An Experimental Examination of intolerance of Uncertainty in Obsessive-Compulsive Disorder

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ABSTRACT

AN EXPERIMENTAL EXAMINATION OF INTOLERANCE OF UNCERTAINTY IN OBSESSIVE-COMPULSIVE DISORDER

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Anxiety is considered a fear response to threat, driven by the absence of certainty and elevated perceptions of the cost of harm. It has been suggested that exaggerated responding to uncertainty underlies all anxiety disorders. Although no longer classified under the anxiety disorders section of the Diagnostic and Statistical Manual (DSM), anxiety still is considered a primary component of obsessive-compulsive disorder (OCD). OCD is a chronic, debilitating condition that affects multiple domains of functioning. The current gold standard of treatment for OCD is exposure and response prevention (ERP), a form of cognitive-behavioral psychotherapy. However, ERP is not effective for all individuals with OCD, as about 50-70% of individuals respond to treatment. Given the heterogeneous nature of OCD, treatment research may need to be targeted toward individual difference variables. Cognitive-behavioral models suggest that dysfunctional beliefs contribute to the etiology and maintenance of OC symptoms. One such dysfunctional belief, intolerance of uncertainty (IU), is the tendency to find uncertainty intolerable and view oneself as unable to cope in the face of change. IU has been suggested to contribute to the etiology and maintenance of OCD.

The effect of uncertainty on anxious responding is somewhat unclear in the literature. Experimental manipulations of threat (electric shocks) revealed that participants did not become...
more physiologically aroused when threat was 50% or 100% likely; further, participants did not endorse a preference for the lower probability of shocks. Alternatively, Nelson and Shankman found that participants with high levels of IU endorsed more anxiety when faced with uncertain versus certain threat. A recent experimental paradigm found that trait IU was significantly associated with anxiety in the face of uncertain threat. However, no known studies have examined these factors in the context of OCD.

The current study had a sample of $N = 187$ students complete a measure of IU and then undergo the paradigm created by Oglesby and Schmidt in which they were randomized into either a certain threat condition or an uncertain threat condition. In the certain threat condition, participants were told that they would complete a threatening task at the end of the study. In the uncertain threat condition, participants were told that the result of a coin toss would determine whether they completed a threatening task. Participants then were asked to report distress ratings and complete the threatening task (based on the thought-action fusion literature), in which they were asked to write, “I hope [loved one] is in a car accident today.”

Results suggest that participants felt distressed by the sentence task. However, an ANCOVA revealed that there were no differences between conditions on distress ratings prior to completing the threatening task, controlling for thought-action fusion beliefs. A hierarchical regression found that IU significantly predicted distress ratings but did not moderate the relationship between conditions and distress ratings. Implications, limitations, and future directions are discussed.
AN EXPERIMENTAL EXAMINATION OF INTOLEANCE OF UNCERTAINTY IN
OBSESSIVE-COMPULSIVE DISORDER

BY
HANNAH FALEER MARTYN
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FOR THE DEGREE
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CHAPTER 1
INTRODUCTION

An Overview of OCD

Aptly named, obsessive-compulsive disorder (OCD) is characterized by the presence of obsessions and/or compulsions. Obsessions are intrusive, unwanted thoughts that cause distress, and compulsions are repetitive behaviors or mental acts that serve the function of neutralizing the distress (American Psychiatric Association [APA], 2013). Notably, compulsions are considered maladaptive because they are not connected to the intrusive thought in a realistic way or are a disproportionate response to the stimulus (APA, 2013). Obsessions and compulsions may comprise a wide array of content but consistently have been categorized into themes, such as contamination and washing, symmetry and ordering, checking, and unacceptable thoughts (Abramowitz et al., 2010; McKay et al., 2004). For example, a principal components analysis of the Yale-Brown Obsessive Compulsive Scale symptom checklist (YBOCS; Goodman, Price, Rasmussen, & Mazure, 1989), a semi-structured clinical interview, yielded six dimensions: hoarding, contamination/cleaning, doubt/checking, symmetry/ordering, and unacceptable/taboo thoughts (Brakoulas et al., 2013). Notably, individuals with OCD often endorse more than one symptom dimension (McKay et al., 2004).

1 As of 2013, hoarding no longer was considered only as a subtype of OCD but instead was classified as a separate diagnosis in the Diagnostic and Statistical Manual, 5th Edition.
The lifetime prevalence rate of OCD in the United States is 2.3%, with a 12-month prevalence rate of 1.2% (Ruscio, Stein, Chiu, & Kessler, 2010). Among industrialized societies, OCD has been ranked the 10th leading cause of disability, projected to 2020 (Murray & Lopez, 1996). OCD is highly impairing; the obsessions and compulsions cause dysfunction in daily living and can lead to negative outcomes in social, employment, and romantic domains (APA, 2013). Individuals diagnosed with OCD were found less likely to be employed, to be of lower socio-economic status, and less likely to be married as compared to individuals without OCD (Torres et al., 2006). Further, individuals diagnosed with OCD demonstrate lower quality of life compared to community populations and equivalent or worse quality of life compared to other clinical populations (Eisen et al., 2006; Huppert, Simpson, Nissenson, Liebowitz, & Foa, 2009). When examining symptom dimensions, harm and contamination symptom subtypes were significantly associated with negative health-related outcomes, such as dermatologic problems and dental complications (Schwartzman et al., 2017).

OCD is considered chronic if left untreated (APA, 2013). Exposure and response prevention (ERP) currently is the gold standard of treatment, and involves exposure to the feared stimuli in a hierarchical fashion, preventing any compulsions or neutralizing behavior. However, ERP is not effective for all clients, and improvement rates range from 50% to 70%, indicating that alternative treatments are needed (Öst, Havnen, Hansen, & Kvale, 2015). Exposure therapy may not be an attractive therapy to many clients because it involves contact with the stimulus they most fear; not surprisingly, approximately 25% of patients refuse ERP (Franklin & Foa, 2007). In addition, many clinicians have negative beliefs about exposure therapy (e.g., that it evokes more distress than it is worth, does not work for complex symptom presentations, or is rigid and insensitive), which can affect their delivery of treatment and lead to suboptimal outcomes (Farrell, Deacon, Kemp, Dixon, & Sy, 2013; Olatunji, Deacon, & Abramowitz, 2009).
In addition to psychotherapy, biological treatments may be efficacious in the treatment of OCD. Serotonin reuptake inhibitors (SRIs) affect the serotonin transporter protein (5-HT) and can be effective at reducing symptoms (McDougle, Epperson, Price, & Gelernter, 1998). Serotonin has been implicated in brain regions thought to be relevant to OCD, including the basal ganglia and orbitofrontal cortex (Lavoie & Parent, 1990). However, like ERP, medication is not 100% effective; SRIs have a similar improvement rate to ERP and typically achieve a 40% reduction in symptoms (Pigott, 1998; Tundo, Salvati, Busto, Spigno, & Falcini, 2007). The varied symptom presentations of individuals with OCD signify that it is an exceedingly heterogeneous disorder, indicating that treatment could be more effective if targeted more specifically toward ideographic beliefs.

Uncertainty in Anxiety: A Review

Although fear and anxiety often are thought to define similar experiences, fear occurs when an individual is imminently threatened (e.g., being attacked; Barlow, 2000). Conversely, anxiety is considered a fear response to future threat, created by the absence of certainty about possible consequences (Carleton, 2012). At its core, anxiety consists of a sense of unpredictability and uncontrollability over threat, requiring a state of vigilance and over-preparedness (Barlow, 2000; Nelson & Shankman, 2011). Carleton (2012) proposed that when threat is certain, two outcomes are possible: fear or no fear. When a threat is certain but the consequences are removed or an individual is able to cope with the consequences, calmness replaces fear. Alternatively, when the negative consequences are high or coping abilities are low, fear ensues. However, when a threat is uncertain, a fear response may be sustained over time to
help an individual prepare for the possible danger. Thus, uncertainty is a central component of anxiety and key in eliciting distress.

Monat, Averill, and Lazarus (1972) suggested that uncertainty may be conceptualized as either temporal or probabilistic. Temporal uncertainty involves doubt about when a negative event may occur, whereas probabilistic (event) uncertainty involves knowing when a negative event may occur but not whether the event will happen. Monat et al. (1972) experimentally manipulated event uncertainty by attaching an electrode to undergraduate participants and telling them that at the end of three minutes they would either have a 100% chance of experiencing the shock or a 50% chance. Results revealed that regardless of probability of the event occurring, no significant differences in arousal (as measured by skin conductance and heart rate) were achieved at the end of three minutes ($p > .05$). Surprisingly, participants reported similar levels of preference for the 50% and 100% shock conditions ($p > .05$); this result runs counter to expectations that participants prefer a smaller likelihood of a negative event occurring. The results of this study also were unexpected considering research suggesting that arousal should increase when an uncertain negative event looms (e.g., Breznitz, 1967) and other research that has supported the notion that both humans and non-human animals prefer predictable events to unpredictable events (Fanselow, 1980; Mineka & Kihlstrom, 1978). Although it is possible that participants may not feel significantly more distressed when faced with an uncertain, negative stimulus, the three-minute time period in Monat et al. (1972) may have allowed participants to engage in coping mechanisms that they would not have had time for when immediately faced with an uncertain stimulus. More research is needed to determine the impact of uncertainty on distress.

Uncertainty is a universal experience that elicits emotional reactions, but not everyone develops clinically significant anxiety. Therefore, it is important to identify individual difference
variables that contribute to the etiology of anxiety and maladaptive responses to uncertainty. From a behavioral perspective, Eysenck (1979) proposed that the inability to extinguish a fear response contributes to the onset of pathological anxiety. More recently, Davis, Falls, and Gewirtz (2000) suggested that the inability to inhibit fear in the face of safety signals serves as the primary factor in the development of anxiety. This model has some support. Individuals with an activated amygdala, the primary brain region associated with fear, have more difficulty with attention toward important features of a distressing stimulus, indicating that they may miss safety cues (Lissek et al., 2005).

Another factor that may contribute to the onset of an anxiety disorder is the tendency to cope with distress by over-preparing for or avoiding frightening stimuli. Indeed, anxiety disorders appear to share this feature of “aberrant and excessive anticipatory responding” in the face of uncertainty (Grupe & Nitschke, 2013, p. 488). Recently, Grupe and Nitschke (2013) proposed a five-factor model of anxiety, noting that the factors have equal weight in their contribution to anxiety. These factors are: (1) inflated estimates of cost and probability of a negative outcome, (2) increased threat attention and hypervigilance, (3) deficient safety learning, (4) behavioral and cognitive avoidance, and (5) heightened reactivity to uncertainty. The uncertainty component provides a condition under which other components, such as increases in threat expectancy and avoidance of threatening stimuli, are heightened. By targeting components of this model in treatment, symptoms of anxiety disorders may remit.

Cognitive models of psychopathology may elucidate why some individuals develop specific anxiety disorders. Beck (1976) proposed a model suggesting that psychopathology is a result of dysfunctional beliefs. This foundational cognitive specificity hypothesis suggests that many different disorders arise from cognitive schema. When the cost or probability of a feared outcome outweighs the ability to cope, anxiety ensues (Beck, Emery, & Greenberg, 1985).
Specific to OCD, Carr (1974) suggested that OCD is a result of the overestimation of probability and severity of negative consequences and that compulsions serve the function of reducing distress related to uncertainty. Notably, Carr (1974) emphasized the role of unrealistic threat appraisals. Following this work, Salkovskis (1985) proposed one of the seminal models of OCD, which argued that nearly every individual experiences relatively benign intrusive thoughts, but obsessions arise from appraisals that intrusions are threatening and that one owns a personal responsibility for preventing them. In essence, intrusive thoughts are paired with beliefs about responsibility for preventing harm to produce negative thoughts (obsessions). The obsessions evoke distress, leading to unreasonable or even desperate attempts to avoid or prevent the harmful outcomes and uncertainty as to when the harmful outcomes will occur. Krohne’s (1989) model of coping modes argues that aversive stimulation and ambiguity are the two core components that increase an individual’s perception of an event as stressful and thus increase anxiety. Krohne (1989) posited that individuals who primarily are affected by uncertainty cope by becoming increasingly vigilant in order to decrease the possibility of the negative outcome occurring. Individual differences in reactions to uncertainty may be a significant contributor to the etiology of anxiety.

Intolerance of Uncertainty

Intolerance of uncertainty (IU) first was defined as a set of reactions to uncertainty in everyday life (Freeston et al., 1994). Carleton (2016) proposed a contemporary definition of IU as “an individual’s dispositional incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty” (p. 31). IU is conceptualized as the tendency for an individual to avoid
ambiguous situations and view him or herself as unable to cope in the face of uncertainty. In essence, IU represents a fear of the unknown (Carleton, 2012).

To date, research on IU primarily has been conducted in the context of generalized anxiety disorder (GAD), a disorder characterized by persistent, excessive, and unrealistic worry about a number of domains occurring most of the day nearly every day (APA, 2013). Some researchers have suggested that IU is GAD specific, as IU appears to be the primary cognitive vulnerability for the manifestations of anxiety symptoms, particularly worry (e.g., Dugas, Schwartz, & Francis, 2004; Freeston et al., 1994). However, other research has questioned this narrow specificity. Given Carleton’s (2012) conceptualization of emotional disorders as an attempt to avoid uncertainty, IU may instead be transdiagnostic. In fact, IU has been associated with numerous disorders, including panic disorder (Carleton et al., 2014), health anxiety (Fergus & Bardeen, 2013; Rosen & Knäuper, 2009), posttraumatic stress disorder (Bardeen, Fergus, & Wu, 2013), social anxiety disorder (Boelen & Reijntjes, 2009; Mahoney & McEvoy, 2012b), hoarding (Castriotta, Dozier, Taylor, Mayes, & Ayers, 2019) and eating disorders (Renjan, McEvoy, Handley, & Fursland, 2016). Importantly, IU also has been identified as an OC-relevant belief that may be central to the disorder (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013).

Behavioral correlates of self-reported trait IU have been examined in the extant literature, particularly in regard to decision making. Ladouceur, Talbot, and Dugas (1997) had undergraduate participants complete the Beads Task, in which they were asked to make an inference about the color ratio of beads in a container by drawing as many beads as they wanted from the container. IU was positively associated with the number of draws before choosing a color ratio ($r_s = .26 - .32$). Jacoby, Abramowitz, Buck, and Fabricant (2014) replicated Ladouceur et al. (1997) in both undergraduate and clinical samples; results indicated a significant
association \((r = .36)\) between the Perfectionism/Certainty subscale of the OBQ-44 and the number of bead draws before making a decision about the color ratio.

