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Altering state intolerance of uncertainty and its influence on checking behavior

Hannah Faleer

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ABSTRACT

ALTERING STATE INTOLERANCE OF UNCERTAINTY AND ITS INFLUENCE ON CHECKING BEHAVIOR

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Obsessive-Compulsive Disorder (OCD) is a heterogeneous mental disorder characterized by the presence of obsessions and compulsions that can have debilitating effects on the lives of individuals affected by it. Whereas obsessions and compulsions can fixate on nearly any subject, they tend to cluster around certain themes (e.g., cleaning, checking, symmetry). From a cognitive-behavioral perspective, certain dysfunctional beliefs or attitudes are believed to contribute to the etiology and maintenance of OCD. One of these beliefs is intolerance of uncertainty (IU), the tendency for an individual to avoid ambiguous situations and view him or herself as unable to cope in the face of uncertainty. It has been suggested that the manifestation of particular compulsions may be affected by the presence of certain dysfunctional beliefs; IU may be more highly implicated in specific OC symptoms, such as checking.

To date, research on IU primarily has been conducted in the context of generalized anxiety disorder (GAD). Although there has been growing interest in IU in the OCD literature, the majority of research has been correlational in nature. Moreover, few studies have examined IU as a causal risk factor for checking compulsions. The current study manipulated IU through a false-feedback paradigm and examined its effects on overestimation of threat (another cognitive vulnerability believed to contribute to OCD), worry, and a computerized delayed matching-to-sample task designed to measure checking behavior. By offering an experimental examination of
IU as a causal risk factor for the presence of checking behavior, this study contributes an important step in understanding the effects of dysfunctional beliefs on compulsions in the context of OCD.

Participants were 122 students who completed baseline questionnaires and a two-part IU manipulation. In Phase 1, participants completed a modified IU questionnaire, rating each statement as “true” or “false.” In the high IU condition, each statement was paired with the qualifier “occasionally” to induce participants to endorse more items; in the low IU condition, each statement was paired with the qualifier “almost always” to induce participants to endorse fewer items. In Phase 2, participants received false feedback: participants in the high condition received feedback that they do not tolerate certainty well; participants in the low condition received the opposite feedback. Following the manipulation, participants completed a second questionnaire battery and then engaged in a delayed matching-to-sample computerized task which measured accuracy, response time, and number of checks.

Results indicated that conditions were significantly different on IU scores following the manipulation ($t_{(80)} = 3.711, p < .001, d = .80$) and participants endorsed significantly different worry scores ($t_{(81)} = 2.25, p = .027$). The experimental manipulation did not, however, distinguish conditions on checking behavior. The conditions did not differ on task accuracy ($t_{(80)} = .601, p = .55$), response time ($t_{(80)} = -1.51, p = .14$), or number of checks ($t_{(77)} = -.728, p = .46$), nor were conditions significantly different on threat estimation scores, ($t_{(81)} = 1.08, p = .28$). These results suggest that the IU manipulation was successful in altering IU levels for one of two conditions and affecting worry, but it did not appear to have an effect on analog checking behavior or threat estimation.
ALTERING STATE INTOLERANCE OF UNCERTAINTY AND ITS INFLUENCE ON CHECKING BEHAVIOR

BY

HANNAH FALEER
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A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE MASTER OF ARTS

DEPARTMENT OF PSYCHOLOGY

Thesis Director:
Kevin D. Wu
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CHAPTER 1
INTRODUCTION

Obsessive-Compulsive Disorder: An Overview

OCD is a psychological disorder defined by the presence of obsessions and compulsions. Obsessions are characterized as unwanted, intrusive thoughts that cause anxiety or stress. Intrusive thoughts are disturbing for the individual and attempts are often made to suppress or ignore them. Compulsions are repetitive behaviors that can be overt, including washing, checking, and ordering; or they can be covert mental acts such as counting, canceling thoughts, and praying (Franklin et al., 1998). Compulsions serve the purpose of neutralizing or reducing an individual’s anxiety, even if they are not connected to the source of the anxiety in a realistic way (American Psychiatric Association [APA], 2013). For example, an individual with an obsession about a natural disaster may turn a light switch on and off to reduce anxiety and to prevent the natural disaster from occurring.

