Cognitive Processes in Obsessive-Compulsive Disorder: An Investigation of Evaluation of Thoughts, Intolerance of Uncertainty, and Risk Aversion in Adults With OCD

Citation
Hezel, Dianne Marie. 2017. Cognitive Processes in Obsessive-Compulsive Disorder: An Investigation of Evaluation of Thoughts, Intolerance of Uncertainty, and Risk Aversion in Adults With OCD. Doctoral dissertation, Harvard University, Graduate School of Arts & Sciences.

Permanent link
http://nrs.harvard.edu/urn-3:HUL.InstRepos:42061479

Terms of Use

Share Your Story

The Harvard community has made this article openly available.
Please share how this access benefits you. Submit a story .

Accessibility

Cognitive processes in obsessive-compulsive disorder: An investigation of evaluation of

thoughts, intolerance of uncertainty, and risk aversion in adults with OCD

A dissertation presented

by

Dianne M. Hezel

to

The Department of Psychology

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

Psychology

Harvard University

Cambridge, Massachusetts

March 2017

Dissertation Advisor: Professor Richard J. McNally   Dianne M. Hezel

Cognitive processes in obsessive-compulsive disorder: An investigation of evaluation of

thoughts, intolerance of uncertainty, and risk aversion in adults with OCD

Abstract

Obsessive-compulsive disorder (OCD) is a debilitating illness characterized by repetitive intrusive thoughts and ritualistic behavior. Cognitive models of OCD have underscored the importance of dysfunctional thoughts in the etiology and maintenance of the disorder. Researchers have identified three broad domains of beliefs that figure prominently in the cognitive model, including inflated responsibility and estimation of threat, importance of and need to control thoughts, and perfectionism and intolerance of uncertainty. In this dissertation, I examined specific aspects of these thoughts to clarify their relation to OCD. Three papers are presented.

Paper one demonstrates that people with OCD and those with social anxiety disorder (SAD) evaluate their own thoughts as more significant than they do others' thoughts. Moreover, a heightened belief that one's thoughts increase the likelihood of harm to others distinguished people with OCD from those with SAD and those without anxiety disorders. Paper two indicates that OCD and SAD individuals report heightened negative affect in response to hypothetical scenarios involving even minimal uncertainty. However, whereas socially anxious subjects showed a preference for negative outcomes to uncertainty (even if there was a possibility of a better outcome in the future), those with OCD did not. Neither group demonstrated an intolerance of uncertainty for positive outcomes. Paper three featured a gambling task enabling me to examine affective forecasting ability in people with and without OCD. Obsessive-

compulsive individuals performed similarly to socially anxious and non-anxious individuals, indicating that they are not less accurate in predicting their emotional response to positive and negative events. Moreover, discrepancies between predicted and experienced affect were not associated with how subjects rated the riskiness of different behaviors.

Taken together, these findings are consistent with the theory that people with OCD are more prone to dysfunctional thinking than are non-anxious individuals. However, these studies also revealed that people with clinically significant social anxiety disorder possess similarly elevated levels of biased thinking. Moreover, this dissertation clarifies aspects of dysfunctional thinking (e.g., the specificity of the Thought-Action Fusion bias) that may have important treatment implications. These findings call into the question whether the cognitive model can adequately explain how dysfunctional thoughts are uniquely related to OCD. These dysfunctional thought patterns are insufficient to produce OCD if people with SAD alone exhibit them as well. Hence, this dissertation underscore the importance of examining transdiagnostic factors that contribute to the development of OCD and anxiety disorders and of identifying shared areas of intervention for them.

Table of Contents

you do for me more than you know. And to my family and friends, too numerous to name – there is no doubt that I would never have gotten to where I am today without you.

And finally, many thanks to Dr. Bradley Riemann, without whose collaboration I would still be collecting data, and to the many patients and research subjects who inspired this work, volunteered their time, and shared their stories to make this research possible.

Background and Introduction[1]

Obsessive-compulsive disorder (OCD) is characterized by repetitive intrusive thoughts (obsessions) and rituals (compulsions) that are performed to reduce anxiety or distress (American Psychiatric Association, 2013). The content of the obsessions and related compulsions is frequently illogical; for example, one patient in a treatment center avoided driving past roadkill for fear that he would contract rabies. Another patient feared that saying the word "death" increased the probability that she would die in the near future. Although these patients, and many others who suffer from OCD, understand that their fears and behavior are irrational, they continue to engage in rituals and avoidance to prevent the feared outcome. Though OCD ranges in severity from person to person, the disorder has been ranked as one of the most disabling conditions in the world (Murray & Lopez, 1996).

Characterized broadly by obsessions and compulsions, OCD is nonetheless a very heterogeneous disorder. Researchers have outlined four major symptom dimensions, or subtypes, of OCD, including (1) contamination obsessions and cleaning compulsions, (2) responsibility for harm obsessions and checking compulsions, (3) symmetry/incompleteness obsessions and ordering/arranging/repeating compulsions, and (4) aggressive/sexual/religious obsessions (e.g., "unacceptable thoughts") and mental/checking compulsions (Abramowitz et al., 2010). Research indicates that different subtypes are associated with different treatment outcomes (Mataix-Cols, Rauch, Manzo, Jenike, & Baer, 1999) and thus may be relevant to understanding the mechanisms mediating the disorder.

---

[1]Parts of the introduction and general discussion are adapted from Hezel, D.M. & McNally, R.J. (2016). A theoretical review of cognitive biases and deficits in obsessive-compulsive disorder. *Biological Psychology*, *21*, 221-232.

The Cognitive Model of OCD

An influential framework for understanding the etiology of OCD was inspired by Mowrer's (1939) two-factor theory of fear and avoidance. He asserted that through classical conditioning, people associate stimuli with aversive or painful experiences, which in turn, results in anticipatory anxiety when people subsequently encounter these stimuli. Subsequent avoidance of the feared objects and situations assuages people's anxiety, which in turn reinforces their avoidant behavior through operant conditioning. Similarly, people with OCD perform compulsions in an effort to reduce anxiety triggered by obsessive thoughts, thereby reinforcing their fear. Despite their value in elucidating why a person might engage in ritualistic or avoidant behavior, conditioning models fail to explain why obsessive thoughts develop in the first place (Taylor, 2002).

Building on Mowrer's work, Salkovskis (1985) developed a cognitive-behavioral model of OCD that illustrates how obsessions may begin. He theorized that people develop the disorder when they misconstrue the meaning and importance of normal, distressing intrusive thoughts. Research indicates that the majority of people without OCD will experience intrusive thoughts that are similar in content to those that do have the disorder; yet prevalence rates of OCD are only 1-2% of the population (Karno, Golding, Sorenson, & Burnam, 1988; Kessler et al., 2005). Salkovskis's work indicates that whereas healthy individuals can dismiss the intrusions as meaningless, people who develop OCD misinterpret the significance and consequences of these thoughts, thus motivating them to engage in compulsions. Central to Salkovskis's model is the role of inflated responsibility in people with OCD. Specifically, he stated that obsessive-compulsive individuals feel responsible for preventing harm to themselves or others (Salkovskis, 1985; Shafran, 2005). Consequently, not only are these people more likely to interpret normal

intrusive thoughts as indicative of harm or danger, but also they are likely take measures to prevent negative consequences, often by engaging in rituals. According to this model, a woman without OCD who has an intrusive thought of accidentally starting a fire is likely to dismiss the thought as meaningless. However, a woman at risk for developing OCD would interpret the same thought as a premonition of danger and a true threat to one's own or others' safety. In an attempt to prevent harm, she would then perform compulsions (e.g., checking the stove or electrical outlets, repeating a lucky phrase, checking the news for any report of fires, etc.) that would temporarily decrease her anxiety. According to Salkovskis's cognitive model, this decrease in anxiety not only reinforces the woman's ritualistic behavior, but also deprives her of the opportunity to learn that her thought is insignificant and that her distress would naturally decline even without engaging in compulsions (Salkovskis, 1985; Taylor, 2002). Indeed, attempts to suppress the obsessive thoughts may paradoxically increase their frequency, further reinforcing the woman's belief that she is a threat to others' safety.

Rachman (1997) subsequently expanded upon Salkovskis's work by identifying the role of biases other than inflated responsibility in the cognitive conceptualization of OCD. He asserted that "catastrophic misinterpretation[s]" (p. 794) of thoughts cause people with the disorder to construe them as meaningful, significant, and threatening. Rachman (1997) outlined a number of cognitive misappraisals in addition to inflated responsibility, including the importance of and need to control thoughts. Since its inception, this model of OCD has garnered a great deal of support from studies that have examined different cognitive factors that may figure in the etiology and maintenance of the disorder.

Dysfunctional Beliefs

Since the introduction of Salkovskis's and Rachman's model, myriad studies have

provided support for the cognitive conceptualization of OCD. Indeed, researchers identified a

number of biased thoughts that people with the disorder typically demonstrate. In an effort to

devise better measures to detect dysfunctional thoughts that are specific to OCD, the Obsessive-

compulsive Cognitions Working Group (OCCWG) was established. The group subsequently

published a series of papers in which they outlined three domains of thoughts that are theorized

to be central to the development and the maintenance of the disorder, including (1)

overestimation of threat and inflated responsibility, (2) importance of and need to control

thoughts, and (3) perfectionism and intolerance of uncertainty (OCCWG, 1997, 2001, 2003,

2005).

Inflated responsibility & overestimation of threat

Given its prominence in Salkovskis's (1985) original cognitive model, inflated

responsibility has been researched a great deal in the context of OCD. Defined as the belief that

one is accountable for preventing harm to oneself or others, inflated responsibility has been

associated with OCD symptoms in clinical populations and unselected samples (Salkovskis et al.,

2000). For example, Lopatka and Rachman (1995) observed different outcomes based on

whether people with OCD were assigned to a low responsibility (the experimenter takes

accountability for the results of a series of behavioral approach tests) or high responsibility

condition (the liability is placed solely on the subjects). Specifically, those in the low

responsibility group experienced reductions in distress and urges to ritualize, whereas the same

people experienced the opposite outcome when they were placed in a high responsibility

condition, though the latter failed to reach statistical significance. Likewise, Ladouceur et al.

(1995) found that non-clinical subjects experienced an increase in anxiety and engaged in more checking behaviors after being placed in a high responsibility condition. Another study revealed that four patients with OCD demonstrated a decrease in OCD symptoms after undergoing 32 sessions of cognitive therapy that specifically addressed dysfunctional beliefs about inflated responsibility, but not other thoughts (Ladouceur, Leger, Rheaume, & Dube, 1996). Finally, researchers have theorized how inflated responsibility develops in individuals, and have posited that expectations and environmental factors in childhood (e.g., rigid rules of conduct, etc.) might result in the manifestation of cognitive misappraisals (Salkovskis, Shafran, Rachman, & Freeston, 1999). Though there is some support for these developmental pathways (Careau, O'Connor, Turgeon, & Freeston, 2012; Coles, Schofield, & Nota, 2014; Smari, Martinsson, & Einarsson, 2010), other studies have found only modest support for them (Coles et al., 2014). Therefore, more research is warranted for a better understanding of how this belief might develop in individuals.

Overestimation of threat, like inflated responsibility, is related to dysfunctional thoughts about harm to oneself and others. Conceptualized as an exaggerated appraisal of the likelihood of danger in general as well as one's personal vulnerability to danger, overestimation of threat includes an over-approximation of the costs of adverse experiences (Moritz & Pohl, 2009; OCCWG, 1997). That is, people are thought to overestimate the severity of harm in a given situation (Foa & Kozak, 1986; OCCWG, 1997). Some researchers have proposed that this bias includes overestimation of personal vulnerability to harm from external events such as accidents, but also to internal experiences, such as negative emotions, especially in situations that include change or unpredictability (Sookman & Pinard, 1999). It follows, then, that relative to healthy individuals, people with OCD would also demonstrate increased avoidance of potentially

threatening situations. However, avoidance, like compulsions, only serve to reinforce maladaptive thoughts and behavior, thus maintaining a cycle of obsessions and compulsions (Moritz & Pohl, 2009).

Over-importance of and need to control thoughts

In their early cognitive models of OCD, Salkovskis (1985) and Rachman (1993) observed that people with OCD often believe that their thoughts and actions are entangled. Indeed, many individuals with the disorder think that simply having a thought reveals something about their personal desires or true nature (OCCWG, 1997). For example, a thought about pushing someone into oncoming traffic represents the person's wish to commit murder or his reprehensible character. This bias includes a specific misappraisal called thought-action fusion (TAF), which refers to (1) a belief that thinking about doing something bad is equally as immoral as actually doing it, and (2) the belief that thinking about an aversive event makes it more probable (Rachman, 1993; Rachman & Shafran, 1999; Shafran, Thordarson, & Rachman, 1996). Interestingly, some researchers have found that beliefs about the over-importance of thoughts are related to other cognitive biases. For example, Rachman (1993) hypothesized that TAF may develop when misappraisals of thoughts interact with inflated responsibility, and in a subsequent study, Rachman, Thordarson, Shafran, and Woody (1995) found that TAF emerged as one of four factors of responsibility. Though presumably distinct from inflated responsibility, TAF may provoke unrealistic thoughts about the need to prevent negative outcomes and vice versa (Shafran & Rachman, 2004).

Related to the belief that thoughts are especially meaningful or significant is the belief that one should control them (OCCWG, 1997). Indeed, if someone believes that his thoughts can negatively impact himself or others, then he may be more inclined to try to resist such thoughts

to prevent negative consequences (Rachman & Hodgson, 1980). Supporting this notion, the OCCWG (2001) found that people with OCD score higher on thought control measures compared to people without the disorder (Purdon & Clark, 2002). Moreover, people who attempt to control their thoughts with rituals or thought control techniques, such as worry or thought suppression, are likely to experience a subsequent increase in future intrusive thoughts (Purdon & Clark, 2002).

Perfectionism and intolerance of uncertainty

Conceptualized as the maladaptive belief that one must meet exceptionally high standards, perfectionism includes excessive concern about making mistakes, seen as shortcomings to be avoided (Frost, Novara, & Rheaume, 2002). Though associated with OCD symptoms in non-clinical and clinical populations (Frost, Steketee, Cohn, & Griess, 1994; Rheaume, Ladouceur, & Freeston, 2000), perfectionism appears especially prominent in individuals with checking and "just right" compulsions (Coles, Frost, Heimberg, & Rheaume, 2003; Moretz & McKay, 2009). Frost et al. (2002) assert that obsessive-compulsive individuals may strive for perfection to control their environment, thereby preventing negative outcomes and unpleasant states, such as uncertainty. As with the need to control thoughts, perfectionism may interact with other beliefs to contribute to the onset and maintenance of OCD. For example, Bouchard, Rheaume, and Ladouceur (1999) found that perfectionism may cause people to feel heightened responsibility for preventing harm to oneself or others. Hence, examining the relationship between and the interaction of dysfunctional beliefs with one another and their impact on OCD is an important avenue of future study.

Lastly, intolerance of uncertainty (IU) signifies distress in response to ambiguous or unpredictable situations (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; OCCWG,

1997; Sarawgi, Oglesby, & Cougle, 2013). More specifically, people who possess this bias believe that uncertainty is undesirable and should be avoided (Buhr & Dugas, 2009). Several studies have highlighted the association between intolerance of uncertainty and heightened worry, even after controlling for other factors such as anxiety sensitivity (Buhr & Dugas, 2009; Dugas, Gosselin, & Ladouceur, 2001; Ladouceur, Gosselin, & Dugas, 2000). IU may be a transdiagnostic factor in OCD and other anxiety disorders, and decrements in IU correlate with decreases in anxiety symptoms following treatment (Boswell et al., 2013). In the context of OCD, IU may motivate people to ritualize to resolve their uncertainty associated with distressing intrusive thoughts (Tolin et al., 2001).

Dysfunctional Beliefs and OCD

Given the centrality of biased thinking to the cognitive model of OCD, many researchers have examined the relationship between dysfunctional thoughts and symptoms of the disorder. In a study using self-report measures, Steketee, Frost, and Cohen (1998) found that relative to healthy people and those with anxiety disorders, individuals with OCD reported elevated levels of dysfunctional thinking. Though subjects with anxiety disorders also endorsed some dysfunctional beliefs, the relationship between these thoughts (specifically, elevated responsibility, threat estimation, intolerance of uncertainty, and need to control thoughts) was more strongly associated with OCD than with anxiety symptoms. Likewise, another study found a similar relationship between OCD symptoms and biased thinking in a non-clinical college sample. Abramowitz, Lackey, and Wheaton (2009) observed that subjects with elevated OCD symptoms (as measured by the Obsessive-Compulsive Inventory), had higher levels of dysfunctional thinking than did people with fewer OCD symptoms. Moreover, these thoughts not only predicted obsessive thinking and ritualistic behavior after controlling for other factors in

this unselected sample, but also predicted variance in OCD symptoms and severity of compulsions in a clinical sample of OCD patients (Taylor, McKay, & Abramowitz, 2005).

Other research has examined the relationship between specific OCD symptoms and biased thinking to test whether certain beliefs are more closely related to certain subtypes of the disorder than to others. For example, one study demonstrated that dysfunctional beliefs in a non-clinical sample predicted OCD symptoms in general, but that different thoughts predicted specific symptoms (Taylor et al., 2010). That is, overestimation of threat and inflated responsibility predicted ordering, checking, neutralizing, obsessing, hoarding (previously classified as an OCD symptom), and washing symptoms; a need for perfectionism and intolerance of uncertainty predicted ordering rituals; and belief in the significance of and need to control thoughts predicted obsessive thoughts and washing and neutralizing behaviors. Therefore, dysfunctional thinking may be more strongly associated with some subtypes of the disorder than they are with others (Abramowitz, Lackey, et al., 2009; Taylor et al., 2010; Tolin, Woods, & Abramowitz, 2003). Given the heterogeneity of OCD and the broad range of symptoms an individual with the disorder may experience, further examination of the unique relationships between beliefs and symptoms is merited.

Finally, rather than relying on cross-sectional data, some studies have tested whether dysfunctional beliefs prospectively predict the development of OCD symptoms. Research has shown that first-time parents may be especially vulnerable to developing OCD symptoms, especially intrusive thoughts related to harming their child; therefore, pregnancy and birth may present a unique opportunity to examine the development of OCD symptoms. Indeed, one study evaluated 100 parents three months prior to and three months after the birth of their first baby (Abramowitz, Khandker, Nelson, Deacon, & Rygwall, 2006). Findings indicated that levels of

dysfunctional thinking prior to the child's birth predicted the severity of post-partum OCD symptoms (e.g., obsessing, checking, and washing) even after accounting for other factors such as anxiety, depression, and baseline obsessive-compulsive symptoms. A separate prospective study on a non-clinical sample similarly showed that maladaptive thinking was predictive of obsessive-compulsive symptom severity six weeks later, and that specific thoughts (e.g. inflated responsibility) were more strongly associated with future symptoms than others (Coles & Horng, 2006). However, a subsequent study failed to replicate these findings in a six-month prospective study of a non-clinical sample (Coles, Pietrefesa, Schoefield, & Cook, 2008). The authors found that biased thoughts predicted distress associated with obsessive-compulsive symptoms, but not their frequency. Therefore, more research on the causal relationship between thoughts and symptoms is warranted.

Though the etiology of dysfunctional thinking is still unknown, research demonstrates that modifying these beliefs can affect subsequent thoughts and behavior. For example, cognitive therapy is a validated treatment for OCD (Wilhelm et al., 2009), and decreases in dysfunctional beliefs following cognitive therapy mediate reduction in OCD symptoms (Wilhelm, Berman, Keshaviah, Schwartz, & Steketee, 2015). Nevertheless, some reports have questioned the causal direction of diminished beliefs and symptom improvement (Woody, Whittal, & McLean, 2011), and others have found that cognitive therapy is less effective than behavioral therapy at reducing OCD symptoms (Olatunji et al., 2013). Hence, a better understanding of these thoughts, their development, and how they relate to specific OCD symptoms may result in even more effective and targeted treatments for the disorder.

Research Questions

Although a number of studies have investigated cognitive factors within the three broad domains outlined above, there are aspects of each that have yet to be studied in OCD. The goal of the studies described below is to clarify specific aspects of dysfunctional thinking within these three domains, thus lending insight into the nature of these thoughts. We conducted studies that examined the specificity of evaluation of one's own and others' thoughts, intolerance of uncertainty and standard of proof, and risk aversion and affective forecasting in adults with OCD. A better understanding of the cognitive biases that people with OCD possess can potentially help us to better identify not only the etiology of the disorder and the relationship among thoughts and specific symptoms, but also to devise more effective treatments for it. Specifically, I present three papers to address the following questions:

Question 1. Are people's beliefs about importance of and need to control thoughts (i.e., thought-action fusion beliefs) universal or specific to oneself? That is, do people with the disorder evaluate all thoughts as significant and potentially harmful, or only their own thoughts as such?

Paper 1. Hezel, D.M., Stewart, S.E., Riemann, B.C., McNally, R.J. (under review). Clarifying the thought-action fusion bias in obsessive-compulsive disorder.

Paper one uses self-report and behavioral tasks to examine whether, relative to socially anxious and non-anxious individuals, people with OCD evaluate others' thoughts the same way as they evaluate their own thoughts.

Question 2. Do people with OCD require a higher "standard of proof" to resolve uncertainty than do people without OCD? Do people with the disorder prefer negative outcomes

to uncertainty, even if a better outcome is possible? Are people with OCD also intolerant of uncertainty associated with positive information?

Paper 2. Hezel, D.M., Stewart, S.E., Riemann, B.C., McNally, R.J. (under review). Standard of proof and intolerance of uncertainty in obsessive-compulsive disorder and social anxiety disorder.

We created a questionnaire to measure people's emotional reaction to different scenarios involving minimal uncertainty, to examine whether they choose negative outcomes to uncertainty, and to determine whether people with OCD are intolerant of uncertainty in general or if their intolerance is limited to potentially negative outcomes. We also examined whether obsessive-compulsive subjects requested more information before making a decision in a probabilistic reasoning task than did socially anxious and non-anxious individuals.

Question 3. Are people with OCD less accurate than non-anxious individuals in predicting their affective response to positive and negative events? Is the accuracy or inaccuracy of affective forecasting associated with estimation of risk?

*Paper 3. H*ezel, D.M., Riemann, B.C., McNally, R.J. (under review). Affective forecasting accuracy in obsessive-compulsive disorder.

Paper three used a gambling task to determine whether, compared to non-anxious and socially anxious subjects, those with OCD were especially inaccurate at predicting their emotional response to winning and losing money. We compared predictions to actual affect both immediately and ten minutes following a coin toss. We also tested whether discrepancies in forecasted versus actual affect was correlated with how risky subjects rated a number of different behaviors across several domains.

Paper 1: Clarifying the Thought-Action Fusion Bias in Obsessive-Compulsive Disorder

Dianne M. Hezel, S. Evelyn Stewart, Bradley C. Riemann, Richard J. McNally

Abstract

Studies indicate high levels of thought-action fusion (TAF) in OCD. The current study aimed to determine if people with OCD evaluate others' thoughts the same way as their own, as existing measures do not test for this distinction. Forty-two non-anxious, 40 OCD, and 41 socially anxious subjects completed self-report and behavioral measures of thought-action fusion. Findings indicated that self-report measures of TAF, but not behavioral ones, indicate that people with SAD as well as those with OCD evaluate their own thoughts as more significant/dangerous than they do others' thoughts. Moreover, although the SAD and OCD groups had similarly elevated scores on the total self-report TAF Scale, analyses of subscales indicated that relative to the other groups, OCD subjects had higher scores on the likelihood subscales of the measure. These results were partially supported by the behavioral measure of TAF as well. These findings have important implications for our understanding of the TAF bias in both OCD and other disorders.

13

Introduction

Early cognitive models of obsessive-compulsive disorder (OCD) posited that distorted

evaluation of one's thoughts contributes to both the onset and the maintenance of the disorder.

Specifically, Salkovskis (1985) and Rachman (1993) observed that patients with OCD seem to

overemphasize the dangerousness of their thoughts and the subsequent need to control them.

Whereas most people dismiss the occasional intrusive thought as inconsequential, individuals

with OCD tend to believe that such thoughts have significant moral and practical implications.

This cognitive distortion, known as thought-action fusion (TAF), denotes the belief that merely

thinking about doing something bad (e.g., killing someone) is just as immoral as doing it ("moral

TAF") or the belief that thinking about a negative outcome makes it more likely to happen

("likelihood TAF"; Rachman, 1993; Shafran, Thordarson, & Rachman, 1996; Rachman &

Shafran, 1999). Measures of TAF have consistently shown that this bias is present in individuals

with the disorder (Hezel & McNally, 2016; Shafran & Rachman, 2004; Shafran et al., 1996).

Accordingly, TAF has featured prominently not only in the cognitive model of OCD, but also in

the metacognitive model of the disorder. The latter holds that dysfunctional appraisals of one's

thoughts (e.g., "thoughts are dangerous" or "thoughts must be controlled") contribute to the

repetitive nature of obsessions, the development of compulsions, and other dysfunctional

thinking commonly associated with OCD (Fisher, 2009; Myers, Fisher, & Wells, 2009). Indeed,

research suggests that TAF may influence the development of other cognitive biases, such as

inflated responsibility for preventing harm (Amir, Freshman, Ramsey, Neary, & Brigidi, 2001).

The Thought-Action Fusion Scale (TAF Scale; Shafran et al., 1996) is one of the most

widely used self-report measures of the TAF bias (Berle & Starcevic, 2005). The scale consists

of three groups of questions that assess subjects' beliefs about the moral implications of certain

thoughts (TAF moral) and how likely thoughts are to influence the occurrence of negative events for others (TAF likelihood-other) and oneself (TAF likelihood-self). Studies using the TAF Scale suggest that the total score and each of the three subscales are correlated with the presence and severity of OCD symptoms as assessed by several measures, with the strongest association between OCD symptoms and the likelihood component of TAF (Berle & Starcevic, 2005; Shafran & Rachman, 2004). Interestingly, TAF seems to extend to positive outcomes, such that people with elevated OCD symptoms are also more likely than others to believe that their thoughts can *prevent* harm from befalling other people (Amir et al., 2001).

Several researchers have used behavioral paradigms to induce the TAF bias in non-clinical samples. Rachman, Shafran, Mitchell, Trant, and Teachman (1996) developed a task where subjects first write a sentence about wishing that harm befall a loved one (e.g., "I hope my sister is in a car accident today"). Subjects then rate their anxiety and urge to neutralize the thought, the immorality of writing the sentence, and the likelihood of the event occurring. Subsequent studies confirm that this task causes people to experience increased anxiety and an urge to neutralize (Berman, Abramowitz, Wheaton, Pardue, & Fabricant, 2011; Marcks & Woods, 2007; Rassin, 2001; van den Hout, van Pol, & Peters, 2001). Berman et al. (2011) showed that performance on this task correlates with scores on the TAF Scale and thus may qualify as a behavioral assessment of TAF. Indeed, researchers have used sentence paradigm TAF induction to investigate the association of different responses (e.g., neutralizing, thought suppression, and acceptance) following distressing thoughts with obsessive-compulsive experiences, such as anxiety, urge to neutralize, and negative thoughts (Marcks & Woods, 2007; van den Hout et al., 2001).

One study using a different TAF induction approach demonstrates how this cognitive bias may contribute to OCD pathology. Rassin, Merckelbach, Muris, and Spaan (1999) explained to subjects that an EEG machine could accurately detect their thoughts of certain words. Half of the sample was told that every time they thought of the word "apple," a person in another room would receive a non-life threatening, but painful shock. This group was also told that in the event that they did think about an apple, they could prevent the shock by pressing a button within a couple of seconds of having the thought. The other half of the sample was simply instructed not to think of an apple. Results indicated that relative to those in the latter condition, subjects who believed their thoughts would cause others harm experienced more unwanted thoughts of the word apple, felt more distress, and made a greater effort to avoid thinking about the object. These individuals also reported feeling responsible for and guilt about others' receiving shocks; in fact, they attempted to prevent the shock from occurring approximately 50% of the time after thinking of the word apple. This study provides a model for how activating TAF beliefs can lead to intrusive thoughts and ritualized behaviors akin to those reported in people with OCD.