Along similar lines, Luhmann, Ishida, and Hajcak (2011) had participants complete a computerized decision task in which they were presented with information about a reward (i.e., 50% chance of receiving 4 cents). Participants could either select the reward or wait for a second reward (i.e., 70% chance of receiving 6 cents). Following their decision, participants were told whether they had received the reward or not, based on the chosen probability. Results revealed that trait IU (measured by the IUS) predicted participants’ willingness to wait for the bigger reward \((\beta = -.49, t_{45} = 3.69, p < .001)\), such that individuals with higher levels of IU were less likely to wait for the bigger reward than participants low in IU. The authors suggest that participants with higher levels of IU felt more aversion to waiting in a state of uncertainty, regardless of the possibility of a more favorable outcome. The data from these studies suggest that individuals with high levels of IU may choose less desirable outcomes if they are certain in order to reduce the negative emotional consequences associated with uncertainty.

**IU in OCD**

Cognitive content has been hypothesized to contribute to the etiology and maintenance of OCD in several models (e.g., Foa & Kozak, 1986). In 1997, a working group consisting of 40 researchers with expertise in OCD was formed with the primary goal of developing measures of beliefs to differentiate OCD from other disorders. The identified belief domains were inflated responsibility, overimportance of one’s thoughts, the necessity to control one’s thoughts, overestimation of threat, intolerance of uncertainty, and perfectionism. The working group (Obsessive Compulsive Cognitions Working Group [OCCWG], 2001) created the Obsessive
Beliefs Questionnaire (OBQ), an 87-item measure designed to assess the six belief domains. Later, due to high intercorrelations and the result of a factor analysis, the measure was condensed to three factors, resulting in the following “combined” subscales: IU/Perfectionism, Importance/Control of Thoughts, and Responsibility/Threat Estimation (OCCWG, 2003). Despite these findings, the beliefs are considered to be distinct conceptually, and separate measures for many of them exist within the extant literature (e.g., Intolerance of Uncertainty Scale [IUS], Freeston et al., 1994; Perfectionism Inventory, Hill et al., 2004).

OCCWG’s (1997) model hypothesized IU as a pan-situational construct consisting of three core dimensions, including (1) beliefs about the necessity of certainty, (2) a view that the individual has a reduced ability to function in the face of change, and (3) beliefs that the individual will be unable to manage in situations that are ambiguous. This definition appears similar to definitions of IU in the GAD literature. For example, Bredemeier and Berenbaum (2008) conceptualized IU as consisting of two components: uncertainty paralysis and a desire for predictability. Dugas et al. (2005) considered IU as the tendency to find uncertainty upsetting and unfair and to avoid uncertain situations.

IU has been shown to be strongly related to both GAD and OCD; individuals with either disorder have been shown to endorse more IU than non-anxious controls, but not significantly more than each other (Holaway, Heimberg, & Coles, 2006). Despite the similarities in definitions, it has been suggested that experiences of IU may differ across disorders (Carleton, Gosselin, & Asmundson, 2010). That is, levels of IU appear to vary depending on disorder; for example, individuals with GAD endorsed higher levels of IU than individuals with panic disorder, although this may have been due to measurement issues (i.e., the measure of IU used in the study, the IUS, was created in the context of GAD; Dugas et al., 2005). Another important difference may be the focus of uncertainty. For example, in the context of panic disorder, the
focus of uncertainty may center on when the next panic attack will occur; in the context of OCD, the focus of the uncertainty may center on causing harm or on an intrusive thought becoming reality.

Interest in disorder-specific IU has grown in recent years, resulting in the development of self-report measures to assess disorder-specific aspects of IU (e.g., Disorder-Specific Intolerance of Uncertainty Scale [DSIU]; Thibodeau et al., 2015). However, research that examines disorder-specific versus trait IU has been mixed with regard to OC phenomena. For example, trait IU (measured by the Intolerance of Uncertainty Scale, 12-item version [IUS-12] Carleton, Norton, & Asmundson, 2007) has been shown to be more associated with OC symptoms than disorder-specific IU (measured by the DSIU; Thibodeau et al., 2015). However, research also has shown contamination symptoms were more highly associated with disorder-specific IU (measured by an instruction-modified IUS-12) than trait IU (measured by the IUS-12). It has been suggested that trait IU may affect disorder-specific IU and, in turn, disorder-specific symptoms (Shihata et al., 2017). Although the literature on disorder-specific IU is growing, it remains important to examine experimentally the impact of trait IU on symptoms of anxiety, which few studies have done. More research about trait IU will lay the foundation for future studies focused on IU specificity.

Pursuant to the present study, IU has been associated with symptoms of OCD (e.g., Fergus & Wu, 2010; Gentes & Ruscio, 2011). Individuals diagnosed with OCD display a need to control and predict outcomes (Makhlouf-Norris & Norris, 1973). Elevated IU has been associated with OCD symptom frequency and distress (Holaway et al., 2006), and some research has indicated that IU is highly associated with specific OC symptoms, including doubting and checking behaviors (Krohne, 1993; Lind & Boschen, 2009). In fact, it has been suggested that IU is a primary factor in the onset of checking behavior, paradoxically decreasing the possibility of
achieving certainty with every check (Rachman, 2002). Grayson (2010) suggested that once clients are able to cope with feelings of uncertainty, their anxiety is reduced. Moreover, others have suggested that primary features of OCD, including compulsions and ritualistic behaviors, are maintained by reducing discomfort from uncertain and potentially threatening situations (Steketee, Frost, & Cohen, 1998).

Given the relevance of IU to anxiety disorders, an important aspect of many treatments may involve addressing IU. Checking behavior in OCD, for example, can be conceptualized as an attempt to gain certainty; learning to live with uncertainty may be a key component of effective treatment in OCD (Grayson, 2010). Taking a step further, Carleton (2012) posited that the goal of all therapies is to assuage IU, which may be done through five possible approaches: (1) correcting misinterpretations of threat, (2) removing/minimizing threat, (3) removing/minimizing uncertainty, (4) increasing the capacity to cope with the consequences of the threat, and (5) increasing the ability to tolerate uncertainty. Although many therapies for anxiety contain one or more of these components, Dugas and Ladouceur (2000) created a therapy specifically to target beliefs about IU. Developed in the context of GAD and worry, these components of the treatment also may be applicable to other disorders. In the treatment, patients first undergo awareness training, in which they record immediate worries three times a day and identify whether the worries relate to issues that can be solved or those that cannot. Patients then work with a therapist to re-evaluate beliefs about worry (e.g., challenge beliefs that worry is useful); undergo problem orientation training involving identifying key elements of the problem and completing the problem-solving process; and cognitive exposure, in which they listen to recordings of descriptions of their worry. Through this treatment, the authors suggested that IU was diminished by altering the meaning given to future negative events and finding a compromise between gathering excessive amounts of information and avoiding the problem
altogether. However, this treatment has not yet been adapted for OCD, and it is unclear what the impact of explicitly addressing IU would be on OC-relevant outcomes.

Some researchers have suggested that instead of developing a new treatment approach, it may be beneficial to augment ERP with IU-specific content (CBT-IU; Gillett, Bilek, Hanna, & Fitzgeral, 2018). Modifications include psychoeducation about noticing uncertainty, challenging cognitive distortions about the benefits of certainty, and exposures to explicitly uncertain situations (Gillett et al., 2018). However, no protocol currently exists for CBT-IU and research on outcomes for IU as a target for treatment is limited. Despite the potential importance of IU to OCD, IU is relatively understudied in the OCD literature, and there is a dearth of experimental research examining the maladaptive belief on OC-relevant outcomes. The need for more experimental work in the area of IU has been expressed, particularly outside the context of GAD (Shihata et al., 2016).

Experimental Manipulations of IU

One avenue for developing a greater understanding of IU on disorder-relevant outcomes is through the manipulation of IU in the laboratory. The majority of existing IU manipulations are from the GAD literature. The first, developed by Ladouceur, Gosselin, and Dugas (2000), aimed to assess the causal influence of IU on worry. In their IU manipulation, participants were asked to play a computerized roulette game and were told that money would be donated to a (fictitious) charity if they made a certain amount of money on the game. In actuality, all participants ended with the same amount of money at the end of the game. Throughout the game, researchers made comments intended to increase IU (noting that the chances of winning were low and that most participants were not doing well, so less money was going to the charity) or
decrease IU (noting that the chances of winning were high and that the task was just a game so winning was not very important). IU and worry levels were measured after the roulette task was completed. Results indicated that there were significantly higher levels of worry about the charity in the high IU ($M = 37.81, SD = 7.58$) versus the low IU ($M = 19.71, SD = 8.55$) group ($t_{40} = 7.26, p < .05$). However, although the manipulation check of IU was successful, it is unclear if IU per se was being manipulated. It is possible that group differences on the manipulation check were caused by variations in expectations of success or increases in feelings of personal responsibility, rather than IU.

A second IU manipulation was developed by Grenier and Ladouceur (2004) and subsequently extended by Mosca, Lauriola, and Carleton (2016). The manipulation involved two sessions. In the first session, undergraduate participants thought of a possible future negative life event and then were asked to think of three consequences for that event in a hierarchical fashion. After a few hours (Study 1) or 7-14 days (Study 2), participants engaged in a second session. During the second session, participants in the increasing IU condition read statements about uncertainty on a computer (e.g., “Concerning the negative event it’s difficult not knowing what will happen”) with their negative life event written on a piece of paper and affixed above the monitor. Participants in the decreasing IU condition read positive statements about uncertainty (e.g., “It doesn’t bother me to not know what will happen to me”). Results from Study 1 revealed that individuals in the increasing IU condition reported greater state IU ($F_{1, 37} = 13.93, p < .001$, partial $\eta^2 = .27$) and negative affect ($F_{1, 37} = 17.28, p < .001$, partial $\eta^2 = .32$) than those in either the decreasing IU or control conditions whereas the decreasing and control conditions did not differ on these variables. Study 2 yielded similar results for group differences in state IU and negative affect, but the increasing IU condition also was found to differ significantly on worry ($F_{3, 163} = 5.48, p < .001$, partial $\eta^2 = .09$). This paradigm, designed to be used in an experimental
setting, was both novel and creative and provides support for the causal effect of IU on worry and negative affect. However, the manipulation may be limited in its generalizability; thus far, it has yet to be replicated in an English-speaking sample. Grenier and Ladouceur (2004) used a French-Canadian sample, whereas Mosca et al. (2016) used an Italian sample. Further, it may not be suited to examining IU in the context of disorders other than GAD because the task pertained to a GAD-like future negative event.

A final IU manipulation from the GAD literature is a vignette-based task designed to elicit feelings of uncertainty (Kelly, 2009), which was subsequently replicated by Meeten, Dash, Scarlet, and Davey (2012). The manipulation involved participants reading vignettes about a character experiencing uncertain dating and finance situations, followed by participants writing a story about an uncertain situation in their own lives. Once finished writing, participants were asked to memorize their narrative from the perspective of the character in the vignettes. Following the manipulation, Kelly (2009) found a significant difference in IU levels (measured by the IUS-12) between the high ($M = 30.00, SD = 8.60$) and low ($M = 24.70, SD = 6.01$) groups ($t_{38} = 2.77, p < .05$). In a replication study, Meeten et al. (2012) found similar results between the high ($M = 29.64, SD = 6.05$) and low ($M = 25.86, SD = 7.04$) groups on levels of IU ($t_{44} = 1.96, p = .06$). This manipulation, though successful, is limited by the amount of time needed to complete it (i.e., > 40 minutes) and the focus on IU in regard to everyday situations, which are more relevant to GAD than OCD. Further, the manipulation was developed in Australia, and some of the situations are not applicable elsewhere in the world (e.g., the finance situation is about Australia-specific retirement systems).

In one of the only IU manipulations in the context of OCD, Faleer, Fergus, Bailey, and Wu (2017) attempted to manipulate IU across three studies with a linguistic paradigm created by Rosen and Knäuper (2009). The manipulation altered the wording of the IUS by inserting the
words “almost always” to reduce the number of responses endorsed as “true” or inserting the word “occasionally” to increase the number of endorsements. Participants then received false feedback about their level of IU based on the number of items endorsed as true (e.g., if fewer than 24 statements were endorsed as “true,” participants received the low IU feedback). In the high IU feedback condition, participants read that they do not tolerate uncertainty well and that they find uncertainty unfair; feedback for the low IU manipulation stated that participants tolerated uncertainty well. This manipulation is based on the theory that answering questions in a particular way will increase cognitions consistent with the answers, affecting attitudes or traits (Salancik & Conway, 1975). Study 1 results revealed that conditions (high or low IU) differed significantly in the number of steps taken during a catastrophizing worry interview ($F_{1, 58} = 6.55, p = .007, d = 0.69$), suggesting that level of IU affected the amount of worry about intrusive, ego-dystonic thoughts.

In Study 2, checking behavior was measured by a behavioral task that required participants to find errors in a math-based text (MacDonald & Davey, 2005). In this task, participants were instructed to read over a math text that had a large number of spelling errors and make a note of every error they saw. The text consisted of 42 lines and 100 spelling/punctuation errors; after participants read through the text once, they were given the opportunity to read through it again, this time noting how many lines they checked. Participants were sorted into groups in which they were instructed either to check until they had found as many errors as possible or to check until they felt like stopping. Participants did not differ significantly between conditions either for number of checks performed ($F_{1, 80} = .62, p = .22, d = 0.18$) or amount of time spent checking ($F_{1, 80} = .32, p = .28, d = 0.13$). In Study 3, the manipulation only was partially successful; IU was reduced in the low condition but not increased in the high condition, nor did it have an effect on an OC-relevant measure of IU (OBQ-
Additionally, the study found no significant effect on a computerized matching-to-sample checking task designed to measure checking behavior. An ANCOVA revealed that participants did not complete a significantly different number of checks \( (F_{1, 92} = .64, p = .42, d = 0.01) \) nor did they spend different amounts of time on the checking task \( (F_{1, 92} = .05, p = .81, d = 0.06) \). Notably, baseline IU differed significantly between conditions in Studies 2 and 3 (it was not measured in Study 1); this may indicate that the manipulation was not particularly powerful and that participants may have self-selected out of the study if their IU did not match the feedback they received.

Although this series of studies had limitations, it was the first known investigation of the causal impact of IU on OC phenomena. Further, this series of studies was one of the few to attempt experimental manipulation of IU in the context of OCD. The results of these studies suggest that IU is a difficult belief to manipulate, and causal relationships between IU and OC-outcomes are not firmly established. Extant research on IU manipulations has demonstrated mixed results warranting additional research to clarify these relations, suggesting that it remains important to experimentally examine IU in the laboratory (Rosser, 2018). Further, although examining causal relationships remains an important step, it also is necessary to examine the effects of IU on emotional outcomes in the disorder-specific context. A better understanding of the relationship between IU and certainty may allow for more effective manipulations and, ultimately, treatments of IU.

**Responses to Uncertainty: The Effect of IU**

Uncertainty is a key component in anxiety disorders, and IU is an individual difference factor that may contribute to the onset and maintenance of anxiety. IU also appears to impact
behavioral, affective, and cognitive reactions. For example, individuals with high levels of IU appear to consider uncertainty distressing due to a tendency to perceive novel stimuli as threatening (Carleton, 2012; Dugas et al., 2005). Einstein (2014) suggested that threat is a key component in the relationship between uncertainty and emotional responding, writing, “If there is no elevated threat expectancy, there will be no emotional response in the face of uncertainty” (p. 292).

