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Training interpretation biases among individuals with symptoms of obsessive compulsive disorder

Elise M. Clerkin¹ and Bethany A. Teachman²

¹The Center for Alcohol & Addiction Studies, Brown University

²The Department of Psychology, The University of Virginia

Abstract

The current study tested the causal premise underlying cognitive models of obsessive compulsive disorder (OCD) that negative interpretations of intrusive thoughts lead to the distress and impairment associated with symptoms of OCD. Specifically, we sought to determine: a) whether it was possible to train healthier (defined as more benign/less threatening) interpretations regarding the significance of intrusive thoughts; and b) whether there was a link between modifying negative interpretations and subsequent emotional vulnerability to an OC stressor. A nonclinical sample of students high in OC symptoms completed either a Positive ($n=50$) or Neutral ($n=50$) interpretation training procedure designed to alter OC-relevant interpretations and beliefs. As expected, participants in the Positive (versus Neutral) training condition endorsed healthier OC-relevant interpretations and beliefs following training. Additionally, when controlling for baseline affect, participants in the Positive (versus Neutral) training condition reported less negative affect during the OC stressor task (at the level of a nonsignificant trend) and reported less desire to perform neutralizing activities. In general, results provide some support for cognitive models of obsessions and suggest that negative interpretations of intrusive thoughts may be causally related to symptoms of OCD.

Keywords

training; interpretations; OCD; obsessional beliefs; thought action fusion

“What we think, we become.” – Buddha

Cognitive models propose that it is the *interpretations* (as opposed to the *content*) of intrusive, unwanted thoughts that leads to the pathological cycle of self-derision, distress, and repetitiveness characteristic of obsessive compulsive disorder (OCD; see Frost & Steketee, 2002; Rachman, 1997). Thus, having a thought of harming one’s newborn baby is not itself thought to be problematic; it is the interpretation that this thought means one is a terrible person or is likely to act out the thought that is the difficulty in OCD.

To date, there is substantial correlational evidence supporting the link between negative interpretations of intrusive thoughts and OC symptoms. For instance, symptoms of OCD are associated with beliefs that intrusive thoughts are personally meaningful and indicative of

Correspondence concerning this manuscript can be sent to: Elise Clerkin, Department of Psychology, University of Virginia, P.O. Box 400400, Charlottesville, VA 22904-4400 USA, emc2t@virginia.edu..

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one's moral character (Obsessive Compulsive Cognitions Working Group; OCCWG, 2003,2005). Experimental work also suggests that it is possible to manipulate OC-relevant beliefs (e.g., Forrester, Wilson, & Salkovskis, 2002; Teachman, Woody, & Magee, 2006; Zucker, Craske, Barrios, & Holgiun, 2002). Critically, manipulating these beliefs also appears to have substantial cognitive, behavioral, and emotional consequences. For instance, Rassin, Merckelbach, Muris, and Spaan (1999) demonstrated that it was possible to increase intrusive thinking and discomfort through a manipulation designed to exacerbate thought-action fusion (TAF)—an OC-relevant belief that simply having an intrusive thought is morally equivalent to committing a harmful action and/or increases the likelihood that a negative outcome will occur.

In the current study, our goal was to build on these findings to determine whether it was possible to train healthier (defined as more benign/less threatening) interpretations of intrusive thoughts across a variety of OC-relevant belief domains. Moreover, we were interested in evaluating whether there was a link between modifying negative interpretations and subsequent emotional vulnerability to an OC stressor. Unlike many prior studies which have relied on explicit methods for manipulating negative OC-relevant beliefs (e.g., cognitive restructuring), we sought to modify negative interpretations in a less explicit manner by repeatedly pairing an OC trigger with a benign interpretation. Specifically, we relied upon recent research utilizing cognitive bias modification (CBM) procedures to directly modify maladaptive interpretations by training contingencies between positive interpretations and ambiguous but potentially threatening cues. For instance, in their pioneering work, Mathews and Mackintosh (2000) induced relatively benign interpretation biases by having participants read and imagine themselves in a variety of scenarios in which the emotional ambiguity of the situations were consistently resolved to reflect a positive outcome (see also Beard & Amir, 2008; Murphy, Hirsch, Mathews, Smith, & Clark, 2007; Steinman & Teachman, 2010). Because negative interpretations of intrusive thoughts are at the heart of cognitive models of OCD, we predicted that directly activating healthier interpretations would result in less anxious responding to an OC-relevant stressor. Furthermore, in contrast to much of the past experimental research that has focused only on one specific maladaptive belief domain, we adapted the Mathews and Mackintosh (2000) methodology to modify a variety of OC-relevant interpretations given the heterogeneous nature of OCD symptoms.