Further evidence for the role of TAF in the pathology of OCD comes from a study in which patients' scores on the TAF Scale decreased as OCD symptoms improved pre- to post-treatment (Rassin, Diepstraten, Merckelbach, & Muris, 2001). Interestingly, the authors found that individuals with anxiety disorders (i.e., panic disorder, social anxiety disorder, and PTSD) had similarly elevated scores on the TAF Scale at both pre- and post-treatment, suggesting that the bias is not specific to OCD. A number of other studies have likewise indicated the presence of heightened TAF in a range of other disorders, such as generalized anxiety disorder, eating disorders, and depression (Berle & Starcevic, 2005; Shafran & Rachman, 2004; Thompson-Hollands, Farchione, & Barlow, 2013). After examining TAF in people with anxiety disorders,

OCD, and depression, Abramowitz, Whiteside, Lynam, and Kalsy (2003) found that elevated

TAF may be more strongly related to negative affect (anxiety and depression) than to specific

OCD symptoms.

The present study aimed to clarify the specific nature of thought-action fusion.

Specifically, we investigated whether people with OCD evaluate other people's thoughts in the

same way as they evaluate their own thoughts, given that existing measures of TAF do not test

for this distinction. Determining the specificity or generalizability of the TAF bias may be useful

in conceptualizing and treating a range of psychopathology. Specifically, this distinction may

reveal if subjects' TAF bias reflects underlying distorted beliefs about themselves (e.g., "I am

unique, only my thoughts are dangerous") or thoughts in general (e.g., "everyone's thoughts

have the potential to do harm"). Accordingly, we revised the Thought-Action Fusion Scale to

include both indirect and direct evaluations of one's own versus others' thoughts. Additionally,

subjects completed the Obsessive-Compulsive Beliefs Questionnaire, which yields a subscale

score related to the TAF bias (i.e., "Importance of and Need to Control Thoughts"), and the

sentence task described above (Rachman et al., 1996; van den Hout, Kindt, Weiland, & Peters,

2002; van den Hout et al., 2001). We hypothesized that individuals with OCD would evaluate

their own thoughts as more immoral and potentially dangerous than others' thoughts. We

predicted that non-anxious subjects would not show this same bias.

Methods

Subjects

Subjects included 123 adults (63 female, 51%) with a mean age of 31.6 years ($SD = 13.8$)

and with no history of psychosis. After completing a phone prescreening and in-person clinical

interview, individuals were categorized into one of three groups: those who meet diagnostic criteria for OCD (with or without anxiety disorders), those who meet criteria for social anxiety disorder (SAD) but not OCD, and those with no history of OCD or anxiety disorders. The OCD group comprised 41 subjects (26 female, 63%) with a mean age of 26.1 years ($SD = 8.4$), the SAD group comprised 40 subjects (22 female, 55% and one transgender woman) with a mean age of 31.0 years ($SD = 13.8$), and the non-anxious comparison group comprised 42 subjects (15 female, 36%) with a mean age of 37.6 years ($SD = 16.1$). Individuals were recruited via an online posting on a study pool website, which includes students at a local university as well as community members who live in the greater Boston area. In addition, ads were posted on other local university job boards, at the university health center, and in public notice areas in the community. Subjects with OCD were also recruited from a research study pool at a Boston OCD outpatient clinic, and 17 subjects were recruited from the intensive outpatient, partial hospitalization, and Rogers Memorial Hospital intensive residential treatment programs in Oconomowoc, Wisconsin. All subjects received either study pool credit or compensation of $10/hour for their participation.

Materials and Procedures

After completing a phone prescreening, all eligible subjects came into the lab to complete the study. Subjects recruited from Rogers Memorial Hospital were tested on site in a private room at the hospital. The first author conducted a semi-structured clinical interview with the MINI International Neuropsychiatric Interview (Sheehan et al., 1998) and confirmed diagnoses of OCD and SAD with the relevant subscales of the Structured Interview for DSM-5 (First, Williams, & Spitzer, 2015). As part of a larger study, all subjects completed a number of measures that broadly examine different aspects of dysfunctional thinking commonly associated

with OCD. For the current study, we analyzed data from the following measures. Study participation took approximately one and a half to two hours.

The Yale-Brown Obsessive-Compulsive Scale (YBOCS) and symptom checklist (Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) assesses OCD severity, and was thus only administered to subjects with OCD. The scale is a clinician-rated, 10-item scale, with each item rated from 0 (no symptoms) to 4 (extreme symptoms). The scale includes five questions about the amount of time the patients spend on obsessions, how much impairment or distress they experience, and how much resistance and control they have over these thoughts. Five similar questions are asked about compulsions (i.e., time spent, interference, etc.). Scores range from zero to 40, with higher scores indicating more severe OCD symptoms. Used widely in both clinical and research settings, the YBOCS has been shown to have good psychometric properties (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). The OC Checklist asks patients to specify the content of their obsessions and compulsions (e.g. contamination, aggressive thoughts, etc.). In addition, we asked subjects to identify their most distressing obsession and most time-consuming compulsion.

The Obsessional Beliefs Questionnaire, or OBQ-44 (OCCWG, 2001, 2003, 2005), is a self-report measure that assesses dysfunctional beliefs associated with OCD, including heightened responsibility and threat estimation, perfectionism and intolerance of uncertainty, and importance of and need to control thoughts. Individuals are asked to indicate on a seven-point Likert Scale the degree to which they agree or disagree with statements like, "I often think things around me are unsafe" or "If I'm not absolutely sure of something, I'm bound to make a mistake." Prior studies indicate that the OBQ-44 reliably and validly measures dysfunctional

thinking in non-clinical and clinical samples (OCCWG, 2005). Internal consistency in this study was excellent for the total scale (α = .97) and each of the subscales (all (αs $\geq$ .91).

The Liebowitz Social Anxiety Scale-Self Report (LSAS) assesses a person's fear and avoidance of 24 different situations (e.g., going to a party, working while being observed, etc.) to identify the presence and severity of social anxiety disorder (Liebowitz, 1987). The LSAS has strong internal consistency and convergent and divergent validity (Fresco et al., 2001). A score of 30 (out of a possible score of zero to 144) is the suggested clinical cutoff for SAD and 60 is the suggested clinical cutoff for generalized social anxiety (Mennin et al., 2002; Rytwinski et al., 2009). All subjects in the present study completed the LSAS, which had very strong internal consistency of α = .98.

The Center for Epidemiologic Studies Depression Scale, Revised (Eaton, Smith, Ybarra, Muntaner, & Tien, 2004) is a 20-item scale that measures depressive symptoms, including mood, motor functioning, interactions with others, and somatic symptoms (Eaton et al., 2004). Scores range from zero to 60, with higher scores indicating more severe depression. A score of 16 has been identified as a clinical cutoff for depression. The CESD has high internal consistency, acceptable test-retest reliability, and good discriminant and convergent validity (Radloff, 1977). The internal consistency in our sample was excellent at α = .95.

In order to determine how people with OCD self-reportedly evaluate their own and others' thoughts, we created three blocks of questions which ask subjects to rate the degree to which they agree or disagree with statements about the importance and implications of different thoughts. All items were based on those of the Revised TAF Scale. All responses were recorded on a Likert scale of one to four instead of the original measure's scale of zero to four ("neutral" was omitted as a response option from the latter due to experimenter error). In block one, some

items were taken directly from the TAF Scale, whereas others were reworded slightly to specify

that the question is asking about one's *own* thoughts, not thoughts in general. For example, the

statement "Thinking of making an extremely critical remark to a friend is almost as unacceptable

to me as actually saying it" was changed to "*When I think of* making an extremely critical remark

to a friend, it is almost as unacceptable to me as actually saying it" (italics indicate text that was

added to the original item). Block two consists of the same statements reworded to indicate

another person's thoughts (e.g., "When my friend thinks of making an extremely critical remark

to someone, it is almost as unacceptable as his actually saying it."). Block three requires that the

subject make a direct comparison between his/her own thoughts and those of others (e.g., "When

I think of making an extremely critical remark to a friend, it is less acceptable than if my friend

thinks of making an extremely critical remark to his friend."). Subjects were asked to rate each

item on a scale of one ("strongly disagree") to four ("strongly agree"). High scores indicate

greater emphasis on one's own thoughts. In the current sample, all three blocks of measure had

excellent internal reliability (all αs $\geq$ .94).

Subjects were then asked to complete the TAF sentence paradigm described above

(Berman et al., 2011; Rachman et al., 1996; Shafran et al., 1996). As was done in prior studies,

subjects were asked to think of a close living relative other than a spouse or romantic partner.

After telling the experimenter the name of the person they were imagining, subjects were asked

to write the following sentence on a blank index card, inserting the loved one's name where the

blank appears: "I hope ____ is in a car accident today." This sentence tests the belief that one's

negative thoughts make it more likely that harm will befall others (i.e., TAF-likelihood other).

Subjects were then asked to close their eyes and imagine the situation for 30 seconds before

using visual analogue scales (from 1-100) to answer the following questions (Rachman et al., 1996):

> (1) How much anxiety do you feel right now? (2) What is the likelihood of the event occurring in the next 24 hours? (3) How morally wrong was it to write out the sentence? (4) How strong is your urge to reduce or cancel the effects of writing the sentence? (p. 891).

The above procedure was repeated with two additional sentences, including "I hope I have sex with [family member's name]" and "I hope I fall down the stairs today." (Berman et al., 2011). The first sentence tests the belief that thinking about something is just as immoral as doing it (i.e., TAF moral) whereas the second sentence tests whether people believe their own thoughts have negative consequences for themselves (i.e., TAF likelihood-self). In the present study, subjects were randomly assigned to one of two groups to examine if ratings differed based on who wrote the sentence. The first group was asked to complete the three TAF sentence paradigms as described above. The second group did not write the sentence themselves, but after providing the name of a loved one, watched while the experimenter wrote the sentences down on a blank index card. Both groups were then asked to visualize the scenario and answer the same questions as listed above (ratings of anxiety, likelihood of event occurring, moral wrongness, and urge to neutralize). After providing their ratings, all subjects were given the opportunity to do anything they would like to the index card in order to "neutralize the thought or make the thought go away." We recorded if a person did do something to the card, including flipping it over, tearing it up, writing other words or phrases on the card, etc.

Results

Preliminary Analyses

The OCD group had a mean YBOCS score of 21.00 ($SD = 5.45$), which indicates moderately severe OCD symptoms (Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). Relative to non-anxious comparison subjects, those with OCD and SAD had higher levels of social anxiety, depression, and obsessive thinking (as measured by the OBQ-44); however, OCD and SAD subjects' scores did not differ on any of these measures (Table 1). The mean age of OCD subjects was significantly lower than that of the non-anxious group ($p < .001$), but did not differ from the mean age of the SAD group ($p = .29$); there was a trend toward a significant age difference between non-anxious and SAD subjects ($p = .08$). Twenty-four individuals in the OCD group also met diagnostic criteria for social anxiety disorder, and both the OCD and SAD groups had average LSAS scores above 60, which indicate clinical severity of generalized social anxiety (Rytwinski et al., 2009). Thirty-six of the 41 OCD subjects, 34 of the 40 SAD subjects, and nine of the 42 non-anxious subjects met diagnostic criteria (current or past episode) for another disorder as assessed by the MINI (Table 2). Finally, we performed a Pearson correlation analysis across groups between self-report TAF (as measured by the modified TAF Scale) and behavioral measures of TAF in order to confirm that these measures are assessing the same construct (see Table 3) as done by Berman et al. (2011).

Table 1

Group Characteristics

	OCD M (SD)	SAD M (SD)	Non-Anxious M (SD)	$F(2,122)$	P	Effect Size r
OBQ-44 Total Score	177.46 (53.29)[a]	181.10 (37.20)[a]	121.83 (43.15)	22.50	< .001*	.52
OBQ: Respon/Threat Est	63.71 (21.49)[b]	66.50 (14.89)[b]	45.05 (17.96)	16.76	< .001*	.47
OBQ: Import of Thoughts	41.95 (16.98)[c]	38.78 (12.05)[c]	26.57 (10.79)	14.97	< .001*	.45
OBQ: IU/Perfectionism	71.80 (21.98)[d]	75.83 (18.73)[d]	50.21 (18.99)	19.71	< .001*	.50
LSAS (anxiety severity)	61.95 (31.92)[e]	71.18 (25.71)[e]	19.95 (15.74)	48.23	< .001*	.67
CESD (depression severity)	21.59 (13.26)[f]	22.28 (14.22)[f]	4.62 (6.12)	30.26	< .001*	.58

Note. * = *p* ≤ .05 criteria; OBQ = Obsessive Beliefs Questionnaire; Import of Thoughts = Importance of and Need to Control Thoughts; TAF = Thought-Action Fusion; IU = Intolerance of Uncertainty; LSAS = Liebowitz Social Anxiety Scale; CESD = Center for Epidemiologic Studies Depression Scale
Means that share the same superscript letter do not significantly differ from one another.

Table 2

DSM Diagnoses

Diagnosis	OCD n (%)	SAD n (%)	Non-Anxious n (%)
Obsessive-compulsive Disorder	41 (100%)	0	0
Social Anxiety Disorder	24 (59%)	40 (100%)	0
Major Depressive Disorder	26 (63%)	25 (62.5%)	6 (14%)
Bipolar Disorder (I & II)	6 (15%)	4 (10%)	1 (2%)
Generalized Anxiety Disorder	19 (46%)	16 (40%)	0
Panic Disorder (with & without Agoraphobia)	6 (15%)	5 (12.5%)	0
Agoraphobia (without Panic Disorder)	1 (2%)	2 (5%)	0
PTSD	1 (2%)	1 (2.5%)	0
Substance Use Disorders	6 (15%)	4 (10%)	4 (9.5%)

Table 3

Correlations Between Self-Report and Behavioral TAF Measures

In Vivo Rating	TAFS Subscale: Moral	TAFS Subscale: Likelihood-Other	TAFS Subscale: Likelihood-Self
I hope [family member] is in a car accident today.			
Anxiety	.33**	.29*	.29*
Likelihood	.36**	.39**	.33**
Moral Wrongness	.46**	.19	.19
Urge to Neutralize	.29*	.13	.24
I hope I have sex with [family member].			
Anxiety	.35**	.27*	.26*
Likelihood	.21	.15	.20
Moral Wrongness	.46**	.35**	.37**
Urge to Neutralize	.21	.09	.14
I hope I fall down the stairs today.			
Anxiety	.31*	.22	.22
Likelihood	.47**	.34**	.35**
Moral Wrongness	.43**	.08	.04
Urge to Neutralize	.24	.14	.18

*significant at $p < .05$
** significant at p < .01

Self-Reported TAF

Indirect Comparison of TAF Own and Others' Thoughts (Block 1 vs. Block 2)

First, we analyzed the data to determine whether people with OCD evaluate their own

thoughts differently from others' thoughts when making an *indirect* comparison of the two (as

measured by the total TAF Scale, blocks 1 and 2, respectively). Findings from a 3 (group: non-

anxious, OCD, SAD) x 2 (actor: self vs. other) repeated measures ANOVA with follow-up

analyses showed a main effect of group ($F(2,120) = 7.68$, $p = .001$, $r = .36$, 90% CI[0.18, 0.44])

such that subjects with OCD and SAD had higher scores on the TAF Scale than did non-anxious

subjects. There was also a main effect of actor ($F(1,120) = 17.93$, $p < .001$, $r = .36$, 90% CI[0.22,

0.47]), such that subjects rated their own thoughts as more significant than others' thoughts.

Pairwise comparisons showed that there were no significant differences between SAD and OCD

groups in how they scored on either block one or two of the TAF Scale (*ps* > .29). The ANOVA

revealed an interaction between group and actor ($F(2,120) = 4.85$, *p* = .009, *r* = .27, 90%

CI[0.10, 0.39]). Follow-up analyses (with a Bonferroni adjusted *p* threshold of .02) indicated that

subjects with OCD ($t(40) = 2.98$, *p* = .005, *r* = .43, 90% CI[0.19, 0.59]) and subjects with SAD

($t(39) = 4.16$, *p* < .001, *r* = .55, 90% CI[0.34, 0.68]) had higher scores on block one of the TAF

Scale than they did on block two. That is, OCD and SAD subjects rated their thoughts as more

immoral and more likely do to harm than they did others' thoughts. Conversely, non-anxious

subjects did not differ in how they evaluated their own and others' thoughts (i.e., there were no

significant differences between their scores on blocks one and two of the TAF Scale, $t(41) = .42$,

p = .68; see *Figure 1*).

Figure 1. Performance on Self-Report TAF Scale: Total Score
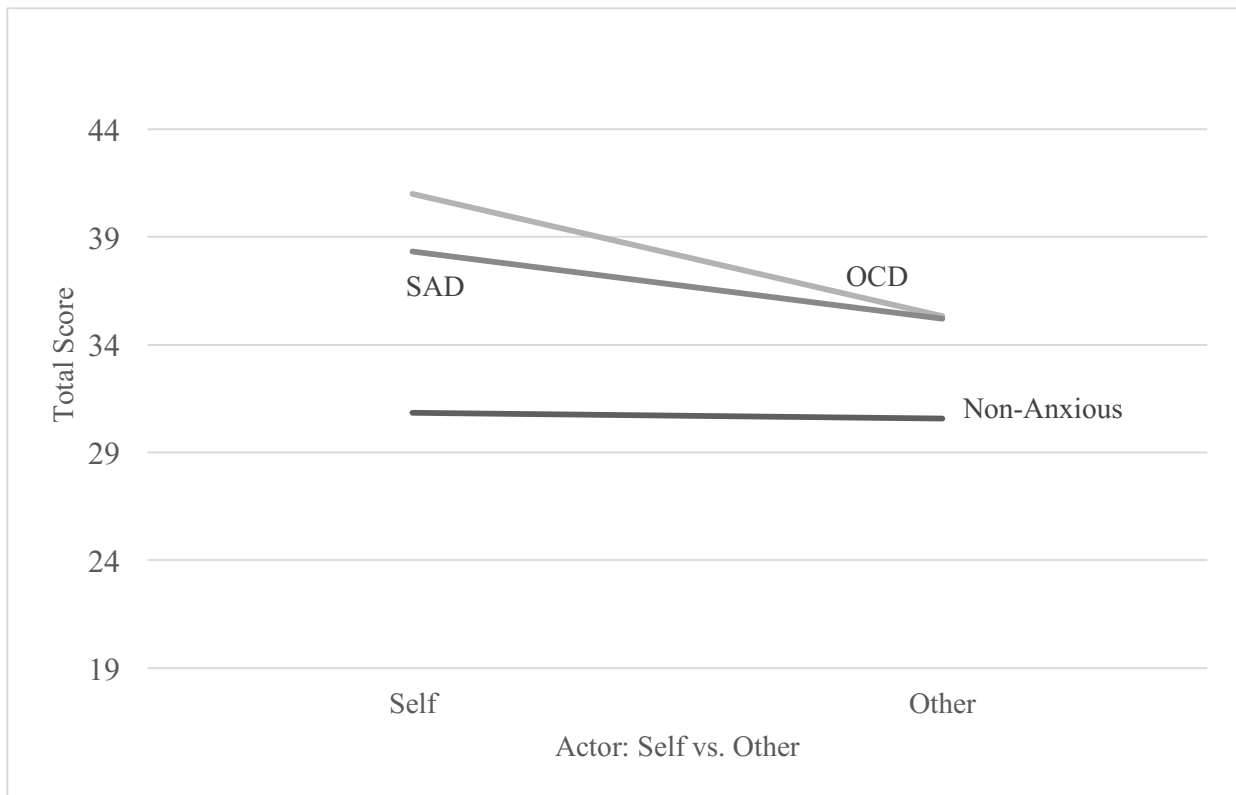
Next, we performed the same analysis on the subscales of the TAF Scale to determine if groups differed in how they evaluated specific aspects (moral, likelihood-other, likelihood-self) of thought-action fusion. For the moral subscale of TAF, a 3 (group) x 2 (actor) ANOVA showed the same pattern of results as above (see *Figure 2*). Specifically, there was a main effect of group ($F(2,120) = 5.91$, $p = .004$, $r = .30$, 90% CI[0.14, 0.41]) and actor (self vs. other; $F(1,120) = 21.87$, $p < .001$, $r = .40$, 90% CI[0.26, 0.50]) and an interaction between the two ($F(2,120) = 5.62$, $p = .005$, $r = .29$, 90% CI[0.13, 0.40]). Follow-up analyses with Bonferroni corrections revealed that relative to the non-anxious group, both OCD and SAD groups had higher scores on the TAF moral subscale overall ($ps \leq .03$) and rated the moral wrongness of their own thoughts as more severe than they did others' thoughts ($ps \leq .001$). Non-anxious subjects did not differ in how they rated the moral wrongness of their own versus others' thoughts, $t(41) = .30$, $p = .77$.

Figure 2. Performance on Self-Report TAF Scale: Moral Subscale Scores
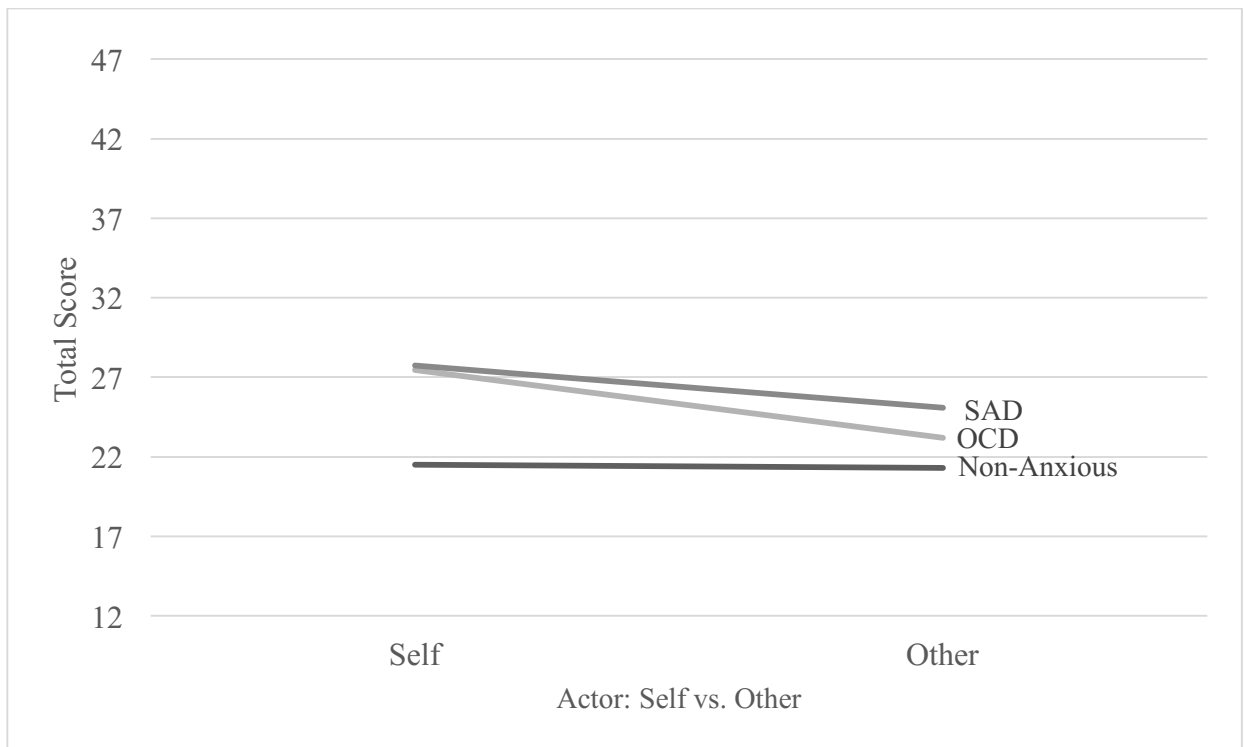
A different pattern of findings emerged for the likelihood subscales of the TAF Scale (see

Figure 3). Results indicated a main effect of group ($F(2,120) = 7.87$, $p = .001$, $r = .34$, 90%

CI[0.18, 0.45]), such that OCD subjects rated the likelihood that thoughts would negatively

impact other people (i.e., TAF-likelihood-other) to be higher than did either the SAD or non-

anxious group, regardless of the person (self vs. other) having the thought. There was neither a

main effect of actor (self vs. other; $F(1,120) = .12$, $p = .70$), nor an interaction between group

and actor, $F(2,120) = 1.41$, $p = .25$. Additionally, socially anxious subjects' and non-anxious

subjects' ratings of likelihood-harm to other were indistinguishable ($p = 1.00$). Finally, when

examining the likelihood-harm to self subscale of the TAF Scale across blocks (with corrections

for multiple comparisons), we found a significant main effect of group ($F(2,120) = 6.67$, $p =$

.002, $r = .32$, 90% CI[0.16, 0.43]) such that people with OCD had higher scores overall on the

subscale than did the non-anxious group ($p = .001$), whereas the socially anxious group did not

significantly differ from the non-anxious group ($p = .33$) or the OCD group ($p = .14$; see *Figure*

4). There was also a main effect of actor ($F(1,120) = 11.57$, $p = .001$, $r = .30$, 90% CI[0.15,

0.42]), but no interaction ($F(2,120) = 1.60$, $p = .21$). In other words, all groups believed that if

they had thoughts about something bad happening to themselves, a negative outcome was more

probable than if someone else had a thought about something bad happening to him/her (i.e., the

belief that "my thoughts are more likely to hurt me than other people's thoughts are to hurt

them").

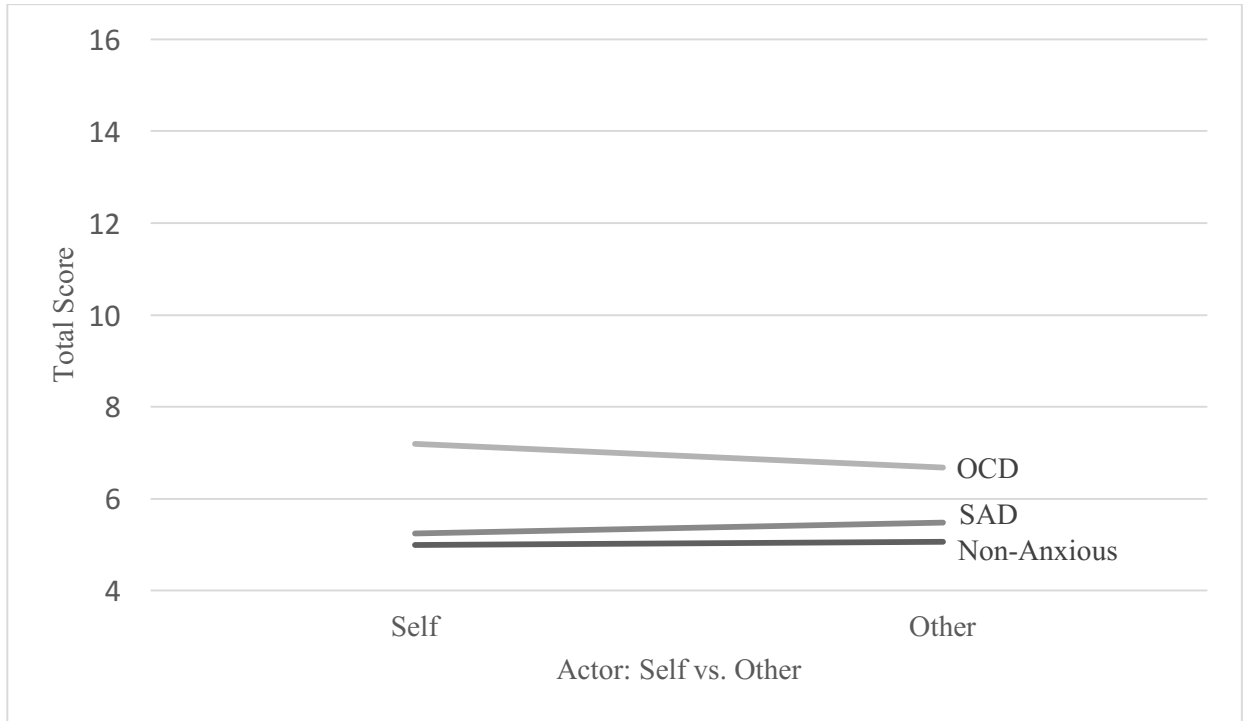*Figure 3*. Performance on Self-Report TAF Scale: Likelihood-Other Subscale Scores

Figure 4. Performance on Self-Report TAF Scale: Likelihood-Self Subscale Scores

Direct Comparison of TAF Own and Others' Thoughts (Block 3)

Next, we conducted a one-way ANOVA on block three of the TAF Scale to determine if the same pattern of results emerged when subjects were asked to make a *direct* comparison of their own versus others' thoughts. Results from the ANOVA and planned contrasts showed that this was the case. Specifically, there was a main effect of group $F(2,120) = 12.96$, $p < 0.001$, $r = .42$, 90% CI[0.30, 0.55], such that subjects with OCD and SAD had higher scores on the TAF Scale than did non-anxious controls ($t(120) = 4.85$, $p < .001$, $r = .40$, 90% CI[0.27, 0.51] and $t(120) = 3.73$, $p < .001$ $r = .32$, 90% CI[0.18, 0.44], respectively). There were no significant differences between OCD and SAD groups on overall score, $t(120) = 1.08$, $p = .28$). As was the case with the indirect comparison of TAF, we found a similar pattern of performance on the subscales of block 3. That is, a multivariate analysis of variance with follow-up analyses (all Bonferroni corrected p values are reported) showed that though the OCD and SAD groups had identically elevated scores on the moral subscale of the measure ($p = 1.00$), the OCD group had higher scores than did the other groups on the likelihood-harm to other (ps $\leq .001$) and likelihood-harm to self subscales (ps $< .04$) of the measure. These results indicate that OCD subjects think their thoughts are more likely than other people's thoughts to influence negative consequences.

