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# Examining Attentional Bias in Scrupulosity: Null Findings From the Dot Probe Paradigm

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Research consistently demonstrates that individuals with anxiety symptoms exhibit attentional biases toward threatening stimuli using various computer-based tasks. However, the presence of attentional biases across obsessive-compulsive symptom presentations has been mixed and requires clarification. This study was the first to use the dot probe paradigm to investigate the association between scrupulosity symptoms (obsessions and compulsions having to do with religion and morality) and selective attention to scrupulosity-relevant lexical stimuli. Contrary to hypotheses, individuals with higher levels of scrupulosity did not selectively attend (i.e., have faster reaction times) to scrupulosity-specific threat words (e.g., *hell*) more so than to general threat or neutral words. Various potential explanations for these null findings, as well as directions for future research, are discussed.

**Keywords:** attention bias; religiosity; obsessive-compulsive disorder

Scrupulosity is a presentation of obsessive-compulsive disorder (OCD) involving obsessions and compulsions having to do with religion and morality (Abramowitz, 2001, 2008; Abramowitz & Jacoby, 2014; Huppert & Siev, 2010). Specifically, individuals with scrupulosity experience unwanted intrusive thoughts (i.e., obsessions) associated with the possibility that they have committed a moral or religious transgression (e.g., “Did I commit a sin without realizing it?”); intrusive blasphemous thoughts or images (e.g., images of the devil); doubts that one may not be faithful, moral, or pious enough (e.g., “Am I truly a Christian?”); concerns that one didn’t perform a religious prayer or ceremony correctly (e.g., “Did I really confess *all* of my sins at confession?”); and fears of eternal damnation (e.g., “Am I going to hell?”). These intrusions

are experienced as highly distressing and are accompanied by the drive to perform compulsive rituals—such as excessive prayer, re-reading Bible verses until they are read “perfectly,” and repeatedly seeking reassurance from religious figures or loved ones about religious topics—that function to reduce anxiety. Individuals with scrupulosity also often avoid situations and stimuli that trigger obsessive thoughts and distress.

Cognitive behavioral models of scrupulosity propose that one maintaining factor of this problem is attentional biases for threat (Abramowitz & Jacoby, 2014), which refers to the preferential processing of danger-related stimuli over neutral stimuli when both types of stimuli are competing for processing priority (MacLeod, Mathews, & Tata, 1986). For example, consider the case of Rebecca, a Catholic woman with scrupulosity whose obsessive doubts include uncertainty over whether she has fully confessed all of her sins at confession. Hypervigilant for cues related to confession, sin, and hell, Rebecca has become exquisitely sensitive to these words and notices every time they appear or whenever someone uses them (and even words that sound similar; e.g., being greeted by someone saying “Hello”). She also has difficulty disengaging her attention from these intrusive words and starts to ruminate about whether she has committed a sin that she has not confessed and if God is going to punish her by damning her to hell. Her anxiety steadily increases until she feels she can no longer tolerate the discomfort. To make herself feel better, she often makes excuses to leave these situations and return to church, confess any possible perceived sins, and reduce her anxiety.

Research on anxiety, more generally consistently demonstrates—using various experimental paradigms—that individuals with anxiety symptoms exhibit attentional biases toward threatening stimuli (for a meta-analytic review, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). The dot probe task (MacLeod et al., 1986) is one such paradigm, in which participants are asked to indicate as quickly as possible which letter (i.e., probe) replaced a pair of stimulus words (often one threatening and one neutral word) on a computer screen. Anxious participants tend to selectively attend to the location of more threatening stimulus words (e.g., *murder*) and thus respond more quickly when the probe letter appears in the same location of the threatening word versus the nonthreatening (i.e., neutral) word (e.g., *banana*). This bias for threat is not demonstrated in participants without anxiety (Bar-Haim et al., 2007). It is worth noting that although the dot probe paradigm has been criticized for having only moderate internal consistency and test–retest reliability (Schmukle, 2005; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014), authors (e.g., Bar-Haim et al., 2007) have expressed greater concerns about the limitations of other paradigms to measure attentional bias (e.g., emotional Stroop paradigm); accordingly, we used the dot probe in this study.