After training, participants completed measures of interpretation bias, maladaptive OC beliefs, and an OC stressor designed to exacerbate TAF beliefs. Our expectation was that following training, participants in the Positive (relative to Neutral) condition would make more positive and fewer negative interpretations, have healthier OC-relevant beliefs, report less distress and urges to neutralize, and engage in fewer neutralizing activities associated with the OC stressor. Consistent with many prior studies, the intervention was not expected to directly impact state affect, reinforcing our hypothesis that the intervention was not merely an affect manipulation (see Murphy et al., 2007).

Methods

Participants

Undergraduate students were recruited for this study based on their responses to the Obsessive Compulsive Inventory-Revised (OCI-R; Foa, Huppert, Leiberg, Langner, Kichic, Hajcak, et al., 2002), which was administered as part of a larger pre-screening battery that hundreds of psychology students completed at the beginning of each semester. This allowed us to select student participants that were very high in OCD symptoms. According to Foa and colleagues (2002), individuals diagnosed with OCD had a mean score of 28.01 ($SD=13.53$) on the OCI-R and 7.23 ($SD=3.84$) on the OCI-R Obsession subscale. Thus, in

the current study, participants were invited to participate if they scored above 28.01 on the OCI-R during pre-selection, resulting in a highly anxious sample (OCI-R: $M=36.29$, $SD=7.19$, $Range=28.59-69.88$; OCI-R Obsession subscale: $M=6.14$, $SD=2.81$, $Range=1-12$). There were 100 participants in the final sample (Age: $M = 18.76$, $SD = 1.0$; 65% women). Race was reported as 69% Caucasian, 12% African-American, 12% Asian, 4% Bi- or multiracial, 2% Other, and 1% declined to answer.

Materials

Pre-training OC Symptoms, Beliefs and Negative Affect—The *Obsessive-Compulsive Inventory-Revised* (OCI-R; Foa et al., 2002) is an 18-item self-report questionnaire that assesses overall severity of OC symptoms. Although previous research using the OCI-R has demonstrated that it has good psychometric properties (Foa et al., 2002), reliability in the current study was low (Cronbach's $\alpha=.47$). However, reliability for the six subscales composing the OCI-R were each higher than the total scale reliability (Washing: .62; Obsessing: .71; Hoarding: .74; Ordering: .72; Checking: .53; Neutralizing: .57).

The *Interpretations of Intrusions Inventory* (III; OCCWG, 2003,2005) measures interpretations associated with intrusive thoughts. In the current study, only the 10-item Importance of Thoughts subscale was used (referred to as III-Importance; Cronbach's $\alpha=.90$). Due to privacy concerns, given the often secretive nature of intrusive thoughts in the context of OCD symptoms, the directions for completing the III-Importance were slightly modified. Specifically, participants were not asked to write out or report upon two specific intrusions they had experienced. Instead, participants were asked to respond to the questions on the III-Importance scale regarding the unwanted thoughts that had occurred most frequently for them or that had been the most upsetting.

Note that in the present study, we drew from the OCCWG (1997) definition of Appraisals, which include interpretations: "Ways in which meaning is given to a specific event such as the occurrence of an intrusion. Appraisals may take the form of expectations, interpretations or other types of judgments of the event as a function of one or more of several dimensions." (p. 670). Following this guideline, we use the term "interpretations" when discussing findings related to the III-Importance.

The Positive and Negative Affect Schedule-Negative Affect (PANAS-NA; Watson & Clark, 1994) contains 10 items that assess current negative affect. The PANAS-NA was administered prior to and immediately following training (termed PANAS-Pre and PANAS-Post, respectively), as well as during the OC stressor task (termed PANAS-Stressor; average Cronbach's $\alpha=.87$).