Using a computerized visual search task, Fergus, Bardeen, and Wu (2013) examined the relationship between IU and facilitated engagement (detecting threat-related stimuli more quickly) and disengagement (removing attention from threatening stimuli). Undergraduate participants completed a visual search task in which an uncertain word (e.g., “chance”) or neutral word (e.g., “mantel”) was placed near several non-word stimuli (e.g., “gtygq”). Results revealed that trait IU was significantly correlated with facilitated engagement ($r = .22, p < .05$), suggesting that the detection of threat may be an important attentional mechanism underlying IU.

Research indicates that individuals with higher levels of IU interpret ambiguous information as threatening, suggesting that biased information processing may play a role in the relationship between IU and anxiety (Oglesby, Raines, Short, Capron, & Schmidt, 2016). Dugas et al. (2005) presented participants with 15 uncertain and 15 neutral words on a screen for 10 seconds per word; results indicated that individuals with high IU recalled more uncertain words than did participants with low IU ($t_{99} = 2.05, p < .05$). In a second study, Dugas and colleagues (2005) had participants read the Ambiguous/Unambiguous Situations Diary (Davey, Hampton, Farrell, & Davidson, 1992), which consists of ambiguously and non-ambiguously worded fictional diary entries. Participants were subsequently asked to rate their level of concern about each entry. Results indicated that participants with high levels of IU (as measured by the IUS) reported significantly more concern about ambiguous situations than participants with low levels
of trait IU ($F_{1, 146} = 17.24, p < .001$). Finally, Koerner and Dugas (2008) compared appraisals of hypothetical situations between individuals with high and low levels of IU. Participants were asked to rate their level of concern for 55 vignettes that covered 11 content areas (e.g., work, family) and were positively, negatively, or ambiguously valenced. Results revealed that individuals with higher levels of IU rated ambiguous scenarios as more disconcerting ($F_{1, 192} = 9.62, p < .01, \eta^2_p = 0.05$).

Uncertainty is a core component of anxiety, but experimental research has been mixed on the relationships among uncertainty, IU, and emotional/behavioral outcomes. Using physiological measures, Greco and Roger (2003) found that when viewing unpleasant, aversive pictures, individuals with high IU had higher blood pressure than individuals with low IU. This effect held for both certain and uncertain viewings of unpleasant pictures. Chin, Nelson, Jackson, and Hajcak (2016) used a within-subjects design and had participants undergo a fear conditioning paradigm in which they were exposed to an unpleasant stimulus (an electric shock) 50% of the time and 75% of the time. Results indicated that the 50% condition elicited greater startle responses ($F_{1, 32} = 8.67, p < .01, \eta^2_p = .21$). Further, IU was associated with increased startle responses in the 50% condition but not the 75% condition, suggesting an enhanced fear response in the face of greater uncertainty.

These studies are at odds with the findings Nelson and Shankman (2011), who also examined the relationship between IU and startle responses to an electric shock. Using a within-subjects design, participants cycled through two sets of uncertain, predictable, and no-shock conditions. Participants were informed of which condition they were currently in, and each condition lasted for 90 seconds. Results revealed that participants reported greater anxiety (measured on a 1 [not at all] to 7 [extremely] scale) during the uncertain threat condition as compared to the predictable threat condition ($F_{1, 63} = 48.88, p < .001, \eta^2_p = .44$). Additionally, IU
(measured by the IUS) was significantly negatively associated with uncertain threat responding (startle response); moreover, perceived control (measured by the Anxiety Control Questionnaire; Rapee, Craske, Brown, & Barlow, 1996) significantly mediated this relationship ($R^2 = .17, F = 6.08, p < .01$), such that higher IU led to lower perceived control, which led to a smaller startle response in the uncertain threat condition. In that study, the results run counter to expectations that individuals high in IU would display greater startle responses to uncertain threat. One possibility suggested by Nelson and Shankman (2011) is that individuals with higher levels of IU may implement an avoidance strategy in order to gain some sort of control over uncertain events; the avoidance strategy subsequently may decrease their startle response. However, this explanation is at odds with Krohne’s (1989) model that uncertainty results primarily in vigilant, rather than avoidant, responding. Further, a limitation of the study was the measurement of anxiety. Anxiety ratings were obtained after the experiment, which may have biased results, as retrospective reports of anxiety during the task may not be entirely accurate. More research is needed to examine the relationship between IU and uncertainty before IU-based coping mechanisms can be fully understood.

Reuman, Jacoby, Fabricant, Herring, and Abramowitz (2015) examined relations among uncertainty, threat, and anxiety in an undergraduate sample. The experimental manipulation consisted of 10 vignettes about different scenarios faced by students (e.g., submitting a term paper online) and four conditions that combined uncertainty (explicit or implicit) and threat (low or high). Participants were asked to rate hypothetical feelings from the vignettes (e.g., “How anxious would you feel if you were in this situation?”). In the explicit threat condition, uncertainty was made clear (e.g., You aren’t certain that...). In the implicit condition, participants had to infer uncertainty by the situational context. Results revealed that the explicit uncertainty condition provoked a greater sense of uncertainty than the implicit condition in a
majority of the vignettes. Further, when threat level was low, participants endorsed greater anxiety when uncertainty was explicit \((F_{1,289} = 18.83, p < .001, \eta^2_p = .06)\). This relationship did not hold for the high threat conditions, in which participants rated situations as equally threatening regardless of whether uncertainty was made implicit or explicit. The authors posited that one explanation for this finding is that, once primed to consider the outcome uncertain, participants may be more likely to misinterpret low threat situations as highly threatening, whereas highly threatening situations appeared to evoke anxiety regardless of the priming of uncertainty. Although the study was one of the first to examine the interaction between uncertainty and threat, it is limited by the fact that uncertainty was not manipulated or assessed; uncertainty was high in all situations. Similarly, level of IU was not assessed. Further, the study did not use an in vivo task; rather, participants were asked to imagine what their anxiety would be if they found themselves in one of the situations.

Theory suggests that individuals high in IU find uncertainty itself threatening, but disentangling the effect of uncertainty from negative outcomes has proven challenging. Recently, Pepperdine, Lomax, and Freeston (2018) developed a paradigm in order to assess the nature of IU in the context of uncertainty when controlling for threat. Titled the Positive and Negative Uncertain Situations Questionnaire (PANUSQ), the task asks participants to rate salience, uncertainty, uncertainty discomfort, desire to know the outcome, and likelihood (on a 1 [not at all] to 5 [extremely] scale) of 12 hypothetical uncertain scenarios. Participants also rated valence of each scenario (1 [very positive] to 8 [very negative]). Results indicated that participants judged the scenarios to have positive outcomes but were moderately uncertain. Further, a hierarchical regression predicting IUS-12 scores found that uncertainty appraisals accounted for 14% of the overall model beyond threat appraisals for positive scenarios \((\Delta R^2 = .14, F_{3,215} = 16.88, p = .04)\). These results suggest that high IU is associated with concerns about uncertainty even when threat
expectancy is low. The authors contend that these results support the notion that uncertainty itself is inherently threatening for individuals high in IU, as suggested by Carleton, Mulvogue, et al. (2012). Alternatively, these results oppose Einstein’s (2014) hypothesis that responses to uncertainty occur only when a situation is threatening. A major limitation of the study includes the use of vignettes, which, as mentioned previously, may not equate with responses to real-life situations.

Oglesby and Schmidt (2017) addressed the limitations of extant research by incorporating an in vivo threatening task instead of a vignette. Participants were randomized into an uncertain threat or certain threat condition. In the certain threat condition, participants were told they would be giving a three-minute judged speech on a controversial topic; in the uncertain threat condition, they were told that a coin flip would determine whether they gave the speech. These data were collected as part of a larger study, and only the threat conditions were reported in the current study. Results revealed that trait IU (IUS-12) was associated with pre-speech anxiety (measured by the Brief State Anxiety Measure [BSAM]; Berg, Shapiro, Chambless, & Ahrens, 1998) at trend level ($\beta = .23, t = 1.86, p = .07$) in the uncertain threat condition. However, a linear regression revealed that condition was not predictive of pre-speech anxiety ($\beta = .003, t = .04, p = .97$). Given that a number of studies have found associations among uncertainty, threat, and anxiety (e.g., Carleton, Sharpe, & Asmundson, 2007; Reuman et al., 2015), these results are surprising. It is possible that measurement may have contributed to the null findings. On the BSAM, participants are asked to rate how consistent each item is with their current feelings (relaxed, steady, strained, comfortable, worried, and tense) on a scale from 1 (not at all) to 4 (very much so). Perhaps a more efficient and less distracting way of obtaining this information could have been to have participants complete a VAS or give SUDS ratings.
Further, the authors suggest that the speech task may have been too threatening for participants, resulting in ceiling effects. However, given the mean pre-speech anxiety scores for the certain ($M = 13.33$, $SD = 3.50$) and uncertain ($M = 13.93$, $SD = 4.71$; M. Oglesby, personal communication, February 16, 2017) conditions, and the possible range of scores on the BSAM (6-24), it appears that the task may not have been threatening enough. Perhaps had Oglesby and Schmidt (2017) selected a sample with social anxiety concerns, the task would have performed better; it is possible that individuals who did not find the speech threatening confounded the results. This study also may have been more successful had ideographic concerns been considered, rather than the experimenters providing a list of topics that may not have been perceived as controversial by the participants. Another possibility is that the study was underpowered (i.e., had roughly 40 participants per condition) and that a larger sample size may result in significant findings. Although this study is one of the few to examine the relationship between IU and certainty experimentally, the need remains for more studies to clarify the relationship between these constructs (Shihata et al., 2016).

Thought-Action Fusion

As described above, uncertainty and threat are key components in the development and maintenance of OCD (OCCWG, 1997). Another relevant component may be inflated responsibility for preventing harm. OCCWG (1997) defined beliefs concerning inflated responsibility as feelings that an individual has total power to prevent or generate negative outcomes. Inflated feelings of responsibility can be derived from internal (i.e., thought-action fusion) or external (i.e., physical stimuli such as stoves or locks) sources (Shafran, Thordarson, & Rachman, 1996). Thought-action fusion (TAF) is a belief that having a disturbing thought will
make it more likely to occur or that the thought is the moral equivalent to performing the action (Shafran et al., 1996).

Conceptualizations of TAF have been available in the literature since the early 20th century (see Bleuler, 1934), although the term itself did not appear until the 1990s. In his model of OCD, Salkovskis (1985) included appraisals such as “thinking this is as bad as doing it” (p. 573), which appears similar to modern conceptions of TAF. Shafran et al. (1996) coined the term and suggested that individuals who experience TAF are more prone to experience responsibility for preventing harm and thus more anxiety about intrusive thoughts. Individuals with high levels of TAF are “inclined to feel that their unacceptable thoughts may increase the probability of an adverse event occurring (TAF Likelihood) and/or that such thoughts are morally equivalent to carrying out the corresponding unacceptable action (TAF Morality)” (Rachman, Shafran, Mitchell, Trant, & Teachman, 1996, p. 890). For example, an individual who has a thought about committing adultery may believe that it is equivalent to being adulterous (TAF Moral), whereas an individual who experiences a thought about a loved one dying may believe that the thought has increased the loved one’s chances of dying (TAF Likelihood; Shafran et al., 1996). It has been posited that TAF may be elicited in response to threat that is uncontrollable and uncertain (Zusne & Jones, 1989). Although it is not the only path toward developing obsessions, the presence of TAF may increase the possibility that an individual will experience increased appraisals of threat (Shafran & Rachman, 2004).

A number of studies using self-report data have found evidence of TAF’s relevance to OC phenomena. Shafran and colleagues’ (1996) TAF Scale (TAFS) is the primary self-report measure of this construct. The TAFS typically is identified as having a three-factor structure, which consists of Moral (e.g., “Having violent thoughts is almost as unacceptable to me as violent acts”), Likelihood-Others (e.g., “If I think of a relative/friend being in a car accident, this
increases the risk that he/she will have a car accident”), and Likelihood-Self (e.g., “If I think of myself falling ill, this increases the risk that I will fall ill”). In student samples, this three-factor structure appears to account for more of the variance than a two-factor structure (59-65% as compared to 66-69%), but in a clinical sample, a two-factor solution was supported (accounting for 71% of the variance; Shafran et al., 1996). Conversely, Bailey, Wu, Valentiner, and McGrath (2014) found a three-factor solution for both clinical and non-clinical samples. A consistent finding is that the three-factor structure should be used with student samples.

Broadly, the three TAFS scales (Moral, Likelihood-Self, Likelihood-Others) were significantly related to obsessive features (Obsessive-Compulsive Inventory; Foa et al., 1998) after controlling for worry (Coles, Mennin, & Heimberg, 2001). Bailey et al. (2014) found that certain subscales (TAFS-Moral and Likelihood-Others) were more strongly associated with OC symptoms than with symptoms of other disorders; TAFS Likelihood-Self was associated with other symptoms of anxiety and depression. Smári and Hólmsteinsson (2001) found that TAF was associated with responsibility (Responsibility Attitudes Scale; Salkovskis et al., 2000; r = .47) and obsessional symptoms (Maudsley Obsessive-Compulsive Inventory [MOCI] Hodgson & Rachman, 1977; r = .37). When examining associations between the TAFS subscales and OC phenomena, the only correlation to remain significant after controlling for depression was Likelihood-Others and checking (Shafran et al., 1996).

Causal models of TAF also have been examined. Rassin, Merckelbach, Muris, and Spaan (1999) attempted to elicit TAF by having high school students undergo a fake electroencephalography (EEG) session in which they were told either that thinking the word “apple” would deliver shocks to another person (experimental condition) or that their thoughts about the word “apple” would be monitored but would result in no consequences (control condition). Results revealed that as compared to the control condition, the experimental
condition endorsed more discomfort ($t_{44} = 4.2, p < .01$), higher frequency of intrusions ($t_{44} = 2.8, p < .05$), and greater effort to avoid thinking ($t_{44} = 4.6, p < .01$). These results suggest that altering appraisals about the connection between thoughts and outcomes can result in OC-relevant responses.

It is the task created by Rachman et al. (1996) that appears to be the most used paradigm in eliciting feelings of TAF. In the task, participants are asked to keep in mind the name of a loved one; copy the sentence, “I hope ____ is in a car accident”; and write their loved one’s name in the blank space. Anxiety scores, as measured by a visual analogue scale (VAS; 0-100) were much higher right before writing out the sentence (i.e., approximately 15 at baseline to 65 at pre-task) in individuals with high TAF. This anxiety, however, was short lived. Anxiety was reduced both after immediate neutralizing ($M = 23.5$) and delaying 20 minutes before neutralizing ($M = 9.7$; Rachman et al., 1996).

The paradigm also has been shown to elicit similar levels of anxiety and distress in unselected student samples (van den Hout et al., 2001). Further, van den Hout et al. (2002) examined the components of the task and found that both writing and thinking about the task increased anxiety. The methodology is convincing because it appears to mimic the reaction of obsessional patients to negative intrusions, and therefore is useful in the study of clinical obsessions (van den Hout et al., 2001).