Although evidence has been somewhat mixed (Harkness, Harris, Jones, & Vaccaro, 2009; Moritz et al., 2008; Moritz et al., 2004; Moritz & von Mühlénen, 2008), a series of studies has documented attentional biases in samples of participants with symptoms of OCD (for reviews, see Muller & Roberts, 2005; Summerfeldt & Endler, 1998). Furthermore, a subset of these studies has compared participant response times to *OCD-relevant* threatening stimuli such as contamination-relevant (e.g., *dirty toilet*) or checking-relevant words or images (e.g., *broken door*; Amir, Najmi, & Morrison, 2009; Cisler & Olatunji, 2010; da Victoria, Nascimento, & Fontenelle, 2012; Moritz, von Mühlénen, Randjbar, Fricke, & Jelinek, 2009; Rao, Arasappa, Reddy, Venkatasubramanian, & Reddy, 2010). For example, in one study (Tata, Leibowitz, Prunty, Cameron, & Pickering, 1996), patients with OCD who had contamination concerns attended to contamination-relevant threat words more so than did individuals high in trait anxiety (HTA) and those low in trait anxiety (LTA). Individuals with HTA were vigilant for social anxiety threat words but not contamination-related words; LTA controls displayed no attention-related effects. These findings demonstrate content specificity in attentional biases to threat that warrants future study.

Despite extensive research in the area of attentional biases in anxiety disorders and OCD, no research to date has evaluated attentional biases in scrupulosity more specifically, which is important given the demonstrated heterogeneity of OCD symptoms (McKay et al., 2004). Indeed, it is possible that individuals with certain presentations of OCD exhibit attentional biases more so than do others. For example, there is more support for attentional biases in individuals with contamination symptoms compared to those with checking symptoms. As a result, some researchers have proposed that there are differences in cognitive processing between these two subtypes, such that patients with checking symptoms focus on indicators of safety rather than signs of danger (Harkness et al., 2009). Given the potentially important implications of these findings, investigation of attentional biases in scrupulosity is warranted. It may be that the factors that maintain presentations of OCD involving unacceptable thoughts (i.e., scrupulosity) are different (e.g., thought suppression, neutralizing, or avoidance) than those maintaining contamination and responsibility for harm (i.e., checking) concerns.

In addition, there are two methodological limitations of previous studies that are important to address for future research. First, many studies that did not find evidence for attentional bias also did not measure the personal relevance of their stimuli (e.g., Moritz et al., 2008; Moritz et al., 2004). Examining whether the stimuli used in the attention bias task are perceived to be personally relevant to participants allows researchers to maximize both the internal validity of the study and the sensitivity of the stimuli (Harkness et al., 2009). Second, habituation to threatening information over the course of numerous dot probe trials could serve as an alternative explanation when null findings are observed with this paradigm. Indeed, a previous study (Amir et al., 2009) that compared early and late trials revealed an attenuation of attention bias in individuals with OCD, suggesting that the threat words lose their ability to compete for attention over time. Thus, more studies are needed that examine attentional biases over time to determine whether habituation effects are occurring.

This study, therefore, aimed to investigate the extent to which individuals with scrupulosity selectively attend to religious or morally relevant stimuli, which they perceive as threatening. Strengths of this study include measurement of personal relevance of stimuli and modeling changes in attention bias over time. We tested two primary hypotheses: First, we predicted that individuals with higher levels of scrupulosity, compared to those with lower levels, would have faster reaction times (RTs) on trials in which the probe appears in the same spatial location of a threat word (i.e., *probe in threat vicinity*) than when the probe appears in the same spatial location of a neutral word (i.e., *probe in neutral vicinity*). In other words, we expected that scrupulosity would be a factor in attention toward threat generally and that we would find a two-way (Scrupulosity  $\times$  Probe Vicinity) interaction. Second, we predicted that the differences in Hypothesis 1 would be especially pronounced when the threat word was *scrupulosity-specific* (vs. a *general* threat word). In other words, we hypothesized that scrupulosity would be a factor in attention toward *scrupulosity-specific* threat, resulting in a three-way (Scrupulosity  $\times$  Probe Vicinity  $\times$  Threat Word Type) interaction. Finally, we also examined whether this effect diminished over time, potentially reflecting habituation to threatening information over the course of the experiment. In other words, we examined whether there was a four-way (Scrupulosity  $\times$  Probe Vicinity  $\times$  Threat Word Type  $\times$  Time) interaction.