Training OC-Relevant Interpretation Biases—The experimental training of interpretation biases followed the paradigm originally used by Mathews and Mackintosh (2000). Because OCD is a heterogeneous disorder, participants in the present study were asked to read and imagine themselves in 64 scenarios related to a broad array of common triggers for negative OC-relevant interpretations. This helped to ensure that all participants would likely have some of their key obsessional beliefs trained. Scenarios were based on the domains outlined by the OCCWG (2003, 2005), including: Tolerance for Uncertainty (e.g., difficulty tolerating ambiguity); Threat Estimation (e.g., overestimation of the likelihood of negative outcomes); Control of Thoughts (e.g., notion that thoughts must be actively controlled); Importance of Thoughts (e.g., belief that intrusive thoughts are meaningful and indicative of one's character); Responsibility (e.g., idea that one must be vigilant about preventing harm at all times); and Perfectionism (e.g., belief that one must be "perfect"). See Table 2 for sample training scenarios.

For example, the following scenario was designed to tap into Importance of Thoughts: “You and a friend are having a personal discussion. You tell her that you sometimes have bizarre thoughts about hurting people you care about – thoughts you don’t really want to have. Your friend tells you this is really weird.” The last word in each scenario was a word fragment that resolved the ambiguity of the scenario to be either consistent (or inconsistent) with a negative OC interpretation, depending on training condition. In this instance, the word “weird” resolved the meaning in an OC-relevant manner (i.e., the belief that thoughts are very meaningful); the comparable word fragment “normal” would be used to resolve the meaning of this scenario in a positively valenced direction. Note that participants were not allowed to proceed to the next trial until they had correctly completed the word fragment. Participants were also asked to complete a comprehension question to underscore their interpretation condition (e.g., “Does your friend judge you negatively for having these thoughts?”).

Participants in the Positive training condition were always required to resolve the ambiguity of the scenario in a manner that contradicted the negative OC-relevant interpretation (e.g., completing “normal” in this case). Participants in the Neutral training condition were required to resolve the ambiguity for half of the scenarios in a manner *inconsistent* with negative OC-relevant interpretations (so the resulting interpretation would be positive), and the other half in a manner *consistent* with negative OC-relevant interpretations (so the resulting interpretation would be negative). A negative training condition was not included due to ethical concerns about potentially exacerbating participants’ OC symptoms. Interspersed with the OC-relevant training scenarios ($N=64$) were 24 irrelevant filler scenarios that were included to make the purpose of training less transparent. Participants also completed five unrelated practice scenarios at the outset of training.

Evaluating the Impact of Training—The *Obsessional Beliefs Questionnaire-Short Form* (OBQ; OCCWG, 2005) is a 44-item inventory derived from the 87-item version of the OBQ with good psychometric properties. It measures three belief domains relevant for OCD: Responsibility/Threat Estimation, Perfectionism/Certainty, and Importance/Control of Thoughts (Cronbach’s $\alpha=.94$). This measure was used to assess post-training beliefs (rather than repeating the III-Importance) because of concerns about participants recalling their pre-training answers given the closeness in time of the pre-and post-training measures. Importantly, prior research has demonstrated that there is a significant, positive relationship between each of the III and OBQ-87 subscales (OCCWG, 2001), attesting to their ability to capture related constructs. Directions for the OBQ were modified slightly to capture state (relative to trait) beliefs by removing the language that asked participants to note if a given belief was typical for them most of the time.

Note that in the present study, we drew from the OCCWG (1997) definition of Assumptions, which include beliefs: “Relatively enduring assumptions that are held by an individual and that are pan-situational rather than specific to a particular event. These assumptions are typically measured in the form of dysfunctional attitudes or irrational beliefs.” (p. 670). Following this guideline, we use the term “beliefs” when discussing findings related to the OBQ (as opposed to the term interpretations).

Recognition Scenarios and Ratings: After the training trials, participants read 10 new, OC-relevant test scenarios that did not resolve the ambiguity of the scenario, even after completion of the word fragment. Ambiguity in this case refers to the potential OC interpretation (e.g., whether the interpretation was consistent or inconsistent with a maladaptive OC-relevant belief). Again, test scenarios were created so that they tapped into each of the OC belief domains outlined by the OCCWG. For instance, a test scenario designed to capture Importance of Control was: “You are preparing for a job interview. As

you prepare, you have a number of unwanted, intrusive thoughts about messing up the interview. As thoughts about the interview pop into your mind, you think about whether or not these thoughts will mess up your interview if you can't get rid of them." Each scenario was paired with a comprehension question to ensure that participants were attending to the scenario's content (e.g., "Are you getting ready for a job interview?"). Additionally, participants saw ten new, non-OC relevant scenarios (tapping into spider fear) that had been previously used by Teachman and Addison (2008). These scenarios were included so the purpose of training was not as readily apparent.