The number of studies utilizing the TAF sentence task is growing and may be indicative of its relative ease of use and effectiveness with a variety of samples (e.g., Bocci & Gordon, 2007; Marcks & Woods, 2007; Rassin, 2001; Rassin et al., 1999; van den Hout et al., 2001, & 2002; Zucker et al., 2002). All studies found that participants who engaged in the TAF task reported increased distress, increases on the TAF scale used, and some neutralizing behaviors. Further, although the sentence task remained the same in terms of theme, modifications were
made across studies, including altering instructions to encourage visualization, adjusting time allowed for neutralizing, and visualization of a more severe accident. In fact, modifications to the task appear to be the norm rather than the exception. These studies also suggest that neutralizing is common in non-clinical samples (e.g., 75.5% of the sample engaged in neutralizing behaviors without prompting; Bocci & Gordon, 2007) and suggest that the task is sufficiently threatening that many individuals require cancelling out the effects of writing it.

Berman, Abramowitz, Wheaton, Pardue, and Fabricant (2011) created a modified TAF task based on Rachman et al. (1996) in which participants completed two sentence tasks (“I hope [relative] is in a car accident today” and “I hope I have sex with [relative]”). The purpose of the sentences was to activate beliefs about both TAF-Likelihood and TAF-Moral. After writing each sentence, participants were asked to imagine the event for five seconds and provide ratings of anxiety, moral acceptability, and likelihood of the thought coming true. Results revealed that the car accident sentence task likelihood ratings ($r = .26, p < .01$) and anxiety ratings ($r = .37, p < .001$) were moderately correlated with TAFS Likelihood-Others scale; the incest sentence task elicited moderate correlations between TAFS Moral and ratings of moral wrongness ($r = .26, p < .01$). The average anxiety rating on a VAS for both sentence tasks was 40.7, indicating that they elicited a non-trivial amount of anxiety and discomfort. The results of these studies suggest that the TAF sentence task is sufficiently threatening to non-clinical samples and may provide an OC-relevant context in which to examine IU.

**Summary**

Although research examining the cognitive components that contribute to the etiology and maintenance of OCD is growing, the heterogeneous nature of the disorder indicates that
there is still more work to be done in order to improve treatment outcomes and broaden our understanding of underlying mechanisms. Much of the prior research on OCD has focused on symptoms rather than beliefs, which indicates that there is still much research to be done on the cognitive-behavioral model of OCD (Sookman & Pinard, 2002). One individual difference variable that may contribute to the onset of OCD symptoms is IU, which concerns the need to be sure and reduced ability to function in the face of ambiguity. IU encompasses a fear of the unknown and is hypothesized to heighten cognitive, behavioral, and emotional reactions toward uncertainty (Carleton, 2012). However, IU primarily has been studied in the context of GAD; studies that examine this belief in the context of OCD generally are correlational in nature.

Trait IU has been associated with negative appraisals of ambiguous situations (Koerner & Dugas, 2008), differences in decision making (Luhmann et al., 2011; Tolin et al., 2003), attentional bias toward uncertainty (Dugas et al., 2005), and increased threat perception (Bredemeier & Berenbaum, 2008; Dugas, Buhr, & Ladouceur, 2004). However, relatively little experimental research has been conducted on the effect of IU on emotional responses or in the context of OCD. IU may contribute to compulsions by allowing for an easier association with threat in uncertain situations or by increasing vigilance toward possible uncertainty (Carleton, Mulvogue, et al., 2012). There currently exists a gap in the experimental literature about the relationship between IU and OCD (Shihata et al., 2016).

**Limitations of Existing Research**

Currently, few studies examine the relationship between the effects of IU on emotional reactions to uncertainty in a disorder-specific context. Not focused on any particular disorder, Reuman et al. (2015) examined the effects of high and low threat situations in which uncertainty
was made explicit or kept implicit on ratings of anxiety; however, the study did not include an in vivo task and did not actually alter uncertainty (only participants’ awareness of it). Although the task may have been relevant to students (i.e., submitting a term paper online), it was not designed to approximate OC situations. Oglesby and Schmidt (2017) extended this work by manipulating uncertainty of a threatening task to assess anxiety. The task, a three-minute speech to a camera, may not have been threatening enough to participants, which could account for the lack of differences between conditions. Level of threat was not assessed or manipulated, and it appears that all participants felt a similar level of responsibility (i.e., to prevent discomfort to themselves). This may not have been enough to produce high levels of anxiety. Further, measurement appeared to be a key limitation in this study: Anxiety ratings, measured by the BSAM, may not have fully captured participants’ experiences of anxiety.

Although the current IU literature suggests that certainty of an aversive outcome is preferable to coping with uncertainty, the studies that have attempted to assess this relationship have produced mixed results. For example, Monat and colleagues (1972) found that participants had no preference between a 50% and 100% chance of a negative outcome (shock) occurring. However, IU was not measured, and participants were asked about their preferences at the end of the study, once the shock already had occurred. Nelson and Shankman (2011) found that participants felt more anxious in response to an uncertain shock than to a predictable shock, but subjective anxiety ratings were not captured until after the shock had occurred. On the other hand, Carleton, Sharpe, and Asmundson (2007) suggested that participants with higher levels of IU should have a preference for a certain negative outcome over an uncertain negative outcome and Luhmann et al (2011) found that individuals high in IU were more likely to choose an immediate, lower probability reward rather than waiting in a state of uncertainty for a higher value, higher probability reward. Research still is needed to clarify participant reactions to an
immediate, uncertain stressor as compared to an immediate, certain stressor and to assess how IU may affect this relationship in a disorder-specific context.
CHAPTER 2
CURRENT STUDY

The current study adapted existing experimental paradigms to assess the effects of IU on perceptions of distress. Specifically, the major purpose of the study was to assess the effects of uncertainty about a personally relevant, threatening task to produce distress in a non-clinical sample. Broadly, the current study sought to examine participant responses to an uncertain or certain threat. Another primary aim of this study was to experimentally examine IU theory using an in vivo, OC-relevant task. Theory suggests that individuals with higher levels of trait IU would prefer to know a certain negative outcome rather than an uncertain negative outcome (Carleton, 2012); an operationalization of this theory is that individuals high in trait IU find uncertainty anxiety provoking. Conversely, the findings of Oglesby and Schmidt (2017) suggest that for individuals high in trait IU, an uncertain negative outcome is just as anxiety provoking as a certain negative outcome. Thus, it remains important to assess whether individuals with higher levels of trait IU react more negatively in a laboratory context to an uncertain threat versus a certain threat. The work of Oglesby and Schmidt (2017) should be replicated, as it is the first study to assess this question using an in vivo task.

Although a primary aim of this study was to examine IU in a disorder-specific context, the study used an unselected student sample. Non-clinical samples can be a useful source of information regarding psychopathology variables. Although the use of a non-clinical sample often is considered a limitation, they can be advantageous when examining symptom subtypes
(e.g., harm), as compulsions observed in individuals with OCD also are observed in non-clinical samples (Flament et al., 1988). That is, OC symptoms are considered to be dimensional rather than categorical, suggesting some degree of prevalence within the general population (Abramowitz et al., 2014). Non-clinical samples are useful to understand OC-relevant phenomena, and symptoms are considered to differ only in severity between clinical and non-clinical samples (Abramowitz et al., 2014; Gibbs, 1996). Although not without limitations, the use of a student sample in the current study is justifiable, as there still is information to be learned from studying OC phenomena in non-clinical populations.

Replicating the design by Oglesby and Schmidt (2017), this study sought to manipulate the level of certainty for threat. That is, participants were randomly assigned into either a certainty condition, in which they were told that they would be completing a threatening task, or an uncertainty condition, in which they were told that whether they would complete the task would be dependent on the outcome of a coin toss. It was hypothesized that the certainty condition would elicit more distress than the uncertainty condition, such that participants in the certainty condition would endorse significantly higher SUDS ratings before the threatening task than would participants in the uncertainty condition. That is, when faced with an immediate, certain threat, participants would feel more distressed than participants faced with an immediate, uncertain threat. Although extended periods of uncertainty may be considered aversive (Luhmann, Chun, Yi, Lee, & Wang, 2008), it was hypothesized that, in general, participants would feel less anxiety when the chances of experiencing a threat were reduced. Put another way, participants should feel greater levels of distress when faced with 100% probability of engaging in an aversive stimulus versus only a 50% probability. Conversely, it was hypothesized that the amount of distress elicited by the conditions would depend on the level of trait IU; participants in the uncertainty condition would experience the most distress when trait IU levels
are high. That is, uncertainty will bias the thinking of individuals with higher levels of IU, by magnifying the negative emotional consequences of immediate uncertainty. IU will alter the effects of the uncertainty condition such that individuals with higher levels of IU should experience more distress in the face of a 50% probability of an aversive stimulus versus a 100% probability.

The current study also built upon the extant literature by incorporating an in vivo, threatening task that is OC relevant. Oglesby and Schmidt’s (2017) paradigm is the first known research to experimentally examine IU using a disorder-relevant, in vivo stressor, answering the call for examinations of in vivo manipulations of threat and uncertainty (Shihata et al., 2016). This work was extended to OCD by altering the threatening task and by incorporating an ideographic component into the threatening task to increase personal responsibility. That is, participants were told that they would be completing a TAF sentence task with a loved one’s name, which was designed to elicit more distress. Additionally, the TAF task may enhance ecological validity because it does not require participants to suspend disbelief. Instead, the TAF task appears to elicit general discomfort even when individuals know it is objectively unlikely to happen. Carr (1974) suggested that even a low-probability event may be distressing if the consequences are severe. The TAF sentence task has been shown to elicit anxiety in undergraduate samples (van den Hout et al., 2002) and may approximate beliefs of inflated responsibility that individuals diagnosed with OCD experience.

In order to take the next step in the literature, the current study aimed to replicate the paradigm of Oglesby and Schmidt (2017) while extending the examination to an OC-relevant context. Instead of a speech task, the threatening TAF sentence task was proposed to anchor this study in an OC-relevant context. A simpler measure of distress (i.e., SUDS ratings) was used in order to provide more external validity. Further, given the nature of the threatening task, thought-
action fusion Likelihood-Others beliefs were measured at baseline and incorporated as a covariate in order to narrow the cause of predicted differences in distress to trait IU.

Hypotheses

1. Compared to participants who experience the certain threat manipulation, participants who experience the uncertain threat manipulation will endorse significantly lower distress prior to completing the sentence task, and this relationship will be robust to the effect of thought-action fusion Likelihood-Others beliefs.

2. Trait IU will moderate the relationship between condition and distress such that the uncertain threat condition will elicit the greatest amount of distress when IU level is high and the least amount of distress when IU level is low; the certain threat condition will elicit greater distress when IU level is low versus high. This relationship will be robust to the effect of thought-action fusion Likelihood-Others beliefs. See Figures 1 and 2.
Figure 1. Predicted statistical moderation diagram for intolerance of uncertainty.

Figure 2. Predicted conceptual moderation diagram for intolerance of uncertainty.
CHAPTER 3

METHOD

Participants

Participants were recruited from Psychology 102 and Psychology 316 courses at Northern Illinois University (NIU). A power analysis was conducted for fixed-effects ANCOVA (fixed effects, main effects, and interactions) using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) and relevant effect sizes ($f^2 = .07$) based on previous findings from the literature (Oglesby & Schmidt, 2017). Based on the distressing nature of the TAF sentence task, the current study predicted a medium effect size (Cohen’s $f = .25$). With a power of $.80$ and alpha of $.05$, the total estimated sample size for this study was 128. This study ultimately recruited 253 students. After data screening (see Results section), the final sample retained for analysis was $n = 187$. The average age of participants was 19.7 years ($SD = 2.72$; four declined to answer) and 65.2% identified as female. Participants self-identified as Asian (5.3%), Black (17.6%), Native American (.5%), White (61.5%), Multiracial (9.6%), “Other” (4.8%), and “prefer not to respond” (.5%). Additionally, 15% of the sample identified as Hispanic. See Table 1 for sample characteristics.
Table 1

Sample Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (N = 187)</th>
<th>Certain (n = 93)</th>
<th>Uncertain (n = 94)</th>
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<tr>
<td></td>
<td>n</td>
<td>% (SD)</td>
<td>n</td>
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<tr>
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<td>2</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>4.3</td>
<td>5</td>
</tr>
</tbody>
</table>

Note. Age range for entire sample was 18-45.
Measures

**Demographic Data Questionnaire**

The Demographic Data Questionnaire (DDQ) is a nine-item self-report questionnaire that was used to assess basic demographic information. Individuals were asked questions about their sex, age, and race. Additionally, participants were asked a brief set of questions to determine if they received current or past psychological or psychiatric treatment, carried a diagnosis of OCD, or lost a loved one to a car accident. If they endorsed a diagnosis of OCD or had lost a loved one in a car accident, they were prevented from going further in the study and were debriefed.

**Subjective Units of Distress Scale**

The Subjective Units of Distress Scale (SUDS; Wolpe, 1969) is a verbally administered rating scale that measures state distress. Participants were asked to rate their distress on a scale ranging from 0 (*absolute calmness*) to 100 (*the worst distress ever experienced*).  