## METHOD

### Participants

We elected to examine our hypotheses using a nonclinical sample. The use of such a sample as an apt analogue for clinical levels of scrupulosity is predicated on the assumption that

obsessive-compulsive (OC) symptoms are prevalent in both clinical and nonclinical populations, are phenomenologically similar across both populations, and are associated with the same developmental and maintenance factors in clinical and nonclinical individuals (e.g., Abramowitz et al., 2014).

Ninety-five undergraduate students recruited from Introduction to Psychology classes at the University of North Carolina at Chapel Hill (UNC-CH) participated in this study. The sample was primarily female (75.8%,  $n = 72$ ), right-handed (88.3%,  $n = 83$ ), and White (70.5%,  $n = 67$ ; 11.6% African American, 5.3% Latino, 9.5% Asian, 3.2% other). A range of religious affiliations was represented: 14.7% Catholic ( $n = 14$ ), 54.7% Protestant or nondenominational Christian ( $n = 52$ ), 8.4% other religion ( $n = 8$ ; e.g., Islamic, Jewish), and 22.1% no religion (i.e., agnostic or atheist,  $n = 21$ ). Only participants without visual impairments that would make it difficult to use a computer were eligible to participate in the study (corrected vision was acceptable for participation). This was the only inclusion/exclusion criterion for the study.

## Measures

***Penn Inventory of Scrupulosity.*** The Penn Inventory of Scrupulosity (PIOS; Abramowitz, Huppert, Cohen, Tolin, & Cahill, 2002) is a 19-item self-report measure developed to assess religious OC symptoms (i.e., scrupulosity). The PIOS consists of two subscales: (a) fears of having committed a religious sin (i.e., Fear of Sin subscale; e.g., “I am afraid of having sexual thoughts”) and (b) fears of punishment from God (i.e., Fear of God subscale; e.g., “I worry that God is upset with me”). Items are scored on a 5-point Likert scale ranging from 0 (*never*) to 4 (*constantly*); total scores range from 0 to 76. The PIOS has demonstrated adequate psychometric properties in non-clinical samples generally (Abramowitz et al., 2002; Olatunji, Abramowitz, Williams, Connolly, & Lohr, 2007) as well as in the present sample ( $\alpha = .97$ ).

***Religiosity.*** We assessed participants’ degree of religiosity with a single-item question: “How strongly do you hold your religious beliefs?” Participants responded on a scale from 1 (*not at all*) to 5 (*very strongly*). In previous studies, responses to this question were strongly correlated with items that asked participants about their religious practice, such as strength of affiliation with their religion ( $r = .71$ ) and frequency of attending religious services ( $r = .60$ ; Abramowitz et al., 2002).

## Procedure

***Overview.*** Informed consent was obtained from all patients for being included in the study. Participants first completed the PIOS online using secure internet software (i.e., Qualtrics) and were recruited to participate in the study based on their score.<sup>1</sup> Specifically, at the beginning of study recruitment, all participants were eligible to participate, and as the study progressed, we specifically recruited those with high and low PIOS scores to ensure our sample would demonstrate the full range of possible scores. To all participants, the study was described as a 1-hour experiment investigating “attention and belief systems.” Participants were informed that they would be asked to complete a computerized test of attentional processing as well as several questionnaires about different beliefs they may have. All participants were tested individually in the laboratory.