After a filler task, participants were then provided with a Recognition Rating form where they saw the title of only the 10 OC-relevant (not spider-relevant) test scenarios (e.g., "THE JOB INTERVIEW") in which they had previously imagined themselves. This time, each title corresponded with four different interpretations, none of which was worded identically to the sentence in the paragraph they had previously read. Participants were asked to rate each sentence independently in terms of how similar each interpretation option was to the meaning of the scenario they had previously read.

Of the four interpretations, one was consistent with a healthy OC-relevant response in that it challenged the interpretation regarding the need to control one's thoughts (OC Positive: "As thoughts about the interview pop into your mind, you realize that controlling all of them won't matter for whether or not you get the job"); one was consistent with a negative OC response in that it reinforced the interpretation of the need to control one's thoughts (OC Negative: "As thoughts about the interview pop into your mind, you realize that you need to control them if you want to make a favorable impression"); one was positive but not tied to importance of control (Foil Positive: "As thoughts about the interview pop into your mind, you realize how excited you are about the new job"); and one was negative but not tied to importance of control (Foil Negative: "As thoughts about the interview pop into your mind, you think about how you don't really like to work"). Akin to the III-Importance subscale, we use the term "interpretations" for this measure based on the OCCWG (1997) definition, and the focus on specific events in the Recognition Scenarios.

Unfortunately, we did not formally conduct pilot work on these new materials. However, it is important to note that in the current sample, the OC Positive Ratings were significantly *negatively* related to the OBQ total score ($r = -.25, p = .01$) while the OC Negative Ratings were significantly *positively* related to the OBQ total score ($r = .38, p < .001$). This suggests that the Positive and Negative OC Ratings were tapping into conceptually meaningful constructs, which mapped on to the validated OBQ.

Test Probes: There were 16 test 'probes' mixed in with the other scenarios throughout the training task. Probes are word fragments that complete OC-relevant scenarios that all participants see, regardless of training condition. Half of the test probes were consistent, and half were inconsistent, with a negative OC interpretation. Probes were included based on the hypothesis that participants in the Positive condition would become faster over the course of training at completing the word fragment when it connoted a positive, as opposed to negative, OC-relevant interpretation.

OC Stressor—TAF Induction (see Rachman, Shafran, Mitchell, Trant, & Teachman, 1996): To assess the degree to which training impacted emotional vulnerability, participants completed an OC stressor designed to exacerbate TAF beliefs. Specifically, participants were asked to write that they hoped their best friend got into a car accident on a slip of paper and to concentrate on the thought for one minute. Next, participants reported how they felt during the most distressing point of the task and completed a form in which they reported the extent to which they wanted to engage in various neutralizing activities, or behaviors that

they believed would make them feel better, on a 0 (*not at all*) to 8 (*totally/definitely*) scale (referred to as Neutralizing Urge). Neutralizing Urge was calculated by computing an average score of the extent to which participants wanted to engage in each of the neutralizing activities, which included: ripping up the paper; writing out a new sentence; washing their hands; distracting themselves with a video; calling their friend; saying a prayer; and “other.” Participants were also allowed to engage in any of the neutralizing activities, and the number of activities completed was recorded.

Procedure

Following approval by the university’s ethics review board and informed consent, participants completed a measure of demographic information, as well as baseline measures of negative affect (PANAS-Pre) and interpretations tied to intrusive thoughts (III-Importance). Next, participants were randomly assigned to an interpretation training condition: Positive Training ($n=50$) or Neutral Training ($n=50$). Following training, participants completed the PANAS-Post to evaluate the extent to which training directly influenced negative affect, as well as a brief filler task (a puzzle). Next, Recognition Ratings for the ambiguous test scenarios and the OBQ were completed to determine whether training modified OC-relevant interpretations and beliefs (measured with Recognition Ratings and the OBQ). Subsequently, participants completed the OC-stressor (TAF car accident sentence), followed by measures of negative affect (PANAS-Stressor) and urge to neutralize (Neutralizing Urge). Participants were then invited to engage in neutralizing activities if they wished. Finally, a funnel debriefing interview was conducted to determine whether participants were aware of the researchers’ primary hypotheses. Participants were then fully debriefed and compensated for their time.