Finally, we conducted a correlational analysis to examine if performance on the three blocks of the revised TAF Scale were related. All correlations were significant, with the largest association between blocks one (evaluation of one's own thoughts) and three (direct comparison of self vs. others' thoughts), $r = .82$, $p < .001$. Blocks one and two were correlated at $r = .71$ ($p < .001$) and blocks two and three were correlated at $r = .54$ ($p < .001$).

Behavioral Measure of TAF

In order to examine if subjects' ratings of their own and others' thoughts differed on a behavioral measure of TAF, we analyzed the ratings (i.e., anxiety, likelihood of event occurring, moral wrongness of writing the sentence, and urge to neutralize) given by subjects after writing or observing someone else write each of the three TAF sentences. We performed separate multivariate analysis of variance (MANOVAs) for the three sentences. Results indicated that across all three sentences, there was a significant main effect of group, but there was no main effect of who wrote the sentence (actor: subject or experimenter) and no significant interactions between group and actor.

Distinct patterns of group differences emerged based on the specific scenario (see *Figure 5)*. Specifically, for the moral TAF sentence[2] ("I hope I have sex with [family member]"), subjects with OCD and SAD had similarly elevated ratings of anxiety ($F(2,114) = 22.03$, $p < .001$, $r = .53$, 90% CI[0.40, 0.61]), moral wrongness ($F(2,114) = 4.15$, $p = .02$, $r = .26$, 90% CI[0.08, 0.38]), and urge to neutralize ($F(2,114) = 11.41$, $p < .001$, $r = .41$, 90% CI[0.26, 0.51]) relative to the non-anxious group. Interestingly, with respect to likelihood ratings, and in a similar pattern to that observed via self-reported TAF, there was a trend toward a significant group difference. Specifically, the OCD group estimated the probability of their committing incest higher than did the SAD and non-anxious groups $F(2,114) = 2.47$, $p = .09$, $r = .20$, 90% CI[0.0, 0.33], though this difference failed to reach statistical significance. Moreover, pairwise comparisons revealed that the likelihood ratings provided by the SAD and non-anxious groups were indistinguishable ($p = 1.00$).

---

[2]We omitted the responses to this sentence from three non-anxious subjects, who stated they did not have a family member with whom they were close. For the likelihood-other sentence, they used the name of a close friend.

Figure 5. Performance on Behavioral Measure of TAF: Likelihood Ratings for All Three Sentences
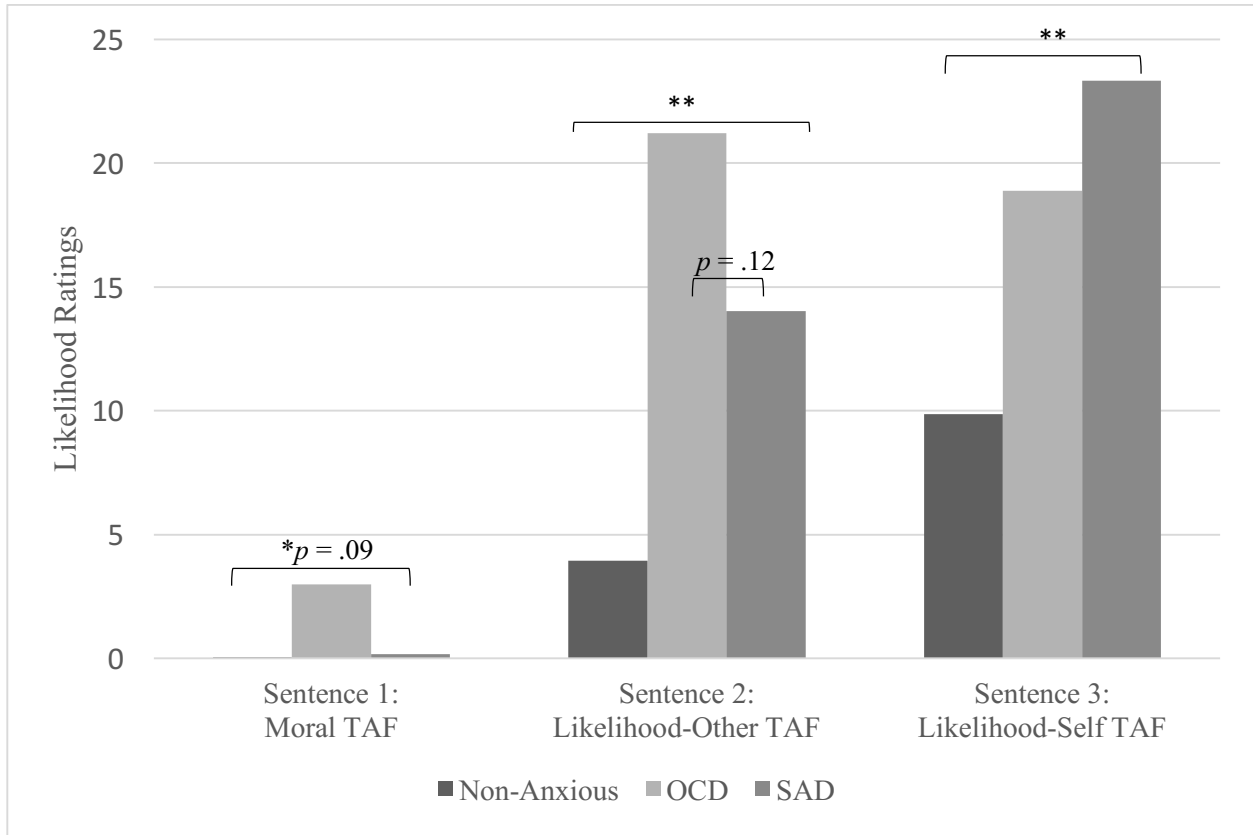
* = trending toward significance
** = significant at *p* < .05

A similar pattern of findings emerged for the likelihood-harm to other TAF sentence ("I hope [family member] is in a car accident today."). That is, both OCD and SAD subjects had higher anxiety ($F(2,117) = 29.16$, $p < .001$, $r = .58$, 90% CI[0.46, 0.65]) and a greater urge to neutralize ($F(2,117) = 6.32$, $p = .002$, $r = .31$, 90% CI[0.15, 0.42]) after imagining the scenario. There was a trend for significant group difference in moral wrongness of writing the sentence ($F(2,117) = 2.47$, $p = .09$, $r = .20$, 90% CI[0.0, 0.32]) such that SAD subjects had higher ratings relative to non-anxious, but not to OCD, subjects. There was also a significant main effect of group for likelihood ratings ($F(2,117) = 12.91$, $p < .001$, $r = .43$, 90% CI[0.28, 0.52]), with

subsequent paired comparisons showing that the OCD and SAD groups rated the probability of the outcome higher than did the non-anxious ($ps \leq .01$) group. The OCD group also provided higher likelihood scores than did the SAD group, but this difference failed to reach statistical significance ($p = .12$).

Analysis of the likelihood-harm to self TAF sentence ("I hope I fall down the stairs today") showed that again, OCD and SAD groups experienced more anxiety than did the non-anxious group, $F(2,117) = 18.54$, $p < .001$, $r = .49$, 90% CI[0.36, 0.58]. There was a trend toward significant group differences on the moral wrongness ratings ($F(2,117) = 2.61$, $p = .08$, $r = .21$, 90% CI[0.0, 0.33] with the SAD and OCD groups rating writing the sentence as more morally wrong than did the non-anxious group. Moreover, there was a significant main effect of group on the likelihood ($F(2,117) = 4.39$, $p = .02$, $r = .26$, 90% CI[0.09, 0.38]) and urge to neutralize ($F(2,117) = 4.43$, $p = .01$, $r = .27$, 90% CI[0.09, 0.38]) ratings. Follow-up analyses showed that the socially anxious group had higher likelihood estimations and urges to neutralize than did non-anxious subjects ($ps = .02$); however, group differences were not identified for the SAD versus OCD groups or for the OCD versus non-anxious groups ($ps \geq .13$).

Finally, we examined if subjects differed in the frequency with which they neutralized the effects of writing or watching someone else write the three sentences. A chi-square revealed no group differences, $\chi(6) = 7.5$, $p = .28$, suggesting that people with OCD and SAD were no more likely to engage in visible[3] ritualistic behavior following the behavioral TAF task than were non-anxious subjects.

---

[3]It is possible that subjects engaged in mental rituals without the experimenter knowing, as subjects were not asked to report such covert responses.

Additional Analyses

Given the high rates of comorbid OCD and SAD in our sample, we repeated all analyses after moving subjects who met criteria for both disorders to a fourth group. The OCD-only group consisted of 17 individuals and the comorbid OCD/SAD group consisted of 24 people. Findings of self-reported TAF remained largely consistent, with the OCD-only, SAD-only, and comorbid groups reporting higher overall scores on all three blocks of the TAF Scale than did the non-anxious group, and evaluating their own thoughts as more important/significant than others' thoughts. However, results did differ when examining specific subtypes of TAF. Specifically, relative to the non-anxious group, only the SAD-only group had higher scores on the moral subscale; the OCD-only and comorbid groups differed from neither the non-anxious group nor the SAD-only group. Patterns remained consistent with initial analyses on the likelihood subscales, with the OCD-only group reporting higher scores on the likelihood-other subscale relative to the non-anxious and SAD-only group (there were no differences in how OCD-only and comorbid groups rated likelihood-other). Moreover, for the likelihood-self subscale, the OCD-only and the comorbid groups had higher scores than did the non-anxious group, whereas socially anxious subjects did not differ from any of the groups.

With respect to the behavioral TAF measure, results differed from the initial analyses. Specifically, for the moral sentence (i.e., committing incest) and the likelihood-other sentence (i.e., car accident), only the comorbid group indicated higher likelihood scores than did the other groups; the OCD group did not differ from any of the other groups. Additionally, the SAD group gave higher estimates of likelihood on the likelihood-self sentence (i.e., falling down the stairs) than did the non-anxious group, whereas neither the OCD-only nor comorbid group's likelihood ratings differed from those of the SAD or non-anxious groups.

Discussion

The aim of the present study was to examine if people with OCD evaluate their own thoughts as more significant than they do other people's thoughts. We tested this question three ways: indirectly via self-report (TAF Scale block 1 vs. 2), directly via self-report (TAF Scale Block 3), and via two separate conditions (self writing vs. other writing) on a behavioral measure of TAF. Analysis of both the indirect and direct comparisons showed that the OCD and SAD groups evaluated their thoughts as more morally wrong and more likely to do harm than they did others' thoughts; the non-anxious group did not evaluate their own and others' thoughts differently. These results indicate that TAF may be more related to biased evaluation of one's own thoughts than to thoughts in general. However, the behavioral measure of TAF revealed no differences in how any of the groups evaluated the significance of their own versus others' thoughts on four different dimensions (anxiety, likelihood, moral wrongness, and urge to neutralize the thought). What might account for this inconsistency between self-report and behavioral measures of how people evaluate their own versus others' thoughts? One possibility is that the behavioral measure was more emotionally salient than was the modified TAF Scale. Indeed, the TAF Scale neither includes specific names of friends or relatives, nor does it ask subjects to write down a certain thought or to picture an upsetting scenario. Conversely, the sentence paradigm requires subjects to imagine and provide the name of a specific loved one, write out or watch someone else write sentences that involve incest or harm to oneself or the family member, and imagine the scenario for 30 seconds. Myriad studies confirm that emotional information affects cognitive processes, such as memory and attention, and that the neural processing of emotional stimuli differs from that of less emotionally salient information (Anderson & Phelps, 2001; Vuilleumier, 2005). The scenarios used in the behavioral TAF

35

paradigm may have been so emotionally arousing that the person who physically wrote them out made little difference in how they were assessed.

Another possibility that might explain discrepancies between the self-report and behavioral measures of TAF is that the tasks are measuring different constructs. Indeed, the self-report TAF and behavioral TAF tasks differ in an important way. On the TAF Scale, subjects are asked to indicate how they would feel if they or others had a number of different thoughts. The questions imply that the thought originated with either the subjects themselves or with their friends. However, in the sentence paradigm, the thoughts being assessed are not the subjects' own. Rather, the experimenter read the sentences aloud and, irrespective of condition, all subjects were asked to imagine the three scenarios. Our data indicate that although aspects of the scales were correlated, the associations between some of the variables were not expected. For example, scores on the moral and likelihood-harm to self subscales of the TAF Scale were more highly correlated with ratings given for the likelihood-harm to other sentence (car accident) than they were for the moral sentence (incest). In this way, our findings differ from Berman et al. (2011), whose study investigated the convergent validity of the TAF behavioral paradigm. This discrepancy could be due to the fact that their study used an unselected student sample whereas ours used a clinical sample. It would therefore be important to replicate these findings in more samples – unselected and selected – to gain a better understanding of the task's convergent validity.

Using three different measures of TAF, we found that relative to non-anxious people, obsessive-compulsive and socially anxious individuals have similar beliefs about the significance of and need to control their thoughts. Specifically, the OCD and SAD groups had similar scores on the TAF subscale of the OBQ-44 and on the total score of the modified Thought-Action

Fusion Scale. Similarly, SAD and OCD subjects had comparably elevated ratings on most subscales of a behavioral measure of TAF. These findings are in line with other studies reporting that people with anxiety disorders possess cognitive biases that are also associated with OCD (Steketee et al., 1998). For example, studies by Rassin et al. (2001) and Thompson-Hollands et al. (2013) found that individuals with a range of anxiety disorders scored similarly on the TAF Scale to people with OCD.

Despite their comparable total score on TAF measures, one aspect that seems to distinguish OCD subjects from SAD subjects is the extent to which they believe that thoughts influence the likelihood of outcomes (i.e., the belief that thinking about something makes it more likely to happen). Hence, the magical thinking aspect of TAF seems to distinguish the OCD group from the SAD. Analyses of the subscales of the modified TAF scale showed that OCD and SAD groups did not differ in how they rated the moral wrongness of different thoughts, but that people with OCD had higher scores than SAD and non-anxious subjects on the likelihood-other subscale of the measure and higher scores than non-anxious subjects on the likelihood-self subscale. These findings are consistent with prior research, which showed that subjects with OCD had higher scores on the likelihood subscales of the TAF Scale than did people with social anxiety disorder (Abramowitz et al., 2003). However, in the same study, the authors found that likelihood scores did not significantly differ between people with OCD and certain other anxiety disorders, such as generalized anxiety disorder and panic disorder. Though it is possible that likelihood scales only distinguish OCD from SAD, but not other anxiety disorders, Abramowitz et al. (2003) examined groups with homogenous diagnoses, whereas our OCD and SAD groups included people who met criteria for comorbid anxiety disorders. It is noteworthy that despite the fact that 59% of our OCD group also met criteria for SAD, the group differences on likelihood

scales were still present. Moreover, after repeating analyses after separating subjects with comorbid OCD and SAD into a separate group, the findings remained consistent.

Behavioral measures showed a similar trend in that OCD subjects gave higher likelihood ratings in response to writing and imagining scenarios designed to evaluate moral and likelihood-other TAF. Specifically, relative to the other groups, OCD subjects provided higher likelihood ratings of committing incest, whereas the SAD and non-anxious groups gave indistinguishable ratings. Moreover, OCD subjects gave higher likelihood estimates that a loved one would get into a car accident, though the difference between OCD and SAD groups did not reach significance after correcting for multiple comparisons. Additionally, these trends disappeared when we separated subjects with comorbid OCD and SAD into a fourth test group. In fact, relative to non-anxious subjects, only the comorbid OCD/SAD group had higher likelihood estimates in response to the moral scenario (i.e., incest) and the likelihood-harm to other scenario (i.e., car accident), whereas no differences occurred between the OCD and SAD groups or the OCD and non-anxious groups in response to these sentences. Only the SAD-only group gave higher likelihood estimates than did the non-anxious group in response to the TAF likelihood-harm to self sentence, whereas the OCD group did not differ from either the non-anxious, comorbid, or SAD groups. It is possible that with only 17 OCD-only subjects, we had insufficient power to detect group differences on the behavioral measures of TAF. Alternatively, likelihood estimations may only differentiate people with OCD from other disorders when captured with a self-report measure, but not a behavioral one.

Interestingly, in response to the likelihood-self sentence ("I hope I fall down the stairs today"), there were no differences in how subjects with OCD and those with SAD rated the likelihood of the outcome (and this finding remained consistent after separating subjects with

comorbid OCD and SAD). It is possible that the object of the action – in this case, oneself –

influences how different groups assess the likelihood of harm. Unlike the other two sentences,

the TAF-likelihood-harm to self scenario does not involve physically harmful consequences for

other people, but only for oneself. Indeed, as noted above and in line with the behavioral

measure, socially anxious subjects scored similarly to OCD subjects on the self-report

likelihood-harm to self subscale, but not the likelihood-harm to other subscale, of the TAF Scale.

These self-report and behavioral findings suggest that socially anxious individuals do not

overestimate the likelihood of negative events occurring in general, but rather only when the

potential object of harm is themselves. In other words, when the threat is to themselves, their

likelihood scores do not differ from those with OCD, but when the threat is to others' well-being,

they perform more like non-anxious subjects. One potential explanation for this finding is

socially anxious people's well-documented tendency to focus attention inward and on self-

referent information (Boehme, Miltner, & Straube, 2015). This amplified inward focus causes

biased processing of information and increases anxiety, arousal, and negative evaluation of

oneself (Boehme et al., 2015; Bogels & Mansell, 2004; Woody & Rodriguez, 2000). Therefore,

SAD subjects may have processed situations in which they are at risk differently from those in

which others are at risk. Moreover, socially anxious subjects may have viewed the likelihood-

harm to self scenario (i.e., falling down the stairs) as a potentially embarrassing event. Given that

SAD entails an intense fear of humiliation, interpreting the sentence as socially threatening could

explain why this group deemed it more likely to occur than the other non-socially relevant

scenarios.

Interestingly, the SAD group rated their urge to neutralize the effects of writing the

sentences just as high (and in the case of the likelihood-harm to self sentence, higher) as did the

OCD group. In a review paper, Berle and Starcevic (2005) posited that what differentiates OCD patients from those with anxiety disorders, is not heightened TAF, but rather the response to upsetting TAF thoughts. They asserted that whereas OCD subjects are likely to react to such thoughts by performing compulsions, seeking reassurance from others, or avoiding triggering situations, individuals with other disorders are likely to respond with avoidance only. Our findings, however, do not support this hypothesis. Indeed, there were no group differences in the frequency with which subjects neutralized the effects of writing the sentence (e.g., crossing the sentence out, ripping up the card, etc.). When using the same task in a student sample, Berman et al. (2011) likewise observed that "…More strongly believing that one's thoughts can affect the likelihood of events occurring in the external environment may not be related to a greater frequency of engagement in overt neutralizing behaviors" (p. 162).

Some of the OCD subjects were undergoing treatment with exposure with response prevention at the time of their study participation. As such, it is possible that, in keeping with their treatment goals, they attempted to resist the urge to neutralize more than usual. However, this explanation seems unlikely given that a number of these patients were only beginning treatment and were observed engaging in other visible rituals (e.g., refusing to touch objects for fear of contamination, etc.). Even if treatment setting did influence OCD subjects' behavior on the task, it does not explain why their urge to neutralize was no higher than those in the SAD group. Indeed, in our study, estimations of likelihood seem to be the only factor that consistently distinguishes these groups. Perhaps more fixed and generalized beliefs about the probability or likelihood of negative outcomes are unique contributors to OCD pathology versus other disorders.

Alternatively, the dominant fear of people with SAD is doing something socially

awkward that provokes ridicule from other people, whereas a dominant fear of people with OCD is doing something dangerous that provokes moral condemnation from other people as well from themselves. Hence, in everyday life the focus of fearful preoccupation will differ between these groups. As Tversky and Kahneman (1973) wrote in their article on the *availability heuristic*, "Continued preoccupation with an outcome may increase its availability, and hence its perceived likelihood" (p. 230). Accordingly, this heuristic may explain why OCD subjects reported higher likelihood ratings than did SAD subjects despite both groups responding similarly on other measures TAF.

The current study has important research and clinical implications. First, we replicated the finding that the thought-action fusion bias is not specific to OCD, despite the fact that it is has been studied most widely in this disorder (Berle & Starcevic, 2005; Shafran & Rachman, 2004). Therefore, our study supports the theory that some vulnerabilities cross diagnostic boundaries, and that focusing on transdiagnostic factors may be useful in understanding the etiology and improving the treatment of mental illness (Insel et al., 2010). Despite the fact that OCD has been removed from the anxiety disorders category in the most recent version of the DSM (APA, 2013), this study adds to the body of literature indicating there is substantial overlap in cognitive processes implicated in both OCD and anxiety disorders (Stein et al., 2010).

Second, this study is the first to examine if the TAF bias is specific to one's own thoughts or if it generalizes to how people with OCD evaluate others' thoughts. We found that in both indirect and direct assessments of this question, people with OCD and those with SAD evaluated their thoughts as more potentially dangerous and more likely to do harm than others' thoughts. Cognitive therapy for OCD includes exercises to combat dysfunctional thoughts about beliefs. However, this study indicates that it might be more useful to target the distorted belief that "there

is something about me or my thoughts that are especially dangerous" as opposed to "thoughts in general are dangerous" as they likely represent different schemas or core beliefs. Finally, the current study underscores the importance of using multiple modes of measurement when examining a given construct (Kazdin, 2002). Though there were similarities in how subjects performed on the self-report and behavioral measures of TAF, there were also some notable differences, as delineated above. The majority of studies on TAF have relied on self-report measures, but ours provides evidence that *in vivo* paradigms may yield different results that are not captured by the former. Further, this study indicates that relying on self-report data may be insufficient to determine how cognitive factors affect day-to-day behavior.

Third, we have replicated and extended the finding that heightened TAF likelihood estimation may distinguish OCD from other psychopathology (Shafran & Rachman, 2004). Not only did we find evidence of this distinction on self-report measures of TAF, but also we found similar patterns of performance on the behavioral sentence paradigm. To our knowledge, this study is the first to have used both measures to assess this construct in a clinical sample. Taken with other studies, these findings suggest that when treating OCD, it may be worthwhile to target TAF likelihood specifically (especially when assessed with a self-report measure such as the TAF Scale), as it may play a unique role in the maintenance of the disorder. It would be interesting to examine if people at risk for OCD show similar patterns of performance on TAF-likelihood measures than do people with the active disorder. If so, these measures could be used to identify individuals who may be more prone to developing OCD as opposed to a different disorder.

Our study has limitations, including a modest sample size in each condition of the behavioral TAF task (e.g., 20 people each). In addition, although ecologically valid, high rates of

comorbidity may be a weakness if the goal is to understand how different symptoms of psychopathology (e.g., social anxiety versus generalized anxiety) are specifically related to TAF. However, given that we detected group differences despite the high rates of comorbidity (including social anxiety disorder in the OCD group), the heterogeneity of the sample is unlikely to have diminished the validity of our study. Indeed, most of our findings remained significant after separating subjects with comorbid OCD and SAD into a fourth group. Second, the OCD group was significantly younger than the non-anxious group. However, we have no a priori hypotheses about age and TAF, nor are we aware of any relationship between the two variables. Finally, we neither used idiographic sentences in the behavioral TAF paradigm, nor did we examine the relationship between TAF and specific OCD subtypes or domains (e.g., contamination versus unacceptable thoughts), as we did not have sufficient power to do so. Though it is not customary to use idiographic sentences in the behavioral TAF task, it is possible that doing so would have captured differences not apparent with generic scenarios. Indeed, research on other cognitive processes in OCD, such as attention and memory, demonstrate the importance of self-referent stimuli in testing these constructs (Radomsky & Rachman, 2004). However, despite the more generalized approach used in the current investigation, important group differences emerged.

In conclusion, the current study provides evidence for the presence of TAF in other disorders, the relative importance of TAF likelihood estimation in distinguishing OCD subjects from those with anxiety disorders, and the potential benefit of addressing dysfunctional beliefs about one's individual thoughts (as opposed to thoughts in general) when targeting TAF in OCD and other anxiety disorders.

Paper 2: Standard of Proof and Intolerance of Uncertainty in

Obsessive-Compulsive Disorder and Social Anxiety Disorder

Dianne M. Hezel, S. Evelyn Stewart, Bradley C. Riemann, Richard J. McNally

Abstract

Researchers have identified intolerance of uncertainty (IU) as one of the three broad domains of

dysfunctional thinking that contribute to the phenomenology of OCD. Case examples of OCD

suggest that uncertainty and anxiety persist despite the low likelihood of feared outcomes. In the

current study, we created a questionnaire to elucidate the level of experienced distress when

there is only minimal uncertainty regarding a given outcome. The questionnaire also assessed the

extent to which people with OCD prefer situations with the certainty of negative outcomes in the

present versus situations associated with uncertainty of whether outcomes will be negative or

positive in the future. Part two of our study tested whether IU is related to performance on both a

neutral and an idiographic version of the Beads Task. Our results revealed that people with OCD

and those with SAD reacted to hypothetical scenarios involving minimal risk with greater

negative affect than did non-anxious subjects; however, after repeating analyses to account for

comorbid disorders, OCD subjects no longer showed elevated scores relative to non-anxious

subjects. Only SAD subjects showed a preference for negative information in the present versus

the option of living with uncertainty of a future outcome, despite the fact that it may actually be

positive. Finally, part two of our study revealed that self-reported IU was only marginally

associated with performance on the neutral Beads Task, but not on the self-referent version of the

task. This study provides further evidence that IU may not figure prominently in all individuals

with OCD, but rather may play a larger, more consistent role in anxiety disorders such as SAD

and GAD. It also suggests that the Beads Task may be an inadequate behavioral measure of IU.

Introduction

Cognitive-behavioral theories of psychopathology underscore the importance of dysfunctional

beliefs or thoughts, which figure prominently in the development and maintenance of a number

of disorders (Beck, 2005). One is *intolerance of* uncertainty – the belief that uncertainty is

unbearably unacceptable (Starcevic & Berle, 2006). Intolerance of uncertainty (IU) has been

defined in several ways (for a review, see Starcevic & Berle, 2006), including as a need for an

answer to an unclear or ambiguous scenario, irrespective of the valence or the accuracy of the

answer (Berle & Starcevic, 2005; Kruglansky, 1990). Indeed, anecdotal evidence indicates that

people with generalized anxiety disorder may prefer immediate negative outcomes rather than

uncertainty about the outcome even when the outcome may positive (Newman & Llera, 2011).

As noted by Starcevic and Berle (2006), IU has also been defined as reacting negatively to

situations involving uncertainty regardless of the likelihood or outcome of the event (Ladouceur

et al., 2000) and as a belief that the possibility of a negative outcome is unacceptable, even if the

likelihood of its occurrence is minimal (Dugas et al., 2001).

Initially identified as an important etiological factor in generalized anxiety disorder

(GAD), IU has since been shown to be a transdiagnostic factor in other anxiety disorders (e.g.,

panic disorder and social phobia), obsessive-compulsive disorder (OCD), and depression

(Carleton et al., 2012; McEvoy & Mahoney, 2012). Specifically, intolerance of prospective

uncertainty, or uncertainty about the future, is more strongly associated with symptoms of GAD

and OCD, whereas inhibitory anxiety, or inaction when faced with uncertainty, is more closely

related to symptoms of social anxiety disorder, panic disorder, and depression (McEvoy &

Mahoney, 2011, 2012). Moreover, post-treatment reductions in IU are associated with symptom

improvement and decreases in anxiety and fear (Talkovsky & Norton, 2016) and repetitive

negative thinking (McEvoy & Erceg-Hurn, 2016) across a number of anxiety disorders. These

findings underscore the importance of better understanding the role of IU both

transdiagnostically and within specific disorders (Shihata, McEvoy, Mullan, & Carleton, 2016).