The experimenter first obtained informed consent. Using the Qualtrics online data collection software, participants then completed the study measures described earlier and rated the threat level of each of the 62 words to be used in the attention bias task. These ratings were completed electronically by dragging the cursor along a visual analogue scale on the computer screen that ranged from 0 (*not at all threatening*) to 100 (*extremely threatening*). These ratings were used as a manipulation check to ensure the stimuli included in the dot probe task were

perceived to be threatening (and nonthreatening) by participants. Finally, participants completed the 15-min attention bias task (as described in the following text). At the end of the visit, participants were debriefed and given educational material about scrupulosity, including information about campus resources available to help treat scrupulosity (should the participant be interested in such resources). Participants all received 1 hour of credit toward the research requirement of Introduction to Psychology. No animal studies were carried out by the authors for this article.

**Dot Probe Task.** The dot probe task is a routinely used computer-based paradigm to determine attentional biases (delivered by the computer program E-Prime). In this study, we used a color monitor with a 22-inch screen. Each trial began with a fixation cross “+” presented in the center of the screen for 500 ms. Immediately following the disappearance of the fixation cross, two words were presented: one just above and one just below where the cross had been (6 cm between words). Each word pair was presented for 500 ms, and following its disappearance, one of two probes (the letter *E* or the letter *F*) appeared in the space left empty by either the upper or lower word. Participants were instructed to indicate whether an *E* or an *F* appeared by pressing one of two keyboard keys (the *Z* key or the *M* key, respectively). The computer measured the time (in milliseconds) it took the participant to press the correct (or incorrect) key as the dependent variable (i.e., response time). The letter remained on the screen until the participant responded.

After receiving written and oral instructions for how to complete the dot probe task, there were 24 practice trials (word pairs containing two neutral words) to orient the participant to the task,<sup>2</sup> followed by 62 critical trials (word pairs containing one neutral and one threatening word). Specifically, 31 distinct word pairs were each presented twice (with the words switching positions on the screen). Of the 31 word pairs, 15 contained a neutral word (e.g., *banana*) paired with a general threat word (e.g., *violence*) and 16 contained a neutral word paired with a scrupulosity-specific threat word (e.g., *damnation*). Neutral and threat words were matched based on the number of letters and frequency of use in the English language (Carroll, Davies, & Richman, 1971). A complete list of stimuli is presented in the Appendix. The order of trials was randomly determined for each participant. Threat word location (top vs. bottom), letter presented (*E* vs. *F*), and probe vicinity (probe in neutral vs. probe in threat vicinity) were all evenly distributed across trials. Choice RT was measured to determine the degree to which individuals with high levels of scrupulosity preferentially attend to scrupulosity-specific threat words over neutral or general threat words (i.e., faster RTs). Attention bias for threat is indicated if response latencies for probes in the vicinity of threat words are smaller than response latencies for probes in the vicinity of neutral words.

## Data Analytic Strategy

Because of the nested structure of the data (i.e., 62 trials per participant), a multilevel model was used to predict RT. The model predictors included (a) scrupulosity total score (Level 2; measured by the PIOS), (b) threat word type (Level 1; general threat word vs. scrupulosity-specific threat word), (c) probe vicinity (Level 1; probe in neutral vicinity vs. probe in threat vicinity), and (d) trial number (Level 1; trial number from 1–62).

First, we fit an unconditional linear growth model (i.e., where trial was the only predictor) to determine whether there was a fixed effect for time (i.e., if there was an aggregate change in RT across trials). If this effect was not significant, we planned to remove trial from the model. We then fit the full model predicting RT from threat word type, probe vicinity, and trial (if the effect was significant) as time-varying predictors and scrupulosity as a time-invariant predictor. We used a continuous-time autoregressive structure for the residuals to account for potential serial correlation across trials (i.e., the fact that the RT for trials close in time may be more strongly correlated than trials farther apart in time).