Results

Sample Characteristics and Baseline Symptoms of OCD

We first evaluated differences in demographic variables and baseline symptoms of OCD and negative affect to help ensure that training groups were comparable following assignment to condition. Chi-square tests revealed that there were no significant group differences in gender ($\chi^2(1)=1.10, p=.30$), or race ($\chi^2(4)=6.02, p=.20$). Additionally, independent-samples t-tests indicated that there were no significant group differences in age ($t_{98}=1.00, p=.32, d=0.20$), baseline symptoms of OCD (OCI-R: $t_{98}=.32, p=.75, d=0.06$), baseline interpretations (III-Importance: $t_{97}=.70, p=.49, d=0.14$), or baseline negative affect (PANAS-Pre; $t_{97}=1.19, p=.24, d=0.24$). (Note, a natural log transformation was computed for the PANAS variables at all time points to help minimize the impact of skew and outliers.)

Effects of Training

To test the effects of training above and beyond the impact of baseline functioning, baseline interpretations (assessed with the III-Importance) were used as a covariate for omnibus analyses evaluating post-training OC beliefs, and baseline negative affect (assessed with the PANAS-Pre) was covaried in tests evaluating the impact of training on subsequent emotional vulnerability. Importantly, unless otherwise noted, analyses were comparable when baseline variables were *not* controlled for.

Effects of Training on OC-Relevant Interpretations

Obsessional Beliefs: In line with expectations, a univariate analysis of covariance (ANCOVA) indicated that there was a significant effect of training group on OC-beliefs (assessed with the OBQ) when controlling for baseline interpretations ($F_{(1,96)}=7.16, p = .$

009, $\eta_p^2 = .07$). Supporting our hypotheses, participants in the Positive, relative to Neutral, training condition were less likely to endorse negative OC beliefs following training.

Recognition ratings: A repeated measures ANCOVA with one between-subjects factor (Condition: Positive versus Neutral training), two within-subjects factors (Interpretation Type: OC versus Foil; and Valence: Positive versus Negative), and one covariate (baseline III-Importance) was conducted. There was a significant main effect for Type ($F_{(1,96)}=323.70, p<.001, \eta_p^2=.77$), with individuals endorsing more OC-relevant (versus Foil) interpretations, and a significant main effect for Valence ($F_{(1,96)}=62.30, p<.001, \eta_p^2=.39$), with participants making more positive (versus negative) interpretations. The main effect of Condition was not significant ($F_{(1,96)}=.001, p=.98, \eta_p^2<.001$), and there was not a significant Type by Condition interaction ($F_{(1,96)}=.65, p=.42, \eta_p^2=.007$). However, there were significant Valence by Condition ($F_{(1,96)}=20.42, p<.001, \eta_p^2=.18$) and Type by Valence ($F_{(1,96)}=25.17, p<.001, \eta_p^2=.21$) interactions, which were subsumed by the expected Valence by Type by Condition ($F_{(1,96)}=15.96, p<.001, \eta_p^2=.14$) interaction.

As expected, follow-up independent samples t-tests revealed that participants in the Positive (relative to Neutral) training condition endorsed more positive and fewer negative OC-relevant interpretations (OC Positive: $t_{98}=3.82, p<.001, d=0.76$; OC Negative: $t_{98}=3.00, p=.003, d=0.60$). There were no significant group differences on the Foil items (Foil Positive: $t_{98}=0.10, p=.92, d=0.02$; Foil Negative: $t_{98}=1.60, p=.11, d=0.32$). These findings support our hypothesis that participants in the Positive (versus Neutral) condition were successfully trained to make healthier interpretations, as indexed by more positive as well as less negative OC-relevant interpretations. Effects were also specific to the content of training (i.e., no significant effects on Foil items).