In light of both research efforts and clinical observations about the relevance of IU in

mental disorders, researchers have identified this factor as one of the three broad domains of

dysfunctional thinking that contribute to the phenomenology of OCD (Hezel & McNally, 2016;

OCCWG, 2005). Studies using self-report measures indicate that IU is associated with OCD

symptoms in both analogue and clinical samples. Specifically, Holaway, Heimberg, and Coles

(2006) discovered similarly elevated levels of IU in people with symptoms of either GAD or

OCD, and Sarawgi et al. (2013) found that IU scores predicted unselected subjects' subsequent

performance on a variety of *in vivo* tasks relevant to common OCD concerns (e.g., checking,

washing, etc.). Moreover, a study by Steketee et al. (1998) revealed that people meeting criteria

for OCD possess lower tolerance for uncertainty relative to healthy individuals or those with

other anxiety disorders and that, compared to other cognitive biases, IU most strongly predicts

OCD symptoms. From a conceptual standpoint, a low tolerance for uncertainty may motivate

individuals with OCD to engage in compulsions in an attempt to decrease their doubt about a

given situation (e.g., doubt that the door is locked, uncertainty regarding how clean one's hands

are, etc.; Tolin et al., 2003). These compulsions paradoxically reinforce obsessions and subsequent rituals (Abramowitz, Taylor, & McKay, 2009).

As critics have observed (Jacoby, Abramowitz, Buck, & Fabricant, 2014), almost all research on IU in OCD has been based on two self-report measures: the Intolerance of Uncertainty Scale (Buhr & Dugas, 2002) and the Intolerance of Uncertainty Scale Short Form (Carleton, Norton, & Asmundson, 2007). A notable exception is the Risk and Ambiguity Task (Levy, Snell, Nelson, Rustichini, & Glimcher, 2010), which asks subjects to make decisions when the likelihood of a monetary outcome is unknown. Findings revealed that people with OCD showed higher avoidance of ambiguous, but not risky (i.e., when probabilities of monetary gain/loss are clearly specified) situations than did people without the disorder (Pushkarskaya et al., 2015). These results are consistent with a study revealing impaired decision-making under uncertainty in both obsessive-compulsive individuals and their unaffected first-degree relatives (Zhang et al., 2015). Consequently, the authors suggested that intolerance of ambiguity might be an endophenotype for the disorder.

Though OCD is very heterogeneous, many individuals suffering from the disorder fear outcomes that are scientifically implausible, such as contracting cancer from a dirty doorknob, impregnating a woman by shaking her hand, or having an increased chance of dying after saying the word "death" (all examples of actual cases the first author has treated). Individuals with good insight will often concede that the outcomes are improbable, but continue to obsess about and engage in compulsions to prevent them "just in case". Though cognitive therapy for OCD challenges dysfunctional beliefs by having the patient calculate more realistic likelihoods of such outcomes (van Oppen & Arntz, 1994), simply providing people with evidence that something is implausible seldom cures them of their symptoms. These case examples suggest that uncertainty

and anxiety persist despite the low (or zero) likelihood of related negative outcome. In the current study, we created a questionnaire to clarify this phenomenon and related aspects of IU in OCD. Part one of the questionnaire assesses standard of proof, or the level of distress a person feels when there is even minimal uncertainty (i.e., 1%) associated with a given outcome. As noted above, individuals with GAD may prefer immediate negative outcomes rather than living with uncertainty, even when a better future outcome is feasible. To our knowledge, there is no extant measure of this phenomenon. Therefore, the second part of the questionnaire assesses the extent to which people with OCD prefer the certainty of negative outcomes in the present to the uncertainty of negative *or positive* outcomes in the future. The inclusion of positive scenarios allowed us to determine whether intolerance of uncertainty generalizes to positively valenced information, or if it is limited to negatively valenced outcomes. We predicted that relative to non-anxious individuals, subjects with OCD would experience greater distress when faced with even negligible uncertainty, would prefer the certainty of a negative outcome over any uncertainty, and would be more intolerant of uncertainty about both negative and positive outcomes.

To measure IU behaviorally, researchers have examined if performance on the Beads Task is related to self-reported IU (Jacoby, Abramowitz, Buck, & Fabricant, 2014; Ladouceur, Talbot, & Dugas, 1997). The Beads Task (Dudley, John, Young, & Over, 1997; Phillips & Ward, 1966) assesses probabilistic reasoning by prompting subjects to indicate whether different colored beads are drawn from a jar with predominantly blue beads or one with predominantly green beads. Subjects continue to request that further beads be drawn until they feel sufficiently confident that the jar contains predominantly blue (or green) beads. The number of beads drawn ("draws-to-decision") is the primary dependent variable tapping desire for certainty. Subjects are

then asked to rate their confidence that the jar does, indeed, contain predominantly blue (or green) beads. Ladouceur et al. (1997) found that self-reported IU was significantly correlated with the number of beads subjects viewed when presented with low (proportion of beads = 85:15) but not high (proportion of beads = 60:40) levels of ambiguity. Subsequently, Jacoby et al. (2014) found no differences in the number of beads that people with and without anxiety disorders (in a mixed sample) requested to see, and there were no group differences in confidence about their answers or in the time they took to make a decision. However, neither of the aforementioned studies included a decision-making task with idiographic stimuli. Because the personal relevance of stimuli to individuals can significantly influence their performance on cognitive tasks (e.g., Radomsky & Rachman, 2004), we tested whether IU was related to performance on two different versions of the Beads Task in the second part of our study.

We asked subjects to complete both a neutral version of the Beads Task with blue and green beads), and a personally relevant version with positive and negative self-referent words provided by each subject. In the self-referent version, subjects were presented with idiographic positive and negative words that describe themselves and are asked to choose the hypothetical survey (mostly positive or mostly negative) from which the words were taken. We predicted that relative to non-anxious and socially anxious individuals, those with OCD would request to see more words, would have lower confidence in their answers, and would take a longer time to complete the personally relevant, but not neutral, version of the Beads Task. Conversely, given their propensity to assume they are being negatively evaluated and to make more exaggerated valuations of what others are thinking or feeling (Hezel & McNally, 2014), we expected that relative to the other groups, the socially anxious group would make decisions based on fewer self-referent words. We did not expect to find group differences on the neutral version of the

49

task. We specifically recruited individuals who met criteria for SAD as a clinical control group because we had specific hypotheses about how socially anxious subjects might perform on this task given prior research.

Methods

Subjects

Three groups of individuals completed the study, including people meeting criteria for OCD (n = 41, 26 female, 63%), those meeting criteria for social anxiety disorder, but not OCD (SAD; n = 40, 22 female, 55% and one transgender woman), and people with no history of anxiety disorders or OCD (n = 42, 15 female, 36%) for a total sample of 123 adults (mean age = 31.6 years, SD = 13.8). All group assignments were based on a short prescreening phone call prior to the study visit followed by a more comprehensive in-person assessment with a semi-structured clinical interview. Subjects were recruited in-person at outpatient and residential OCD treatment programs in Boston, Massachusetts and Oconomowoc, Wisconsin; with ads and posters at local mental health centers; and via university job boards and study pools that were available to students and community members in the greater metropolitan area. Individuals were compensated $10/hour for their participation or, for some students, with study pool credit for relevant courses.

Materials and Procedures

Testing of socially anxious, non-anxious, and some obsessive-compulsive subjects was completed at our lab at Harvard University lab in Cambridge, Massachusetts. Obsessive-compulsive patients at Rogers Memorial Hospital was completed at the hospital in a private room. After providing basic demographic information, all subjects were assessed with the MINI

International Neuropsychiatric Interview, a semi-structured clinical interview designed to identify the presence of OCD as well as various anxiety, mood, substance use, and eating disorders (Sheehan et al., 1998). Individuals meeting criteria for OCD were also assessed with the clinician-rated Yale-Brown Obsessive-Compulsive Scale (YBOCS) and symptom-checklist, which details the person's history of specific symptoms and provides a severity rating for present symptoms (Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). Possible scores on the measure range from zero to 40, with scores of 16 or higher indicating clinically significant OCD (Tolin, Abramowitz, & Diefenbach, 2005). The YBOCS has strong psychometric properties and is sensitive to clinical change in symptoms (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989).

All subjects then completed a number of questionnaires and tasks as a part of a broader study examining dysfunctional thinking associated with OCD and other anxiety disorders (sample characteristics therefore also appear in Hezel, Stewart, Riemann, & McNally, in preparation). Average time taken to complete the first part of the study ranged from one and a half to two hours; subjects had the option of completing the Beads task during a second visit. For the present study, we analyzed data from the following measures.

The Obsessional Beliefs Questionnaire (OBQ-44) is a 44-question self-report survey that asks respondents to rate how much they agree or disagree with statements about beliefs that figure in the cognitive theory of OCD (OCCWG, 2001, 2003, 2005). The measure yields one total score (ranging from 44 to 308) and three subscale scores, each representing a domain of dysfunctional thinking, including increased responsibility and over-estimation of threat, importance of and need to control thoughts, and intolerance of uncertainty and perfectionism.

The OBQ-44 is a valid and reliable measure with both unselected and clinical samples (OCCWG, 2005). The internal consistency in our sample was very strong, α = .97.

The Liebowitz Social Anxiety Scale (LSAS) is a self-report measure of social anxiety symptoms (Liebowitz, 1987). By evaluating a person's fear and avoidance of a range of social activities, such as eating in public, the LSAS yields a total score ranging from zero to 144, with 30 representing clinical levels of social anxiety (Mennin et al., 2002; Rytwinski et al., 2009). It has strong internal consistency, and convergent and divergent validity (Fresco et al., 2001). The internal consistency in our sample was excellent at α = .98.

Symptoms of depression were measured with the 20-item Center for Epidemiologic Studies Depression Scale Revised, or the CESD (Eaton et al., 2004). The survey consists of 20 questions that assess the presence and severity of depressive symptoms over the most recent week, and a score of 16 (out of a maximum of 60) is the suggested clinical cutoff for depression. Shown to have strong psychometric properties (Radloff, 1977), the scale's internal consistency in our sample was α= .95.

The Intolerance of Uncertainty Scale – Short Form (IUS-12) is a 12-item measure that assesses the extent to which people fear and avoid feelings of uncertainty (Carleton et al., 2007). The scale yields a total score (ranging from 12 to 60) as well as two subscale scores, one measuring prospective IU, or the fear of uncertain outcomes in the future (e.g., "Unforeseen events upset me greatly") and the other measuring inhibitory IU, or difficulty performing in ambiguous situations (e.g., "When I am uncertain, I can't function very well"). High scores indicate high intolerance of uncertainty. Both the total score and scores on both factors have high internal consistency (Carleton et al., 2007), including in our sample, α = .93. In addition, the

IUS-12 has good convergent and discriminant validity, with comparable scores to longer

versions of the scale (Carleton et al., 2007; McEvoy & Mahoney, 2011).

We created a self-report measure to measure intolerance of uncertainty in two ways. Part

one assesses standard of proof, or the level of distress a person feels when there is even minimal

uncertainty associated with a given outcome. Subjects were asked to rate on a visual analogue

scale of one to 100 how happy, upset, and anxious they would feel in response to eight different

scenarios. Four of the scenarios were framed as a positive outcome (e.g., "you have a 99%

chance of getting promoted"), whereas the remaining four were framed as a negative outcome

(e.g., "you have a 1% chance of losing your job"). Subjects were also asked to estimate how

likely they were to experience a given outcome (e.g., actually losing their job) in spite of the

probability given in the question. We scored part one of the measure by calculating a mean score

for each of the emotions (happy, upset, and anxious) and probabilities; separate means were

calculated for positively framed outcomes and for negatively framed outcomes.

The second part of the questionnaire assesses the extent to which people prefer the

certainty of negative outcomes in the present over the uncertainty of either positive or negative

outcomes in the future. Part two consists of 15 questions, five of which ask about negative events

(e.g., getting audited by the IRS) and five of which involve potentially losing a positive outcome

(e.g., being a finalist for a prize). The remaining five questions ascertain how people make

decisions in situations where they know the outcome will be positive. That is, do they prefer

learning the outcome immediately (e.g., peeking at a birthday present prematurely) or waiting to

learn the outcome later (e.g., waiting until one's birthday to open the present). Each item of part

two was scored as either zero (if the person wanted to know the outcome immediately) or one (if

he/she would wait with the possibility of a more positive outcome). Consequently, low scores on

part two indicate lower tolerance of uncertainty (i.e., higher IU). Both part one and part two of the measure had acceptable internal reliability at $\alpha = .75$ and $\alpha = .72$, respectively.

Finally, all subjects completed a neutral version (consisting of colored beads) and a self-referent version (using adjectives) of the Beads Task. Following the procedures of Reese, McNally, and Wilhelm (2011), we asked all subjects to complete two easy conditions (proportion = 85/15) and two hard conditions (proportion = 60/40) of both versions. Following Reese et al. (2011), we presented the tasks to subjects on a computer, and we used their directions and order of beads/words. In the easy neutral condition, participants were shown the following instructions (note, we used the word "marbles" instead of "beads" because the stimuli used more closely resembled marbles):

> This computer has two virtual jars. Jar A has 85 blue marbles and 15 green marbles. Jar B has 85 green marbles and 15 blue marbles. The computer will randomly select one jar and then draw one marble at a time from this jar. The marbles you see in this part of the experiment will always come from the same jar and will be replaced after they are drawn so that the proportions stay the same. It is your job to decide from which jar the marbles have come: the mostly blue jar or the mostly green jar. You may see as many marbles as you like before making a decision. After each marble is shown you can ask for another marble or you can make your decision.

If subjects did not choose to make a decision after viewing 20 beads, they were prompted to do so. After deciding, they were then asked to rate how confident they were in their decision. Subjects were asked to complete two easy conditions and two difficult conditions of the task, each of which had different color sequences. In the difficult version of the task, subjects saw the same instructions as above, but the proportion of the beads was changed to 60 and 40. The dominant bead color (blue or green) and color sequence were counterbalanced across easy and hard conditions.

After completing the neutral version of the task, subjects were then asked to complete the self-referent version. They first provided the experimenter with 10 positive and 10 negative

words that they would use to describe themselves; they were permitted to look at a list of different adjectives for ideas of words. After selecting the words, they were shown the following instructions:

> For this task, please imagine that two surveys were done about you. Imagine that there were 100 people in each survey. Imagine that in one survey 85 people made positive comments to describe you and 15 made negative comments to describe you. In the second survey, imagine that 85 people made negative comments to describe you and 15 made positive comments to describe you. Remember that this is only imaginary and did not happen. But try to imagine that this happened. The computer will randomly select one survey and then show you one word at a time from this survey. The words you see in this part of the experiment will always come from the same survey and will be replaced after they are drawn so that the proportions stay the same. It is your job to decide from which survey the words have come: the mostly positive survey or the mostly negative survey. You may see as many words as you like before making a decision. After each word is shown you can ask for another word or you can make your decision.

As was case with the neutral version of the task, subjects performed two easy conditions (one with mostly negative and one with mostly positive words) and two difficult conditions (one negative and one positive) of the tasks. Word valence and sequence were counterbalanced across subjects.

Results

Preliminary Results

The OCD and SAD groups did not differ in their severity of depressive symptoms, social anxiety symptoms, or dysfunctional beliefs (e.g., thought-action fusion, perfectionism, etc.), but had significantly higher scores on these measures relative to the non-anxious group (Table 4). Subjects with OCD had moderately severe OCD symptoms as indicated by a mean YBOCS score of 21.0 ($SD = 5.45$; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) and were significantly younger ($m = 26.1$, $SD = 8.4$) than non-anxious ($m = 37.6$, $SD = 16.1$) subjects ($p < .001$). There were no age differences between the OCD and the SAD ($m = 31.0$, $SD = 13.6$)

groups (p = .29), or between the SAD and non-anxious groups (though there was a trend toward

significance at p = .08). Thirty-six OCD subjects and 34 SAD subjects met criteria for at least

one comorbid disorder and nine non-anxious subjects met criteria for at least one non-anxiety

disorder. Rates of comorbidity are displayed in Table 5. A chi-square revealed that the

proportion of OCD subjects with a comorbid diagnosis of GAD did not differ from the number

of SAD subjects with a comorbid GAD diagnosis $\chi(1)$ = .33, p = .57. Despite the equal

proportion of GAD subjects in each group, given that intolerance of uncertainty has been

identified as an important factor in the phenomenology of the disorder, we repeated all analyses

after omitting any subjects who had a diagnosis of GAD.

Table 4

Group Characteristics

	OCD M (SD)	SAD M (SD)	Non-Anxious M (SD)	F(2,122)	P	Effect Size r
OBQ-44 Total Score	177.46 (53.29)[a]	181.10 (37.20)[a]	121.83 (43.15)	22.50	< .001*	.52
OBQ: Respon/Threat Est	63.71 (21.49)[b]	66.50 (14.89)[b]	45.05 (17.96)	16.76	< .001*	.47
OBQ: Import of Thoughts	41.95 (16.98)[c]	38.78 (12.05)[c]	26.57 (10.79)	14.97	< .001*	.45
OBQ: IU/Perfectionism	71.80 (21.98)[d]	75.83 (18.73)[d]	50.21 (18.99)	19.71	< .001*	.50
LSAS (anxiety severity)	61.95 (31.92)[e]	71.18 (25.71)[e]	19.95 (15.74)	48.23	< .001*	.67
CESD (depression severity)	21.59 (13.26)[f]	22.28 (14.22)[f]	4.62 (6.12)	30.26	< .001*	.58

Note. * = $p \le .05$ criteria; OBQ = Obsessive Beliefs Questionnaire; Import of Thoughts = Importance of and Need to Control Thoughts; TAF = Thought-Action Fusion; IU = Intolerance of Uncertainty; LSAS = Liebowitz Social Anxiety Scale; CESD = Center for Epidemiologic Studies Depression Scale
Means that share the same superscript letter do not significantly differ from one another.

Table 5

DSM Diagnoses

Diagnosis	OCD n (%)	SAD n (%)	Non-Anxious n (%)
Obsessive-compulsive Disorder	41 (100%)	0	0
Social Anxiety Disorder	23 (56%)	40 (100%)	0
Major Depressive Disorder	26 (63%)	25 (62.5%)	6 (14%)
Bipolar Disorder (I & II)	6 (15%)	4 (10%)	1 (2%)
Generalized Anxiety Disorder	19 (46%)	16 (40%)	0
Panic Disorder (with & without Agoraphobia)	6 (15%)	5 (12.5%)	0
Agoraphobia (without Panic Disorder)	1 (2%)	2 (5%)	0
PTSD	1 (2%)	1 (2.5%)	0
Substance Use Disorders	6 (15%)	4 (10%)	4 (9.5%)

Intolerance of Uncertainty

Findings revealed that relative to non-anxious individuals, the OCD and SAD groups had elevated scores on self-report measures of IU. Specifically, a one-way analysis of variance (ANOVA) indicated that the groups had higher scores on the IU/perfectionism subscale of the Obsessive Beliefs Questionnaire ($F(2,120) = 19.71$, $p < .001$, $r = .50$, 90% CI[0.37, 0.58]). Likewise, a multivariate analysis of variance (MANOVA) showed the same pattern of findings on the total score ($F(2,120) = 17.79$, $p < .001$, $r = .48$, 90% CI[0.12, 0.32]) and both subscales (i.e., prospective and inhibitory IU, $F(2,120) = 12.19$, $p < .001$, $r = .41$ 90% CI[0.26, 0.51] and ($F(2,120) = 18.61$, $p < .001$, $r = .49$, 90% CI[0.36, 0.57], respectively) of the IUS-12. The OCD and SAD groups had indistinguishable scores on these measures (all Bonferroni-corrected ps = 1.00).

To examine how individuals react to situations that involve even minimal uncertainty, we completed a MANOVA on the groups' mean ratings of happiness, distress, and anxiety on part one of the scale designed for this study. Findings indicated a main effect of group, such that people with OCD and those with SAD felt more upset (negative frame: $F(2,120) = 6.86$, $p = .002$, $r = .32$, 90% CI[0.17, 0.42]; positive frame: $F(2,120) = 4.19$, $p = .017$, $r = .26$, 90% CI[0.08, 0.37]) and anxious (negative frame: $F(2,120) = 8.59$, $p < .001$, $r = .35$, 90% CI[0.20, 0.46]; positive frame = $F(2,120) = 11.92$, $p < .001$, $r = .41$, 90% CI[0.26, 0.51]) than did non-anxious individuals in situations in which there is a very low probability of a negative outcome (e.g., losing one's job) or a high probability of a positive outcome (e.g., getting a promotion). There were no differences between SAD and OCD groups in levels of these emotions (all Bonferroni-corrected ps = 1.0). There were also no significant differences in how any of the groups rated their happiness to negatively ($F(2,120) = 2.30$, $p = .11$) or positively framed scenarios ($F(2,120) = 2.46$, $p = .09$), or in the probability of experiencing the negatively framed ($F(2,120) = 1.57$, $p = .21$) or positively framed ($F(2,120) = 1.91$, $p = .15$) outcomes. Interestingly, all groups rated the likelihood of a given outcome differently from the probability explicitly stated in the question. For example, in questions that stated there was a 1% chance of a negative outcome, all groups believed that the actual probability of the feared outcome was much higher ($m = 18.78\%$, $SD = 19.99$). Conversely, in scenarios that stated there was a 99% chance of a positive outcome, all groups believed the likelihood was lower than stated ($m = 81.20$, $SD = 17.51$).

To determine if individuals prefer negative outcomes to uncertainty, we compared groups' ratings on part two of our measure. An ANOVA revealed a main effect of group, such that relative to the OCD and non-anxious groups, socially anxious subjects had higher levels of

IU as indicated by their desire for negative outcomes in the present even if there was a chance of a better outcome later ($F(2,120) = 4.22$, $p = .02$, $r = .27$, 90% CI[0.08, 0.37]); follow-up comparisons showed there were no significant differences between the non-anxious and OCD groups on the total scale score ($p = 1.00$). To determine whether IU also applies to uncertainty of situations in which there are two positive outcomes, we compared group scores on the subscales of part two of our measure. Only one of the group differences on the subscales of part two was marginally statistically significant, as indicated by the following: negative outcomes ($F(2,120) = 7.06$, $p = .09$), losing positive outcomes ($F(2,120) = 21.51$, $p = .06$), or two positive outcomes ($F(2,120) = .31$, $p = .31$).

We repeated the above analyses after omitting subjects with comorbid GAD, leaving 42 non-anxious subjects, 22 subjects with OCD, and 24 with SAD. Relative to non-anxious subjects, those with OCD and SAD had higher scores on the total and inhibitory subscale scores of the IUS-12, but only socially anxious subjects had significantly higher scores ($ps \leq .005$) on the prospective uncertainty subscale of the measure. The analyses also revealed that the socially anxious group had higher scores than non-anxious subjects on the IU/Perfectionism Subscale of the OBQ-44 ($p < .001$), the level of anxiety in response to positively framed scenarios ($p < .001$), and how upset ($p = .03$) and anxious ($p = .001$) subjects would be in response to negatively framed scenarios. OCD subjects' scores on these measure differed from neither the non-anxious nor the SAD groups, with one exception: the OCD group had significantly lower scores than the SAD group in how anxious they would feel in response to negatively framed situations ($p < .02$). There was a trend toward significance on part two of the scale developed for this study (preference for negative outcomes in the present versus uncertainty of future outcomes), such that SAD subjects had lower tolerance of uncertainty relative to the other groups ($p = .07$).

Given the large number of subjects with comorbid OCD and SAD, we also repeated all analyses after separating individuals with a diagnosis of comorbid OCD and SAD into a fourth group. The new groups consisted of non-anxious (n = 42), OCD-only (n = 17), SAD-only (n = 40), and comborbid OCD/SAD (n = 24). Overall, the OCD group did not differ significantly from the non-anxious group on any measures.[4] We also performed a correlation analysis to examine the specific association between OCD symptoms and intolerance of uncertainty as well as social anxiety symptoms and IU. OCD severity, as measured by the YBOCS, was significantly correlated with the IUS-12 total scale score (r = .36, p = .02). However, LSAS severity was more strongly associated with the IUS-12 within the OCD group (r = .64, p < .001). Social anxiety symptoms were also highly correlated with total score IUS-12 in the non-anxious group (r = .54, p < .001) and was trending towards significance in the SAD group (r = .29, p = .07). Whereas LSAS scores were largely correlated with both the inhibitory and prospective subscales of the IUS-12 in both the non-anxious and OCD groups (all rs ≥ .50), only the inhibitory subscale was correlated with SAD severity in the socially anxious group (r = .34, p = .03).

Finally, we examined the relationship between one of the most widely used self-report measures of IU and our measure of IU across the entire sample. Performance on the IUS-12 was significantly correlated with subjects' ratings of anxiety in response to minimal uncertainty (part one of our measure) and with subjects' tendencies to want to know outcomes in the present

---

[4]Specifically, those with OCD/SAD had higher total and subscales scores on the IUS-12 than did the non-anxious group or the OCD, but not the SAD, groups. Relative to the non-anxious group, SAD-only and comorbid subjects predicted that they would be more upset and anxious in response to positively and negatively framed scenarios, whereas the OCD group's ratings did not differ from any of the other groups (with the exception that they had lower anxiety scores in response to negatively framed scenarios that did the other clinical groups). Finally, compared to the non-anxious group, only SAD-only subjects preferred negative outcomes in the present to living with uncertainty. There were no group differences on the marbles/word task.

rather than live with uncertainty of an unknown outcome (part two of our measure). Specifically, high scores of on the IUS-12 were positively associated with higher rates of anxiety in response to positively ($r = .46$, $p < .001$) and negatively ($r = .47$, $p < .001$) framed scenarios. Moreover, the higher the scores on the IUS-12, the lower subjects' scores for tolerance of uncertainty ($r = -.23$, $p = .01$), as indicated by their preference for certainty in the present.

Beads Task

One-hundred and eighteen people who participated in part one of the study also completed both versions of the Beads Task.[5] To examine performance on the Beads Task, we performed a 3 (group: OCD, SAD, non-anxious) by 2 (difficulty: easy, hard) x 2 (valence: beads, words) mixed ANOVA for each of the following dependent variables: number of beads viewed and confidence in answer. There was a main effect of difficulty, such that all subjects asked to view more beads/words ($F(1,115) = 147.74$, $p < .001$, $r = .75$, 90% CI[0.68, 0.80]) and were less confident in their answers ($F(1,115) = 148.93$, $p < .001$, $r = .75$, 90% CI[0.68, 0.80]) when completing the hard versions of the tasks than when completing the easy versions. There was also a main effect of valence, such that subjects requested to see fewer beads/words and were more confident in their answers when completing the self-referent version. There were no group differences in number of beads viewed or confidence in answers, and there were no interactions between group, difficulty, or valence (all ps ≥ .18). Additionally, there were neither differences in accuracy of groups' answers on easy or hard trials (all $\chi(4) \leq 3.78$, ps ≥ .43) nor in the total time groups took to complete the tasks ($F(2,115) = .56$, $p = .57$).

We performed a correlational analysis within each group between self-reported IU and performance (as measured by number of beads viewed, confidence in answers, and time to

[5]There were five subjects who did not complete the beads/words task because of time constraints.

completion) on both versions of the task. The only correlations that reached statistical

significance were those between non-anxious subjects' scores on the IUS-12 and the number of

beads they viewed in the easy ($r = .34$, $p = .03$) and the hard ($r = .30$, $p = .05$) versions of the

neutral Beads Task. Performance on the IUS-12 was not associated with number of beads viewed

or confidence in any of the other groups or conditions, and the OBQ IU/Perfectionism subscale

was not significantly correlated with any outcome (number viewed, confidence, time to

completion) on either neutral or self-referent version of the Beads Task.

Discussion

Our first aim was to better understand obsessive-compulsive individuals' emotional

response to situations that involve minimal uncertainty. Relative to non-anxious individuals, the

OCD and SAD groups reported similarly elevated levels of intolerance of uncertainty on two

widely used measures, the IUS-12 and the IU/perfectionism subscale of the OBQ-44. In addition,

both groups reported feeling more upset and more anxiety when confronted with hypothetical

situations that involve even minimal uncertainty. The same pattern of findings emerged

regardless of the frame of the question: either a 1% possibility that something bad would happen

(e.g., testing positive for a devastating illness) or a 99% chance of a good outcome (e.g., winning

the lottery). There were no differences in how groups rated the degree of happiness they would

feel in these scenarios. This null finding suggests that subjects' differential emotional responses

to outcomes are due to predicted increased negative affect, as opposed to lower positive affect, in

OCD and anxiety disorders.