## RESULTS

### Preliminary Analyses

**Threat Rating Manipulation Check and Data Reduction.** To ensure that the neutral words used in our analyses were perceived as nonthreatening, and the general threat words were perceived as threatening, we computed mean threat ratings for each word. We excluded neutral words from further analyses whose threat rating was 1 *SD* above the mean and any general threat words whose threat rating was 1 *SD* below the mean. Accordingly, three neutral words (and their word pair) were excluded: *pill* ( $M = 14.76, SD = 20.56$ ), *cliff* ( $M = 26.11, SD = 24.67$ ), and *cold* ( $M = 14.42, SD = 17.92$ ), and three general threat words (and their word pair) were excluded: *grim* ( $M = 25.65, SD = 21.97$ ), *lonely* ( $M = 25.86, SD = 26.27$ ), and *gross* ( $M = 7.98, SD = 13.72$ ). The mean ratings for words retained in analyses appear in Table 1.

We also computed Pearson's correlations between each word's threat ratings and scores on the PIOS to ensure that perceived threat of scrupulosity-specific words was indeed associated with scrupulosity symptoms. Six scrupulosity words (and their word pair) were removed from analyses because their threat rating was not significantly correlated with the PIOS: *salvation* ( $r = .12$ ), *pray* ( $r = .02$ ), *Bible* ( $r = .11$ ), *church* ( $r = .02$ ), *Christ* ( $r = .13$ ), and *doctrine* ( $r = .21$ ). The remaining words were significantly correlated with scores on the PIOS, with *rs* ranging from .30 (*God*) to .74 (*sin*; all  $ps < .01$ ). Overall, this data reduction resulted in 40 trials per participant (i.e., 20 word pairs).<sup>3</sup>

Finally, we computed group means for each word type (neutral, general threat, and scrupulosity-specific threat). On average, the neutral words were rated as nonthreatening ( $M = 2.42, SD = 4.38$ ), the scrupulosity-specific threat words as mildly threatening ( $M = 34.74, SD = 19.43$ ), and the general threat words as moderately threatening ( $M = 52.63, SD = 21.70$ ). A within-subjects repeated measures analysis of variance (ANOVA) with threat rating as the dependent variable revealed a main effect of word type,  $F(2, 188) = 328.04, p < .001, \eta_p^2 = .78$ . Post hoc paired samples *t*-tests revealed that participants on average rated the general threat words as more threatening than the scrupulosity-specific threat words, which were rated as more threatening than the neutral words ( $ps < .001$ ).

**Religiosity and Scrupulosity.** The sample's mean PIOS score ( $M = 20.85, SD = 14.59$ ; skewness =  $-.01$ , kurtosis =  $-1.41$ ) was comparable to a similar sample of undergraduates in a previous study ( $M = 18.98, SD = 11.66$ ; Abramowitz et al., 2002). On average, participants reported moderately strong religious beliefs ( $M = 3.39, SD = 1.34$ , range = 1–5). Religiosity and scrupulosity were significantly positively correlated,  $r(82) = .42, p < .001$ .

**Dot Probe.** Participants correctly responded (i.e., correctly identified the probe as the letter *E* or the letter *F*) in 96.2% of trials ( $n = 3,800$ ). At the most, each participant responded incorrectly in only one trial. One extreme RT value (91 ms) was dropped from analyses because it was more than 2.5 *SD* faster than the mean RT. After the outlier was removed, participant mean RT was 636.16 ms ( $SD = 185.25$ , range = 295 ms–2.36 s). The distribution of RT was positively skewed (skewness = 2.96) and platykurtic (kurtosis = 17.54). Because of the problematic distribution, we log transformed RT, which resulted in a more symmetric distribution (skewness = 0.87; kurtosis = 3.02).

### Unconditional Linear Growth Model

First, we fit an unconditional linear growth model (i.e., where trial was the only predictor). The fixed effect of trial on RT was not significant,  $t(3703) = 0.40, p = .68$ ; this suggests that the model-implied linear slope of RT did not significantly change over time. Thus, trial was not included in future models.