Test Probes: None of the main effects or interactions evaluating probe latency tied to training condition reached significance (all $p>.10$), suggesting that the Positive (versus Neutral) training condition did not lead to faster responding to the positive probes or slower responding to the negative probes over time. Unfortunately, test probe latency did not appear to be a valid indicator of OC-relevant processing given that there were no significant relationships between the probes administered during the second half of training and a variety of OC-relevant outcome measures (III-Importance, OBQ, OC Positive, OC Negative, Neutralizing Urge, PANAS-Stressor; all $p>.10$ except the relationship between the OBQ and Negative Probes during the second half of the training, which were *negatively* related to one another at $r = -.18, p = .07$).

Direct Effect of Training on Negative Affect Prior to the OC Stressor—As predicted, a univariate ANCOVA revealed that there was not a significant effect of Condition on post-training negative affect (PANAS-Post) when controlling for baseline negative affect ($F_{(1,96)}=.001, p=.98, \eta_p^2<.001$), reinforcing our hypothesis that interpretations (as opposed to affect) were being modified.

Effects of Training on Subsequent Emotional Vulnerability—Only participants who completed the OC stressor (i.e., car accident sentence) were included in the following analyses (three individuals chose not to complete the induction).

Negative Affect: In the direction of hypotheses, a univariate ANCOVA evaluating the effect of Condition on PANAS-Stressor (controlling for baseline affect) indicated a non-significant trend for participants in the Positive (relative to Neutral) condition to report less negative affect tied to the OC stressor ($F_{(1,92)}=3.48, p=.07, \eta_p^2=.04$).

Neutralizing Urge: As predicted, a univariate ANCOVA (controlling for baseline negative affect) to evaluate the impact of Condition on Neutralizing Urge indicated that participants in the Positive (relative to Neutral) condition reported *less* desire to engage in various neutralizing activities ($F_{(1,93)}=4.42, p=.04, \eta_p^2=.05$). The effect of Condition did not reach significance for either PANAS-Stressor or Neutralizing Urge when baseline affect was not taken into account.

Neutralizing Activities: Forty-seven participants chose to perform a neutralizing activity while 50 chose not to perform a neutralizing activity. Contrary to predictions, a chi-square test revealed that there was no significant effect of Condition on the percentage of participants who actually completed a neutralizing activity ($\chi^2=.01, p=.92$; baseline negative affect was not controlled for in this analysis).

Checking for Knowledge of Hypotheses

To evaluate participants' knowledge of hypotheses, responses on the funnel debriefing exit interview were evaluated by three trained, independent raters to determine: a) whether participants were aware that training was designed to influence mood or anxiety, and b) whether participants were aware that training was designed to influence interpretations or thoughts. There were no participants who reported awareness of both aspects of these hypotheses; however, six participants (Neutral: $n=4$; Positive: $n=2$) expressed some knowledge that training was designed to influence mood or anxiety. When we reran our primary analyses excluding these six participants, findings were comparable to our original results. Moreover, when excluding these six participants and controlling for baseline negative affect, the effect of Condition on negative affect following the OC stressor reached significance (PANAS-Stressor: $F_{(1,88)}=4.44, p=.04, \eta_p^2=.05$).

Discussion

As expected, negative OC-relevant interpretations and beliefs were reduced among participants who completed a Positive (versus Neutral) training procedure targeting a variety of obsessional beliefs. Relative to participants in the Neutral condition, participants in the Positive training condition endorsed both healthier OC-relevant interpretations (assessed with Recognition Ratings), as well as fewer negative OC-relevant interpretations and beliefs (assessed with Recognition Ratings and the OBQ). This provides support for the growing body of research indicating that cognitive processing associated with pathological anxiety can be directly altered through CBM procedures. Training effects also appeared to be specific to OC-relevant content; however, the small (albeit non-significant) effect for the Negative Foil items suggests that training may have had a small influence on negative interpretations more generally. Finally, consistent with some past research (Steinman & Teachman, 2010), test probes did not appear to be a valid indicator of training outcomes or OC-relevant responding (although see Teachman & Addison, 2008).

Impact of Training on Subsequent Emotional Vulnerability

Training healthier OC-relevant interpretations led to reductions in some aspects of subsequent emotional vulnerability to an OC stressor. In the direction of the hypotheses, when controlling for baseline negative affect, there was a trend for individuals in the Positive (versus Neutral) condition to report less negative affect associated with the OC stressor. There was also a significant effect for participants in the Positive group to report fewer urges to neutralize. Given the brevity of training (less than one hour), this is promising when one considers how resistant obsessional symptoms can be to traditional interventions that typically last many months (Abramowitz, Foa, & Martin, 2003).