Although it can be diagnosed at any age, on average, Obsessive-Compulsive (OC) symptoms are first expressed around 19.5 years of age (APA, 2013). The rate of OCD in women is slightly higher than in men, and epidemiological studies indicate that the lifetime prevalence rate in the United States is 2.3% (Ruscio, Stein, Chiu, & Kessler, 2010). Further, Ruscio et al. (2010) found that nearly 90% of their study respondents with OCD also had a comorbid disorder, usually an anxiety disorder (75.8%) or mood disorder (63.3%). Individuals with OCD generally
have high levels of impairment and distress; the obsessions and compulsions cause dysfunction in daily living, and can lead to negative outcomes in social, employment, and romantic domains (APA, 2013).

OCD is a heterogeneous disorder. Whereas obsessions and compulsions can fixate on nearly any subject, they tend to cluster around certain themes, including cleaning, symmetry, forbidden or taboo thoughts, and harm (APA, 2013). Cluster analysis of the Yale-Brown Obsessive Compulsive Scale symptom checklist (YBOCS; Goodman, Price, Rasmussen, & Mazure, 1989), a semi-structured clinical interview, has demonstrated specific symptom dimensions of OCD: contamination/washing, checking, hoarding, and symmetry/ordering (Abramowitz, Franklin, Schwartz, & Furr, 2003; Calamari et al., 2004). Similarly, analysis of the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002), an 18-item questionnaire in which participants rate degree of distress from OCD symptoms in the past month, revealed six symptom dimensions: checking, hoarding, neutralizing, obsessing, ordering, and washing (Olatunji, Williams, Haslam, Abramowitz, & Tolin, 2008). More recently, principal components analysis of the YBOCS has indicated five OCD symptom dimensions: hoarding, contamination/cleaning, doubt/checking, symmetry/ordering, and unacceptable/taboo thoughts (Brakoulias et al., 2013). Although other symptom dimensions have been identified, including pure obsessions (i.e., obsessions absent compulsions), sexual/religious obsessions, and harming obsessions, cluster analyses have indicated mixed evidence that these additional factors exist (McKay et al., 2004). Notably, symptoms are not mutually exclusive, and individuals often endorse more than one symptom type (e.g., an individual may endorse both washing and checking compulsions; McKay et al., 2004). It should also be noted that as of 2013, hoarding is
no longer conceptualized as a symptom of OCD; in the DSM-5, it is classified as a separate disorder (APA, 2013).

Checking symptoms are among the most prevalent compulsions in OCD (Ball, Baer, & Otto, 1996) with an estimated 46% of adults and children with OCD reporting symptoms of compulsive checking (Rapoport, 1989). Checking behavior on its own can be functional and is common in the general population, but in individuals with OCD, this behavior becomes time-consuming, distressing, and causes significant interference in daily life (Radomsky, & Alcolado, 2010). Checking compulsions are characterized by pathological doubt reflecting extreme uncertainty about a situation or a stimulus and are negatively reinforced through a short-term reduction in anxiety symptoms (Tolin et al., 2001). Paradoxically, repeated checking does not increase information accuracy or certainty, another reason the behavior is considered dysfunctional (Coles, Radomsky, & Horng, 2006). For example, an individual who checks the stove repeatedly is not more certain that it has been turned off than an individual who has not checked the stove. Because of maladaptive functioning and significant disruption in day-to-day living, providing adequate and appropriate treatment is key to improving quality of life.

Previously considered a difficult disorder to treat, a number of psychological and pharmacological treatments for OCD have been developed over the last 40 years (Abramowitz, 1997). The gold standard behavioral treatment for OCD is Exposure and Response Prevention (ERP), a technique used in CBT for many types of anxiety disorders and phobias (Abramowitz, Franklin, Zoellner, & DiBernardo, 2002). ERP for OCD consists of psychoeducation, exposure to the distressing stimulus, and prevention of ritualistic behaviors after exposure (Abramowitz et al., 2002). By engaging in repeated, prolonged exposure to feared stimuli, it is believed that individuals learn to break erroneous associations and foster habituation (Foa & Kozak, 1986). It
has been found that improvement rates for OCD with ERP treatment range from 50-70% (Öst, Havnen, Hansen, & Kvale, 2015; Franklin, Abramowitz, Kozak, Levitt, & Foa, 2000). A study conducted on 20 individuals diagnosed with OCD who were not responsive to medication found that after 15 sessions of CBT by way of ERP, OCD severity, as measured by the YBOCS, was significantly decreased (Tolin, Maltby, Diefenbach, Hannan, & Worhunsky, 2004). Similarly, a meta-analysis comparing the efficacy of ERP and medication treatments for OCD found that after 12 weeks of treatment, individuals who had received ERP differed significantly on YBOCS scores from individuals who had received a placebo pill (Foa et al., 2005).