**TABLE 1. MEAN THREAT RATINGS**

	Threat Rating	
	<i>M</i>	<i>SD</i>
Neutral words		
Oak	1.92	6.24
Sequence	3.80	12.00
Truck	6.12	16.04
Soccer	2.43	7.16
Module	4.00	14.39
Lane	2.94	9.83
Castle	2.64	7.33
Feedback	7.23	12.83
Bells	0.78	2.69
Tutor	1.74	6.29
Analogy	0.52	1.48
Bay	3.21	8.40
Screen	1.19	4.67
Fan	2.18	6.97
Pillar	2.59	6.83
Cake	0.98	5.53
Warmth	1.61	10.49
Kitchen	1.72	5.80
Biscuit	0.23	0.82
Sandwich	0.34	1.57
General threat words		
Violence	63.63	25.57
Danger	61.21	27.48
Threat	56.07	27.38
Knife	39.44	25.40
Stabbed	60.89	30.98
Gun	60.88	32.29
Murder	72.61	29.19
Hazard	42.06	29.28
Attack	56.01	27.35
Trouble	35.00	25.56
Horrible	31.16	26.53
Scrupulosity threat words		
Sin	43.02	31.68
Shame	37.39	26.93
Punish	48.74	27.15
Hell	58.41	37.76
Morality	22.22	24.72
Guilt	37.97	26.51
God	13.79	23.41
Judgment	39.24	30.74
Confess	11.84	19.23



## Full Model

Next, we fit the full model including threat word type and probe vicinity as time-varying predictors and scrupulosity as a time-invariant predictor of RT. We used a continuous-time autoregressive structure for the residuals to account for potential serial correlation across trials. Univariate and bivariate residual distribution plots demonstrated that the Level 1 and Level 2 residuals were normally distributed and homoscedastic and that there were no problematic trends in the data.

There were no significant main effects. First, the main effect of PIOS total score on RT was not significant,  $t(93) = 0.79, p = .43$ , suggesting no relationship between PIOS total score and RT (controlling for threat word type and probe vicinity). Second, the main effect of threat word type on RT was not significant,  $t(3698) = -0.87, p = .38$ , suggesting that RT was not significantly different for trials with a scrupulosity-specific threat word compared to trials with a general threat word (controlling for PIOS score and probe vicinity). Third, the main effect of probe vicinity on RT was not significant,  $t(3698) = -0.35, p = .72$ , which reflects that RT was not significantly different for trials in which the probe was in the threat location compared to trials in which the probe was in the neutral location (controlling for PIOS score and threat word type).

Similarly, none of the two-way interactions was significant. First, the interaction between PIOS total score and threat word type was not significant,  $t(3698) = -0.63, p = .53$ , suggesting that the relationship between PIOS score and RT did not differ as a function of threat word type (general vs. scrupulosity-specific threat word), controlling for probe vicinity. Second, the interaction between PIOS total score and probe vicinity was not significant,  $t(3698) = 0.40, p = .69$ , suggesting that the relationship between PIOS score and RT did not differ as a function of probe vicinity (probe in neutral vicinity vs. probe in threat vicinity), controlling for threat word type. Third, the interaction between threat word type and probe vicinity was not significant,  $t(3698) = 1.64, p = .10$ , suggesting that after controlling for PIOS score, RT did not differ as a function of the combination of threat word type and probe vicinity. For the first hypothesis of interest, we used a planned comparison to examine the specific association between PIOS score and RT when the probe appeared behind a threat word (averaged across general vs. scrupulosity-specific threat words); this simple contrast was not significant,  $t(3698) = 1.05, p = .30$ .