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1 All measures either are in the public domain (TAFS) or are available through the Measurement Instrument Database for the Social Sciences (IUS-12).
The Intolerance of Uncertainty Scale, Short Form (IUS-12; Carleton, Norton, & Asmundson, 2007), measures responses to ambiguity and beliefs about uncertainty (“One should always look ahead so as to avoid surprises”) and was developed as a briefer measure to research IU across disorders (Carleton, Weeks, et al., 2012). The IUS-12 was derived using factor analysis of the original IUS (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994), a 27-item questionnaire developed for and validated on French-speaking populations. Findings from a meta-analytic review suggest that the IUS may have GAD-specific content that influences the measurement of IU in other disorders. Alternatively, the IUS-12 differentiated clinical samples from community and undergraduate samples but did not differentiate between anxiety disorders (Carleton, Weeks, et al., 2012). Nevertheless, the IUS-12 and IUS show high convergent validity in an undergraduate sample (r = .94; Carleton, Norton, & Asmundson, 2007). Items are rated on a 5-point scale ranging from 1 (*not at all characteristic of me*) to 5 (*entirely characteristic of me*). The range of possible scores is 12-60, with higher scores indicating higher levels of IU. In a college-student sample, the IUS-12 demonstrated internal consistency (α = .91) and convergent validity with the Generalized Anxiety Disorder Questionnaire (r = .61) and Penn State Worry Questionnaire (r = .54; Carleton, Norton, & Asmundson, 2007). The IUS-12 differentiated between a clinical sample diagnosed with GAD (M = 36.76, SD = 8.72) and non-clinical samples (M = 30.62, SD = 9.98, p < .001) and showed satisfactory retest reliability over a two-week period (r = .77; Khawaja & Yu; 2010).
The Thought-Action Fusion Scale (TAFS; Shafran et al., 1996) is a 19-item measure assessing three facets of TAF, including Moral (“Having a blasphemous thought is almost as sinful to me as a blasphemous action,” 12 items); Likelihood-Others (“If I think of a relative/friend falling ill, this increases the risk that he/she will fall ill,” 4 items); and Likelihood-self (“If I think of myself being injured in a fall, this increases the risk that I will have a fall and be injured,” 3 items). The three-factor structure consistently has been found to be the best fit in student samples (Bailey et al., 2014; Shafran et al., 1996). Participants rate each statement on a scale from 0 (disagree strongly) to 4 (agree strongly), with a possible range of 0-76. Higher scores on the TAFS indicate higher levels of TAF. The TAFS demonstrated internal consistency (α = .85-.96) in student, non-clinical, and OC samples (Shafran et al., 1996). In a study conducted at NIU, internal consistency ranged from .90-.98 for the three subscales (Bailey et al., 2014). The TAFS demonstrated convergent validity in a student sample through moderate correlations with the MOCI cleaning and checking subscales (r = .21-.38) and discriminant validity through smaller associations with the Beck Depression Inventory (r = .16-.28; Beck, Steer, & Carbin, 1988). Further, in a study conducted at NIU, the TAFS demonstrated smaller associations with the Center for Epidemiological Studies Depression Scale (r = -.19 to .08; Radloff, 1977). Individuals diagnosed with OCD endorsed higher scores on all three of the TAF subscales compared to students and individuals diagnosed with social phobia, GAD, panic, and depression (Abramowitz, Whiteside, Lynam, & Kalsy, 2003). Means for each subscale in an undergraduate student sample (N = 92) were presented for TAFS Moral (M = 26.82, SD = 11.18), Likelihood-Self (M = 5.35, SD = 2.83), and Likelihood-Others (M = 5.72, SD = 2.95; Berman et al., 2011).
Validity Items

To examine whether participants responded in a careless or intentionally false manner, three validity items were included in the current study. The items are: “Choose the number that equals the sum of two plus two;” “I have experienced a fatal heart attack while watching television”; and “If you are paying attention right now, choose ‘5’ as your answer.” Research suggests that participants who incorrectly answer all three validity items have significantly higher total scores on most measures than those who answer fewer than three items incorrectly, suggesting that their scores may be reducing the validity of the findings by increasing the overall sample means (Bailey & Wu, 2013).

Procedure

Informed Consent

When participants arrived to the laboratory, they were greeted by a proctor and received a hard-copy informed consent document that outlined the study procedures, purpose, and participant rights. Once they had time to review the document and ask any questions, participants were asked to sign the document.

Questionnaire Battery

In order to gain baseline information about beliefs, symptoms, and characteristics of the sample, participants completed a computer-administered questionnaire battery comprised of the
DDQ, IUS-12, and TAFS. The SUDS was explained and participants were asked for a SUDS rating after all questionnaires were completed. As noted, participants who self-reported an OCD diagnosis or had experienced the death of a loved one in a car accident were prevented from moving further in the study and debriefed with a partial debriefing form. This portion of the study took approximately 15 minutes.

**TAF Sentence Task Setup**

Participants were asked to write down the name of a loved one who is currently living. They were asked to specify their relationship to this person and then given five minutes to write about one happy memory they shared with this person. Following the task, participants were handed a sheet of paper with the sentence, “I hope _____ is in a car accident today,” from the method used by Rachman et al. (1996).

**Certainty Manipulation**

Block randomization was used to ensure equal cell sizes across conditions. Participants were randomly assigned into the certain threat condition or uncertain threat condition. The certainty manipulation is based on the paradigm created by Oglesby and Schmidt (2017). Participants in the certain threat condition were told that they would be asked to write the sentence with their loved one’s name. Participants in the uncertain threat condition were told that whether they are asked to write the sentence would depend on the outcome of a coin toss. Regardless of the outcome of the coin toss, all participants in the uncertain condition completed the TAF sentence task.
TAF Sentence Task

Participants in the uncertain threat condition were told that the results of a coin toss would determine whether they completed the task; prior to the coin toss, participants provided SUDS ratings. Following the coin toss, the examiner told all participants in this condition that the result of the coin toss matched a predetermined outcome indicating that they (the participant) must complete the task. Participants in the certain threat condition provided SUDS ratings and then completed the TAF task as they initially were told. Following the paradigm by Rachman et al. (1996), participants were given the instructions, “Keeping in mind the loved one who you wrote about earlier, I would like you to write out the following sentence on this piece of paper, inserting the name of the person in the blank.” Participants were then directed to the sheet of paper with which they were provided and asked to copy the sentence with their loved one’s name. Following the TAF task, SUDS ratings were collected.

Neutralizing

Participants then were asked to provide ratings of how threatening they found the task and how likely they believed the sentence would occur. Next, participants who completed the TAF task were given the opportunity to neutralize the sentence. Participants were told that they “may do whatever they wish to try to reduce or cancel the effects of the sentence” and were given up to two minutes to do so; van den Hout et al. (2002) showed that anxiety returns to baseline levels following two minutes of neutralizing.
Debriefing

At the end of the study, participants were debriefed regarding the nature of the study. Before leaving the laboratory, all participants were offered referral information for counseling services in the DeKalb area. The total study lasted approximately 30 minutes. See Figure 3 for graphical representation of the procedure steps.
Figure 3. Procedure.
CHAPTER 4
RESULTS

Data Screening and Preliminary Analyses

Missing Data and Outliers

Analyses were conducted in SPSS 24.0. First, data were screened, and problematic participants were removed from analysis. In total, 66 participants were removed. Participants were removed if they did not meet eligibility criteria (i.e., English not a native language, \( n = 6 \); diagnosis of OCD, \( n = 2 \); endorsing that a loved one had died in a car accident, \( n = 33 \)), if they chose to discontinue early from the study (\( n = 4 \)), or for answering three validity items incorrectly (\( n = 6 \)). Participants also were removed for errors identified during the procedure (\( n = 5 \)) and for not correctly completing the manipulation (e.g., completing the task before hearing the directions, \( n = 10 \)). Next, missing data were analyzed. A missing values analysis determined that \( .07\% \) of data were missing from this dataset. Little’s MCAR test (Little, 1988) revealed that the data were missing completely at random (\( \chi^2 = 71.58, \) df = 89, \( p = .91 \)). The data were imputed using the expectation maximization (EM) method to improve statistical power (Enders, 2001). EM is an item-level, two-step imputation procedure which computes a conditional dataset, initial covariation matrix, and mean vector utilizing the EM algorithm in the first step and calculates maximum likelihood estimate of the covariation matrix and mean vector in the second step (Enders, 2001). The steps are repeated until the covariation matrices of both steps converge. For
the current study, all datasets converged in fewer than 25 iterations. Next, total scores were created for the questionnaire items and data were analyzed for outliers (defined as greater than 3 SD from the mean; Field, 2009). No outlier values were found on any measures.

**Assumptions**

Data were analyzed to determine whether they met the assumptions of linearity, normality, homogeneity, imperfect multicollinearity, homoscedasticity, and independent errors. Homogeneity of variance was examined using Levene’s test, which indicated that variation in responding was not significantly different across conditions on TAFS Likelihood-Others ($F_{1,185} = 1.80, p = .18$) or IUS-12 ($F_{1,185} = .72, p = .40$). To assess for normality, data were examined for skew and kurtosis. Both the TAFS Likelihood-Others and the IUS-12 demonstrated significant positive skew (ratio of skew/standard error > 2.58; Field, 2009). To further test for normality, the Kolmogorov-Smirnov test was conducted. TAFS Likelihood-Others ($D_{187} = 0.27, p < .01$) and the IUS-12 ($D_{187} = 0.09, p < .01$) both demonstrated significant non-normality. The non-normal variables were square root transformed to reduce positive skew (IUS-12 resulting skew: 1.26, resulting kurtosis: 1.12). The TAFS Likelihood-Others scale had skew reduced but became leptokurtic following transformation (resulting skew: 1.83, resulting kurtosis = 3.94).

Several options exist in the literature for addressing variables that remain skewed/kurtotic following transformation. One option, bootstrapping, is a non-parametric statistical approach to hypothesis-testing estimate-sampling distribution of parameter estimates (Efron & Tibshirani, 1994). Bootstrapping does not require the assumption of normality and therefore is suitable for

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$^1$TAFS-LO skew = 6.45, kurtosis = 1.24; IUS-12 skew = 3.16, kurtosis = -.49.
use when data are non-normal. Although it has been argued that regression and ANOVA are robust to violations of normality (Hayes, 1996, 2013), the data were analyzed with both bootstrapped and non-bootstrapped tests.

Multicollinearity was assessed using the variance inflation factor (VIF); a VIF greater than 10 indicates that the predictor variable has a very strong relationship with the other variables. The average VIF was 1.03, indicating that multicollinearity was not problematic for this model. Independence of the errors was assessed with the Durbin-Watson test, which tests for serial correlation between errors. The value fell within the range of 1.5 to 2.5, which indicates independence. Homoscedasticity was examined by plotting the standardized residuals against the standardized predicted values of the dependent variable. No patterns or instances of funneling or curves were observed, indicating homoscedasticity and linearity.

Baseline Differences

Descriptive statistics (mean, standard deviation, and range) were calculated for all variables. Given random assignment to condition, it was not expected that conditions would differ on any variable. Conditions did not differ significantly on baseline distress ($t_{185} = 1.74, p = .08$), trait IU ($t_{185} = .59, p = .56$), or TAFS Likelihood-Others scores ($t_{185} = 1.07, p = .29$). Further, there were no significant differences found between conditions on age ($t_{181} = 1.87, p = .06$), religion ($\chi^2, N=187 = 5.52, p = .48$), race ($\chi^2, N=187 = 6.68, p = .35$), or ethnicity ($\chi^2, N=186 < .01, p > .99$). However, sex was found to be significantly different between conditions ($\chi^2, N=187 = 5.06, p = .02$), with a significantly higher proportion of men in the uncertain (42.5%) versus the certain (26.8%) threat condition. The Holm-Bonferroni correction was used to control for family-wise error due to the number of a priori comparisons (Holm, 1979). This is a sequential
procedure that is intended to increase statistical power above the Bonferroni method and reduced the functional alpha to .006 (Aickin & Gensler, 1996). Therefore, none of the baseline variables were entered as covariates in the primary analyses.

Validity and Reliability

To test for measurement error, internal consistency (Cronbach’s alpha) was computed for the IUS-12 and TAFS. All alphas were above .80 and the median value was $\alpha = .91$. The average inter-item correlation (AIC) was .44 for the IUS-12. The current sample had similar means, standard deviations, and internal consistency on the IUS-12 to student samples in the extant literature. For example, Khawaja and Yu (2010) found IUS-12 sample means of 30.62 (9.98); the current study found a total sample mean of 27.95 (8.49).

Multiple issues were noted when examining the TAFS Likelihood-Others scale. First, the AICs ranged from .38-.86 in the total sample, with the TAFS Likelihood-Others (.86) and TAFS Likelihood-Self (.75) higher than recommended (Briggs & Cheek, 1986). When AICs are too high, they suggest that the items may be redundant and compromise the validity of the scale (Clark & Watson, 1995). Second, the TAFS Likelihood-Others scale evidenced scores much lower than published student samples (i.e., current sample, $M = 2.89$, $SD = 3.54$, versus $M = 4.7$-$5.7$ ($SDs = 2.9$-$4.7$; Berman et al., 2011; Shafran et al., 1996). Notably, the TAFS Likelihood-Others scale was significantly positively skewed in the current sample, with a large number of participants endorsing little of the belief. Given these problems with the scale, the TAFS Likelihood-Others scale may impact the primary analyses and should be interpreted with caution. Descriptive statistics are reported for the total sample (Table 2) and by condition (Table 3).
Table 2

Internal Consistency and Descriptive Statistics (Total Sample)

<table>
<thead>
<tr>
<th>Scale (# of items)</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Possible Range</th>
<th>Obtained Range</th>
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<th>AIC</th>
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<td>12 - 52</td>
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<td>.44</td>
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<td>.46</td>
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<td>SUDS T3</td>
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Note. IUS-12 = Intolerance of Uncertainty Scale, Short-Form; TAFS = Thought-Action Fusion Scale; LO = Likelihood-Others subscale; LS = Likelihood-Self subscale; M = Moral subscale; SUDS = Subjective Units of Distress Scale; T1 = baseline; T2 = ratings collected immediately prior to completing the study manipulation; T3 = ratings collected immediately following the TAF task; T4 = ratings following neutralizing; Likely = How likely participants thought a car accident would occur following the TAFS task; Threat = How threatening the participants rated the TAFS task; α = coefficient alpha; AIC= average inter-item correlation.
Table 3

Internal Consistency and Descriptive Statistics (by Condition)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Certain Threat (n = 93)</th>
<th>Uncertain Threat (n = 94)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>IUS-12 (12)</td>
<td>27.58</td>
<td>7.89</td>
</tr>
<tr>
<td>TAFS (19)</td>
<td>26.18</td>
<td>12.08</td>
</tr>
<tr>
<td>TAFS-LO (4)</td>
<td>2.61</td>
<td>3.19</td>
</tr>
<tr>
<td>TAFS-LS (3)</td>
<td>3.47</td>
<td>3.14</td>
</tr>
<tr>
<td>TAFS-M (12)</td>
<td>20.09</td>
<td>9.07</td>
</tr>
<tr>
<td>SUDS T1</td>
<td>15.56</td>
<td>21.63</td>
</tr>
<tr>
<td>SUDS T2</td>
<td>38.12</td>
<td>33.76</td>
</tr>
<tr>
<td>SUDS T3</td>
<td>46.75</td>
<td>32.16</td>
</tr>
<tr>
<td>SUDS T4</td>
<td>22.30</td>
<td>22.87</td>
</tr>
<tr>
<td>Likely (1)</td>
<td>2.43</td>
<td>1.88</td>
</tr>
<tr>
<td>Threat (1)</td>
<td>6.33</td>
<td>2.66</td>
</tr>
</tbody>
</table>

Note. IUS-12 = Intolerance of Uncertainty Scale, Short-Form; TAFS = Thought-Action Fusion Scale; LO = Likelihood-Others subscale; LS = Likelihood-Self subscale; M = Moral subscale; SUDS = Subjective Units of Distress Scale; Likely = How likely participants thought a car accident would occur following the TAFS task; Threat = How threatening the participants rated the TAFS task; α = coefficient alpha; AIC = average inter-item correlation.
Table 4 presents the zero-order correlations between the baseline measures. Given the skew of the IUS and TAFS, bootstrapping was conducted on all correlations. The TAFS subscales demonstrated significant, moderate intercorrelations ($rs = .35-.59$ in the total sample, $p < .01$) consistent with previous findings in an undergraduate student sample ($rs = .36-.73$, $p < .005$; Bailey et al., 2014). The IUS-12 correlated moderately with the TAFS Likelihood-Others in the total sample ($r = .29$, $p < .01$, BCa$^3$ 95% CI [.05, 32]). Interestingly, in the certain threat condition, the IUS-12 and TAFS Likelihood-Others were significantly correlated ($r = .28$, $p < .01$, BCa 95% CI [.08, .46]); in the uncertain threat condition, this association was non-significant ($r = .12$, $p > .05$, BCa 95% CI [-.10, .34]). Given that IU and TAFS are beliefs relevant to OCD, it is concerning that the uncertain threat group did not evidence a significant correlation between these subscales. It is possible that the high positive skew of both scales, as well as the high AICs of the TAFS, may be attenuating the correlation coefficients by reducing the overall validity of the scales. Subsequent analyses should be interpreted with caution.