Importantly, however, the differences between OCD and non-anxious subjects did not

remain after removing individuals with comorbid GAD from the analyses. Though people with

OCD still had higher levels of *self-reported* IU as measured by the IUS-12, we found that relative to the non-anxious group, only socially anxious individuals predicted higher levels of negative affect in response to the scenarios on the first part of our scale. OCD subjects' scores did not differ significantly from either the non-anxious or the SAD groups' scores on these measures. Similarly, we observed no differences between obsessive-compulsive and non-anxious subjects after separating subjects with comorbid OCD and SAD into a fourth group. Taken together, these findings suggest that different measures of IU may be more strongly associated with anxiety disorders than with OCD. These findings are supported by a correlational analysis which showed that within the OCD group, social anxiety symptom severity was more strongly related to total, inhibitory, and prospective IU than was OCD severity. Anxiety severity scores were also highly correlated with all subscales of the IUS-12 in the non-anxious group. However, only inhibitory IU was correlated with severity within the SAD group. This finding is consistent with research that suggests that social anxiety may be more strongly related to inhibitory IU than to prospective IU (McEvoy & Mahoney, 2011, 2012).

The lack of differences between the non-anxious and OCD groups on some IU measures may be explained by a number of studies that show that low tolerance for uncertainty is especially relevant to patients with certain subtypes of OCD. For example, Tolin, Abramowitz, Brigidi, and Foa (2003) detected elevated levels of IU in individuals with checking compulsions, but no differences between healthy control subjects and OCD patients without such symptoms. The authors also discovered an association between IU and repeating compulsions. Likewise, Lind and Boschen (2009) found that IU mediates the relationship between other dysfunctional thoughts (i.e., heightened responsibility) associated with OCD and checking symptoms. Though we did ask obsessive-compulsive subjects to identify their most distressing obsession, we did not

63

possess sufficient statistical power to analyze the relationship between specific symptom subtypes and dependent variables. Indeed, the vast majority of subjects in our sample stated that unacceptable thoughts were their primary obsessions. Therefore, it seems likely that IU is an important cognitive factor in some cases of OCD, but may not operate as strongly in other cases of the disorder.

Another possibility for the lack of findings is that our measure was tapping an aspect of IU irrelevant to OCD. After omitting GAD subjects from analysis, only people with SAD had significantly elevated scores on the prospective subscale of the IUS-12. Indeed, other papers suggest that people with OCD may have difficulty making decisions in ambiguous situations, but not when the probabilities of different outcomes are clearly defined (Levy et al., 2010). The scenarios in our measure contained very clear probabilities, which therefore may account for the lack of differences on this measure. Finally, it is conceivable that OCD subjects' self-reported IU as measured by the IUS-12 does not actually predict their response to potentially threatening situations. Given that people with OCD suffer from diminished confidence about cognitive processes, such as memory and attention (Muller & Roberts, 2005), it is possible that their confidence in their ability to handle uncertainty is likewise diminished, but their actual emotional response to ambiguous situations remains intact.

Interestingly, when asked to indicate likelihoods of different scenarios, irrespective of the probability given, all groups answered similarly. That is, when the question stated there was a 99% chance of a positive outcome, subjects stated the actual likelihood was 81%; when the question indicated a 1% probability of a negative outcome, subjects rated the actual likelihood as 19%. These estimates suggest that people may feel more vulnerable to negative outcomes (higher chance of something bad or lower chance of something good) than what is actually the case.

Surprisingly, this bias was not limited to the clinical groups. A study by Moritz and Pohl (2006) indicated that both people with and without OCD tend to underestimate the likelihood of negative outcomes, such as the number of people who die in domestic fires or the number of companies that have gone bankrupt in a given year. Our study showed the opposite effect in which people overestimate the likelihood of negative outcomes and underestimate the likelihood of positive events. One important difference that may account for these discrepant findings is that we included scenarios in which the subjects are told specifically that they are at risk for negative outcomes, as opposed to having people estimate outcomes in general (e.g., the likelihood of anyone being audited). Indeed, once people are told that they are specifically at risk for a given outcome it is possible that their estimates of harm become more inflated.

Moreover, research on another cognitive bias, thought-action fusion, suggests that the belief that one's thoughts increase the likelihood of an outcome (e.g., having a thought about one's sister getting into a car accident increases the likelihood that she will do so) may distinguish people with OCD from people with other psychopathology, such as social anxiety disorder (Hezel, Stewart, Riemann, & McNally, in preparation). The present study suggests that biased likelihood estimates may be limited to beliefs about one's own thoughts and do not necessarily generalize to biased likelihood estimates of outcomes of events in general. Our findings are inconsistent with a prior study that showed that people with OCD have an attenuated "unrealistic optimism bias," the tendency of non-anxious people to estimate they are more likely to experience positive events and less likely to experience negative events than are others (Moritz & Jelinek, 2009). If this were the case, we would have expected non-anxious individuals to have lower estimates of harm than the other groups. One noteworthy difference between our study and that by Moritz and Jelinek (2009), however, is that we did not ask subjects to estimate

probabilities relative to others. It is therefore possible that we would have detected a similar bias if we had done so.

That individuals in general seem to overestimate the probability that they will suffer negative outcomes may have interesting implications for treatment of psychopathology. Cognitive treatments of OCD include exercises in which individuals are asked to estimate the likelihood of a feared situation (e.g., the probability that one will contract AIDS from touching a door knob). The goal of the exercise is to help individuals realize that they may be vastly overestimating the probability that they will experience the outcome. However, our findings suggest that even if people are explicitly told that the outcome is highly improbable, they will continue to overestimate the likelihood that it will occur. It is possible that if there is a chance at all of a negative outcome, regardless how small, individuals will continue to overestimate their vulnerability to experiencing it. It may therefore make sense to focus on cognitive strategies other than estimating probabilities to combat biased thinking.

A second aim of our study was to investigate whether people with OCD prefer negative outcomes in the present to uncertainty, even if a better outcome is possible in the future. Findings from part two of our scale showed that relative to others, people with SAD were more likely to prefer negative outcomes to the uncertainty of future possibilities. This difference continued to trend toward significance after we removed subjects with GAD from the sample. Given their tendency to perform compulsions in an effort to prevent negative consequences of their thoughts, perhaps it is not so surprising that people with OCD did not show this same bias. Indeed, individuals with the disorder regularly sacrifice time and energy in the present in an effort to prevent negative future outcomes, even if they concede that their rituals may not directly prevent such outcomes. Therefore, unlike individuals with anxiety disorders, people with OCD may

prefer distress in the present if there is even a chance of preventing future adverse consequences. This hypothesis is highly speculative and merits further investigation.

Our third and final aim was to examine the relationship between a behavioral measure, the Beads Task, and self-reported IU. Results from the neutral and self-referent Beads Task are consistent with prior studies that found no differences in performance between non-anxious individuals and those with other forms of psychopathology, such as anxiety disorders, OCD, and body dysmorphic disorder (Jacoby et al., 2014; Reese et al., 2011). The lack of differences between the SAD and non-anxious group on the idiographic version of the task is partially consistent with a study using a different, but socially relevant, version of the probabilistic reasoning task (Schlier, Helbig-Lang, & Lincoln, 2016). The authors observed no differences in the number of socially relevant stimuli non-anxious and subjects with SAD viewed before making a decision. As was the case in our study, Schlier et al. (2016) also found that both non-anxious and socially anxious subjects requested less information before making decisions about self-relevant stimuli than about neutral information. Researchers have theorized that this phenomenon may arise because people may tend to respond to social evaluation with "threat confirmatory reasoning" (Schlier et al., 2016, p. 53; Dudley & Over, 2003). However, in the same study, the socially anxious group made higher confidence ratings of their decisions in the self-referent task. That we did not observe the same effect may be due to the fact that we used self-selected words whereas Schlier and colleagues used more detailed social situations in the task.

Our analyses revealed no association between self-reported IU and performance on either version of the probabilistic reasoning task, with the exception of non-anxious subjects. In both easy and difficult versions of the Beads Task, total IUS-12 scores were significantly correlated

with the number of beads non-anxious subjects chose to view. It is unclear why this association

was specific to the non-anxious group, but the lack of generalizability to other groups is further

evidence that the Beads Task, in and of itself, may be an inadequate behavioral measure of IU.

The lack of association between self-reported and behavioral measures of IU in the SAD group is

especially compelling given the relevance of the stimuli (positive and negative ideographic

adjectives) to people with the disorder. However, in a recent study, Jacoby, Abramowitz,

Reuman, and Blakey (2016), in an effort to improve its ecological validity, modified the original

task to include the threat of a negative outcome (i.e., cold pressor task, which is used to induce

physical discomfort) if subjects guessed the wrong color of the beads. The authors found that the

level of distress subjects endured while doing the Beads Task was positively associated with self-

reported inhibitory IU. Hence, people's emotional response to the Beads Task may be a more

accurate measure of IU than is their actual performance on it.

Our study has limitations. First, it was designed to clarify aspects of IU in people with

OCD. We included an anxious control group to test whether any IU findings are specific to

OCD. We did not intend, however, to examine the specific relationship between different anxiety

disorders and IU. Therefore, we did not exclude individuals with comorbid anxiety disorders

from participating in the study. Consequently, our sample has high rates of comorbidity.

Although we believe that this strengthens the ecological validity of our study, it precludes us

from drawing strong conclusions about how IU is related specifically to SAD versus GAD, etc.

Second, our OCD group was significantly younger than was the non-anxious group. Given that

subjects were not randomly assigned to groups, it would be statistically inappropriate to "control

for" age differences (Miller & Chapman, 2001). However, we do not have any a priori

hypotheses to believe that age differences would influence how individuals perform on any of the study's measures.

In conclusion, this study provides further evidence that IU may not figure prominently in all individuals with OCD, but rather may play a more consistent role in anxiety disorders such as SAD and GAD. Interestingly, all test groups showed biased estimations of likelihood of experiencing both negative and positive events that varied significantly from the actual probabilities stated in the questions; this finding may have interesting implications for cognitive treatment for OCD and other disorders. Finally, building on prior research, we found little evidence that self-reported IU is associated with performance on neutral or idiographic versions of the Beads Task. Future studies to identify behavioral measure of IU are warranted.

Paper 3: Affective Forecasting Accuracy in Obsessive-Compulsive Disorder

Dianne M. Hezel, Bradley C. Riemann, Richard J. McNally

Abstract

Research indicates that people suffering from obsessive-compulsive disorder (OCD) possess several cognitive biases, including a tendency to overestimate threat and avoid risk. Studies have suggested that people with OCD not only overestimate the severity of negative events, but also underestimate their ability to cope with such occurrences. What is less clear is if they also miscalculate the extent to which they will be emotionally impacted by a given experience. The aim of the current study was twofold. First, we examined if people with OCD are especially poor at predicting their emotional responses to future events (i.e., *affective forecasting*). Second, we analyzed the relationship between affective forecasting accuracy and risk assessment across a broad domain of behaviors. Forty-two non-anxious, 41 OCD, and 40 socially anxious subjects completed an affective forecasting task and a self-report measure of risk-taking. Findings revealed that affective forecasting accuracy did not differ among the groups. Additionally, there was little evidence that affective forecasting errors are related to how people assess risk in a variety of situations. We discuss the implications of these findings for the treatment of OCD.

Introduction

The two hallmarks of obsessive-compulsive disorder (OCD) are the presence of repetitive intrusive thoughts and compulsive rituals (APA, 2013). Though compulsions can take many forms, they are commonly performed to prevent feared outcomes associated with obsessive thoughts. For example, people who experience disturbing thoughts about being contaminated or contracting an illness may wash their hands repeatedly in an attempt to reduce the risk of contamination. Moreover, people with the disorder frequently avoid situations or objects that trigger their obsessions and compulsions (Salkovskis, 1991; Storch et al., 2010). Though one can imagine that some of the feared outcomes really are as bad as people imagine (e.g., the negative repercussions of killing someone or molesting a child), there are a host of others that are likely not as detrimental as some patients expect (e.g., contracting an illness, vomiting, feeling that something is "not just right," insulting someone, forgetting some important information, etc.). In fact, many of these outcomes are common occurrences that the majority of people experience throughout their lives. Cognitive-behavioral theorists attribute this proclivity for overestimating the negative valence of feared outcomes to dysfunctional beliefs held by people with OCD (Rachman, 1997; Salkovskis, 1985).

Overestimation of threat, or the tendency to exaggerate the likelihood and severity of negative events, is one dysfunctional thought to contribute to the etiology and phenomenology of OCD (OCCWG, 1997, 2001, 2005). Support for this definition has come primarily from studies that measure overestimation of threat with the Obsessive Beliefs Questionnaire (OBQ; OCCWG, 2005), which asks individuals to indicate the extent to which they agree with a number of statements about threat and other beliefs associated with the disorder (heightened responsibility, significance of thoughts, etc.; Moritz & Jelinek, 2009). However, because the OBQ includes

71

questions about both facets, it is unclear if people with OCD overestimate the likelihood of harm in general (e.g., the probability of harm is high for everyone) or their personal susceptibility to harm (e.g., I am more likely than others to be harmed; OCCWG, 1997). Using measures other than the OBQ, studies seeking to clarify this distinction have failed to find a relationship between OCD symptoms and general overestimation of harm in clinical samples (Moritz & Jelinek, 2009; Moritz & Pohl, 2006; Woods, Frost, & Steketee, 2002). Indeed, Moritz and Pohl (2006) found that obsessive-compulsive subjects did not differ from healthy controls in estimations of overall harm (e.g., "How many people die each year as a consequence of domestic fires in Germany?"), and that both groups displayed a similar tendency to *underestimate* the probability of these outcomes. However, compared to those without the disorder, obsessive-compulsive subjects expressed more worry, and in cases in which they overestimated the likelihood of negative events, less relief when presented with the actual statistics for the frequency of these incidents.

Similarly, Moritz and Jelinek (2009) found that when asked to guess the frequency of OCD-related, negative, and positive events, people with the disorder indicated they are more susceptible than are others to experience negative outcomes, whereas healthy subjects believed they were more likely than others to experience positive events. The authors concluded that people with OCD may lack an unrealistic optimism bias – the belief that one is less likely to experience harm or more likely to experience positive outcomes than are others – that non-anxious individuals possess. The same study revealed that subjects with OCD were more likely to rate OCD-related and adverse events more negatively and pleasant events less positively than did non-OCD subjects (Moritz & Jelinek, 2009). A study by Woods et al. (2002) suggested that people with the disorder not only overestimate the severity of negative events, but also underestimate their ability to cope with such occurrences. What is less clear is if individuals

suffering from OCD also miscalculate the extent to which they will be emotionally impacted by a given experience. Given their tendency to overestimate and avoid threat, it is possible that individuals with OCD are especially inaccurate at predicting their emotional responses to future events; that is, they may be especially poor at *affective forecasting* (Wilson & Gilbert, 2003).

Research on affective forecasting indicates that people generally miscalculate the emotional impact that different experiences will have on their lives. Specifically, people tend to overestimate both the magnitude and duration of their emotional response to positive (e.g., winning the lottery) and negative (e.g., getting fired) events (less common is the tendency to *underestimate* one's emotional response). Though this *impact bias* error may motivate individuals to avoid negative outcomes, Wilson and Gilbert (2005) posit that it may likewise have negative implications. They suggest that "overestimating the impact of negative events [may create] unnecessary dread and anxiety about the future" (p. 134). It seems plausible then that individuals with anxiety and related disorders may possess an especially pronounced impact bias that causes them to fear and avoid certain situations. Using an experience sampling task, Wenze, Gunthert, and German (2012) found that people, irrespective of anxious and depressive symptoms, inaccurately predicted that they would experience a greater negative affect over the course of the week than they actually did. However, anxious participants demonstrated even more biased predictions than did non-anxious participants. Though this study suggests that anxiety is associated with especially inaccurate affective forecasting ability, it used a non-clinical sample and did not distinguish between people with specific disorders. The present study is designed to examine affective forecasting accuracy in individuals meeting diagnostic criteria for OCD.

Moreover, we investigated the relationship between affective forecasting accuracy and risk assessment in OCD. Research indicates that overestimation of threat may be related to other dysfunctional thoughts and behaviors associated with OCD (OCCWG, 1997), including avoidance of risk (Admon et al., 2012). Indeed, if people believe that danger is widespread or that they are especially vulnerable to harm, they may make a greater effort to avoid potentially unsafe situations. Likewise, it is possible that people who believe they will be more emotionally impacted by negative outcomes will also be less likely to engage in risky behavior. Therefore, in the current study, we asked individuals with OCD, a clinical control group of socially anxious people, and those with no anxiety disorders to evaluate the potential risk and reward associated with a number of behaviors across different domains (e.g., health, financial, social, etc.). We hypothesized the clinical groups would make less accurate affective forecasts than non-anxious individuals, and that a greater discrepancy between predicted and actual emotional response would be associated with self-reported risk assessment across domains.

Methods

Subjects

The subjects were 123 people who, based on a diagnostic clinical interview, were assigned to one of three groups: OCD with or without comorbid anxiety disorders ("OCD"; n = 41, 63% female), social anxiety disorder (SAD) with no comorbid OCD ("SAD"; n = 40, 55% female and one transgender woman), and non-anxious and non-OCD ("non-anxious"; n = 42, 36% female). Recruitment methods comprised postings on public notice boards, hospital treatment clinics, and local university job boards and study pools accessible to adults in the Boston area. In addition, a subset of subjects was recruited from an OCD treatment center

(consisting of residential, partial hospitalization, and intensive outpatient levels of care) at Rogers Memorial Hospital in Oconomowoc, Wisconsin. All participants were compensated at the rate of $10 per hour or with study pool credit.

Materials and Procedures

A brief phone screen determined people's eligibility prior to their enrolling in the study and all subjects provided written informed consent as approved by Harvard's Committee on the Use of Human Subjects and in compliance with the Helsinki Declaration. All study materials were completed in person in private testing rooms in Massachusetts and Wisconsin (only OCD subjects recruited from Rogers Memorial Hospital were tested there). The first author assigned subjects to one of three groups based on the MINI International Neuropsychiatric Interview (Sheehan et al., 1998), a semi-structured measure for diagnosing DSM-IV disorders. Subjects meeting criteria for OCD were also assessed with the clinician-rated Yale-Brown Obsessive-Compulsive Scale (YBOCS) and symptom checklist (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989) to determine symptom severity and presence of specific OCD subtypes (e.g., contamination, symmetry, etc.). The measure consists of 10 questions and yields a total score of zero (no symptoms) to 40 (extreme symptoms). The gold-standard measure of OCD symptom severity, the YBOCS is psychometrically sound and responsive to clinical change (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989).

All groups then completed a battery of self-report and behavioral measures as a part of a larger investigation of biased thinking in OCD. Time to completion of the entire study was approximately one and a half to two hours, and subjects were permitted breaks between tasks if

necessary. Irrespective of diagnosis, all subjects completed The Obsessional Beliefs Questionnaire (OBQ-44), a self-report measure of beliefs common in OCD (OCCWG, 2001, 2003, 2005). Consisting of 44 questions, the OBQ asks people to indicate the extent to which they agree or disagree with statements about inflated responsibility and threat estimation, importance and significant of thoughts, and intolerance of uncertainty and perfectionism. High scores indicate greater presence of dysfunctional thoughts. The scale has strong psychometric properties and has been used in both non-clinical and clinical samples (OCCWG, 2005). The internal consistency in our sample was alpha = .97 (all subscales: αs $\geq$ .91).

Social anxiety symptoms of all subjects, irrespective of diagnostic group, were assessed with the Liebowitz Social Anxiety Scale (LSAS), a self-report measure of social anxiety symptoms (Liebowitz, 1987). With a maximum score of 144, the LSAS asks individuals to indicate the extent to which they fear and avoid different social and performance situations, including hosting a party or speaking to authority figures. Studies have established it as a valid measure of social anxiety with strong internal and external consistency (Fresco et al., 2001) and suggest that a score of 30 indicates clinical levels of social anxiety disorder (Mennin et al., 2002; Rytwinski et al., 2009). The internal consistency in our sample was α = .98.

We included a 20-item dimensional measure of depressive symptoms with the Center for Epidemiologic Studies Depression Scale Revised (CESD; Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). With possible scores ranging from zero to 60 and a clinical cutoff of 16, the self-report measure assesses the frequency (*rarely or none of the time* to *most or almost all the time*) with which people have experienced depressive symptoms (e.g., sleep and appetite disturbances, low mood, psychomotor abnormalities) over the most recent week. The CESD has high internal consistency and sensitivity, and performs well with subjects of diverse ages (Lewinsohn, Seeley,

Roberts, & Allen, 1997; Radloff, 1977). In the current sample, the scale's internal consistency was α = .95.

The Domain-Specific Risk-Taking (DOSPERT) Scale is a 30-item questionnaire that asks subjects to rate how risky, beneficial, and likely they are to engage in a number of activities in different domains, including financial, health and safety, social, recreational, and ethical (Blais & Weber, 2006). Examples include "admitting that your tastes are different from those of a friend" (social domain), "driving a car without wearing a seat belt" (health/safety domain), and "taking a skydiving class" (recreational domain). The DOSPERT has high internal consistency (Blais & Weber, 2006), including in the present study.

To examine affective forecasting accuracy, we used a task developed by Kermer, Driver-Linn, Wilson, and Gilbert (2006). When subjects first arrived at the lab, they were each given $5, which they were told they could keep. They were then asked to privately record (i.e., on a computer outside of the view of the experimenter) their current affective state – that is, how happy, sad, pleased, and disappointed they felt – on a scale ranging from zero (*not at all*) to 100 (*extremely*). Subjects were then asked to predict on the same scale how happy, sad, pleased, and disappointed they would feel immediately and ten minutes after a coin toss in which they win or lose money (heads they lose $3, tails they win an additional $5). Then after completing the clinical interview and study measures described above, subjects viewed a virtual coin flip on the computer; half of subjects won the coin toss and were given an additional $5 whereas the other half lost the coin toss and were penalized $3. Subjects then rated their affect again both immediately after and 10 minutes after the coin flip (after providing their immediate reaction, subjects completed a 10-minute self-report measure unrelated to the gambling task).

Data Analysis Plan

To compare affective forecasting accuracy among the three groups, we first calculated the difference between subjects' baseline affect when making the forecast and their predicted affect. For example, if a person's baseline happiness was 10 and she predicted that her happiness would increase to 30 after winning $5, then her affective forecast for this emotion would be recorded as +20. If the same person predicted that her sadness would fall by 20 points after winning, then her affective forecast for sadness would be recorded as -20. Next, we calculated the difference scores between affect just prior to the coin task and immediately following the coin toss. If the same person rated her happiness as 40 just prior to the coin toss and then 50 just after it, then her actual happiness score would be recorded as +10. If her sadness fell from 20 to 0, then her actual sadness score would be -20. In this example, the subject overestimated how happy she would be by 10 points, but accurately predicted how sad she would be. We then performed a 3 (group: OCD, SAD, non-anxious) x 2 (outcome: win or lose) x 2 (affect: predicted and actual) repeated measures ANOVA to examine the groups' forecasting accuracy. Predicted change in affect was used for the first time point and actual change in affect was used for the second time point. We repeated this analysis for each of the four emotions that we measured (i.e., happy, sad, pleased, disappointed). We used the same procedure to analyze differences between predicted and actual affect ratings ten minutes following the coin toss.

Results

Preliminary Analyses

The OCD and SAD groups had higher scores than did the non-anxious group on all dimensional measures of depression, social anxiety symptoms, and dysfunctional thinking as

measured by the OBQ-44 (Table 6). The mean age of OCD subjects was 26.1 years ($SD = 8.4$),

which was significantly younger than that of the non-anxious group ($p < .001$), which had a

mean age of 37.6 ($SD = 16.1$). The SAD group had a mean age of 31.0 ($SD = 13.6$), which did

not differ from the OCD group ($p = .29$), but was marginally lower than the non-anxious group

($p = .08$). Individuals with OCD possessed moderately severe OCD symptoms, as indicated by a

mean score of 21.00 ($SD = 5.45$) on the Yale-Brown Obsessive-Compulsive Scale (Goodman,

Price, Rasmussen, Mazure, Fleischmann, et al., 1989). Several subjects met criteria for a past or

current episode of a comorbid disorder (Table 7), and 24 people in the OCD group also met

diagnostic criteria for social anxiety disorder. Both the OCD and SAD groups had social anxiety

symptoms in the clinically severe range as indicated by mean scores above 60 on the LSAS

(Rytwinski et al., 2009).

Table 6

Group Characteristics

	OCD M (SD)	SAD M (SD)	Non-Anxious M (SD)	F(2,122)	P	Effect Size r
OBQ-44 Total Score	177.46 (53.29)[a]	181.10 (37.20)[a]	121.83 (43.15)	22.50	< .001*	.52
OBQ: Respon/Threat Est	63.71 (21.49)[b]	66.50 (14.89)[b]	45.05 (17.96)	16.76	< .001*	.47
OBQ: Import of Thoughts	41.95 (16.98)[c]	38.78 (12.05)[c]	26.57 (10.79)	14.97	< .001*	.45
OBQ: IU/Perfectionism	71.80 (21.98)[d]	75.83 (18.73)[d]	50.21 (18.99)	19.71	< .001*	.50
LSAS (anxiety severity)	61.95 (31.92)[e]	71.18 (25.71)[e]	19.95 (15.74)	48.23	< .001*	.67
CESD (depression severity)	21.59 (13.26)[f]	22.28 (14.22)[f]	4.62 (6.12)	30.26	< .001*	.58

Note. * = $p \leq .05$ criteria; OBQ = Obsessive Beliefs Questionnaire; Import of Thoughts = Importance of and Need to Control Thoughts; TAF = Thought-Action Fusion; IU = Intolerance of Uncertainty; LSAS = Liebowitz Social Anxiety Scale; CESD = Center for Epidemiologic Studies Depression Scale
Means that share the same superscript letter do not significantly differ from one another.

Table 7

DSM Diagnoses

| Diagnosis	OCD *n (%)*	SAD *n (%)*	Non-Anxious *n (%)*
Obsessive-Compulsive Disorder	41 (100%)	0	0
Social Anxiety Disorder	23 (56%)	40 (100%)	0
Major Depressive Disorder	26 (63%)	25 (62.5%)	6 (14%)
Bipolar Disorder (I & II)	6 (15%)	4 (10%)	1 (2%)
Generalized Anxiety Disorder	19 (46%)	16 (40%)	0
Panic Disorder (with & without Agoraphobia)	6 (15%)	5 (12.5%)	0
Agoraphobia (without Panic Disorder)	1 (2%)	2 (5%)	0
PTSD	1 (2%)	1 (2.5%)	0
Substance Use Disorders	6 (15%)	4 (10%)	4 (9.5%)

Affective Forecasting

A multivariate analysis of variance (MANOVA) indicated that the groups' baseline affect

(i.e., when they made their affective forecasts) differed significantly. The analysis indicated that

the OCD and SAD groups were less happy ($F(2,120) = 7.01$, $p = .001$, $r = .32$, 90% CI[0.16,

0.43]) and pleased (($F(2,120) = 7.12$, $p = .001$, $r = .33$, 90% CI[0.17, 0.43]) and more sad

($F(2,120) = 18.60$, $p < .001$, $r = .49$, 90% CI[0.36, 0.57]) than was the non-anxious group.

Moreover, the socially anxious group was more disappointed at baseline than both the non-

anxious and OCD groups ($F(2,120) = 8.87$, $p = .001$, $r = .36$, 90% CI[0.21, 0.46]), whose scores

did not differ from one another.