Despite being the gold standard of treatment, not all individuals with OCD respond to ERP. In the meta-analysis by Foa et al. (2005), nearly 29% of individuals who began treatment dropped out prematurely. An analysis of treatment in a clinical OC sample found that one-third of participants receiving CBT were not classified as recovered (defined as a decrease in YBOCS scores of at least 6 points post-treatment, and a final YBOCS score of 11 or less), while 41% of those receiving ERP were not classified as recovered (Whittal, Thordarson, & McLean, 2004). Additionally, even when treatment is considered successful, some individuals have lingering symptoms (Abramowitz, 2002). Improvement is still needed in the treatment of OCD. As checking is the most common compulsion in OCD, and the majority of participants in treatment outcome studies display symptoms of either checking or washing, further investigation into checking compulsions may be necessary to improve treatment (Ball, Baer, & Otto, 1996). It has been suggested that one avenue for improvement may be through the incorporation of therapies targeting dysfunctional beliefs (Starcevic & Brakoulias, 2008). Dysfunctional beliefs have been shown to play a significant role in the etiology and maintenance of OC symptoms (Frost &
Steketee, 2002). To fully understand OCD, it is necessary to consider these underlying cognitions.

A Cognitive Behavioral Perspective

Beck’s (1976) cognitive specificity hypothesis forms the cornerstone of many contemporary theoretical models of OCD, stating that psychopathology arises from different forms of dysfunctional beliefs. This model encapsulates multiple disorders, including major depressive disorder (MDD) and the phobias, but also can be applied to OCD and has laid the groundwork for current cognitive models of the disorder. In 1997, the Obsessive Compulsive Cognitions Working Group (OCCWG) published a review of the cognitive components of OCD and suggested that OCD consists of cognitive vulnerabilities that play a role in symptom expression and severity. Defined as dysfunctional beliefs or attitudes, cognitive vulnerabilities can heighten the probability that a disorder will develop and may directly or indirectly contribute to its maintenance. Importantly, while cognitive vulnerabilities are identified as trait-like in terms of stability, they are malleable and can potentially be altered through intervention (Koerner & Dugas, 2008). The OCCWG presented five dysfunctional beliefs they found most relevant to OCD. These beliefs are: inflated responsibility, the over-importance of one’s thoughts, the necessity to control one’s thoughts, overestimation of threat, and IU. Perfectionism was later added as a sixth domain (OCCWG, 1997). In 2001, the OCCWG developed the Obsessive Beliefs Questionnaire (OBQ), an 87-item measure intended to assess for the presence of these dysfunctional beliefs.
These belief domains are notably interrelated. Questionnaire-based studies have indicated a relationship between threat estimation and IU, and perfectionism and IU (Bredemeier & Berenbaum, 2008; Frost, Marten, Lahart, & Rosenblate, 1990; Reuther et al., 2013). Because of the intercorrelations among dysfunctional beliefs in OCD, the OCCWG (2005) used factor analysis to modify the OBQ from 87 items to 44 items and from six to three dimensions: Responsibility/Threat Estimation, Perfectionism/Intolerance of Uncertainty, and Importance/Control of Thoughts. Despite the results of the factor analysis, however, perfectionism and IU are considered to be distinct cognitive vulnerabilities. Perfectionism has been defined as the belief that mistakes are unacceptable, and that a perfect solution to problems exists, while IU is characterized by the necessity for certainty and the belief that ambiguity is intolerable (OCCWG, 1997). Examining IU apart from perfectionism is worthwhile to clarify the nature of this dysfunctional belief as well as answer the call for research into therapeutic interventions with IU as the primary focus. Grayson (2010) argued that IU is the core of OCD, and that to properly treat the disorder, it is vital for individuals with OCD to accept that uncertainty is a part of life. Therefore, it is important for psychologists to continue to research IU and incorporate findings into clinical practice to aid clients in coping with this cognitive distortion.