Consistent with prior studies, training did not impact state affect measured immediately following training (e.g., Teachman & Addison, 2008). This finding strengthens our confidence that training was not merely an affect manipulation and that interpretations were being modified. Instead, the impact of the Positive training condition on emotional vulnerability was only evident when participants were confronted with an OC stressor and presumably had occasion to utilize healthier interpretations. We suspect that an individual who made a healthier interpretation tied to the OC stressor (e.g., “I don’t really want my friend to get into a car accident—I just had to write the sentence because the experimenter told me to”) likely felt better than someone who made a self-blaming interpretation (e.g., “Because I wrote that sentence, I must be a terrible person”).

Training did not influence all aspects of emotional vulnerability in that there was no significant group difference in neutralizing behaviors, despite the use of a relatively large sample size compared to past interpretation training studies targeting other mental health difficulties (e.g., social phobia: Beard & Amir, 2008; anxiety sensitivity: Steinman & Teachman, 2010). Given that participants only underwent one brief session of training, it is in some ways unsurprising that actual behavioral changes were not observed among participants who came into the study with high symptoms of OCD. Instead, we believe behavioral change is more likely to occur with increased time and experience making healthier interpretations when confronted with intrusive thoughts. Indeed, past research using only one interpretation training session has often produced mixed findings tied to post-training emotional vulnerability (e.g., Murphy et al., 2007; Steinman & Teachman, 2010; Teachman & Addison, 2008). Meanwhile, Beard and Amir (2008) found clearer effects on emotional vulnerability among socially phobic participants when utilizing eight sessions of interpretation training.

Also, the training paradigm utilized in the current study sought to target a broad array of OC-relevant belief domains (e.g., Tolerance for Uncertainty, Importance of Thoughts, etc.). This decision was based on the fact that OCD is a heterogeneous disorder; thus, we wanted training to cover multiple belief domains that are salient in OCD to address the range of concerns encountered in clinical samples. However, our measures of emotional vulnerability all followed an induction designed to exacerbate TAF, a cognitive bias which most clearly taps the Importance of Thoughts domain. Thus, future permutations of this work may choose to include measures of more than one aspect of emotional vulnerability (e.g., vulnerability tied to controlling one’s thoughts or the need for certainty). Alternatively, to strengthen training effects, it may be helpful to focus on only a few belief domains, depending on a person’s idiographic symptom profile.

Choosing an appropriate Control condition for this type of research will be another important goal for future work. In line with prior work, we chose to use a 50% negative and 50% positive split for the Neutral group (e.g., Beard & Amir, 2008), but it is possible that this type of training may have inadvertently altered interpretations for individuals whose baseline interpretation bias was either higher or lower than 50% negative, so it may have been an active (rather than control) condition for some participants.

Limitations and Conclusions

The current findings must be interpreted in light of several limitations. First, the reliability for the full OCI-R was low and depressive symptoms were not measured; therefore, it is not known how well these findings will generalize to a diagnosed sample of individuals with OCD. However, the nonclinical sample of students in the current study did score at or above the mean score for the OCI-R that was previously reported for a sample diagnosed with OCD (Foa et al., 2002). Second, while the impact of training on interpretation biases was robust, the influence of training on subsequent emotional vulnerability was more modest and

depended in part on controlling for baseline negative affect. We suspect this was because participants in the Neutral, versus Positive, condition had somewhat lower levels of negative affect prior to training (although baseline group differences did not reach significance); thus, this variable was important to consider when evaluating post-training outcomes. Further, we were unable to directly evaluate pre- to post-training changes in obsessional interpretations or beliefs because we used different measures at baseline and post-training. This decision to use different (but highly related) measures was made because of concerns about the effect of repeating the identical measure close in time. Also, random assignment appeared to be effective in that the groups did not have discrepant levels of baseline OC-relevant interpretations based on the III-Importance, suggesting it was reasonable to examine post-training differences and control for baseline interpretations. Finally, in some cases it was challenging to ensure that the training scenarios were consistently modifying the *interpretation* of the intrusive thought, and not the intrusive thought itself. This challenge highlights the complexity of working with cognitive models of OCD, relative to other cognitive models that do not emphasize meta-cognitive beliefs as heavily (e.g., cognitive models of panic and social phobia).