In each group, a similar number of subjects made incorrect predictions in the direction in

which their emotions would change after the gambling task. That is, 12 non-anxious subjects

(29%), 13 OCD subjects (32%), and 11 SAD subjects (28%) made at least one unexpected

80

prediction in the valence of their emotional response to winning or losing money, such as feeling more happy or pleased after losing money or feeling more sad or disappointed after winning money. However, mean scores indicated that the direction of predicted and actual change were in the same direction for each group and each emotion. Indeed, results from the repeated measures ANOVAs indicated a main effect of outcome for all emotions, such that subjects who won the coin toss experienced mean increases of happiness and pleasure and mean decreases in sadness and disappointment compared to subjects who lost the coin toss and subsequently experienced changes in the opposite directions, respectively (all ps < .001). Other effects varied by emotion. For happiness (*Figure 6*), there was a main effect of affect, such that subjects' experienced a more positive impact on happiness after the coin toss than they predicted, regardless of if they won or lost money ($F(1, 117) = 25.66$, $p < .001$, $r = .42$, 90% CI[0.29, 0.53]). That is, subjects in the loss condition experienced less of a decrease in happiness than they had anticipated whereas those in the win condition experienced a greater increase in happiness than they had expected.
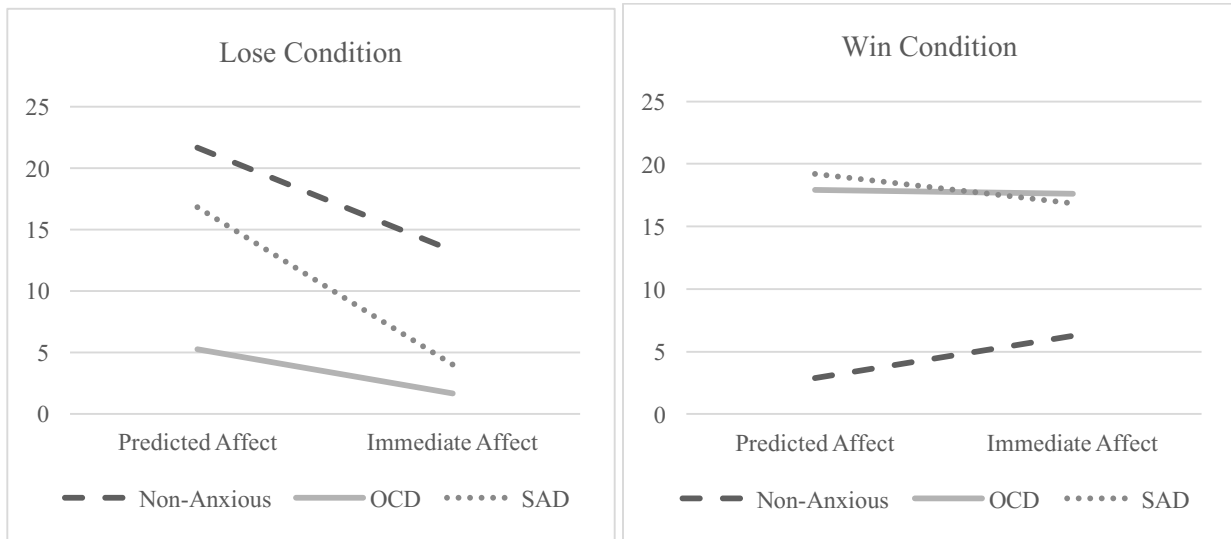
Figure 6. Predicted Impact vs. Actual Impact on Happiness
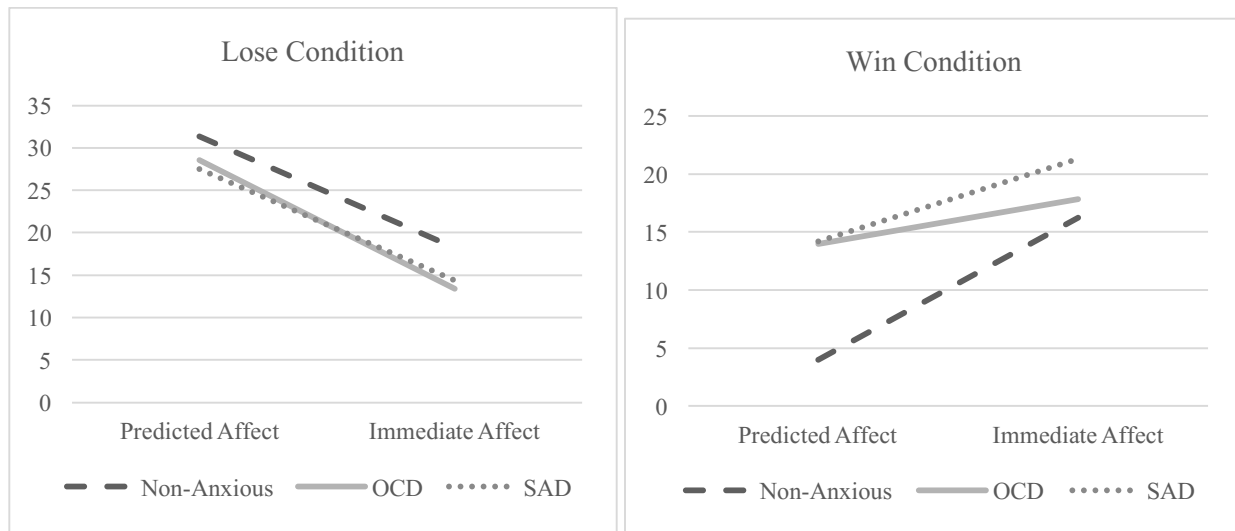
* The y-axis indicates magnitude of impact, whether positive or negative (i.e., absolute values). For the lose condition above, the scores represent magnitude of negative change. Absolute mean scores are shown to improve clarity for comparing magnitude of impact between win and lose conditions. Greater distance from the x-axis indicates greater *impact* on affect (i.e., happiness). All groups in the lose condition predicted and experienced a mean decrease in happiness after losing money.

For sadness (see *Figure 7*), there was a main effect of group, indicating that non-anxious subjects predicted and experienced a more negative impact on sadness than did the OCD and SAD groups ($F(2,117) = 8.51, p < .001, r = .36$, 90% CI[0.20, 0.46]) overall (i.e., greater increases in sadness after a loss and smaller decreases after a win). There were also two differences trending toward significance. First, a main effect for affect showed that all groups experienced less change in levels of sadness than they predicted ($F(1, 117) = 3.23, p = .08$), indicating they overestimated the impact of outcome on their level of sadness. Second, an interaction between affect and outcome indicated that subjects' predictions were less accurate in the loss condition (more steep lines observed) than in the win condition (more horizontal lines observed; $F(1, 117) = 2.91, p = .09$). That is, people more greatly overestimated increases in sadness after losing money, whereas their predictions were more accurate regarding the win scenario.

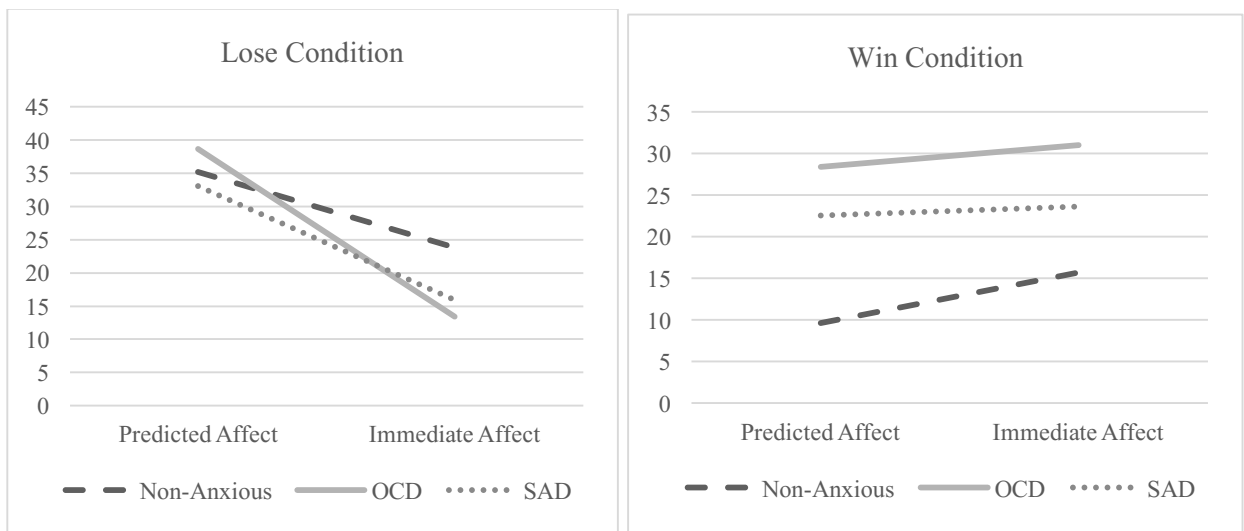*Figure 7.* Predicted Impact vs. Actual Impact on Sadness

* The y-axis indicates magnitude of impact, whether positive or negative (i.e. absolute values). For the win condition above, the scores represent magnitude of negative change. Absolute mean scores are shown to improve clarity for comparing magnitude of impact between win and lose conditions. Greater distance from the x-axis indicates greater *impact* on affect (i.e., sadness). All groups in the win condition predicted and experienced a decrease in sadness after winning money.

Next, we examined subjects' affective forecasting accuracy about feeling pleased (*Figure 8*). We found a main effect of affect such that all subjects experienced a greater impact on feeling pleased than they predicted, regardless of outcome ($F(1, 117) = 17.73$, $p < .001$, $r = .36$, 90% CI[0.22, 0.48]). Specifically, individuals who lost money overestimated a drop in feeling pleased whereas people who won money underestimated an increase in feeling pleased. In addition, there was also a significant interaction between affect and outcome (($F(1, 117) = 8.47$, $p = .004$, $r = .26$, 90% CI[0.11, 0.39]), such that prediction was less accurate by those who lost money versus those who won it. That is, people in both conditions were more pleased after the coin toss than they had predicted, the group that lost money to a larger degree than the one that won (i.e., the loss group's pleased ratings decreased less than they had anticipated, whereas people in the win

condition were more accurate in predicting how their pleased levels would change). Moreover,

there was a main effect of group, ($F(2, 117) = 3.11$, $p = .05$, $r = .22$, 90% CI[0.01, 0.34]);

pairwise analyses revealed that people with OCD predicted and experienced greater impacts in

how pleased they felt overall than the non-anxious group, but this difference did not reach

significance after correcting for multiple comparisons, ($p = .08$).

Figure 8. Predicted Impact vs. Actual Impact in Feeling Pleased

* The y-axis indicates magnitude of impact, whether positive or negative (i.e., absolute values).
For the lose condition above, the scores represent magnitude of negative change. Absolute mean
scores are shown to improve clarity for comparing magnitude of impact between win and lose
conditions. Greater distance from the x-axis indicates greater *impact* on affect (i.e., pleased). All
groups in the lose condition predicted and experienced a decrease in feeling pleased after losing
money.

Finally, for disappointment, there were significant interactions between affect and outcome

(($F(1, 117) = 3.97$, $p = .05$, $r = .18$, 90% CI[0.01, 0.32]), such that those who lost money

overestimated their disappointment, but those who won money were more accurate in predicting

their level of disappointment (see *Figure 9*). There was also a significant interaction between

group and outcome (($F(2, 117) = 4.14$, $p = .02$, $r = .26$, 90% CI[0.08, 0.37]), such that the non-

anxious subjects predicted and experienced less impact on disappointment in the win condition

(decreased disappointment) than in the loss condition (increased disappointment). That there

were no significant interactions between group and affect for any of the emotions indicates that

no group was more or less accurate than the others at predicting the emotional impact of winning

or losing money.

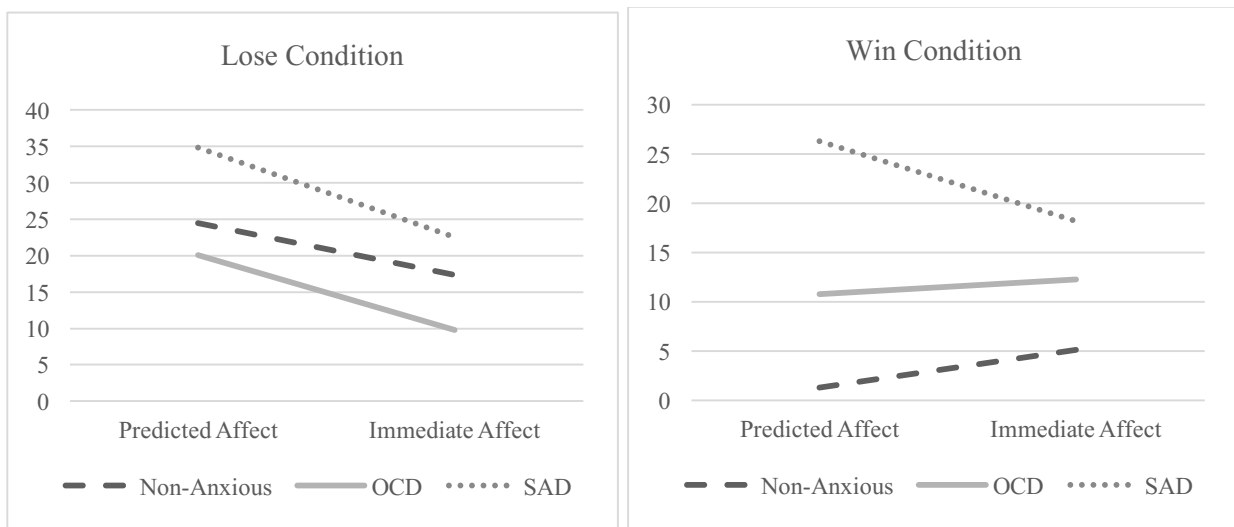*Figure 9*. Predicted Impact vs. Actual Impact in Disappointment

* The y-axis indicates magnitude of impact, whether positive or negative (i.e. absolute values).
For the win condition above, the scores represent magnitude of negative change. Absolute mean
scores are shown to improve clarity for comparing magnitude of impact between win and lose
conditions. Greater distance from the X-axis indicates greater *impact* on disappointment. All
groups in the win condition predicted and experienced a decrease in disappointment after
winning money.

Next, we examined the accuracy of the groups' forecasts of their emotions ten minutes

following the coin toss.[6] A similar pattern of results emerged for all four emotions. The main

effect of outcome showed that subjects who won money predicted and experienced greater

---

[6]We omitted the data of five subjects (one non-anxious, three OCD, and one SAD) from this
analysis because less or more than ten minutes had elapsed after the coin toss when they made
their affect ratings.

increases in happiness and pleased ratings and greater decreases in sadness and disappointed

ratings than those who lost money (all $ps \leq .001$). A main effect of affect indicated that ten

minutes after the coin toss people had greater increases in happiness and pleased feelings and

experienced a greater change in sadness and disappointment than they had predicted (all $ps <$

.03), regardless of winning or losing money. Finally, an interaction between affect and outcome

revealed that people made bigger errors in forecasting the change in how happy (($F(1, 112) =$

11.44, $p = .001$, $r = .30$, 90% CI[0.16, 0.43]) and pleased (($F(1, 112) = 21.80$, $p < .001$, $r = .40$,

90% CI[0.27, 0.51]) they would be in response to losing money than to winning money. That is,

affective forecasting discrepancy was larger in people who lost money. The pattern of results

differed for negative emotions, however. Subjects who lost money experienced a greater

decrease in disappointment than they predicted ten minutes following the coin toss, whereas

subjects who won money experienced greater increases in sadness and disappointment than they

had predicted ($ps < .001$).[7]

Risk Assessment

To determine how groups evaluated the risks, benefits, and the likelihood that they would

engage in a range of different behaviors, we performed separate MANOVAs for each subscale of

the DOSPERT. There were no differences in how groups rated the benefits of behaviors in any

domain (all $ps \geq .11$), but a main effect of group revealed that both the socially anxious and OCD

groups rated financial behaviors (e.g., investing in a speculative stock) as more risky than did the

non-anxious group, $F(2, 120) = 5.00$, $p = .01$, $r = .28$, 90% CI[0.11, 0.39]). There was also a

trend toward a significant difference such that subjects with SAD rated social behaviors (e.g.,

---

[7]Given the high rate of comorbid social anxiety disorder in our OCD group, we repeated the affective forecasting analyses after separating subjects with both disorders into a fourth group. The new groups consisted of 17 people with OCD and 24 with comorbid OCD and SAD. Findings did not differ from the original analyses.

admitting that one's tastes are different from those of a friend) as more risky than did the non-anxious group, though this difference failed to reach statistical significance ($p = .06$). The only group difference that emerged on the likelihood subscale of the DOSPERT revealed that socially anxious subjects stated they were more likely to engage in risky health/safety behaviors (e.g., sunbathing without sunscreen) than was the non-anxious group ($F(2, 120) = 3.77$, $p = .03$, $r = .24$, 90% CI[0.06, 0.36]); there were no differences between OCD and either of the other groups on the likelihood subscale (all $ps \geq .19$).

Finally, we examined the relationship between affective forecasting accuracy and risk assessment, as measured by the DOSPERT. First, we calculated the discrepancy between all subjects' predicted and actual forecasts, as described above. We then correlated those discrepancy scores with the risk ratings on the DOSPERT. A Pearson correlation showed no significant associations between affective forecasting accuracy and perceived risk on any of the domains (all $ps \geq .08$), with one exception. Specifically, discrepancies in happiness forecasts were positively correlated with assessment of risk in ethical situations (e.g., taking credit for someone else's work, having an affair, etc.), $r = .28$, $p = .002$. This association suggests that the less accurate people were in predicting how happy they would be after winning or losing money the more risk they assigned to different ethically questionable actions.

Discussion

Our first aim was to evaluate the affective forecasting accuracy of individuals with OCD relative to people without the disorder. Contrary to our hypothesis, we did not find any evidence that people with OCD, or those with social anxiety disorder, differ in their ability to predict their positive or negative emotional response to winning or losing money. Indeed, the only group

differences that emerged showed that, relative to the other groups, non-anxious individuals predicted and experienced greater change in levels of sadness after losing and winning money, and they made more accurate forecasts of how disappointed they would be in response to winning money and overestimated their disappointment to losing it. However, the absence of any group by affect interaction indicates that no group was more or less *accurate* at predicting its response than were the others. These findings suggest that people with OCD and social anxiety do not possess a global deficit in predicting their emotional response to positive or negative events relative to people without these disorders. Our results deviate from those of Wenze et al. (2012), who found that depressive and anxiety symptoms predicted more biased affective forecasts in a nonclinical sample. One potential explanation for this difference is that their study asked subjects to predict their mood in general over the course of a week, whereas our study focused on the response directly and ten minutes following a specific event. Thus, it is feasible that people with anxiety and depressive disorders overestimate their negative affect in general, but that their predictions about their reactions to specific events are as accurate as non-affected people's. It is also possible that OCD subjects demonstrate a bias in predicting their response to feared outcomes that align with the content of their specific OCD symptoms. However, given practical and ethical considerations, it would be difficult to test this idea in a laboratory setting (e.g., intentionally making a person physically ill).

All groups demonstrated a tendency to overestimate both the increase in negative emotions and the decrease in positive emotions after losing money. Moreover, with respect to both disappointment and pleasure, the discrepancy between people's forecast and actual emotional impact was larger for those who lost money than for those who won it. Subjects in the win condition also experienced more positive emotions than they predicted, but were more

accurate than were those in the loss condition. These finding are consistent with Kermer et al. (2006), who observed that people overestimated the emotional impact of losing money, but provided more accurate estimates of their response to winning money following the same gambling task. These results indicate that people are especially biased when anticipating negative outcomes. Analyses on sustained emotional response ten minutes following the coin toss were consistent with this pattern. In addition, people who won money were more likely to overestimate the impact of winning money on their mood after ten minutes, such that they were more disappointed than they expected ten minutes after the coin toss.

The finding that individuals have difficulty accurately predicting both their immediate and continued response to different outcomes (especially negative ones) has interesting implications for treatment of OCD. Prior research suggests that expectations of a situation can influence subsequent affective experience of the same situation (Wilson, Lisle, Kraft, & Wetzel, 1989; Wilson & Gilbert, 2003). If the experience does not differ significantly from expectations, then the individual's forecast will be strengthened (e.g., one who expects to like a book and actually enjoys it will rate the book more favorably than will those without any prior expectations of it). Conversely, a contrast effect will occur if a person's expectations and experience are highly discordant and the person recognizes this discrepancy (Wilson et al., 1989; Geers & Lassiter, 1999; Wilson & Gilbert, 2003). In this instance, one who expects to like a book but does not enjoy it will like it less than those without any prior expectations of it.

In exposure and response prevention (ERP) therapy, the gold-standard treatment for OCD (Franklin & Foa, 2002; Jenike, 2004), patients are exposed to situations/stimuli they fear and refrain from engaging in the rituals they would usually perform to offset their anxiety. With repeated exposures to the same situation, individuals commonly experience habituation, or a

decrease in anxiety (Jenike, 2004). In order to measure changes in anxiety over the course of an exposure, treaters often ask patients to report their subjective units of distress (SUDs) before, during, and after a session ERP (Foa & Goldstein, 1978). In some instances, patients experience a significant decrement in SUDs, whereas in others their anxiety decreases minimally or not at all. Given the literature on affective forecasting and contrast effects, it is possible that when individuals experience lower SUDs during an exposure than they had anticipated, they will become more quickly habituated to the situation and, subsequently, may make more rapid treatment gains than those with more accurate predictions. Indeed, Rescorla and Wagner's (1972) model of classical conditioning asserts that individuals learn faster when their expectations are highly discrepant from their experience. Therefore, patients may show faster improvement in OCD symptoms when they overestimate their SUDs during and following an exposure. Moreover, the trend in the results suggests that OCD subjects predicted and experienced more positive impacts on how pleased they felt after a win on the gambling task may have implications for ERP. One possibility is that designing exposures that are more likely to result in success for the patient could more strongly impact their pleasure and, therefore, their motivation to continue treatment. These possibilities merit further exploration.

A second aim of our study was to examine if affective forecasting accuracy was related to perceived risk associated with various activities. Results of a correlational analysis revealed this was only the case within one domain of behavior. Specifically, poorer happiness forecasting was correlated with greater risk assessment regarding ethical situations (e.g., taking questionable deductions on tax returns, not returning a lost wallet to its owner, or leaving young children alone at home while running an errand). One potential explanation for this unique relationship is that behaviors indicated in the ethical subscale of the DOSPERT are more diverse than are those

in the other domains. Whereas items in the other domains all pertain to specific outcomes that affect oneself (i.e., investing one's own money, putting oneself at physical or social risk), those in the ethical category include a range of behaviors, several having possible negative consequences for other people (e.g., taking credit for others' work, having an affair, etc.). It is therefore possible that people evaluate risk differently when it pertains to themselves versus others. Finally, the lack of group differences between the OCD and other groups in how likely they were to engage in the behaviors in different domain is consistent with a previous study that similarly found no global risk-avoidance behavior (Lorian & Grisham, 2011). Indeed, the authors asserted that a confluence of factors is likely to influence decisions about risk-taking behaviors.

Our study has limitations, including a sample with high rates of comorbidity, and with a number of subjects with comorbid OCD and social anxiety disorder. Though the presence of comorbid anxiety disorders is common in those with OCD, indicating that our OCD sample is representative of the population, the high comorbidity may render it difficult to detect differences between the OCD and SAD groups. However, our results remained consistent even after we moved subjects with comorbid OCD and SAD from the OCD group to a fourth separate group. Second, a number of our OCD subjects were in treatment with exposure with response prevention when they participated in the current study. Therefore, it is possible that they exhibited less biased affective forecasting relative to non-treatment-seeking individuals as a result of engaging in this therapy. However, a number of these patients had only just started treatment and still demonstrated moderately severe OCD symptoms, biased thinking (as measured by the OBQ-44), and observable rituals (e.g., checking behaviors, cleaning rituals, etc.). Therefore, it seems unlikely that this factor accounts for the lack of differences between our groups. Third, there were significant age differences between the OCD and non-anxious group

and a marginally significant age difference between the SAD and non-anxious group. However, we have no *a priori* reasons to expect age would impact our findings. Finally, we used a gambling task in which a small amount of money was at stake. Though this task has been used in previous research on affective forecasting, it would be interesting to test forecasting accuracy using a task with higher stakes.

In conclusion, we found no evidence for deficient affective forecasting ability in people with OCD. Rather, these individuals demonstrated the same pattern of biased forecasting that has been identified in other studies on unselected subjects. Additionally, we found little evidence that affective forecasting accuracy is related to risk assessment. The results of our study suggest that affective forecasting is unlikely to contribute to the phenomenology of OCD or social anxiety disorder. However, that people overestimate the hedonic impact of negative events might have interesting implications for the treatment of OCD and other disorders treated with exposure therapy. Moreover, the suggestion of increased predicted and experienced pleasure following a win in the OCD population can be leveraged in ERP by establishing a "set-up for success."

Discussion and Conclusion

Summary of Findings

This dissertation presents three studies that examine aspects of dysfunctional thinking in individuals with OCD. Paper one explored whether obsessive-compulsive individuals appraise all thoughts as critically as they do their own. Self-report, but not behavioral, data from paper one indicated that people with OCD and those with SAD evaluate – both directly and indirectly – their own thoughts as more significant and potentially dangerous than they do others'. This pattern of findings differed from those of non-anxious subjects, who evaluated their own and others' thoughts equally. Interestingly, self-report measures revealed that subjects with OCD and SAD had similarly elevated levels of thought-action fusion, with one exception. Specifically, the OCD group had higher scores on the TAF-likelihood-other subscale than did socially anxious subjects. This pattern suggests that strong beliefs about the potential danger that one's thoughts present to other people may distinguish OCD from anxiety disorders. However, group differences on a behavioral measure of TAF-likelihood failed to reach significance, though were trending in the same direction as those on self-reported TAF.

Paper two used a self-report measure, specifically designed for this study, to assess the level of distress that individuals with OCD experience in response to minimal uncertainty and to determine whether people with the disorder prefer negative outcomes to uncertainty, even if there is a possibility of a better outcome in the future. Findings suggested that, relative to non-anxious subjects, both obsessive-compulsive and socially anxious people experience similarly high levels of negative affect in reaction to uncertainty, but only the latter expressed a preference for negative outcomes over uncertainty. However, after repeating the findings to account for high rates of comorbid SAD in the OCD sample, we found that only the socially anxious group

93

demonstrated greater distress in reaction to minimal uncertainty, suggesting that this bias might

be more pronounced in anxiety disorders than in OCD specifically. Part two of this study tested

whether neutral and self-referent versions of a probabilistic reasoning task (i.e., the beads task)

were associated with self-report measures of uncertainty. There were no group differences in task

performance, and we found very little evidence to suggest that it is an adequate measure of

intolerance of uncertainty.

Finally, paper three addressed whether people with OCD are less accurate than are

individuals without the disorder at predicting their emotional response to positive or negative

events. We evaluated affective forecasting accuracy in people with OCD relative to socially

anxious and non-anxious individuals, and whether errors in affective forecasting were related to

risk estimation. Data showed that all groups, irrespective of diagnosis, overestimated the

intensity of their emotions in response to winning and losing money in a gambling task; there

were no group differences in accuracy about the valence, intensity, or duration of affective

response. Moreover, there was minimal support for the hypothesis that errors in predicting one's

emotional reaction to winning or losing money are associated with how a person evaluates the

risk involved in various domains of behavior.

Implications

Taken together, findings are consistent with the theory that people with OCD are more

prone to dysfunctional thinking than are non-anxious individuals. However, these studies also

revealed that people with clinical levels of social anxiety disorder possess similarly elevated

levels of biased thinking. Indeed, the OCD group did not score statistically higher than did the

SAD group on self-report and behavioral measures of thought-action fusion, intolerance of

uncertainty, or affective forecasting and threat estimation. The one notable exception to this

pattern was the likelihood-other subscale of the self-report Thought Action Fusion Scale. That is, relative to both non-anxious and socially anxious subjects, those with OCD endorsed stronger beliefs that negative thoughts are potentially detrimental to the well-being of other people. These results are consistent with prior research that identified TAF-likelihood as a factor that distinguishes people with OCD from those with social anxiety, but not other anxiety disorders (Abramowitz et al., 2003).

Our results suggest that components of TAF might have a unique association with OCD. This interpretation supports the metacognitive model of OCD, which emphasizes the central role of beliefs about one's own thoughts in the development of the disorder. The model makes an important distinction between metacognitive thoughts (e.g., "my thoughts might be harmful to others") and beliefs about the world, such as the need for perfectionism (Wells & Matthews, 1994), and states that the former are more critical to the etiology of OCD, whereas the latter are by-products of metacognitive thinking (Myers et al., 2009). Not only do metacognitive beliefs lead to other cognitive biases and anxiety, but also to the development of coping strategies such as rumination, thought monitoring, and compulsive behaviors (Fisher, 2009). A number of cross-sectional studies have shown that metacognitive appraisals – but not other dysfunctional beliefs – independently predicted OCD symptoms even after controlling for other biased thoughts (Myers et al., 2009) and that inducing metacognitive beliefs can elicit obsessive-compulsive symptoms in a non-clinical sample (Myers & Wells, 2013). Despite compelling evidence that underscores the importance of metacognitive beliefs, Chik, Calamari, Rector, and Riemann (2010) found that these thoughts are more strongly associated with OCD in groups of patients with high levels of dysfunctional (non-metacognitive) thinking than in patients with low levels of dysfunctional

thinking. Therefore, the metacognitive theory may only be relevant for a subgroup of people with the disorder.

That the OCD and SAD groups performed similarly on both self-report and behavioral measures, even after separating subjects with comorbid OCD and SAD into a separate group, has interesting implications for our understanding of how these disorders might be related. Until recently, obsessive-compulsive disorder was classified as an anxiety disorder (APA, 2000) given the high levels of distress that typically result from obsessive thoughts. Though the disorders no longer occupy the same category in DSM-5 (APA, 2013), the comorbidity between OCD and anxiety disorders is high (Bartz & Hollander, 2006) and there is evidence that the disorders share genetic underpinnings (Bienvenu et al., 2012). The fact that OCD and SAD share cognitive features, as observed in our studies, underscores the importance of understanding transdiagnostic mechanisms that underlie these problems (Insel et al., 2010).