Certain dysfunctional beliefs have been shown to be highly relevant to OC symptom expression. For example, univariate linear regression models conducted on self-report data from 562 college students revealed that perfectionism, as measured by the OBQ-87, significantly predicted ordering symptoms ($b = .25, t = 3.83, p < .001$) and neutralizing symptoms ($b = .16, t = 2.44, p < .05$), both of which were measured by the OCI-R (Tolin, Woods, & Abramowitz, 2003b). The hypothesis that certain dysfunctional beliefs are implicated in the maintenance of
specific OC symptoms has been gaining support (e.g., Julien, O’Connor, Aardema, & Todorov, 2006; OCCWG, 2005; Sookman & Pinard, 2002). Building on Salkovskis (1985), Rachman (2002) proposed a cognitive theory of checking behavior, suggesting that individuals feel compelled to check because they consider themselves personally responsible for preventing harm and are uncertain that a threat has been eliminated. In this theory, compulsive checkers have a heightened sense of responsibility for harm, in addition to a heightened perceived likelihood and seriousness of harm. Increases in these three factors may lead to an increase in duration, frequency, and intensity of checking behavior (Rachman, 2002). The implications of this cognitive model suggest that in order to treat an individual with OCD, who, for example, may be a compulsive checker, it is pertinent to address specific dysfunctional beliefs in the cognitive model of OCD, including IU, responsibility, and overestimation of threat (Taylor, 2010).

**Intolerance of Uncertainty**

IU has been defined as “the way in which an individual perceives information in uncertain situations and responds to this information with a set of cognitive, emotional and behavioral reactions” (Ladouceur, Blais, Freeston, & Dugas, 1998, p. 141). Two specific components of IU have been identified in some research studies: a desire for predictability (a desire to know what will happen in future events), and uncertainty paralysis (the tendency to freeze into inaction during uncertain events; Bredemeier & Berenbaum, 2008). Others have defined IU by its association with danger; in essence, it is the ambiguity of a situation that makes it dangerous because it could be harmful or intolerable (Dugas, Gosselin, & Ladouceur, 2001;
The varied definitions of IU make it clear that it is a multi-faceted construct encompassing multiple domains beyond just doubt. The OCCWG (1997) theorized that IU is a dysfunctional belief composed of several core dimensions: (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. Essentially, individuals with elevated IU may feel that they cannot appropriately cope in ambiguous situations, and as a result, they require a high level of certainty in their lives. Further, individuals with IU may have a difficult time with decision-making, and therefore could view themselves as unable to deal with threatening situations that require problem solving (Gentes & Ruscio, 2011). Because of the extensive research supporting it, the current study proceeded using the OCCWG’s (1997) definition.

**IU and OCD**

In essence, IU motivates an individual toward actions that will increase control and predictability. Elevated IU has been associated with OCD symptom frequency and distress (Holaway, Heimberg, & Coles, 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). The need for more investigations into IU as a causal risk factor for certain anxiety disorders has been expressed (Carleton et al., 2012). IU has been shown to be an OCD-relevant cognitive bias that may have an impact on symptom expression and severity.
Others have argued that IU is more than just a dysfunctional belief; it is a central feature of OCD and can be located at the heart of nearly every symptom of the disorder (Grayson, 2010). Reed (1985) considered pathological doubt to be a core feature of OCD, leading an individual to have clear concerns about his or her ability to be certain about and cope with danger. As such, OC symptoms may develop as a mechanism to protect the individual from concerns about uncertainty. For instance, Steketee et al. (1998) have argued that primary features of OCD, including compulsions and ritualistic behaviors, are maintained by reducing discomfort from uncertain and potentially threatening situations. Many years earlier, Beech and Liddell (1974) hypothesized that ritualistic behaviors are negatively reinforced by reducing distress from situations that are ambiguous, and therefore potentially dangerous. Conceptually, IU appears highly related to OCD; the current study provides further investigation of this construct and its relationship with OC symptoms.

It is critical to note that IU is by no means specific to OCD. A substantial amount of research has found that IU is a transdiagnostic feature that underlies many anxiety disorders, including GAD, MDD, social phobia, agoraphobia, and panic disorder (Carleton, et al., 2012; Gentes & Ruscio, 2011; McEvoy & Mahoney, 2012). In fact, the majority of research on IU has been done in the context of GAD (e.g., Bredemeier & Berenbaum, 2008; Kelly, 2009), a disorder characterized by excessive and uncontrollable worry (APA, 2013).