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2 “Moderately” is a qualitative descriptor based on Cohen (1988).
3 BCa refers to bias corrected and accelerated bootstrap interval that adjusts for skewness in the bootstrap distribution.
Table 4  
Zero-Order Correlations Among Baseline Measures

<table>
<thead>
<tr>
<th>Scale</th>
<th>TAFS-M</th>
<th>TAFS-LO</th>
<th>TAFS-LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sample (N = 187)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAFS-LO</td>
<td>.40**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>TAFS-LS</td>
<td>.35**</td>
<td>.59**</td>
<td>--</td>
</tr>
<tr>
<td>IUS-12</td>
<td>.35**</td>
<td>.19**</td>
<td>.29**</td>
</tr>
<tr>
<td>Certain Threat (n = 93)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAFS-LO</td>
<td>.33**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>TAFS-LS</td>
<td>.21**</td>
<td>.63**</td>
<td>--</td>
</tr>
<tr>
<td>IUS-12</td>
<td>.24*</td>
<td>.28**</td>
<td>.29**</td>
</tr>
<tr>
<td>Uncertain Threat (n = 94)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAFS-LO</td>
<td>.45**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>TAFS-LS</td>
<td>.47**</td>
<td>.56**</td>
<td>--</td>
</tr>
<tr>
<td>IUS-12</td>
<td>.43**</td>
<td>.12</td>
<td>.28**</td>
</tr>
</tbody>
</table>

*Note. IUS-12 = Intolerance of Uncertainty Scale, Short-Form; TAFS = Thought-Action Fusion Scale; LO = Likelihood-Others subscale; LS = Likelihood-Self subscale; M = Moral subscale.  
*p < .05. **p < .01.
Primary Analyses

**Overall Effectiveness of the Manipulation**

A series of paired-samples *t* tests revealed that SUDS ratings significantly increased prior to completing the threatening task (*t*\(_{186}\) = 11.56, *p* < .001) and significantly decreased following neutralizing (*t*\(_{186}\) = 14.38, *p* < .001). These results are consistent with results from the extant literature, suggesting that the manipulation is sufficiently distressing but that the distress is temporary (Rachman et al., 1996; van den Hout, 2002). To assess the effectiveness of the manipulation, four one-way ANOVAS were used to compare SUDS ratings. For all comparisons, the *F* statistic was non-significant, indicating that the conditions did not significantly differ on any distress ratings (*F*\(_{1,185}\) = .02-3.02, *ps* = .08 –.89). At the end of the study, participants were asked to rate how threatening they found the TAF task and how likely they believed that the sentence would come true (on a scale of 1 not at all threatening, not at all likely – 10 very threatening, very likely). Results revealed that the participants rated the task as moderately threatening (*M* = 6.02, *SD* = 2.85) but not very likely to occur (*M* = 2.51, *SD* = 1.95). These likelihood ratings are similar to those endorsed by participants post-neutralizing on a 0-100 VAS (*M* = 20.62, *SD* = 19.26; Bocci & Gordon, 2007). Ratings of perception of threat could not be found in any studies using the TAF task and it is thus unclear if the current findings are consistent with previous studies.
Hypothesis 1

Hypothesis 1 predicted that participants in the uncertain threat condition would endorse significantly lower distress prior to completing the TAF task than participants in the certain threat condition, robust to the effect of TAFS Likelihood-Others beliefs. This hypothesis was assessed with a one-way ANCOVA, with SUDS ratings prior to the TAF sentence task serving as the dependent variable, condition serving as the independent variable, and TAFS Likelihood-Others serving as a covariate. The ANCOVA did not find significant differences between conditions ($F_{1,184} = .06, p = .82$). That is, there was no difference between the certain ($M = 38.12, SD = 33.76$) and uncertain ($M = 37.48, SD = 32.13$) threat condition on participant distress ratings prior to completion of the threatening task. The results were similar when TAFS Likelihood-Others was not included as a covariate ($F_{1,186} = .02, p = .89$). Thus, Hypothesis 1 was not supported. These findings also suggest that Hypothesis 2 likely will not be supported, given that conditions do not differ in distress ratings. However, the planned analysis was conducted in order to examine the potential influence of IU on the model.

Hypothesis 2

Hypothesis 2 predicted that there would be a moderating effect of trait IU on the relationship between condition and distress, such that participants with higher levels of IU would find the uncertain threat condition more distressing than the certain threat condition. The continuous variables (TAFS Likelihood-Others, IUS-12) were mean centered, and the condition variable was dummy coded (the certain threat condition was coded “0” and the uncertain threat condition was coded “1”). An interaction term then was created by computing the product of the
dummy-coded condition variable and the mean-centered IUS-12 total score. The covariate (TAFS Likelihood-Others) and main effects (condition and mean-centered IUS-12) were entered into the first step of the model. The interaction term was entered into the second step of the model predicting the criterion of interest (SUDS ratings prior to the sentence task). IUS-12 scores were found to be predictive of pre-task SUDS scores ($\beta = .23, t = 3.17, p < .01$). However, no evidence of moderation was found. That is, the interaction term was non-significant ($\Delta R^2 < .001, p = .55$) and trait IU was not found to influence the relationship between condition and pre-TAF task distress scores. Similar results were observed for the bootstrapped model: IU was predictive of SUDS ($p < .01$, BCa 95% CI [.31, 1.51]) but the interaction term between IU and condition was not significant ($p = .60$, BCa 95% CI [-1.04, 1.69]). Therefore, the regression showed no interaction effect and Hypothesis 2 was not supported. Given that TAFS Likelihood-Others was not correlated with distress, the analyses were run without TAFS as a covariate and also found IUS-12 to be predictive of pre-task SUDS scores ($\beta = .25, t = 3.53, p = .001$) but no evidence of moderation ($\Delta R^2 < .001, p = .61$). See Tables 5 and 6 for regression results.
Table 5

Results for Moderation Using Hierarchical Regression

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Predictor variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>∆R²</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Task Distress</td>
<td>Enter 1</td>
<td>TAFS-LO</td>
<td>.47</td>
<td>.68</td>
<td>.05</td>
<td>.07</td>
<td>.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condition</td>
<td>-1.58</td>
<td>4.69</td>
<td>-.02</td>
<td>.34</td>
<td>.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12</td>
<td>.94</td>
<td>.28</td>
<td>.24</td>
<td>3.33</td>
<td>&lt; .01</td>
</tr>
<tr>
<td></td>
<td>Enter 2</td>
<td>TAFS-LO</td>
<td>.50</td>
<td>.68</td>
<td>.05</td>
<td>&lt; .01</td>
<td>.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condition</td>
<td>-1.58</td>
<td>4.71</td>
<td>-.02</td>
<td>.34</td>
<td>.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12</td>
<td>.76</td>
<td>.43</td>
<td>.20</td>
<td>1.76</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12 X</td>
<td>.31</td>
<td>.56</td>
<td>.06</td>
<td>.55</td>
<td>.58</td>
</tr>
<tr>
<td></td>
<td>Enter 1</td>
<td>Condition</td>
<td>-1.35</td>
<td>4.68</td>
<td>-.02</td>
<td>.38</td>
<td>.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12</td>
<td>.98</td>
<td>.28</td>
<td>.25</td>
<td>3.53</td>
<td>&lt; .01</td>
</tr>
<tr>
<td></td>
<td>Enter 2</td>
<td>Condition</td>
<td>-1.34</td>
<td>4.69</td>
<td>-.02</td>
<td>&lt; .01</td>
<td>.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12</td>
<td>.82</td>
<td>.42</td>
<td>.21</td>
<td>1.93</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IUS-12 X</td>
<td>.28</td>
<td>.56</td>
<td>.06</td>
<td>.50</td>
<td>.62</td>
</tr>
</tbody>
</table>

Note. N = 187. IUS-12 = Intolerance of Uncertainty Scale, Short-Form; TAFS-LO = Thought-Action Fusion Scale, Likelihood-Others subscale.
Table 6

Results for Moderation with Bootstrapping

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Predictor variable</th>
<th>B</th>
<th>SE</th>
<th>p</th>
<th>BCa 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Pre-Task Distress</td>
<td>Enter 1</td>
<td>.47</td>
<td>.72</td>
<td>.52</td>
<td>-.80</td>
</tr>
<tr>
<td></td>
<td>TAFS-LO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Condition</td>
<td>-1.58</td>
<td>4.70</td>
<td>.75</td>
<td>-11.22</td>
</tr>
<tr>
<td></td>
<td>IUS-12</td>
<td>.94</td>
<td>.31</td>
<td>&lt;.01</td>
<td>.31</td>
</tr>
<tr>
<td></td>
<td>Enter 2</td>
<td>.50</td>
<td>.73</td>
<td>.50</td>
<td>-.76</td>
</tr>
<tr>
<td></td>
<td>TAFS-LO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Condition</td>
<td>-1.58</td>
<td>4.68</td>
<td>.75</td>
<td>-11.65</td>
</tr>
<tr>
<td></td>
<td>IUS-12</td>
<td>.76</td>
<td>.50</td>
<td>.13</td>
<td>-.25</td>
</tr>
<tr>
<td></td>
<td>IUS X</td>
<td>.31</td>
<td>.62</td>
<td>.60</td>
<td>-1.04</td>
</tr>
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</table>

Note. N=187. IUS-12 = Intolerance of Uncertainty Scale, Short-Form; TAFS-LO = Thought-Action Fusion Scale, Likelihood-Others subscale; BCa CI = Bias corrected and accelerated confidence intervals.
CHAPTER 5
DISCUSSION

The primary aims of this study were to (1) observe the effects of emotional responding in the context of OC-relevant certain and uncertain threat and (2) examine how IU affects this relationship. Despite well-established theory connecting IU to the etiology and maintenance of anxiety disorders, there currently is a dearth of experimental literature examining IU in a disorder-specific context, particularly OCD. Thus, utilizing the paradigm created by Oglesby and Schmidt (2017), this study offered an examination of IU and emotional responding in the face of an OC-relevant, in vivo threat.

Beyond replicating a paradigm to examine IU theory, the current study sought to extend the literature by examining IU in an OC-relevant context. The call for more experimental examinations of IU has been made explicit in the literature (Rosser, 2018; Shihata et al., 2016). For example, in a recent review of the published IU literature examining IU as a causal mechanism for psychological difficulties, 70 studies were identified—12 were considered experimental and only four were OC relevant (Rosser, 2018). Despite limited evidence of causality, an argument has been made to augment traditional CBT with IU-specific content (Gillett et al., 2018). Potential adaptations could be geared toward explicit exposure to uncertainty, psychoeducation about uncertainty, or even working to take a curious and willing stance toward uncertainty (Gillett et al., 2018; Twohig et al., 2015). However, limited evidence may hinder attempts to target IU as a focus for treatment. Thus, continued examination of IU
within disorder is essential given the established theory (e.g., OCCWG, 1997) but shortage of experimental research.

This project first proposed that participants would prefer an uncertain threat over a certain threat, following the assumption that a lower chance of experiencing an aversive stimulus is preferable to a higher chance of experiencing an aversive stimulus. That is, it was hypothesized that participants would feel less distress when faced with a reduced chance (50%) of experiencing an aversive stimulus. However, extant literature on this specific issue has been mixed, and several studies have found no differences in reactions to certainty versus uncertainty. Recall, for example, the study by Monat et al. (1972) in which participants were told that they either had a 100% or 50% chance of experiencing an electric shock. No significant differences in arousal were observed, and participants did not prefer either condition over the other. Similarly, Oglesby and Schmidt (2017) did not find significant differences in self-reported anxiety between a certain threat condition and an uncertain threat condition. However, no known studies to date have examined this hypothesis in the context of certain versus uncertain OC-relevant threat. Potential limitations in previous study designs may have affected the findings, and thus replication and extension were used to clarify this question.

The findings of the current study suggest that participants did not feel more distressed when faced with a certain (versus uncertain) OC-relevant aversive stimulus when controlling for TAFS Likelihood-Others beliefs. Whereas participants in the current study experienced a significant ($p < .01$) increase in distress from baseline to pre-TAF task, similar levels of distress were endorsed in the uncertain ($M = 37.48$, $SD = 32.13$) and certain ($M = 38.11$, $SD = 33.76$) threat conditions prior to completing the TAF task. These results corroborate the findings of Oglesby and Schmidt (2017); namely, participants did not respond differently when faced with certain or uncertain threat conditions.
A second aim of this study was to examine IU theory in a disorder-specific context. Uncertainty is considered to be threatening to individuals high in IU and may contribute to their levels of both anxiety and threat perception (Carleton, Mulvogue, et al., 2012). That is, IU may contribute to abnormal responding to uncertain threat. The current state of the IU literature is mixed with regard to how individuals may act in the face of uncertainty. In support of Carleton’s theory, research has demonstrated that higher levels of IU were associated with stronger startle responses when faced with a 50% chance of threat (more uncertain) as compared to a 75% (less uncertain) probability of an electric shock (Chin et al., 2016). However, other research examining startle reflexes found the opposite, that IU is associated with weaker startle responses when faced with an uncertain aversive stimulus (Nelson & Shankman, 2011). Further, when examining IU using an in vivo social anxiety task, individuals with high levels of IU did not report the uncertainty condition to be any more anxiety provoking than the certainty condition (Oglesby & Schmidt, 2017). Despite the growing literature on IU in the context of OCD and calls for in vivo manipulations of threat and uncertainty (e.g., Shihata et al., 2016), few studies have examined the effect of IU on emotional responding in the context of OC-relevant threat. Given the proposed relevance of uncertain threat on the etiology and maintenance of anxiety, clarifying this relationship could enhance treatment effectiveness (e.g., in the context of ERP), particularly for disorders in which IU is implicated. Thus, this project sought to assess this relationship within an OC-relevant context.

Hypothesis 2 proposed that IU would moderate the relationship between condition and distress. That is, individuals in the uncertain threat condition would feel greater distress when IU was high; individuals in the certain threat condition would feel greater distress when IU was low, and this relationship would be robust to the effects of TAF Likelihood-Others beliefs. Although IU did predict pre-task distress (i.e., distress increased by .94 for each point on the IUS-12),
condition did not and the interaction between the variables was non-significant. Thus, contrary to predictions, IU did not moderate the relationship between condition and distress. These findings are at odds with theory suggesting that uncertainty should provoke distress for individuals higher in IU (Carleton, Sharpe, & Asmundson, 2007; Carleton, Mulvogue, et al., 2012), but are consistent with Oglesby and Schmidt (2017), who created this paradigm in the context of a social threat.