Moreover, a new model for conceptualizing mental illness offers a strong rationale for examining the relationship among pathological symptoms, rather than treating them as reflective of underlying discrete disorders (Borsboom & Cramer, 2013; Hofmann, Curtiss, & McNally, 2016; McNally, 2016). Indeed, the network analysis approach to studying mental illness uses sophisticated statistical methods to examine the relationships among and interactions between observed symptoms. These models take into account the nature (i.e., positive or negative correlations), magnitude, and predicted direction of these associations, and explain how one symptom of a given disorder might activate a cascade of others (McNally, 2016). Consider the symptoms of depression. It is not difficult to see how sleep disturbances might subsequently lead to fatigue and difficulty concentrating. Interestingly, the network approach can also account for high comorbidity among disorders. As McNally (2016) explains in a review paper, "nonspecific

symptoms (e.g., concentration impairment) that appear in many diagnostic criteria might… serve as bridges linking two syndromes" ultimately leading to comorbidity (p. 96). Hence, network analysis might result in a better understanding of symptoms that bridge OCD and social anxiety disorder, which has subsequent implications for treatment. Developing interventions that target symptoms central to the network could, in turn, prevent other symptoms from being activated, thereby preventing onset of the disorder(s).

Though we saw clear evidence of dysfunctional beliefs in our sample, other studies have found that subgroups of OCD subjects displayed no more biased thinking than did control subjects (Calamari et al., 2006; Taylor et al., 2006). Hence, as with the metacognitive theory, dysfunctional thoughts may play a role in only certain individuals with the disorder, suggesting that biased thinking is not a prerequisite for its development. In a thought-provoking critique of the cognitive model of OCD, Cougle and Lee (2014) similarly called into question several assumptions of the theory. For example, they assert that some intrusive thoughts may be pathological in their own right (e.g., thoughts about killing one's child) and therefore do not require catastrophic misinterpretations to render them distressing. The authors argue that cognitive biases may, in fact, result from OCD symptoms rather than produce them (e.g., "I must check so much because I am a responsible person"), and that future research would benefit from further examination of other important features of the disorder, such as "frequency, duration, and dismissability of obsessions" (p. 14).

Finally, our findings have interesting treatment implications. Most notably, results from paper one revealed that people with OCD and SAD evaluate their own negative thoughts as more morally wrong and potentially harmful than they do other people's thoughts, even if the thoughts in question are identical. Hence, the TAF bias seems to be more related to a person's distorted

beliefs about themselves rather than the potential harm of thoughts in general (e.g., "there is something about me or my thoughts that are especially depraved or dangerous"). Consequently, cognitive therapy methods that focus more specifically on biased beliefs about one's personal threat to others may prove to be more effective than strategies that address how patients evaluate thoughts in general.

Limitations and Outstanding Questions

As discussed in each of the three papers that constitute this dissertation, one limitation is the high comorbidity in our sample, which we used for all three studies. In a review paper, Bartz and Hollander (2006) reported that the lifetime prevalence of comorbid anxiety disorders is as high as 23% in individuals diagnosed with OCD, and that social anxiety disorder is the most common comorbid anxiety disorder observed in this population, with lifetime prevalence rates as high as 36%. Though our sample reflects this reality, the presence of social anxiety in our OCD group limits our ability to identify biases that might be specific to SAD. However, identifying biases unique to social anxiety was not the purpose of these studies. Moreover, the dysfunctional thoughts examined in this dissertation were at one time thought to be specific to OCD, so we would not expect socially anxious subjects to uniquely demonstrate biased thinking. Unless the presence of social anxiety somehow *attenuates* cognitive biases in people with OCD, then comorbidity should not detract from the studies' findings. Indeed, including obsessive-compulsive individuals with comorbid disorders is a more stringent test since the key difference between the clinical groups is the presence of OCD. Our studies confirm that the aspects of dysfunctional thinking that we tested are not specific to or more severe in OCD, with the possible exception of TAF likelihood-other. That there were still significant differences in TAF between the groups despite high comorbidity makes this distinction all the more compelling.

A second shortcoming is that we lacked statistical power to examine the relationship between biased thoughts and specific symptom subtypes of OCD. Prior research has indicated that some beliefs may be more strongly associated with specific symptoms (Taylor et al., 2010), and a better understanding of these relationships could lead to more targeted treatments for the disorder. However, as was the case in our sample, the majority of individuals with the disorder frequently exhibit more than one symptom, and symptoms frequently change quantitatively and sometimes qualitatively over time (Besiroglu et al., 2007; Mataix-Cols et al., 2002; Skoog & Skoog, 1999). For example, a person might identify contamination-related obsessions and compulsions as the most distressing and time-consuming at one point in her life and intrusive sexual thoughts at another. Given the heterogeneity and fluctuating course of OCD, some researchers have argued for a dimensional approach to studying the disorder rather than attempting to categorize people according to one primary subtype (Leckman, Bloch, & King, 2009). Though we did not include a dimensional measure of OCD symptoms, future studies would benefit from doing so. A dimensional assessment would make it possible not only to examine the relative association between specific thoughts and symptoms in clinical samples, but also to identify correlations in individuals who do not meet criteria for OCD.

Our studies included both self-report and behavioral measures of dysfunctional thoughts. Whereas the self-report scales revealed group differences, behavioral measures of thought-action fusion and intolerance of uncertainty did not. Though we did not specifically ask subjects how accurate they think they are at predicting their emotional response to positive and negative outcomes, their actual affective forecasting accuracy did not differ from others'. Given recognized shortcomings of self-report measures (Paulhus & Vazire, 2007), there is a need to develop and test new behavioral measures of dysfunctional thinking. Indeed, research on other

factors associated with OCD, including memory and attentional biases, indicates that people with the disorder have lower confidence in their abilities, but do not demonstrate deficits on actual measures of cognitive ability (Hezel & McNally, 2016). Likewise, future research would benefit from the development of more ideographic measures.

This dissertation explored only one aspect of cognitive aberrations implicated in OCD. However, there is empirical evidence that a range of other biases and deficits may contribute to the development and maintenance of the disorder (for a review, see Hezel & McNally, 2015). Indeed, it is possible that there exists a hierarchy of cognitive processes whereby certain thoughts can lead to other cognitive irregularities in individuals with OCD. Indeed, Hirsch, Clark, and Mathews (2006) proposed a "combined cognitive biases" hypothesis for social anxiety disorder, which has since been extended to depression as well (Everaert, Koster, & Derakshan, 2012; Everaert, Tierens, Uzieblo, & Koster, 2013). The authors propose that disorders are maintained by a confluence of different cognitive factors that impact and interact with one another. To our knowledge, no studies have explicitly examined this possibility in OCD. Doing so may further elucidate the relationship among the various cognitive abnormalities associated with the disorder, thereby resulting in a fuller understanding of its etiology.

Conclusion

Early cognitive models and clinical observations of OCD postulated that dysfunctional thoughts figure prominently in the development and maintenance of the disorder. Since then, a great deal of research has confirmed that these thoughts are frequently associated with obsessive-compulsive symptoms in both non-clinical and clinical populations. The studies presented in this dissertation provide additional evidence for the prevalence of biased thinking in at least some individuals with OCD, and lend additional insight into the nature of these thoughts. Specifically,

findings suggests that relative to non-anxious individuals, those with OCD and with SAD evaluate their own thoughts as more significant and potentially harmful than they do others' thoughts, that they experience higher levels of negative affect in response to even minimal uncertainty, and that they do not possess deficits in predicting their emotional response to positive or negative events. Therefore, targeting certain biases in treatment might be more worthwhile than focusing on all domains of dysfunctional thoughts. However, future research would benefit from further examining if certain thoughts, such as thought-action fusion likelihood-other, can distinguish people with OCD from those with anxiety disorders.

Despite empirical support for the cognitive model, it is still unclear which process or processes best explain symptoms that characterize the disorder, and a full understanding of the etiology of the disorder is lacking. Moreover, as noted above, not every individual with OCD possesses the same cognitive abnormalities (e.g., there is a subset of patients who do not show increased levels of dysfunctional thinking at all). It would thus be worthwhile to identify groups of patients with shared biases (e.g., attentional biases, thought-action fusion, etc.), rather than by OCD diagnosis alone. This method would make it possible to more directly test how these specific factors are related to other etiological factors, such as genetic variants or abnormalities in neural activation. For example, research on depression has revealed that hyperactivation in certain brain regions is associated with cognitive biases in depressed individuals with a specific gene variant (Beck, 2008). Similarly, combining research from various methodologies and disciplines may result in a better understanding of obsessive-compulsive disorder.

References

Abramowitz, J. S., Deacon, B. J., Olatunji, B. O., Wheaton, M. G., Berman, N. C., Losardo, D., . . . Hale, L. R. (2010). Assessment of obsessive-compulsive symptom dimensions: Development and evaluation of the Dimensional Obsessive-Compulsive Scale. *Psychological Assessment, 22*, 180-198. doi: 10.1037/a0018260

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

Abramowitz, J. S., Lackey, G. R., & Wheaton, M. G. (2009). Obsessive-compulsive symptoms: The contribution of obsessional beliefs and experiential avoidance. *Journal of Anxiety Disorders, 23*, 160-166. doi: 10.1016/j.janxdis.2008.06.003

Abramowitz, J. S., Taylor, S., & McKay, D. (2009). Obsessive-compulsive disorder. *Lancet, 374*, 491-499.

Abramowitz, J. S., Whiteside, S., Lynam, D., & Kalsy, S. (2003). Is thought-action fusion specific to obsessive-compulsive disorder?: A mediating role of negative affect. *Behaviour Research and Therapy, 41*, 1069-1079.

Admon, R., Bleich-Cohen, M., Weizmant, R., Poyurovsky, M., Faragian, S., & Hendler, T. (2012). Functional and structural neural indices of risk aversion in obsessive-compulsive disorder (OCD). *Psychiatry Research, 203*, 207-213.

Amir, N., Freshman, M., Ramsey, B., Neary, E., & Brigidi, B. (2001). Thought-action fusion in individuals with OCD symptoms. *Behaviour Research and Therapy, 39*, 765-776. doi: S0005-7967(00)00056-5 [pii]

Anderson, A. K., & Phelps, E. A. (2001). Lesions of the human amygdala impair enhanced

        perception of emotionally salient events. *Nature, 411*, 305-309. doi: 10.1038/35077083

APA (Ed.). (2000). *Diagnostic and statistical manual of mental disorders (Revised 4th ed.).*

        Washington, DC.

APA (Ed.). (2013). *Diagnostic and statistical manual of mental disorders (5th ed.).* Washington,

        DC.

Bartz, J. A., & Hollander, E. (2006). Is obsessive-compulsive disorder an anxiety disorder?

        Progress in Neuro-Psychopharmacology and Biological Psychiatry, 30, 338-352. doi:

        10.1016/j.pnpbp.2005.11.003

Beck, A. T. (2005). The current state of cognitive therapy: a 40-year retrospective. *Archives of*

        General Psychiatry, 62, 953-959. doi: 10.1001/archpsyc.62.9.953

Beck, A. T. (2008). The evolution of the cognitive model of depression and its neurobiological

        correlates. *American Journal of Psychiatry, 165*, 969-977. doi:

        10.1176/appi.ajp.2008.08050721

Berle, D., & Starcevic, V. (2005). Thought-action fusion: Review of the literature and future

        directions. *Clinical Psychology Review, 25*, 263-284. doi: 10.1016/j.cpr.2004.12.001

Berman, N. C., Abramowitz, J. S., Wheaton, M. G., Pardue, C. M., & Fabricant, L. (2011).

        Evaluation of an in vivo measure of thought–action fusion. *Journal of Cognitive*

        Psychotherapy, 25, 155-164.

Besiroglu, L., Uguz, F., Ozbebit, O., Guler, O., Cilli, A. S., & Askin, R. (2007). Longitudinal

        assessment of symptom and subtype categories in obsessive-compulsive disorder.

        Depression and Anxiety, 24, 461-466. doi: 10.1002/da.20240

Bienvenu, O. J., Samuels, J. F., Wuyek, L. A., Liang, K. Y., Wang, Y., Grados, M. A., . . . Nestadt, G. (2012). Is obsessive-compulsive disorder an anxiety disorder, and what, if any, are spectrum conditions? A family study perspective. *Psychological Medicine, 42*, 1-13. doi: 10.1017/S0033291711000742

Blais, A.-R., & Weber, E. U. (2006). Domain-specific Risk-taking (DOSPERT) Scale for Adult Populations. *Judgment and Decision Making, 1*, 33-47.

Boehme, S., Miltner, W. H., & Straube, T. (2015). Neural correlates of self-focused attention in social anxiety. *Social and Cognitve Affective Neuroscience, 10*, 856-862. doi: 10.1093/scan/nsu128

Bogels, S. M., & Mansell, W. (2004). Attention processes in the maintenance and treatment of social phobia: hypervigilance, avoidance and self-focused attention. *Clinical Psychology Review, 24*, 827-856. doi: 10.1016/j.cpr.2004.06.005

Borsboom, D., & Cramer, A. O. (2013). Network analysis: An integrative approach to the structure of psychopathology. *Annual Review of Clinical Psychology, 9*, 91-121. doi: 10.1146/annurev-clinpsy-050212-185608

Boswell, J. F., Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Intolerance of uncertainty: A common factor in the treatment of emotional disorders. *Journal of Clinical Psychology, 69*, 630-645.

Bouchard, C., Rheaume, J., & Ladouceur, R. (1999). Responsibility and perfectionism in OCD: An experimental study. *Behav Res Ther, 37*, 239-248.

Buhr, K., & Dugas, M. J. (2002). The Intolerance of Uncertainty Scale: Psychometric properties of the English version. *Behaviour Research and Therapy, 40*, 931-945.

Buhr, K., & Dugas, M. J. (2009). The role of fear of anxiety and intolerance of uncertainty in

      worry: an experimental manipulation. *Behaviour Research and Therapy, 47*, 215-223.

Calamari, J. E., Cohen, R. J., Rector, N. A., Szacun-Shimizu, K., Riemann, B. C., & Norberg, M.

      M. (2006). Dysfunctional belief-based obsessive-compulsive disorder subgroups.

      Behaviour Research and Therapy, 44, 1347-1360. doi: 10.1016/j.brat.2005.10.005

Careau, Y., O'Connor, K., Turgeon, L., & Freeston, M. (2012). Childhood experiences and adult

      beliefs in obsessive-compulsive disorder: evaluating a specific etiological model. *Journal*

      of Cognitive Psychotherapy, 26, 236-256.

Carleton, R. N., Mulvogue, M. K., Thibodeau, M. A., McCabe, R. E., Antony, M. M., &

      Asmundson, G. J. (2012). Increasingly certain about uncertainty: Intolerance of

      uncertainty across anxiety and depression. *Journal of Anxiety Disorders, 26*, 468-479.

      doi: 10.1016/j.janxdis.2012.01.011

Carleton, R. N., Norton, M. A., & Asmundson, G. J. (2007). Fearing the unknown: A short

      version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders, 21*, 105-

      117.

Chik, H. M., Calamari, J. E., Rector, N. A., & Riemann, B. C. (2010). What do low-

      dysfunctional beliefs obsessive-compulsive disorder subgroups believe? *Journal of*

      Anxiety Disorders, 24, 837-846. doi: 10.1016/j.janxdis.2010.06.006

Coles, M. E., Frost, R. O., Heimberg, R. G., & Rheaume, J. (2003). "Not just right experiences":

      perfectionism, obsessive-compulsive features and general psychopathology. *Behaviour*

      Research and Therapy, 41, 681-700.

Coles, M. E., & Horng, B. (2006). A prospective test of cognitive vulnerability to obsessive-

      compulsive disorder. *Cognitive Therapy and Research, 30*, 723-734.

Coles, M. E., Pietrefesa, A. S., Schoefield, C. A., & Cook, L. M. (2008). Predicting changes in

obsessive-compulsive symptoms over a six-month follow-up: A prospective test of

cognitive models of obsessive-compulsive disorder. *Cognitive Therapy and Research, 32*,

657-675.

Coles, M. E., Schofield, C. A., & Nota, J. A. (2014). Initial data on recollections of pathways to

inflated responsibility beliefs in patients with obsessive-compulsive disorder.

Behavioural and Cognitive Psychotherapy, 43, 385-395. doi:

10.1017/S1352465813001112

Cougle, J. R., & Lee, H. J. (2014). Pathological and non-pathological features of obsessive-

compulsive disorder: Revisiting basic assumptions of cognitive models. *Journal of*

Obsessive-Compulsive and Related Disorders, 3, 12-20.

Dudley, R. E., John, C. H., Young, A. W., & Over, D. E. (1997). The effect of self-referent

material on the reasoning of people with delusions. *British Journal of Clinical*

Psychology, 36 (Pt 4), 575-584.

Dudley, R. E., & Over, D. E. (2003). People with delusions jump to conclusions: A theoretical

account of research findings on the reasoning of people with delusions. *Clinical*

Psychology and Psychotherapy, 10, 263-274.

Dugas, M. J., Gosselin, P., & Ladouceur, R. (2001). Intolerance of uncertainty and worry:

Investigating specificity in a nonclinical sample. *Cognitive Therapy and Research, 25*,

551-558.

Eaton, W. W., Smith, C., Ybarra, M., Muntaner, C., & Tien, A. (2004). Center for Epidemiologic

Studies Depression Scale: Review and Revision (CESD and CESD-R). In M. E. Maruish

(Ed.), *The Use of Psychological Testing for Treatment Planning and Outcomes*

Assessment, Instruments for Adults (3 ed., pp. 363–377). Mahwah, NJ: Lawrence Erlbaum.

Everaert, J., Koster, E. H., & Derakshan, N. (2012). The combined cognitive bias hypothesis in depression. *Clinical Psychology Review, 32*, 413-424. doi: 10.1016/j.cpr.2012.04.003

Everaert, J., Tierens, M., Uzieblo, K., & Koster, E. H. (2013). The indirect effect of attention bias on memory via interpretation bias: evidence for the combined cognitive bias hypothesis in subclinical depression. *Cognition and Emotion, 27*, 1450-1459. doi: 10.1080/02699931.2013.787972

First, M. B., Williams, J. B., & Spitzer, R. L. (2015). *Structured Clinical Interview for DSM-5-Research Version*. Arlington, VA: American Psychiatric Association.

Fisher, P. L. (2009). Obsessive-compulsive disorder: A comparison of CBT and the metacognitive approach. *International Journal of Cognitive Therapy, 2*, 107-122.

Foa, E. B., & Goldstein, A. (1978). Continuous exposure and complete response prevention in the treatment of obsessive-compulsive neurosis. *Behavior Therapy, 9*, 821-829.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin, 99*, 20-35.

Franklin, M. E., & Foa, E. B. (2002). Cognitive behavioral treatments for obsessive-compulsive disorder. In P. E. Nathan & J. M. Gorman (Eds.), *A guide to treatments that work* (pp. 367-386). New York: Oxford University Press.

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: a comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine, 31*, 1025-1035.

Frost, R. O., Novara, C., & Rheaume, J. (2002). Perfectionism in obsessive-compulsive disorder. In R. O. Frost & G. Steketee (Eds.), *Cognitive approaches to obsessions and compulsions: Theory, assessment, and treatment*. Oxford: Elsevier.

Frost, R. O., Steketee, G., Cohn, L., & Griess, K. (1994). Personality traits in subclinical and non-obsessive-compulsive volunteers and their parents. *Behaviour Research and Therapy, 32*, 47-56.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Delgado, P., Heninger, G. R., & Charney, D. S. (1989). The Yale-Brown Obsessive-compulsive Scale. II. Validity. *Archives of General Psychiatry, 46*, 1012-1016.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., . . . Charney, D. S. (1989). The Yale-Brown Obsessive-compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry, 46*, 1006-1011.

Hezel, D. M., & McNally, R. J. (2014). Theory of mind impairments in social anxiety disorder. *Behavior Therapy, 45*, 530-540.

Hezel, D. M., & McNally, R. J. (2016). A Theoretical review of cognitive biases and deficits in obsessive-compulsive disorder. *Biological Psychology, 121*, 221-232. doi: 10.1016/j.biopsycho.2015.10.012

Hezel, D. M., Stewart, S. E., Riemann, B. C., & McNally, R. J. (in preparation). Clarifying the thought-action fusion bias in obsessive-compulsive disorder:
The importance of likelihood.

Hirsch, C. R., Clark, D. M., & Mathews, A. (2006). Imagery and interpretations in social phobia: support for the combined cognitive biases hypothesis. *Behavior Therapy, 37*, 223-236. doi: 10.1016/j.beth.2006.02.001

Hofmann, S. G., Curtiss, J., & McNally, R. J. (2016). A complex network perspective on clinical science. *Perspectives on Psychological Science, 11*, 597-605.

Holaway, R. M., Heimberg, R. G., & Coles, M. E. (2006). A comparison of intolerance of uncertainty in analogue obsessive-compulsive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders, 20*, 158-174.

Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., . . . Wang, P. (2010). Research domain criteria (RDoC): Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry, 167*, 748-751. doi: 10.1176/appi.ajp.2010.09091379

Jacoby, R. J., Abramowitz, J. S., Buck, B. E., & Fabricant, L. (2014). How is the Beads Task related to intolerance of uncertainty in anxiety disorders? *Journal of Anxiety Disorders, 28*, 495-503.

Jenike, M. A. (2004). Clinical practice. Obsessive-compulsive disorder. *New England Journal of Medicine, 350*, 259-265. doi: 10.1056/NEJMcp031002

350/3/259 [pii]

Karno, M., Golding, J. M., Sorenson, S. B., & Burnam, M. A. (1988). The epidemiology of obsessive-compulsive disorder in five US communities. *Archives of General Psychiatry, 45*, 1094-1099.

Kazdin, A. E. (2002). *Research design in clinical psychology* (4 ed.). Boston: Allyn and Bacon.

Kermer, D. A., Driver-Linn, E., Wilson, T. D., & Gilbert, D. T. (2006). Loss aversion is an affective forecasting error. *Psychological Science, 17*, 649-653. doi: DOI 10.1111/j.1467-9280.2006.01760.x

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62*, 593-602. doi: 62/6/593 [pii]

10.1001/archpsyc.62.6.593

Kruglansky, A. W. (1990). Motivations for judging and knowing: Implications for causal attribution. In E. T. Higgins & R. M. Sorrentino (Eds.), *The handbook of motivation and cognition: Foundation of social behavior* (Vol. 2, pp. 333-368). New York: Guilford Press.

Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: A study of a theoretical model of worry. *Behaviour Research and Therapy, 38*, 933-941. doi: S0005-7967(99)00133-3 [pii]

Ladouceur, R., Leger, E., Rheaume, J., & Dube, D. (1996). Correction of inflated responsibility in the treatment of obsessive-compulsive disorder. *Behaviour Research and Therapy, 34*, 767-774.

Ladouceur, R., Rheaume, J., Freeston, M. H., Aublet, F., Jean, K., Lachance, S., . . . de Pokomandy-Morin, K. (1995). Experimental manipulations of responsibility: An analogue test for models of obsessive-compulsive disorder. *Behaviour Research and Therapy, 33*, 937-946.

Ladouceur, R., Talbot, F., & Dugas, M. J. (1997). Behavioral expressions of intolerance of uncertainty in worry. Experimental findings. *Behavior Modification, 21*, 355-371.

Leckman, J. F., Bloch, M. H., & King, R. A. (2009). Symptom dimensions and subtypes of obsessive-compulsive disorder: A developmental perspective. *Dialogues in Clinical Neuroscience, 11*, 21-33.

Levy, I., Snell, J., Nelson, A. J., Rustichini, A., & Glimcher, P. W. (2010). Neural representation of subjective value under risk and ambiguity. *Journal of Neurophysiology, 103*, 1036-1047. doi: 10.1152/jn.00853.2009

Lewinsohn, P. M., Seeley, J. R., Roberts, R. E., & Allen, N. B. (1997). Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and Aging, 12*, 277-287.

Liebowitz, M. R. (1987). Social phobia. *Modern Problems of Pharmacopsychiatry, 22*, 141-173.

Lind, C., & Boschen, M. J. (2009). Intolerance of uncertainty mediates the relationship between responsibility beliefs and compulsive checking. *Journal of Anxiety Disorders, 23*, 1047-1052. doi: 10.1016/j.janxdis.2009.07.005

Lopatka, C., & Rachman, S. (1995). Perceived responsibility and compulsive checking: An experimental analysis. *Behaviour Research and Therapy, 33*, 673-684.

Lorian, C. N., & Grisham, J. R. (2011). Clinical implications of risk aversion: an online study of risk-avoidance and treatment utilization in pathological anxiety. *Journal of Anxiety Disorders, 25*, 840-848. doi: 10.1016/j.janxdis.2011.04.008

Marcks, B. A., & Woods, D. W. (2007). Role of thought-related beliefs and coping strategies in the escalation of intrusive thoughts: An analog to obsessive-compulsive disorder. *Behaviour Research and Therapy, 45*, 2640-2651. doi: 10.1016/j.brat.2007.06.012

Mataix-Cols, D., Rauch, S. L., Baer, L., Eisen, J. L., Shera, D. M., Goodman, W. K., . . . Jenike, M. A. (2002). Symptom stability in adult obsessive-compulsive disorder: Data from a

naturalistic two-year follow-up study. *American Journal of Psychiatry, 159*, 263-268. doi: 10.1176/appi.ajp.159.2.263

Mataix-Cols, D., Rauch, S. L., Manzo, P. A., Jenike, M. A., & Baer, L. (1999). Use of factor-analyzed symptom dimensions to predict outcome with serotonin reuptake inhibitors and placebo in the treatment of obsessive-compulsive disorder. *American Journal of Psychiatry, 156*, 1409-1416.

McEvoy, P. M., & Mahoney, A. E. (2011). Achieving certainty about the structure of intolerance of uncertainty in a treatment-seeking sample with anxiety and depression. *Journal of Anxiety Disorders, 25*, 112-122. doi: 10.1016/j.janxdis.2010.08.010

McEvoy, P. M., & Mahoney, A. E. (2012). To be sure, to be sure: Intolerance of uncertainty mediates symptoms of various anxiety disorders and depression. *Behavior Therapy, 43*, 533-545. doi: 10.1016/j.beth.2011.02.007

McNally, R. J. (2016). Can network analysis transform psychopathology? *Behaviour Research and Therapy, 86*, 95-104. doi: 10.1016/j.brat.2016.06.006

Mennin, D. S., Fresco, D. M., Heimberg, R. G., Schneier, F. R., Davies, S. O., & Liebowitz, M. R. (2002). Screening for social anxiety disorder in the clinical setting: using the Liebowitz Social Anxiety Scale. *Journal of Anxiety Disorders, 16*, 661-673.

Miller, G. A., & Chapman, J. P. (2001). Misunderstanding analysis of covariance. *Journal of Abnormal Psychology, 110*, 40-48.

Moretz, M. W., & McKay, D. (2009). The role of perfectionism in obsessive-compulsive symptoms: "not just right" experiences and checking compulsions. *Journal of Anxiety Disorders, 23*, 640-644. doi: 10.1016/j.janxdis.2009.01.015

Moritz, S., & Jelinek, L. (2009). Inversion of the "unrealistic optimism" bias contributes to overestimation of threat in obsessive-compulsive disorder. *Behavioural and Cognitive Psychotherapy, 37*, 179-193.

Moritz, S., & Pohl, R. F. (2006). False beliefs maintenance for fear-related information in obsessive-compulsive disorder: An investigation with the hindsight paradigm. *Neuropsychology, 20*, 737-742. doi: 10.1037/0894-4105.20.6.737

Moritz, S., & Pohl, R. F. (2009). Biased processing of threat-related information rather than knowledge deficits contributes to overestimation of threat in obsessive-compulsive disorder. *Behavior Modification, 33*, 763-777. doi: 10.1177/0145445509344217

Muller, J., & Roberts, J. E. (2005). Memory and attention in Obsessive-Compulsive Disorder: A review. *Journal of Anxiety Disorders, 19*, 1-28. doi: 10.1016/j.janxdis.2003.12.001

Murray, C. J., & Lopez, A. D. (1996). Evidence-based health policy--lessons from the Global Burden of Disease Study. *Science, 274*, 740-743.

Myers, S. G., Fisher, P. L., & Wells, A. (2009). Metacognition and cognition as predictors of obsessive-compulsive symptoms: A prospective study. *International Journal of Cognitive Therapy, 2*, 132-142.