**IU and Checking Behavior**

Whereas IU and OCD symptoms are correlated in general, it has been proposed that IU may be more highly implicated in specific OC symptoms (Tolin et al., 2003a). It has been
hypothesized that IU is more closely associated with checking symptoms than with washing symptoms in OCD (Sookman & Pinard, 2002). The OCCWG (2005) administered the OBQ-44 and the Padua Inventory Revised (PI-WSUR; Burns, Keortge, Formea, & Sternberger, 1996; a self-report measure that encompasses five content areas of OCD: thoughts about harm to oneself or others, impulses to harm oneself or others, contamination obsessions and washing compulsions, checking compulsions, and grooming compulsions) to a sample of 186 individuals with OCD. Findings indicated that checking symptoms were more closely associated with the Perfectionism/Certainty (PC) subscale of the OBQ-44 ($r = .45$) than the Responsibility/Threat subscale ($r = .27$) and the Importance/Control of Thoughts subscale ($r = .14$). The PC subscale had a greater association with checking, grooming ($r = .43$), and thoughts of harm to self or others ($r = .39$) than impulse to harm others ($r = .19$) and contamination ($r = .27$). Further support for the hypothesis that specific OC symptoms are associated with specific dysfunctional beliefs can be found in a similar study on the OBQ-44 and PI-WSUR. Utilizing a sample of 126 OCD patients and controlling for depression and anxiety, the PC subscale significantly predicted checking scores in a hierarchical regression analysis ($\beta = .283$, $t = 3.09$, $p < .002$; Julien et al., 2006). In another study by Calamari, Wiegartz, and Janeck (1999) examining differences among OC symptomatology, 106 participants with OCD were given the YBOCS and divided into subgroups based on cluster analyses. These subgroups were characterized by harming, hoarding, contamination, certainty, and obsessionals. Each participant then completed OC symptom measures, including the Compulsive Activity Checklist (CAC; Freund, Steketee, & Foa, 1987) and the Maudsley Obsessional–Compulsive Inventory (MOCI; Hodgson & Rachman, 1977). The certainty cluster, characterized by participants who needed absolute certainty about negative outcomes, demonstrated significantly higher scores on checking and doubting scales on both the
MOCI and the CAC than other subgroups. These data suggest that individuals with elevated levels of IU may be more likely to have specific OC symptoms, like checking.

**Behavioral checking measures**

One way to examine these questions is through the use of behavioral tasks in the laboratory, which have been developed to measure checking behavior and its relationship to various OC-related outcomes. van Den Hout and Kindt (2003) created a virtual gas stove to examine checking behavior and memory confidence. Participants completed a training phase and then a pre-test phase, after which they rated how confident they were that they had turned off the stove. Next, participants in the experimental condition were told that they would be checking a gas stove on the computer and must turn it on and off according to directions, while participants in the control condition turned on and off virtual light bulbs. Both groups recorded the number of times they checked the stove/light bulb, and again rated how confident they were about which stove rings/light bulbs had been checked. A two-way ANOVA on memory confidence showed a main effect of group \([F_{(1,37)} = 8.2, p < 0.007]\), a main effect of time \([F_{(1,37)} = 18.3, p < .001]\) and group by time interaction \([F_{(1,37)} = 6.3; p < .017]\). These results indicate that participants in the experimental condition reported significantly lower memory confidence scores that participants in the control condition as time went on, even though memory accuracy was high in both groups. Similarly, Radomsky and Alcolado (2010) used a behavioral task that involved checking a real stove, and instructed participants to either physically or mentally check the stove. Participants who repeatedly physically checked the stove had decreased meta-memory (memory confidence) for their last physical check than participants who repeatedly mentally checked the stove \([F_{(1,58)}\)
Participants who repeatedly mentally checked the stove had decreased meta-memory for their last mental check than participants who repeatedly physically checked the stove \( F_{(1,58)} = 12.15, p < .001 \). The results of this study indicate that repeated physical checking reduces memory confidence only for physical checks, whereas repeated mental checking only reduces memory confidence for mental checks.