The following three possibilities (outlined in Cronbach & Meehl, 1955) offer some explanation for the lack of observed differences in distress between conditions both with and without IU in the model. These hypotheses include (1) inadequate measurement, (2) incorrect theory, and (3) flawed experimental design.

**Inadequate Measurement**

Measurement of IU, traditionally developed in the context of GAD, long has been a concern for OC research. The current study used the IUS-12 because much of the GAD-specific content was removed from the original IUS and it is the most commonly used measure of IU across disorders. However, participants in the uncertain threat condition did not endorse levels of trait IU in the upper 13% of the scale, and participants in the certain threat condition did not endorse IU beliefs in the upper 23%. It is conceivable that individuals with very high levels of IU respond differently when faced with uncertainty, and this was not captured in the current study.

A more disorder-specific measure could provide useful information about OC-relevant IU. One such measure, the OBQ-87, was developed from the cognitive-behavioral model of OCD and included an IU subscale (OCCWG, 1997, 2001) but subsequently was modified such that IU and perfectionism were condensed into one scale (OCCWG, 2005). Given that IU
conceptually is distinct from perfectionism, this measure is not ideal for use in parsing out the effects of IU. Although the original OBQ-IU subscale could have been used in the current study, and is still used in current research studies, the high correlations between the IU subscale, overestimation of threat subscale, and perfectionism subscale ($r = .78-.79$; OCCWG, 2003) suggested that these scales are not well differentiated. However, future studies may consider incorporating both the theoretically derived OBQ-IU and the IUS-12 in order to examine differences and provide useful information about OC-relevant IU.

Measurement remains a problematic issue for disorder-specific IU. A situation-specific version of the IUS-12, the IUS-SS, was created that allows individuals to pick a situation that is regularly occurring and distressing (e.g., intrusive thoughts) and complete the IUS-12 in response to that situation (Mahoney & McEvoy, 2012a). The authors found that participants generally scored higher on the IUS-SS versus the IUS-12, suggesting that uncertainty is particularly aversive when it is associated with specific situations relevant to the individual. However, the IUS-SS did not display an association with OC symptoms beyond trait IU (IUS-12) and it is unclear how this measure would perform with a non-clinical sample (Mahoney & McEvoy, 2012a). Moreover, trait IU (IUS-12) has been shown to be more associated with OC symptoms than a three-item measure of disorder-specific IU (measured by the DSIU; Thibodeau et al., 2015). Future studies may find it useful to incorporate multiple measures that examine trait IU, as well as IU relevant to specific areas of concern, in order to further clarify the mechanisms through which IU influences OC symptoms.

Measurement of the dependent variable, distress, also may have impacted the results. Whereas Oglesby and Schmidt (2017) used the BSAM, a six-item measure of anxiety, as a dependent variable, the current study used SUDS ratings in order to produce a rapid assessment of subjective feelings. SUDS ratings are advantageous in that they measure distress on an
interval scale and allow for a meaningful interpretation of the mean. Although multi-item inventories often utilize ordinal scales (e.g., strongly disagree to strongly agree), they may “avoid unwanted reductionism of complex experiences” (Rosser, 2018, p. 22) and thus may be considered for future studies. Notably, the current study asked participants to rate distress rather than anxiety, which may have unintentionally measured non-specific aspects of negative affect rather than specific worry about the future. Although a balance must be struck between over-assessment and under-assessment, it is possible that a validated multi-item measure of anxiety would have produced more nuanced results that are more distinct from general negative affect.

Incorrect Theory

Another consideration for the null findings of this study is the nature of the effect of IU. That is, it is possible that the influence of IU on emotional responding could be more interactional, dependent upon the presence of one or more additional variables. One such variable may be perceived control. Although IU is considered to be a maladaptive response to uncertainty, it may be possible that this relationship only holds when an individual perceives that s/he has little control over the situation (Ruggiero et al., 2012). Perceived control was not measured in the current study, but it may have been unintentionally augmented due to a few factors. For one, per IRB recommendations toward minimizing risk of harm, all participants were told at the beginning of the study that they may discontinue at any time without consequence. Further, if participants asked if they “had” to complete the study, they were informed, “This is not a test of courage. You are free to refuse to engage in the task and you can end the task at any point.” Although most participants completed the sentence task, several refused to do so. It is
possible that with these instructions in mind, participants felt an increase in perceived control despite the study conditions and thus experienced a reduction in overall distress.

Perceived control also may have been increased by the nature of participant engagement with the threatening task. For example, participants in physiological studies passively endure an aversive stimulus, such as an electric shock. In Oglesby and Schmidt (2017) and the current study, participants were asked to actively engage with the aversive stimuli either by writing or giving a speech. Participants may have felt an increased sense of control given that they only engaged with a threat by their own actions, which in turn may have increased their perceived ability to prepare and cope with the threat. Future studies may consider adding a measure of perceived control in order to understand how it interacts with uncertainty and threat. Studies also may consider how participants engage with a threat. In order to reduce perceived control, the current paradigm could be modified such that participants are passively exposed to the threat. For example, researchers could verbally repeat the threatening sentence over and over again to the participant, rather than having the participants write the sentence themselves. Considering the TAF further, a potential modification could include altering the TAF task to examine how participants respond to a Likelihood-Self sentence (i.e., “I hope I get into a car accident today”). It is possible that focusing on Likelihood-Self beliefs could affect threat perception, as participants are likely highly motivated to avoid behaviors that could cause harm to themselves or affect their survival. Conversely, focusing on Likelihood-Self beliefs may lead to even more perceived control, as a participant who is concerned about getting into a car accident may choose to not drive for the rest of the day. Future studies using this paradigm should consider how Likelihood-Self and Likelihood-Others beliefs interact with perceptions of control and threat.

Perhaps a more nuanced conceptualization of IU also is warranted. Factor analysis of the IUS-12 proposed that IU may be composed of two distinct factors: prospective IU, which
involves a desire for predictability, and inhibitory IU, which involves uncertainty paralysis
(Carleton, Norton, & Asmundson, 2007). Carleton (2012) suggested that prospective IU (e.g.,
“Unforeseen events upset me greatly”) is more cognitively focused and implicated in OCD and
GAD, whereas inhibitory IU (e.g., “When it’s time to act, uncertainty paralyzes me”) is more
behavioral and may be related to social anxiety and depression. Findings regarding the
relationship between the IUS-12 subscales and OC symptoms have been mixed. For example,
there is evidence that OCD may be related to both prospective and inhibitory IU. Jacoby,
Fabricant, Leonard, Riemann, and Abramowitz (2013) found evidence that symmetry, ordering,
and “just right” OC symptoms were associated with prospective IU, whereas taboo thoughts
were associated with inhibitory IU. Both subscales were associated with intrusive thoughts about
preventing harm and checking. No specific hypotheses were made about these subscales in the
current study, given the limited literature on these subscales. However, when examining these
subscales separately in the current study, both prospective and inhibitory IU were significantly
($p < .01$) correlated with distress prior to the TAF task (prospective IU: $r = .25$; inhibitory IU: $r =
.24$). Future studies may wish to further examine these constructs separately in order to assess
whether they demonstrate variations in OC-relevant outcomes. Perhaps prospective IU may be
more relevant in studies utilizing self-report measures of anxiety and distress, whereas inhibitory
IU may be more related to physiological responses.

Flawed Experimental Design

A final reason for the null findings is flaws in the experimental design that resulted in a
failed test of the hypotheses. One possibility is that the threatening task itself involved some
level of uncertainty. That is, it may not be the act of writing the TAF sentence that is aversive,
but rather the possible consequences of writing the sentence that is aversive (i.e., harm coming to a loved one). Unlike other studies that incorporated an electric shock or puff of air, this study involved manipulation about uncertainty of an uncertain event, which may have put too much distance between the participant and the threat. It is possible that participants will respond differently depending on the type of threat. That is, other OC-relevant threats may demonstrate more variation in responding. Perhaps future studies could examine this paradigm in the context of contamination-based threat, using the stimuli outlined in behavioral approach tasks (e.g., touching a dirty toilet or dirt, dead insects, and cat hair; Najmi & Amir, 2010). Given the heterogeneity of OC symptoms, it is possible that IU results in diverse responding across different symptom dimensions or even could be relevant only for certain symptom dimensions (e.g., checking; Tolin et al., 2003). There currently is a scarcity of experimental literature examining the relevance of IU to OC-specific outcomes, limiting conclusions.

The current study findings are consistent with those of Reuman et al. (2015), who suggested that highly threatening situations may evoke anxiety regardless of the priming of uncertainty. That is, for low-threat situations, individuals may respond differently depending on the salience of uncertainty, but in highly threatening situations, anxiety may increase simply because the chance of the negative outcome occurring is highly aversive. For the current project, the TAF sentence task was intended to be aversive and likely was made more so due to the ideographic component (i.e., writing the name of a loved one). Indeed, on a follow-up question at the end of the study, participants generally rated the task as threatening on a 1 (not at all threatening) – 10 (very threatening) scale ($M = 6.02$, $SD = 2.84$). Notably, this rating should be interpreted with caution as a more formal and validated assessment of threat perception was not administered. The TAF task also was distressing enough that approximately 43% of participants reported engaging in some form of overt behavior to neutralize the effects of the sentence
following completion—this included praying, calling their loved one, crossing out the sentence, knocking on wood, and so forth. Eight (4%) participants refused to write the sentence at all. An additional nine (5%) participants engaged in coping strategies (e.g., deep breathing and distraction).

Distress ratings also were collected following the TAF task and following neutralizing, although no specific hypotheses were made about these variables. Notably, the highest distress levels were endorsed after the TAF task was completed within each condition ($M_{s} = 45.52 – 46.75$). Despite methodological differences (i.e., each of the reported studies below asked participants to visualize the sentence occurring after writing it), the current ratings are in range with previous research. For example, using a VAS, Bocci and Gordon (2007) found that participants rated themselves as highly distressed following the completion of the sentence task and 30 seconds of visualization ($M = 59.71, SD = 20.68$). Berman et al. (2011) found that participants rated their anxiety as high following five seconds of visualization ($M = 40.71, SD = 27.24$).

There are several possible explanations that could account for the increase in distress ratings following the completion of the task. First, it is possible that participants did not have enough time to fully process the threatening nature of the task until after it had been completed. That is, participants were told that they either would be completing the task or had a chance of completing the task and then proceeded to do it in a relatively quick fashion. Detection of threat may be an important mechanism underlying IU and responding to uncertainty (Einstein, 2014; Fergus et al., 2013) and IU has been associated with the perception of threat and uncertainty in many different types of positive and negative situations (Pepperdine et al., 2018). Given the quick turnover between participants being introduced to the threatening task, instructed that they would or would not be completing the task, and asked for distress ratings, it is possible that
participants did not have enough time to fully attend to the threat of the task until after they were asked to complete it, resulting in lower distress scores. Although some studies propose that having too much time to think about the negative stimulus may increase control behaviors and decrease responding (e.g., Nelson & Shankman, 2011), it is possible that with too little time participants do not experience the threat as intended. Perhaps had participants been given more time to sit and process the information about the next step of the study, they would have experienced an increase in their distress.

It also is possible that distress increased following the completion of the task because the conditions represented a counter-attitudinal behavior (i.e., writing that one hopes for something that one does not actually want to happen). Cognitive dissonance theory suggests that individuals are motivated to reduce dissonance and avoid situations that may increase dissonance (Festinger, 1957). Given that the conditions facilitated engagement with a highly dissonant behavior, it is possible that the distress elicited in the current study stems from dissonance rather than uncertainty, and behaviors at the end of the study, such as rationalization and neutralization, were attempts at achieving consonance. Distress and threat-likelihood ratings displayed a small to moderate correlation ($r = .21, p < .01$), suggesting that distress may have emerged from multiple factors, not just beliefs that the threat was likely to occur. A potential modification could remove the “I hope” from the TAF task (i.e., “[Loved one] will get into a car accident today”), which may reduce dissonance.

Another possibility is that participants may not have believed the deception in the manipulation, specifically that there was a 50% chance of completing the TAF sentence. In order to capture as many data points as possible, all participants completed the sentence regardless of the outcome of the coin toss, although efforts were made to increase plausibility that it was a true 50% chance and SUDS ratings were collected before the coin toss was initiated. Despite the
efforts of the research design, it could be that participants correctly perceived themselves as having a 100% chance of completing the TAF sentence regardless of condition, thus rendering conditions equivalent. Notably, however, Oglesby and Schmidt (2017) did honor the results of the coin toss and discontinued participants from the study based on the outcome; despite this, they also found no differences between conditions. In addition, participants completed the task mentally once they saw the sentence, again rendering the conditions equivalent as all participants were exposed to the task prior to the uncertainty manipulation.

A limitation of extant research (and the current study) is the dichotomization of threat. Recent calls for a wider spectrum of uncertainty probability in experiments suggests that examining only 50% versus 100% chance of threat may not be capturing the whole picture (Tanovic, Pruessner, & Joormann, 2018). That is, it is not currently clear if IU is implicated only when uncertainty is greatest or how much certainty is needed to elicit variations in responding. Uncertainty may need to be examined at multiple levels in order to examine if and when it elicits different levels of anticipatory emotion and physiologic responses. Future studies should consider incorporating designs that allow for a wider range of contact with an aversive stimulus in order to examine how uncertainty and probability interact.

Limitations and Future Directions

A limitation of the current study is the use of a non-clinical sample. Student samples can provide useful information about psychological phenomena when examining preliminary hypotheses, and OC symptoms and IU both are viewed as dimensional rather than categorical constructs, suggesting that it is likely that this pattern of findings may be observed in a clinical sample (Abramowitz et al., 2014; Carleton, 2012). However, it is important to note several
limitations of using non-clinical samples. Given the distressing nature of the TAF sentence task, all individuals who endorsed having a current diagnosis of OCD were discontinued from this study, so no clinical levels of OCD were encapsulated. It is possible that nonclinical and clinical samples approach TAF thoughts differently. For example, individuals with OCD may evidence a lower degree of insight and a more intense urge to neutralize when experiencing TAF beliefs (Berle & Starcevic, 2005). That is, when confronted with the TAF task, non-clinical participants may be able to rationalize that they are not responsible for harm, suggesting that the TAF task is less distressing for them overall. Similarly, reactions to uncertainty may not be as strong at lower levels of IU. Perhaps a higher dose of perceived threat would help to overcome some of these differences and more closely approximate a clinical sample.

Motivation can be a concern with student samples, as students may feel less of a commitment to engage in the study than might a participant with a diagnosed disorder. For the current study, level of motivation and engagement were not measured explicitly. However, participants who did not answer all three “check” questions (see Method for more information) were excluded from data analysis, as it was unclear if they were answering at random. Further, although there is no way to be certain that participants put forth genuine effort in this study, the relatively short length of the study (i.e., 30 minutes) and the distressing nature of the task may reasonably indicate that participants did not suffer from fatigue or boredom.