Finally, the three-way interaction between scrupulosity, threat word type, and probe vicinity was not significant,  $t(3698) = 0.34, p = .73$ , suggesting that the relationship between the PIOS and RT did not differ as a function of the combination of threat word type and probe vicinity. For the second hypothesis of interest, we used a planned comparison to examine the specific association between PIOS score and RT when the probe appeared behind a scrupulosity-specific threat word; this simple contrast was not significant,  $t(3698) = 0.93, p = .35$ .<sup>4</sup>

## DISCUSSION

This study was the first to use the dot probe paradigm to investigate the association between scrupulosity and selective attention to religious and morally relevant stimuli. The study's primary hypothesis, that individuals with higher levels of scrupulosity would selectively attend (i.e., have faster RTs) to scrupulosity-specific threat words (e.g., *hell*) more so than to general threat or neutral words, was not supported. There was no support for any of the hypothesized main effects or interactions involving scrupulosity. Moreover, contrary to previous studies that have reported an attenuation of attention bias over time in individuals with OC symptoms (conceivably caused by habituation to threatening stimuli), this study did not find a significant change in RT across trials. Power analyses suggest that with a sample size of 95, this study is sufficiently powered (power > .85) to detect a significant attention bias effect at the .05 level, based on previous research with analogue samples (Bar-Haim et al., 2007).

There are various potential reasons that the study's hypotheses were not supported. First, scrupulosity symptoms might not be associated with attentional biases. Despite many findings that individuals with anxiety symptoms exhibit attentional biases toward threatening stimuli, some studies have failed to replicate this effect in OC samples (Harkness et al., 2009; Moritz et al., 2008; Moritz et al., 2004; Moritz & von Mühlengen, 2008), and previous researchers have suggested that cognitive biases differ between the various presentations of OC symptoms (Summerfeldt & Endler, 1998). Thus, it may be that OC phenomena focused on religion are different from other OC presentations (e.g., contamination) and other anxiety disorders. There may be other cognitive processes (e.g., thought–action fusion; Berle & Starcevic, 2005) that are more critical to the development and maintenance of obsessions involving unwanted religious thoughts.

Second, it may be that the impact of scrupulosity on attentional biases in a nonclinical sample is different from scrupulosity symptoms in a clinical sample. Indeed, mean levels of scrupulosity on the PIOS were only mild to moderate in this undergraduate sample. Future studies should recruit samples with greater levels of scrupulosity to address this question. However, meta-analyses have found there is no difference in the magnitude of attentional biases in clinical versus analogue samples (Bar-Heim et al., 2007). If analogue samples are used, one option would be to behaviorally verify group assignment using a behavioral approach task. For example, Armstrong, Sarawgi, and Olatunji (2012) used a self-report measure (i.e., the Padua Inventory Contamination Fear subscale) to establish high and low contamination fear groups. Then, to verify group assignment (i.e., that the high contamination fear group reported significantly higher levels of distress in a contamination-relevant situation than the low contamination fear group), they asked participants to rate their distress level after performing anxiety provoking contamination-related acts in a public restroom (e.g., touching the inside of a toilet). Incorporating behavioral approach tasks into analogue studies of attention bias would provide confidence in the clinical importance of group assignment.

Third, approximately 20% of our sample identified no religious affiliation, which may have impacted mean threat ratings for scrupulosity words (vs. general threat words). Research suggests, however, that one does not need to identify with a religious affiliation to have scrupulosity. Specifically, nearly one in five scrupulous participants reports no religious affiliation (Siev, Baer, & Minichiello, 2011).

Fourth, the threat stimuli for this study, although carefully selected for their relevance to scrupulosity by raters with extensive OCD experience (JSA and NCB) and statistically evaluated to ensure they fit within their predetermined threat versus neutral categories, were nomothetically selected. Thus, although relevant for the sample *on average*, the relevance of the stimuli varied among participants (i.e., there is a wide range in perceived threat of the words). For example, certain scrupulosity-specific words (e.g., *hell*) may not have been relevant for all participants with scrupulosity (e.g., Judaism places less emphasis on hell as compared to other religions). However, our results remained nonsignificant even when we removed non-Christian participants. Nonetheless, in future studies, it would be useful to ideographically select the most personally relevant general and scrupulosity-specific threat words for each individual in advance to reflect each participant's idiosyncratic concerns (e.g., Amir et al., 2009).