Myers, S. G., & Wells, A. (2013). An experimental manipulation of metacognition: a test of the metacognitive model of obsessive-compulsive symptoms. *Behaviour Research and Therapy, 51*, 177-184. doi: 10.1016/j.brat.2013.01.007

Newman, M. G., & Llera, S. J. (2011). A novel theory of experiential avoidance in generalized anxiety disorder: a review and synthesis of research supporting a contrast avoidance model of worry. *Clinical Psychology Review, 31*, 371-382. doi: S0272-7358(11)00013-4 [pii]

10.1016/j.cpr.2011.01.008

OCCWG. (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy, 35*, 667-681.

OCCWG. (2001). Development and initial validation of the obsessive beliefs questionnaire and the interpretation of intrusions inventory. *Behaviour Research and Therapy, 39*, 987-1006.

OCCWG. (2003). Psychometric validation of the Obsessive Beliefs Questionnaire and the Interpretation of Intrusions Inventory: Part I. *Behaviour Research and Therapy, 41*, 863-878.

OCCWG. (2005). Psychometric validation of the obsessive belief questionnaire and interpretation of intrusions inventory--Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy, 43*, 1527-1542.

Olatunji, B. O., Rosenfield, D., Tart, C. D., Cottraux, J., Powers, M. B., & Smits, J. A. (2013). Behavioral versus cognitive treatment of obsessive-compulsive disorder: an examination of outcome and mediators of change. *Journal of Consulting and Clinical Psychology, 81*, 415-428. doi: 10.1037/a0031865

Paulhus, D. L., & Vazire, S. (2007). The self-report method. In R. W. Robins, R. C. Fraley & R. F. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 224-239). New York: Guilford Press.

Phillips, L. D., & Ward, E. (1966). Conservatism in a simple probabilistic inference task. *Journal of Experimental Psychology, 72*, 346-354.

Purdon, C., & Clark, D. A. (2002). The need to control thoughts. In R. O. Frost & G. Steketee (Eds.), *Cognitive approaches to obsessions and compulsions: Theory, assessment, and treatment*. Oxford: Elsevier.

Pushkarskaya, H., Tolin, D., Ruderman, L., Kirshenbaum, A., Kelly, J. M., Pittenger, C., & Levy, I. (2015). Decision-making under uncertainty in obsessive-compulsive disorder. *Journal of Psychiatric Research, 69*, 166-173. doi: 10.1016/j.jpsychires.2015.08.011

Rachman, S. (1993). Obsessions, responsibility and guilt. *Behaviour Research and Therapy, 31*, 149-154. doi: 0005-7967(93)90066-4 [pii]

Rachman, S. (1997). A cognitive theory of obsessions. *Behaviour Research and Therapy, 35*, 793-802. doi: S0005-7967(97)00040-5 [pii]

Rachman, S., & Hodgson, R. J. (1980). *Obsessions and compulsions*. Englewood Cliffs, NJ: Prentice Hall.

Rachman, S., & Shafran, R. (1999). Cognitive distortions: Thought-action fusion. *Clinical Psychology and Psychotherapy, 6*, 80-85.

Rachman, S., Shafran, R., Mitchell, D., Trant, J., & Teachman, B. (1996). How to remain neutral: An experimental analysis of neutralization. *Behaviour Research and Therapy, 34*, 889-898.

Rachman, S., Thordarson, D. S., Shafran, R., & Woody, S. R. (1995). Perceived responsibility: structure and significance. *Behaviour Research and Therapy, 33*, 779-784. doi: 0005-7967(95)00016-Q [pii]

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401.

Radomsky, A. S., & Rachman, S. (2004). The importance of importance in OCD memory research. *Journal of Behavior Therapy and Experimental Psychiatry, 35*, 137-151. doi: 10.1016/j.jbtep.2004.04.005

Rassin, E. (2001). The contribution of thought-action fusion and thought suppression in the development of obsession-like intrusions in normal participants. *Behaviour Research and Therapy, 39*, 1023-1032.

Rassin, E., Diepstraten, P., Merckelbach, H., & Muris, P. (2001). Thought-action fusion and thought suppression in obsessive-compulsive disorder. *Behaviour Research and Therapy, 39*, 757-764.

Rassin, E., Merckelbach, H., Muris, P., & Spaan, V. (1999). Thought-action fusion as a causal factor in the development of intrusions. *Behaviour Research and Therapy, 37*, 231-237.

Reese, H. E., McNally, R. J., & Wilhelm, S. (2011). Probabilistic reasoning in patients with body dysmorphic disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 42*, 270-276. doi: 10.1016/j.jbtep.2010.11.005

Rheaume, J., Ladouceur, R., & Freeston, M. (2000). The prediction of obsessive–compulsive tendencies: Does perfectionism play a significant role? *Personality and Individual Differences, 28*, 583-592.

Rytwinski, N. K., Fresco, D. M., Heimberg, R. G., Coles, M. E., Liebowitz, M. R., Cissell, S., . . . Hofmann, S. G. (2009). Screening for social anxiety disorder with the self-report version of the Liebowitz Social Anxiety Scale. *Depression and Anxiety, 26*, 34-38. doi: 10.1002/da.20503

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy, 23*, 571-583. doi: 0005-7967(85)90105-6 [pii]

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

Salkovskis, P. M., Shafran, R., Rachman, S., & Freeston, M. H. (1999). Multiple pathways to inflated responsibility beliefs in obsessional problems: Possible origins and implications for therapy and research. *Behaviour Research and Therapy, 37*, 1055-1072.

Salkovskis, P. M., Wroe, A. L., Gledhill, A., Morrison, N., Forrester, E., Richards, C., . . . Thorpe, S. (2000). Responsibility attitudes and interpretations are characteristic of obsessive-compulsive disorder. *Behaviour Research and Therapy, 38*, 347-372.

Sarawgi, S., Oglesby, M. E., & Cougle, J. R. (2013). Intolerance of uncertainty and obsessive-compulsive symptom expression. *Journal of Behavior Therapy and Experimental Psychiatry, 44*, 456-462.

Schlier, B., Helbig-Lang, S., & Lincoln, T. M. (2016). Anxious but thoroughly informed? No jumping-to-conclusions bias in social anxiety disorder. *Cognitive Therapy and Research, 40*, 46-56.

Shafran, R. (2005). Cognitive-behavioral models of OCD. In J. S. Abramowitz & A. C. Houts (Eds.), *Concepts and controversies in obsessive-compulsive disorder*. New York: Springer.

Shafran, R., & Rachman, S. (2004). Thought-action fusion: A review. *Journal of Behavior Therapy and Experimental Psychiatry, 35*, 87-107.

Shafran, R., Thordarson, D. S., & Rachman, S. (1996). Thought-action fusion in obsessive-compulsive disorder *Journal of Anxiety Disorders, 10*, 379-391.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): the

development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry, 59 Suppl 20*, 22-33.

Skoog, G., & Skoog, I. (1999). A 40-year follow-up of patients with obsessive-compulsive disorder. *Archives of General Psychiatry, 56*, 121-127.

Smari, J., Martinsson, D. R., & Einarsson, H. (2010). Rearing practices and impulsivity/hyperactivity symptoms in relation to inflated responsibility and obsessive-compulsive symptoms. *Scandinavian Journal of Psychology*. doi: 10.1111/j.1467-9450.2010.00819.x

Sookman, D., & Pinard, G. (1999). Integrative cognitive therapy for obsessive-compulsive disorder: A focus on multiple schemas. *Cognitive and Behavioral Practice, 6*, 351-362.

Starcevic, V., & Berle, D. (2006). Cognitive specificity of anxiety disorders: A review of selected key constructs. *Depression and Anxiety, 23*, 51-61. doi: 10.1002/da.20145

Stein, D. J., Fineberg, N. A., Bienvenu, O. J., Denys, D., Lochner, C., Nestadt, G., . . . Phillips, K. A. (2010). Should OCD be classified as an anxiety disorder in DSM-V? *Depression and Anxiety, 27*, 495-506. doi: 10.1002/da.20699

Steketee, G., Frost, R. O., & Cohen, I. (1998). Beliefs in obsessive-compulsive disorder. *Journal of Anxiety Disorders, 12*, 525-537.

Storch, E. A., Rasmussen, S. A., Price, L. H., Larson, M. J., Murphy, T. K., & Goodman, W. K. (2010). Development and psychometric evaluation of the Yale-Brown Obsessive-Compulsive Scale--Second Edition. *Psychological Assessment, 22*, 223-232. doi: 10.1037/a0018492

Taylor, S. (2002). Cognition in obsessive-compulsive disorder: An overview. In R. O. Frost & G.

    Steketee (Eds.), *Cognitive approaches to obsessions and compulsions: Theory,*

    assessment, and treatment. Oxford: Elsevier.

Taylor, S., Abramowitz, J. S., McKay, D., Calamari, J. E., Sookman, D., Kyrios, M., . . . Carmin,

    C. (2006). Do dysfunctional beliefs play a role in all types of obsessive-compulsive

    disorder? *Journal of Anxiety Disorders, 20*, 85-97. doi: 10.1016/j.janxdis.2004.11.005

Taylor, S., Coles, M. E., Abramowitz, J. S., Wu, K. D., Olatunji, B. O., Timpano, K. R., . . .

    Tolin, D. F. (2010). How are dysfunctional beliefs related to obsessive-compulsive

    symptoms? *Journal of Cognitive Psychotherapy, 24*, 165-176.

Taylor, S., McKay, D., & Abramowitz, J. S. (2005). Hierarchical structure of dysfunctional

    beliefs in obsessive-compulsive disorder. *Cognitive Behaviour Therapy, 34*, 216-228.

    doi: 10.1080/16506070510041167

Thompson-Hollands, J., Farchione, T. J., & Barlow, D. H. (2013). Thought-action fusion across

    anxiety disorder diagnoses: Specificity and treatment effects. *Journal of Nervous and*

    Mental Disease, 201, 407-413. doi: 10.1097/NMD.0b013e31828e102c

Tolin, D. F., Abramowitz, J. S., Brigidi, B. D., Amir, N., Street, G. P., & Foa, E. B. (2001).

    Memory and memory confidence in obsessive-compulsive disorder. *Behaviour Research*

    and Therapy, 39, 913-927.

Tolin, D. F., Abramowitz, J. S., Brigidi, B. D., & Foa, E. B. (2003). Intolerance of uncertainty in

    obsessive-compulsive disorder. *Journal of Anxiety Disorders, 17*, 233-242. doi:

    S0887618502001822 [pii]

Tolin, D. F., Abramowitz, J. S., & Diefenbach, G. J. (2005). Defining response in clinical trials for obsessive-compulsive disorder: a signal detection analysis of the Yale-Brown obsessive-compulsive scale. *Journal of Clinical Psychiatry, 66*, 1549-1557.

Tolin, D. F., Woods, C. M., & Abramowitz, J. S. (2003). Relationsihp between obsessive beliefs and obsessive-compulsive symptoms. *Cognitive Therapy and Research, 27*, 657-669.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5*, 207-232. doi: doi:10.1016/0010-0285(73)90033-9

van den Hout, M., Kindt, M., Weiland, T., & Peters, M. (2002). Instructed neutralization, spontaneous neutralization and prevented neutralization after an obsession-like thought. *Journal of Behavior Therapy and Experimental Psychiatry, 33*, 177-189. doi: S0005791602000484 [pii]

van den Hout, M., van Pol, M., & Peters, M. (2001). On becoming neutral: Effects of experimental neutralizing reconsidered. *Behaviour Research and Therapy, 39*, 1439-1448.

van Oppen, P., & Arntz, A. (1994). Cognitive therapy for obsessive-compulsive disorder. *Behaviour Research and Therapy, 32*, 79-87.

Vuilleumier, P. (2005). How brains beware: neural mechanisms of emotional attention. *Trends in Cognitive Sciences, 9*, 585-594. doi: 10.1016/j.tics.2005.10.011

Wells, A., & Matthews, G. (1994). *Attention and emotion: A clinical perspective*. Hove, UK: Erlbaum.

Wenze, S. J., Gunthert, K. C., & German, R. E. (2012). Biases in affective forecasting and recall in individuals with depression and anxiety symptoms. *Personality and Social Psychology Bulletin, 38*, 895-906. doi: 10.1177/0146167212447242

Wilhelm, S., Berman, N. C., Keshaviah, A., Schwartz, R. A., & Steketee, G. (2015). Mechanisms of change in cognitive therapy for obsessive-compulsive disorder: Role of maladaptive beliefs and schemas. *Behaviour Research and Therapy, 65*, 5-10. doi: 10.1016/j.brat.2014.12.006

Wilhelm, S., Steketee, G., Fama, J. M., Buhlmann, U., Teachman, B. A., & Golan, E. (2009). Modular cognitive therapy for obsessive-compulsive disorder: A wait-list controlled Trial. *Journal of Cognitive Psychotherapy, 23*, 294-305.

Wilson, T. D., & Gilbert, D. T. (2003). Affective forecasting. *Advances in Experimental Socal Psychology, 35*, 345-411.

Woods, C. M., Frost, R. O., & Steketee, G. (2002). Obsessive-compulsive (OC) symptoms and subjective severity, probability, and coping ability estimations of future negative events. *Clinical Psychology and Psychotherapy, 9*, 104-111.

Woody, S. R., & Rodriguez, B. F. (2000). Self-focused attention and social anxiety in social phobics and normal controls. *Cognitive Therapy and Research, 24*, 473-488.

Woody, S. R., Whittal, M. L., & McLean, P. D. (2011). Mechanisms of symptom reduction in treatment for obsessions. *Journal of Consulting and Clinical Psychology, 79*, 653-664. doi: 10.1037/a0024827

Zhang, L., Dong, Y., Ji, Y., Zhu, C., Yu, F., Ma, H., . . . Wang, K. (2015). Dissociation of decision making under ambiguity and decision making under risk: A neurocognitive endophenotype candidate for obsessive-compulsive disorder. *Progress in Neuropsychopharmacology and Biological Psychiatry, 57*, 60-68. doi: 10.1016/j.pnpbp.2014.09.005

Appendix

Supplemental Material Paper 1 Methods

Task Stimuli

REVISED THOUGHT-ACTION FUSION (TAF) SCALE (Shafran, 1996)

Please rate each item on a scale of 1-4 (strongly disagree to strongly agree).
1 = strongly disagree   2 = disagree   3 = agree   4 = strongly agree

Original scale followed by:
a = block 1 (self)
b = block 2 (other)
c = block 3 (direct comparison)

TAF-Moral
1. Thinking of making an extremely critical remark to a friend is almost as unacceptable to me as actually saying it.
    a. When I think of making an extremely critical remark to a friend, it is almost as unacceptable to me as actually saying it.
    b. When my friend thinks of making an extremely critical remark to someone, it is almost as unacceptable as his actually saying it.
    c. When I think of making an extremely critical remark to a friend, it is more unacceptable than if my friend thinks of making an extremely critical remark to his friend.

2. Having a blasphemous thought is almost as sinful to me as a blasphemous action.
    a. When I have a blasphemous thought, it is almost as sinful to me as taking a blasphemous action.
    b. When my friend has a blasphemous thought, it is almost as sinful as if he took a blasphemous action.
    c. When I have a blasphemous thought, it is more sinful than when my friend has a blasphemous thought.

3. Thinking about swearing at someone else is almost as unacceptable to me as actually swearing.
    a. When I think about swearing at someone else, it is almost as unacceptable to me as actually swearing at them.
    b. When my friend thinks of swearing at someone else, it is almost as unacceptable as his actually swearing at them.
    c. When I think about swearing at someone else, it is more unacceptable than if my friend thinks of swearing at someone.

4. When I have a nasty thought about someone else, it is almost as bad as carrying out a nasty action.
   a. When I have a nasty thought about someone else, it is almost as bad as if I carried out a nasty action.
   b. When my friend has a nasty thought about someone else, it is almost as bad as if she carried out a nasty action.
   c. When I have a nasty thought about someone else, it is worse than if my friend has a nasty thought about someone else.

5. Having violent thoughts is almost as unacceptable to me as violent acts.
   a. If I have violent thoughts, it is almost as unacceptable to me as committing a violent act.
   b. If my friend has violent thoughts, it is almost as unacceptable as if he committed a violent act.
   c. If I have violent thoughts, it is more unacceptable than if my friend has violent thoughts.

6. When I think about making an obscene remark or gesture in church, it is almost as sinful as actually doing it.
   a. When I think about making an obscene remark or gesture in church, it is almost as sinful as if I actually do make an obscene remark or gesture in church.
   b. When my friend thinks about making an obscene remark or gesture in church, it is almost as sinful as if he actually does make an obscene remark or gesture in church.
   c. When I think about making an obscene remark or gesture in church, it is worse than if my friend thinks about making an obscene remark or gesture in church.

7. If I wish harm on someone, it is almost as bad as doing harm.
   a. If I wish harm on someone, it is almost as bad as my doing harm to that person.
   b. If my friend wishes harm on someone, it is almost as bad as his doing harm to another person.
   c. If I wish harm on someone, it is worse than if my friend wishes harm on someone.

8. If I think about making an obscene gesture to someone else, it is almost as bad as doing it.
   a. If I think about making an obscene gesture to someone else, it is almost as bad as my doing it.
   b. If my friend thinks about making an obscene gesture to someone else, it is almost as bad as her doing it.

    c. If I think about making an obscene gesture to someone, it is worse than if my friend thinks about making an obscene gesture to someone

9. When I think unkindly about a friend, it is almost as disloyal as doing an unkind act.
    a. When I think unkindly about a friend, it is almost as disloyal of me as doing an unkind act.
    b. When my friend thinks unkindly about her friend, it is almost as disloyal of her as doing an unkind act.
    c. When I think unkindly about a friend, it is worse than if my friend thinks unkindly about her friend.

10. If I have a jealous thought, it is almost the same as making a jealous remark.
    a. If I have a jealous thought, it is almost the same as if I made a jealous remark.
    b. If my friend has a jealous thought, it is almost the same as if she made a jealous remark.
    c. If I have a jealous thought, it is worse than if my friend has a jealous thought.

11. Thinking of cheating in a personal relationship is almost as immoral to me as actually cheating.
    a. If I think of cheating in a personal relationship, it is almost as immoral as if I actually cheated.
    b. If my friend thinks of cheating in his personal relationship, it is almost as immoral as if he actually cheated.
    c. If I think of cheating in a personal relationship, it is more immoral than if my friend thinks of cheating in a personal relationship.

12. Having obscene thoughts in a church is unacceptable to me.
    a. If I have obscene thoughts in church, it is unacceptable.
    b. If my friend has obscene thoughts in church, it is unacceptable.
    c. If I have obscene thoughts in church, it is more unacceptable than if my friend has obscene thoughts in church.

TAF-Likelihood-Other
1. If I think of a relative/friend losing their job, this increases the risk that they will lose their job.
    a. No change.
    b. If my friend thinks of his relative/friend losing her job, this increases the risk that his friend/relative will lose her job.
    c. If I think of my friend losing her job, this increases the risk that she will lose it more than if her other friend has the same thought.

2. If I think of a relative/friend being in a car accident, this increases the risk he/she will have a car accident.
   a. No change.
   b. If my friend thinks of a relative/friend being in a car accident, this increases the risk that his friend/relative will be in a car accident.
   c. If I think of a friend being in a car accident, this increases the risk that he will have a car accident more than if his other friend has the same thought.

3. If I think of a friend/relative being injured in a fall, this increases the risk that he/she will have a fall and be injured.
   a. No change.
   b. If my friend thinks of a friend/relative being injured in a fall, this increases the risk that her friend/relative will fall and be injured.
   c. If I think of a friend being injured in a fall, this increases the risk that she will fall and be injured more than if her other friend has the same thought.

4. If I think of a relative/friend falling ill, this increases the risk that he/she will fall ill.
   a. No change.
   b. If my friend thinks of a relative/friend falling ill, this increases the risk that her relative/friend will fall ill.
   c. If I think of a friend falling ill, this increases the risk that he will fall ill more so than if his other friend has the same thought.

TAF-Likelihood-Self
1. If I think of myself being injured in a fall, this increases the risk that I will have a fall and be injured.
   a. No change.
   b. If my friend thinks of being injured in a fall, this increases the risk that she will have a fall and be injured.
   c. If I think about myself being injured in a fall and my friend thinks about himself being injured in a fall, I am more likely than he to fall and be injured.

2. If I think of myself being in a car accident, this increases the risk that I will have a car accident.
   a. No change.
   b. If my friend thinks of being in a car accident, this increases the risk that he will have a car accident.
   c. If I think of being in a car accident and my friend thinks about herself being in a car accident, I am more likely than she to be in a car accident.

3. If I think of myself falling ill, this increases the risk that I will fall ill.
    a. No change.
    b. If my friend thinks of himself falling ill, this increases the risk he will fall ill.
    c. If I think of myself falling ill and my friend thinks of herself falling ill, I am more likely than she is to fall ill.

Supplemental Material Paper 2 Methods

Task Stimuli

INTOLERANCE OF UNCERTAINTY (Hezel, 2014)
<u>Part 1: Standard of Proof</u>
Subjects will respond to each question using visual analogue scales from 1-100.
1. Imagine that you go to the doctor because you noticed a suspicious lump on your body. Your doctor performs a test and tells you that there is a 99% chance that you are fine.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that something is very wrong?

2. Imagine that you receive results from a blood test that indicate you have a 1% chance of having a devastating illness.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that you are ill?

3. Imagine that during your annual job review, your boss tells you that you have a 99% chance of being promoted.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that you get promoted?

4. Imagine there is a wave of layoffs at your job. Your boss tells you there is a 1% chance you are going to lose your job.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that you lose your job?

5. Imagine that you buy a lottery ticket and you later find out that there is 99% chance that you won.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that you won the lottery?

6. Imagine that the stock market has crashed. Your stockbroker tells you there is a 1% chance you have lost all of your investments.
    a. How happy/unhappy do you feel?
    b. How anxious do you feel?
    c. How likely is it that you have lost your money?

7. Imagine you receive a letter notifying you that you have been placed on the waitlist for your #1 choice of colleges. The letter states that you have a 99% chance of being admitted.
   a. How happy/unhappy do you feel?
   b. How anxious do you feel?
   c. How likely is it that you will get into the school?

8. Imagine that you have been placed on academic probation and that you have a 1% chance of failing out of school.
   a. How happy/unhappy do you feel?
   b. How anxious do you feel?
   c. How likely is it that you will fail out of school?

Part 2: Certainty vs. Uncertainty (Negative Outcomes)
Please select (a) or (b).
1. Imagine you are applying to colleges. You receive a letter from your #1 choice of schools informing you of their decision on your application. Would you rather
   a. Receive a rejection immediately.
   b. Be placed on the waitlist for several months, after which you may or may not be rejected.

2. Imagine that you and your significant other have been having serious relationship trouble. Would you rather
   a. Break up immediately.
   b. Wait several months in the hope of improving the relationship, after which time you may or may not break up.

3. Imagine that you have received a poor performance review at work. Would you rather
   a. Be fired immediately.
   b. Be placed on "probation" for several months, after which you may or may not be fired.

4. Imagine that you may have the gene for an untreatable disease. Would you rather
   a. Get tested immediately and find out that you have the gene.
   b. Wait several months before getting tested, after which time you may or may not test positive for the gene.

5. Imagine that you have received a scary looking document from the IRS. Would you rather
   a. Open the envelope immediately to find out you are being audited.
   b. Wait several months to open the envelope, after which you may or may not be audited.

Part 2a: Certainty vs. Uncertainty (Positive Outcomes)

6. Imagine that you bought a lottery ticket and that the jackpot is worth several million dollars. Would you rather
   a. Find out immediately that you lost.
   b. Wait several months, after which you may or may not have lost.

7. Imagine that you are house-shopping and that you placed a bid on the house of your dreams. Would you rather
   a. Find out immediately that you did not get the house.
   b. Wait several months, after which you may or may not get the house.

8. Imagine that you have been nominated for a major prize at school or work. Would you rather
   a. Find out immediately that you did not receive the prize.
   b. Wait several months, after which you may or may not receive the prize.

9. Imagine that you are being considered for an early promotion at work. Would you rather
   a. Find out immediately that you did not receive the promotion.
   b. Wait several months, after which you may or may not receive the promotion.

10. Imagine that you are a finalist in a contest, and the prize is an all-expenses paid trip to a destination of your choice. Would you rather
    a. Find out immediately that you lost the contest.
    b. Wait several months, after which you may or may not lose the contest.

Part 3: Intolerance of Uncertainty (Positive Information)

1. Imagine that you and your spouse are expecting a baby. Would you rather
   a. Know the sex of the baby immediately.
   b. Wait several months until the baby is born to find out the sex.

2. Imagine that you are told you that you won one of three different prestigious awards at work/school. Would you rather
   a. Find out immediately which award you won.
   b. Wait several months for the awards ceremony to find out which award you won.
3. Imagine that your loved one is really good at buying you gifts. Your birthday is in several months and you find a birthday gift from him/her hidden in the closet. Would you rather
   a. Open the gift immediately.
   b. Wait several months to open it when your loved one gives it to you on your birthday.

4. Imagine that your fiancé(e) is planning your honeymoon to a tropical island that he/she knows you would like. Would you rather
    a. Find out immediately where you are going.
    b. Wait several months until after the wedding to find out where you are going.

5. Imagine that series finale of your favorite television show is airing in several months. Would you rather
    a. Read online spoilers immediately to find out how it ends.
    b. Wait several months until the finale is on television to see how it ends.

Supplemental Material Paper 3 Methods

Task Stimuli

Domain-Specific Risk-Taking (Adult) Scale – Risk Taking

For each of the following statements, please indicate the **likelihood** that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from *Extremely Unlikely* to *Extremely Likely*, using the following scale:

1	2	3	4	5	6	7
Extremely Unlikely	Moderately Unlikely	Somewhat Unlikely	Not Sure	Somewhat Likely	Moderately Likely	Extremely Likely

1. Admitting that your tastes are different from those of a friend. (S)
2. Going camping in the wilderness. (R)
3. Betting a day's income at the horse races. (F/G)
4. Investing 10% of your annual income in a moderate growth mutual fund. (F/I)
5. Drinking heavily at a social function. (H/S)
6. Taking some questionable deductions on your income tax return. (E)
7. Disagreeing with an authority figure on a major issue. (S)
8. Betting a day's income at a high-stake poker game. (F/G)
9. Having an affair with a married man/woman. (E)
10. Passing off somebody else's work as your own. (E)
11. Going down a ski run that is beyond your ability. (R)
12. Investing 5% of your annual income in a very speculative stock. (F/I)
13. Going whitewater rafting at high water in the spring. (R)
14. Betting a day's income on the outcome of a sporting event (F/G)
15. Engaging in unprotected sex. (H/S)
16. Revealing a friend's secret to someone else. (E)
17. Driving a car without wearing a seat belt. (H/S)
18. Investing 10% of your annual income in a new business venture. (F/I)
19. Taking a skydiving class. (R)
20. Riding a motorcycle without a helmet. (H/S)
21. Choosing a career that you truly enjoy over a more secure one. (S)
22. Speaking your mind about an unpopular issue in a meeting at work. (S)
23. Sunbathing without sunscreen. (H/S)
24. Bungee jumping off a tall bridge. (R)
25. Piloting a small plane. (R)
26. Walking home alone at night in an unsafe area of town. (H/S)
27. Moving to a city far away from your extended family. (S)
28. Starting a new career in your mid-thirties. (S)
29. Leaving your young children alone at home while running an errand. (E)
30. Not returning a wallet you found that contains $200. (E)

Note. E = Ethical, F = Financial, H/S = Health/Safety, R = Recreational, and S = Social.

Domain-Specific Risk-Taking (Adult) Scale – Risk Perceptions

People often see some risk in situations that contain uncertainty about what the outcome or consequences will be and for which there is the possibility of negative consequences. However, riskiness is a very personal and intuitive notion, and we are interested in **your gut level assessment of how risky** each situation or behavior is.

For each of the following statements, please indicate **how risky you perceive** each situation. Provide a rating from *Not at all Risky* to *Extremely Risky*, using the following scale:

1	2	3	4	5	6	7
Not at all Risky	Slightly Risky	Somewhat Risky	Moderately Risky	Risky	Very Risky	Extremely Risky

Domain-Specific Risk-Taking (Adult) Scale – Expected Benefits

For each of the following statements, please indicate **the benefits** you would obtain from each situation. Provide a rating from **1 to 7**, using the following scale:

1	2	3	4	5	6	7
No benefits At all			Moderate Benefits			Great Benefits

Reference:
Blais, A-R. and E. U. Weber. 2006. "A Domain-specific Risk-taking (DOSPERT) Scale for Adult Populations." *Judgment and Decision Making, 1*, 33-47.