on threat	.684*	.299	-	.884**
Fixation count on threat	.585*	.298	.936**	-

Note. Pearson product-moment correlations are presented (n=42). HCC group correlations

above the diagonal, LCC group below the diagonal (in grey). ** $p < .001$, * $p < .01$.

To follow up, we explored whether there was a difference between groups on attention to threat. A multivariate GLM was conducted with proportion fixation time on threat and proportion fixation count on threat as dependent variables, and group (HCC, LCC) as predictor. It was not significant, $F(2, 39)=.013$, $p=.777$. Mean fixation time on threat was not significantly different between the HCC ($M=.058$, SD=.042) and LCC ($M=.067$, SD=.043) groups, nor was fixation count on threat ($M_{HCC}=.074$, SD=.055; $M_{LCC}=.085$, SD=.040).

Hypothesis 3: Time spent looking at threat and post-check certainty

We hypothesized that less time spent looking at threat would predict greater post-check certainty in the HCC group. We conducted a regression analysis on certainty to test this hypothesis, entering group on step one, proportion fixation time on threat on step two, and the interaction of group and proportion fixation time on step three (see *Table* 2). Step one was not significant, $p=.069$; but addition of proportion fixation time on step two resulted in a significant change in R^2 ($p= .018$), such that greater proportion fixation time on threat predicted less certainty. Entry of the interaction term on step three also resulted in a significant change in R^2 ($p=.023$). Examination of the zero-order correlations revealed that proportion fixation time and post-check certainty were negatively correlated in the HCC group ($r(22)= -.608$, $p= .003$), whereas in the LCC group, they were not significantly correlated ($r(20)= -.027$, $p= .910$). Thus, our third hypothesis was supported.

Hypothesis 4: Need to avoid threat and post-task certainty

We hypothesized that greater need to avoid threat would be associated with greater post-check certainty in the HCC group. We conducted a hierarchical regression analysis with group entered on step one, need to avoid attending to threat on step two, and the interaction of group and need to avoid on step three. Group predicted certainty ($p= .002$) such that those in the HCC

were less certain overall than those in the LCC group. Need to avoid attending to threat did not

result in a significant change in R^2 ($p= .675$), nor did the interaction on step three ($p= .497$).

Results are presented in *Table 2*. Thus, contrary to our hypothesis, greater need to avoid was not

associated with increased certainty in either group.

Table 2. Hierarchical multiple linear regression analyses of post-check

certainty

Model	Predictors	R^2	R^2 change	ß	F change (df)
1	Group	.080	.080	-.283	3.495 (1, 40)
2	Group	.205	.125	-.319*	6.116 (1, 39)*
	Fixation time on threat			-.355*	
3	Group	.307	.102	.667	5.610 (1, 38)*
	Fixation time on threat			-.110	
	Group x Fixation time on threat			-.643*	
1	Group	.151	.151	-.388*	10.101 (1, 57)*
2	Group	.153	.003	-.406*	0.178 (1, 56)
	Need to avoid threat			.055	
3	Group	.160	.007	-.545*	0.467 (1, 55)
	Need to avoid threat			-.303	
	Group x Need to avoid threat			.433	

* $p < .05$.

Discussion

The purpose of this study was to examine participants' need to attend to threat and to

avoid attending to threat during a checking task, to explore whether the need to attend versus

avoid mapped onto actual viewing patterns, and to determine whether need to attend and visual

attention to threat influenced post-check certainty. Consistent with Nelson et al. (2015) and Xu et

al. (2021) the correlation between motivation to attend to and avoid attending to threat stimuli

was quite low (in our case non-significant) in both groups suggesting ambivalence about whether

to attend or to avoid. As hypothesized, we found that those with checking concerns (HCC)

reported greater need to avoid looking at threat than those without checking concerns (LCC).

Furthermore, the HCC group reported greater need to avoid threat items than neutral items and

greater need to attend to neutral items than threat items, whereas in the LCC group, there were

no differences in need to avoid looking at threat versus neutral objects.

However, there was a non-significant trend whereby the HCC group showed higher

desire than the LCC group to avoid neutral items as well. Thus, the HCC group appeared to feel

a general need to avoid looking at all objects around the stove, which we had not hypothesized.

This could reflect the fact that the threat objects were in the same visual field as the threat objects

so the need to avoid neutral was nested in need to avoid threat. This finding may also suggest

that participants high in checking concerns are motivated to stay very focused on the task; given

that lack of cognitive confidence is common in OCD, it is possible that those HCC felt more

vulnerable to distraction. Another possibility is that those HCC envision ways that harm can

occur, even with non-flammable objects.