Perhaps most concerning, the use of a student sample resulted in highly positively skewed variables that did not adequately respond to transformation. Although previous research suggests that community and student samples demonstrate positive skew on the IUS-12, this skew likely impacted the results (Carleton, Mulvogue, et al., 2012). Regression and ANOVA are considered robust to violations of normality (e.g., Hayes, 2013) and non-parametric bootstrapping was employed to combat this issue. However, the IUS-12 still demonstrated
restricted range, particularly in the certain threat condition, and the TAFS Likelihood-Others means were much lower than published estimates. If using a student sample, future studies may want to consider selecting participants that score on all levels of the IUS-12 (and TAFS if using the sentence task) in order to have more generalizable results.

Importantly, in the current study an unexpectedly high number of participants endorsed experiencing a friend or family member had died in a car accident ($n = 33$). This high proportion (13%) is at odds with national crash statistics for 2017, in which there were approximately 11.4 fatalities per 100,000 people (National Highway Traffic Safety Administration, 2018). It is unclear why so many individuals in the current study endorsed experiencing a loved one die, but it is possible that the results were biased due to these individuals being discontinued from the study. That is, these participants may have felt far more distress in response to the TAF task and engaged in different responding to the certainty versus uncertainty conditions due to the higher dose of threat. In terms of the questionnaire data, participants who were removed for endorsing the car accident question scored higher on the TAF Likelihood-Others subscale ($M = 3.21$, $SD = 3.48$) and IUS-12 ($M = 30.52$, $SD = 8.85$) than participants retained for analysis, although the scores were not significantly different between groups on either the IUS-12 ($t_{218} = .48$, $p = .63$) or the TAFS Likelihood-Others ($t_{218} = 1.59$, $p = .11$).

Physiological measures are another avenue for examination. Currently, the literature suggests that individuals with higher levels of IU display higher amygdala and interior insula activity in response to uncertainty, as well as some evidence for increased startle responses, heart rate, and skin conductance (Tanovic, Gee, & Joorman, 2018). For example, a study examining IU and skin conductance found that higher levels of IU are associated with reduced fear extinction (Dunsmoor, Campese, Ceceli, LeDoux, & Phelps, 2015). Attention processing and emotion processing appear to be sensitive to uncertainty, and anticipatory emotion may be
experienced differently when an individual is faced with uncertain versus certain threat (Grillon, 2008). Much of the extant literature has examined temporal uncertainty, or uncertainty about when a threat will occur (e.g., when an electric shock will occur; Monat et al., 1972). The current study assessed likelihood uncertainty, or uncertainty about if a threat will occur; another avenue of exploration is to examine uncertainty related to the intensity of the threat (Bennett, Dickmann, & Larson, 2018). A recent study by Bennett and colleagues (2018) compared temporal uncertainty to likelihood uncertainty and found that participants displayed higher startle responsivity to temporally uncertain threat (electric shock) than to likelihood uncertainty and certainty. Interestingly, participants reported similar levels of anxiety in response to the uncertainty trials, which is inconsistent with their physiological response. Further, self-reported IU was not correlated with startle response in any of the certainty or uncertainty trials. These findings suggest that the measures used to examine anticipatory responding and the type of uncertainty may result in dissimilar responses. Thus, future studies should consider incorporating multiple types of measurement as well as examining type of uncertain threat in order to gain a better understanding of the role of uncertainty in producing anxious responding.

Conclusion

Limitations notwithstanding, the current project answered calls for experimental research into IU within a disorder-specific context. Although theory suggests that IU plays a role in the development and maintenance of OC symptoms, relatively few studies have moved beyond correlational data despite entreaties to do so. The current project examined IU theory using an ideographic, in vivo, OC-relevant threat. Although the proposed hypotheses were not supported, this study improved upon existing research designs and provides a foundation for future studies
looking to examine IU. Ultimately, the findings of this study suggest that IU may be far more nuanced and challenging to study than expected. As experimental IU research moves into its prime, an abundance of questions remains to be addressed in order to understand the role of IU as both a transdiagnostic and disorder-specific dysfunctional belief.
REFERENCES


APPENDIX A

CONSENT FORM
INFORMED CONSENT FORM

I agree to participate in the research project titled “Uncertainty and Stress Assessment Study” being conducted by Hannah Faleer, a clinical psychology graduate student at Northern Illinois University (NIU). I have been informed that the purpose of this study is to examine how college students respond to tasks with varying degrees of distress. Broadly, this project seeks to learn more about relationship between how you think and feel and your behavioral and emotional responses.

I understand that if I agree to participate in this study, I will be asked to complete several questionnaires related to beliefs, feelings, thoughts, and experiences I may have had. In addition, I will be asked to participate in a task involving writing a short, personal sentence that may produce distress. My participation will require approximately 30 minutes of my time.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice, and that if I have additional questions concerning this study, I may contact Hannah Faleer at hfaleer1@niu.edu, or her research advisor, Dr. Kevin D. Wu at kevinwu@niu.edu. I understand that if I wish to learn further information regarding my rights as a research participant, I may contact the NIU Office of Research Compliance at 815-753-8588.

I understand that there may be no direct benefit to me for participating in this study. However, the intended benefits of this study relate to improving our knowledge about how thoughts perpetuate certain psychological conditions, which will help to better understand research and treatment of these problems.

I have been informed that potential risks and/or discomforts I could experience during this study are considered minimal, but include finding some of the questionnaire items to ask about sensitive information, and I may experience emotional discomfort during the task. As such, although I will be encouraged to answer all questions and participate in the study tasks, I understand that I may omit any questions that I do not wish to answer and I may withdraw from the study at any time without penalty. I further understand that all information gathered during this study will be kept confidential by not including my name or personal identifying information related to my answers. I have been informed that any scientific manuscripts written that include these data will report only group-level data (i.e., no individual answers of any one participant will be discussed).

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I may receive a copy of this consent form should I request one.

Participant Signature ______________________ Date __________ Printed Name
APPENDIX B

DEMOGRAPHICS QUESTIONNAIRE
Demographic Data Questionnaire

Instructions: Please answer the following questions by circling the letter corresponding to your choice or by writing in your response.

1. What is your sex?
   a. Male
   b. Female
   c. Transgendered Male-to-Female
   d. Transgendered Female-to-Male

2. What is your current age? ________ years old

3. What is your race? (please circle all that apply)
   a. Asian or Asian-American
   b. Black or African-American
   c. Native American
   d. White/Caucasian
   e. Multi-racial
   f. Other
   g. Prefer not to answer

4. Do you self-identify as Hispanic or Latino/Latina?
   a. Yes
   b. No

5. Is English your native language?
   a. Yes
   b. No
   c. Prefer not to answer

6. What is your religion?
   a. Buddhist
   b. Hindu
   c. Jewish
   d. Mormon
   e. Muslim
   f. Catholic
   g. Protestant
   h. None
   i. Other (please specify______)

7. Please indicate which psychological disorders, if any, you have been diagnosed with:
   a. Generalized Anxiety Disorder
   b. Social Phobia
   c. Obsessive-Compulsive Disorder (OCD)
   d. Depression
   e. Bipolar Disorder
   f. Schizophrenia
   g. Other (please specify_______)
   h. None

8. If you have ever received a diagnosis of OCD, please indicate if the diagnosis is current, or if your symptoms are in remission. If you have not been diagnosed with OCD, please mark ‘C – Not Applicable.’
   a. Current diagnosis of OCD
   b. Past diagnosis of OCD – symptoms are in remission
   c. Not applicable

9. Have any of your family or friends died in a car accident?
   a. Yes
   b. No
   c. Other (please specify_________)


APPENDIX C

THOUGHT-ACTION FUSION SCALE
TAFS

Do you disagree or agree with the following statements?

0 = Disagree Strongly     1 = Disagree     2 = Neutral     3 = Agree     4 = Agree Strongly

1. Thinking of making an extremely critical remark to a friend is almost as unacceptable to me as actually saying it…………………………………….…………… 0 1 2 3 4

2. If I think of a relative/friend losing their job, this increases the risk that they will lose their job…………………………………………………………… 0 1 2 3 4

3. Having a blasphemous thought is almost as sinful to me as a blasphemous action……………………………………………………………………………… 0 1 2 3 4

4. Thinking about swearing at someone else is almost as unacceptable to me as actually swearing……………………………………………………………… 0 1 2 3 4

5. If I think of a relative/friend being in a car accident, this increases the risk that he/she will have a car accident……………………………………………….………… 0 1 2 3 4

6. When I have a nasty thought about someone else, it is almost as bad as carrying out a nasty action……………………………………………………………………… 0 1 2 3 4

7. 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…………………………………………………...………… 0 1 2 3 4

8. Having violent thoughts is almost as unacceptable to me as violent acts………………………………………………………………………………………………………………… 0 1 2 3 4

9. If I think of a relative/friend falling ill this increases the risk that he/she will fall ill………………………………………………………………………………………… 0 1 2 3 4

10. When I think about making an obscene remark or gesture in church, it is almost as sinful as actually doing it………………………………………………………………………………………… 0 1 2 3 4

11. If I wish harm on someone, it is almost as bad as doing harm………… 0 1 2 3 4

12. If I think of myself being injured in a fall, this increases the risk that I will have a fall and be injured………………………………………………………………………………………… 0 1 2 3 4

13. If I think about making an obscene gesture to someone else, it is almost as bad as doing it………………………………………………………………………………………… 0 1 2 3 4

14. If I think of myself being in a car accident, this increases the risk that I will have a car accident………………………………………………………………………………………… 0 1 2 3 4
15. When I think unkindly about a friend, it is almost as disloyal as doing an unkind act…………………………………………………………………………………………….0 1 2 3 4

16. If I think of myself falling ill, this increases the risk that I will fall ill… 0 1 2 3 4

17. If I have a jealous thought, it is almost the same as making a jealous remark……………………………………………………………………………………………………………………………………………………………………………0 1 2 3 4

18. Thinking of cheating in a personal relationship is almost as immoral to me as actually cheating………………………………………………………………………………………………………………………………………………………………………………0 1 2 3 4

19. Having obscene thoughts in a church is unacceptable to me………………0 1 2 3 4
APPENDIX D

VALIDITY ITEMS
1. Choose the number that equals the sum of two plus two
2. I have experienced a fatal heart attack while watching television
3. If you are paying attention right now, choose “5” as your answer
APPENDIX E

THOUGHT-ACTION FUSION TASK SET-UP
Please write down the name of a loved one who is currently alive: ________________________

What is your relationship to the person listed above (e.g. spouse, mother, father, etc)?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Write about a happy memory involving the loved one listed above:
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
APPENDIX F

THOUGHT-ACTION FUSION SENTENCE TASK
Thought-Action Fusion Sentence Task

I hope ______________ is in a car accident today.

Keeping in mind the loved one who you wrote about earlier, please copy the above sentence, inserting the name of your loved one in the blank:
APPENDIX G

END OF STUDY QUESTIONNAIRE
On a scale of 1 to 10, how threatening did you find the sentence?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all threatening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very threatening</td>
</tr>
</tbody>
</table>

On a scale of 1 to 10, how likely do you think it is that the sentence will come true?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very likely</td>
</tr>
</tbody>
</table>

What did you do to neutralize or cancel out the effects of writing the sentence?

______________________________________________________________________________
______________________________________________________________________________
____________________________________
________________________________________
____________________
________________________________________________________
APPENDIX H

PARTIAL DEBRIEFING FORM
DEBRIEFING FORM A

Thank you for participating in our study entitled “Uncertainty and Stress Assessment Study.” You were told that the study involved examining how thinking affects outcomes. That was true, but we also wanted to know whether students would feel differently under different circumstances. Specifically, we wondered whether students who were told that they had a 50% chance of completing a threatening task would feel more distress than students who were told that they would engage with the threatening task no matter what. A model of obsessive-compulsive disorder (OCD) suggests that people who have negative beliefs about uncertainty will feel worse in uncertain, threatening situations because they find uncertainty distressing.

You indicated on one of our questionnaires that you may have life experiences that would cause you to experience a greater amount of distress than is intended by the behavioral tasks in this study. To ensure your safety and prevent you from experiencing distress, the study was discontinued upon completion of the questionnaires. We understand that the content that was covered in the questionnaires may be highly relevant to your life experiences, so should you have any concerns related to increased symptoms, you are encouraged to contact the professionals listed on the Counseling Resources form made available to you. Further, if you have questions regarding the study, you may contact Hannah Faleer (hfaleer1@niu.edu), or Dr. Kevin Wu (kevinwu@niu.edu).

If you are interested in reading further about this type of research, the following two journal articles are available either through the NIU Library or from Hannah Faleer (the study’s PI; see below for her contact information).


Please do not discuss your experiences in this study since we are planning to continue data collection during the remainder of the academic year. Too much knowledge about the study will spoil the experience for subsequent students in your class and render their data invalid.
APPENDIX I

FULL DEBRIEFING FORM
DEBRIEFING FORM B

Thank you for participating in our study entitled “Uncertainty and Stress Assessment Study.” You were told that the study involved examining how thinking affects outcomes. That was true, but we also wanted to know whether students would feel differently under different circumstances. Specifically, we wondered whether students who were told that they had a 50% chance of completing a threatening task would feel more distress than students who were told that they would engage with the threatening task no matter what. For this study, all students completed the sentence task, regardless of the outcome of the coin toss. A model of obsessive-compulsive disorder (OCD) suggests that people who have negative beliefs about uncertainty will feel worse in uncertain, threatening situations because they find uncertainty distressing. Further, literature suggests that individuals with OCD have higher levels of thought-action fusion, in which they believe that having a thought makes it more likely to occur or is the moral equivalent of carrying out the thought. Thought-action fusion beliefs can also be induced in student samples. This study used the fill in the blank (with your loved one’s name) sentence task to increase personal responsibility to prevent harm, as well as increase perceptions of threat. We also collected information from you about your personal characteristics, such as your beliefs about uncertainty, in case those variables explain any differences that this study may find. Our main goal is to better understand who is at risk for OCD symptoms and whether we might detect them earlier – before symptoms become a problem. Please understand that nearly everyone endorses some of the questions asked but very few people who go on to have problems consistent with OCD. For example, many people endorse experiencing intrusive thoughts, but it is only when those thoughts are distressing in daily life that they are a clinical problem. Should you have any concerns about whether you exhibit such problems, you are encouraged to contact the professionals listed on the Counseling Resources form made available to you (which is also online at: http://www.orc.niu.edu/orc/human_research/applications/counseling_resources.pdf). They will be able to perform a formal clinical assessment of the issues raised in this study. If you are interested in reading further about this type of research, the following two journal articles are available either through the NIU Library or from Hannah Faleer (the study’s PI; see below for her contact information).


If you have any questions regarding the study, please feel free to contact Hannah Faleer (hfaleer1@niu.edu), or Dr. Kevin Wu (kevinwu@niu.edu). Please do not discuss your experiences in this study since we are planning to continue data collection during the remainder of the academic year. Too much knowledge about the study will spoil the experience for subsequent students in your class and render their data invalid.