Notwithstanding, this study provides the first evidence to our knowledge that it is possible to use a CBM procedure to modify OC-relevant interpretations, beliefs, and aspects of emotional vulnerability. These findings provide some support for cognitive models which predict that it is the interpretations of intrusive thoughts that lead to obsessional problems. Determining the parameters under which interpretation training influences various symptoms of OCD in both the short- and long-term will be exciting next steps.

Research Highlights

- A nonclinical sample of students high in OC symptoms completed either a Positive ($n=50$) or Neutral ($n=50$) interpretation training procedure designed to alter OC-relevant beliefs.
- As expected, participants in the Positive (versus Neutral) training condition endorsed healthier OC-relevant interpretations following training.
- When controlling for baseline affect, participants in the Positive (versus Neutral) training condition reported less negative affect during the OC stressor task (at the level of a nonsignificant trend) and reported less desire to perform neutralizing activities.

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Table 1

Descriptive statistics (Means and SDs) for pre- and post-training outcomes

	Full Sample		Positive Training		Neutral Training	
	M	SD	M	SD	M	SD
Pre-training measures						
Obsessive Compulsive Inventory – Revised	36.29	7.19	36.06	7.17	36.52	7.28
Interpretations of Intrusions Inventory - Importance	280.92	184.65	268.02	184.11	294.08	186.18
PANAS-Pre (transformed)	2.60	.27	2.63	.28	2.57	.25
Post-training measures						
Obsessional Beliefs Questionnaire – Short Form	164.06	38.26	154.41	41.77	173.71	31.98
Recognition Ratings:						
Positive OC	3.06	.53	3.25	.51	2.87	.49
Negative OC	2.48	.55	2.33	.55	2.64	.50
Positive Foil	1.58	.41	1.59	.42	1.58	.41
Negative Foil	1.26	.30	1.21	.27	1.30	.31
PANAS-Stressor (transformed)	3.19	.38	3.14	.40	3.23	.36
Neutralizing Urge	3.83	1.69	3.57	1.69	4.09	1.66
Neutralizing Activities	Percentage		Percentage		Percentage	
	48.5		47.9		49.0	

Note. For the Neutralizing Activities variable, percentage refers to the percentage of participants who completed a neutralizing activity tied to the OC-stressor task (out of the participants who attempted the task).

Table 2

Training Scenario Examples

Belief Domain	Training Scenario	Positive Conclusion	Maladaptive Conclusion	Comprehension Question
Importance of Thoughts	You and a friend are having a personal discussion. You tell her that you sometimes have bizarre thoughts about hurting people you care about – thoughts you don't really want to have. Your friend tells you this is really...	normal	weird	Does your friend judge you negative for having these thoughts?
Control of Thoughts	You are lying in bed late at night. You've had a busy day, and your mind is racing. If you can't control your thoughts, this is...	acceptable	unacceptable	Is it OK if you can't control your thoughts?
Responsibility	You see a piece of broken glass on the sidewalk. You are in a hurry and don't throw it away. If someone gets hurt from the glass, you are...	blameless	responsible	Are you at fault if someone gets hurt from the glass?
Threat Estimation	You are volunteering at the local hospital. As part of a routine procedure, one of the doctors asks you to transfer several used hypodermic needles. The likelihood of accidentally spreading a disease is...	improbable	probable	Is it likely that you will spread a disease?
Uncertainty	You are taking a challenging exam. On one of the questions, you are 90% certain that you know the correct answer. When you respond, you feel...	confident	anxious	Are you uneasy about your answer?
Perfectionism	You are going to turn in a paper. As you walk, you glance down and realize there is a small typo on the last page of your paper. You believe that you should be...	upset	unconcerned	Should you be troubled about the small typo?

Note. The last word in each scenario, which would follow the ellipsis, was a word fragment that resolved the ambiguity of the scenario to be either consistent (or inconsistent) with a negative OC interpretation. Examples of the resolved word fragments are listed in the Positive and Maladaptive Conclusion columns.