Our second hypothesis was that need to avoid threat would correlated with visual

attention to threat. This was not supported, as need to avoid was not related to actual attentional

deployment. Although the HCC group reported greater need to avoid attending to threat than the

LCC group, they did not have fewer fixations on threat, nor did they spend less time looking at

threat. This could be indicative of vigilance monitoring whereby participants glanced frequently

at threat objects and quickly looked away. These findings could also indicate that the HCC group experienced facilitated attention to the threat objects (a bottom-up/stimulus-driven process) followed by immediate strategic avoidance (a top-down/goal-driven strategy), as per Cisler and Koster, 2010. An analysis of probability of fixation on a neutral item after a fixation on a threat item, as per Amir, Zvielli, and Bernstein (2016), would be required to explore this possibility. Future studies may benefit from using this methodology to understand how avoidance motivation influences moment to moment attention.

Our third hypothesis was that less time spent looking at threat would be associated with higher post-check certainty in the HCC group. This hypothesis was supported. This finding is consistent with an understanding of avoidance as a short-term strategy to reduce distress and/or the need to engage in time-intensive compulsions (e.g., McGuire et al., 2011). Additionally, avoiding threat items may reduce both the amount of visual information to track and the mental elaborations of vectors by which harm could occur. At the same time, avoiding any stimulus requires vigilance for that stimulus, and interferes with new learning about the importance of the obsessional concern. Failure to successfully avoid (as we saw in this study) may degrade mood and fortify ideas about the importance of avoidance, just as failure to fully control obsessional thoughts degrades mood and increases conviction in negative appraisal of the thought's meaning (e.g., Purdon, 2001; Purdon, Rowa, & Antony, 2005).

However, our fourth hypothesis – that greater need to avoid threat would predict greater post-check certainty – was not supported. This hypothesis was based on Nelson et al. (2015) and Xu et al. (2021) who found that people have the capacity to avoid looking at threat when motivated to do so. Bucarelli and Purdon (2016) found that people with OCD looked *less* at threat objects than did anxious controls, but their control group comprised people with a

diagnosis of GAD who may have been more threat sensitive than the control group in the current study. Their OCD group had substantially higher scores on the DOCS Responsibility scale than did our HCC group (16.67 vs. 10.93). As Bucarelli and Purdon (2016) argued, it may be that as compulsions become more established and interfering people develop awareness of compulsion triggers and traps and develop better capacity to control attention in specific circumstances, such as when they are not ultimately responsible for harm that might ensue if they fail to check properly. Thus, the contrasting findings discussed here may be in part due to varying severity of OCD found in these samples.

This student sample was selected on the basis of scores on a self-report measure of compulsive checking, and was over-represented by women, which limit the generalizability of the results. It may be that analogue samples behave differently than people with OCD due to their history with their symptoms and the stage of development of strategies to manage them. The eye tracker was vulnerable to disruptions in calibration, with either failure to calibrate or loss of calibration (e.g., due to participants touching the device or making large head movements) reducing eye movement data to 42 participants. Our regression analyses were slightly underpowered to detect a strong effect size of the ironic effect of checking on certainty (as per van den Hout et al., 2019). Our study had people check a real (as opposed to virtual) stove and there were material consequences if they failed to turn off the stove (the pot of rice could catch fire), which increases external validity. However, the consequences would not harm participants' own environment or loved ones and would ultimately be the responsibility of the researcher. Future work could examine visual attention to threat during checking compulsions as conducted in participants' own environment.

Despite these limitations, this study was the second to our knowledge to assess in vivo visual attention to threat during checking and the first to explore situational goals regarding attention to threat in those with checking concerns. Our findings suggest that people high in checking concerns feel the need to avoid threat when conducting their compulsion, but success in actually avoiding threat seemed limited, and the more they attended to threat the less certain they were about the status of the stove afterwards. As noted above, the need to avoid stimuli during checking may be problematic. Left unaddressed, visual avoidance during checking could thwart the success of exposure and behavioural experiments. Identifying and addressing the origins of the need to avoid threat could be a useful. For example, people may feel the need to avoid threat because the more they see it the more "flash forwards" they can generate as to how it will produce harm (e.g., "maybe a breeze will cause the paper towels to unfurl so they reach the burner", "what if the shelf collapses and the matches fall onto the burner?"), which would increase harm probability and severity estimations and increase pressure for certainty in the status of that being checked. Identifying and exploring the worthiness of these automatic fantastical ideas may reduce the perceived need to avoid looking at threat. People may also feel the need to avoid threat and other stimuli because they lack confidence in their sensory, attention, and memory processes (e.g., Radomsky & Rachman, 1999) and feel the need to focus on only the most critical details (e.g., the stove light, colour of the burner). Targeting these ideas as per Radomsky, Shafran, Coughtrey, and Rachman (2010) will likely reduce avoidance. Finally, introducing threat stimuli to the checking environment may be a simple means of systematically increasing the intensity of exposure exercises.

In sum, these findings indicate that although people are high in checking concerns feel the need to avoid threat objects while checking, they do not check less than people with low

checking concerns who report less need to avoid. Visual attention to threat items was associated

with less confidence in the status of the stove post-task, indicating that people may be motivated

to avoid in an attempt to circumvent this doubt-check-doubt cycle.

Acknowledgements

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