The usage of words instead of more vivid or explicit stimuli (e.g., pictures) is yet another possible reason for not finding associations between scrupulosity and attentional bias in this study. Dot probe experiments can use either words or pictures and it is possible that words simply are not evocative enough to elicit an attentional bias, as has been argued previously by other authors (da Victoria et al., 2012; Harkness et al., 2009; Moritz et al., 2008). Although meta-analyses have demonstrated no difference in the magnitude of attention bias effects for words versus pictures for anxiety more generally (Bar-Haim et al., 2007), the qualms of patients with OCD are usually activated by visual cues or images such as an open door or dirty sink (vs. worries, e.g., which are

more word-based; e.g., Barlow, 2004), thus questioning the ecological validity of verbal material in OC samples.

Finally, future studies should also examine a broader variety of stimulus durations (vs. this study that only included 500 ms durations) to differentiate between stages of informational processing: automatically processing of subliminally presented stimuli that are below conscious awareness (i.e., less than 500 ms) versus strategically processing of supraliminally presented stimuli that can be consciously perceived (i.e., 500 ms or longer; McNally, 1995). Doing so would facilitate an examination of the mechanisms by which an attentional bias occurs (e.g., attentional avoidance). Similarly, dot probe protocols have more recently been modified to include trials with two neutral (i.e., nonthreatening) words. This allows researchers to determine whether attentional biases are caused by *facilitated attention* to threat (i.e., faster responses to probe in threat trials vs. neutral-neutral trials, suggesting that individuals quickly orient to threatening words) or *difficulty disengaging* attention away from threat (i.e., slower responses to probe in neutral trials vs. neutral-neutral trials, suggesting that individuals take time to shift attention away from the threatening location; Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004). This distinction would help to clarify the mechanisms of attentional biases in OC samples. Furthermore, some studies have suggested that attention bias may be a dynamic and fluctuating process (vs. a stable individual difference) in which participants alternate between attending toward and away from the target stimuli over time (Zvielli, Bernstein, & Koster, 2014a, 2014b), which requires further investigation. Finally, as previously mentioned, the dot probe paradigm has been criticized for having only moderate internal consistency and test–retest reliability (Schmukle, 2005; Waechter et al., 2014), although other paradigms also have methodological flaws.

In summary, this study failed to support the hypothesis that individuals with higher levels of scrupulosity selectively attend to scrupulosity-specific threat words more so than to general threat or neutral words. Given the variety of methodologies and mixed findings regarding attentional biases in individuals with anxiety and OC symptoms, we believe the reporting of null findings is important to elucidate where true relationships exist.

## NOTES

1. The original sample size was 105, but 10 participants were removed from data analysis because the difference between their PIOS score as measured online and in person were  $>2 SD$  above the mean (suggesting unreliable reporting).
2. The practice trials were not analyzed in this article.
3. We ran analyses both ways (with and without these trials removed). When all trials were retained, our results remained the same (i.e., all main effects and interactions were not significant).
4. Because many of the scrupulosity words pertained specifically to the Christian faith, we also ran our multilevel modeling analyses removing the eight participants self-identifying as non-Christian. All results of these analyses were also nonsignificant.

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## APPENDIX: ATTENTION BIAS WORDS

*Neutral words* (31 words): sequence, module, castle, bells, analogy, bay, screen, pillar, warmth, kitchen, sandwich, oak, truck, soccer, lane, feedback, tutor, fan, cake, biscuit, pill, cold, cliff, packet, phrase, cloth, recipient, piano, street, editor, graphics

*General threat words* (15 words): violence, danger, threat, knife, stabbed, gun, murder, hazard, attack, trouble, horrible, grim, lonely, guilty, gross

*Scrupulosity-specific threat words* (16 words): sin, shame, punish, hell, morality, guilt, God, judgment, confess, pray, salvation, Bible, church, Christ, doctrine, devil