MacDonald and Davy (2005) examined the relationship between responsibility, checking, and mood. A negative or positive mood was induced in participants through music and lighting. Participants were then instructed to read over a 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 and punctuation errors, and once participants had 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 either instructed to check until they had found as many errors as possible, or they were instructed to check until they felt like stopping. Results indicated that mood did not have a significant effect on checking perseveration, whereas participants who were instructed to check for as many errors as possible demonstrated a significantly higher total number of checks \( F_{(1,59)} = 7.8, p < .007 \) and more time spent checking \( F_{(1,59)} = 14.6, p < .001 \) than the group that was instructed to check until they felt like stopping. This study introduced a relatively easy-to-implement task to measure checking behavior, though limitations of the task include a lack of feedback about checking accuracy and possible participant fatigue from having to look for so many errors during a monotonous task.

Other research has focused specifically on the relationship between checking behavior and IU. Tolin et al. (2003a) examined the relationship between IU and checking compulsions. They theorized that pathological doubt, one component of IU, is a major factor in individuals
with checking compulsions, as these individuals keep checking because they doubt they checked correctly each previous time. The authors administered a number of measures to clinical OCD checkers, clinical OCD non-checkers, and non-anxious controls, including the Structured Clinical Interview for the DSM-IV (First, Spitzer, Gibbon, & Williams, 1995), YBOCS, and the Intolerance of Uncertainty Scale (IUS; Freeston, Rheaume, Letarte, Dugas, & Ladouceur, 1994). Results indicated that OC checkers scored higher on the IUS than both non-checkers and non-anxious controls. Repeating symptoms (performing the same act over and over) were also correlated with IU. However, after averaging across all IUS scores, OCD patients did not show evidence of higher IU symptoms than the controls, which provides some preliminary evidence that only certain OCD compulsions may be driven by uncertainty.

Some research has incorporated technology to more effectively capture checking behavior. Kim et al. (2010) created a virtual checking task in which the participant was equipped with a head-mounted display and a joystick to engage with a virtual apartment. The sample consisted of OC checkers, OC non-checkers, and healthy controls. Participants were instructed to pretend they were in a real apartment and check all features of the apartment before leaving, including a gas stove, light switches, and doors with locks. Significant group differences were found on amount of time spent checking \( F_{(2, 67)} = 6.538, p < .05 \). Post-hoc analyses revealed that OC checkers (\( M = 154.43 \)) displayed significantly more time (measured in seconds) spent checking the virtual apartment than OC non-checkers (\( M = 107.14 \)) and healthy controls (\( M = 98.62 \)). Time spent checking was not significantly different, however, between OC non-checkers and the healthy controls. Results of this study suggest it is an effective measure of checking behavior, and was able to distinguish participants with a diagnosis of OCD and primary checking compulsions from participants with a diagnosis of OCD with primary non-checking
compulsions, and healthy controls. Though the implications of this virtual reality measure are promising, the technology currently needed to conduct such a task is expensive, time consuming to use, and may be confounded by participants’ inability to effectively manipulate the joystick.

A simpler behavioral measure was created by Rotge et al. (2008). The computerized measure consists of a delayed matching-to-sample task. Participants were 36 adults with OCD, 14 adults without OCD, and 50 healthy controls. During the task, participants viewed an image followed by a delay, followed by another image, and were instructed to indicate whether the second image matched the first. They were given the opportunity to check the first image as many times as they needed in order to be sure of their answer. The task was designed to assess response time (time from when the matching image appeared to when the participants made a choice), number of checks completed, and accuracy.

Significant group differences were found on number of checks completed \( F(2,97) = 18.88, \ p < .001 \) and response time \( F(2,87) = 10.80, \ p < .001 \). Post hoc analyses revealed that OC checkers completed significantly more checks during the task than OC non-checkers \( (p < .02) \) and that OC non-checkers completed significantly more checks than healthy controls \( (p < .02) \). Response time was compared in trials with and without checking behaviors. In trials with checking behaviors, significant group differences were found, \( F(2,87) = 9.57, \ p < .001 \), with post-hoc analyses indicating that OC checkers had significantly longer response times than healthy controls \( (p < .002) \) but OC non-checkers did not \( (p > .05) \). In trials without checking behaviors, significant group differences were again found, \( F(2,87) = 7.18, \ p < .001 \), and post-hoc tests demonstrated that the response time for OC checkers and OC non-checkers was significantly longer than healthy controls \( (p < .01 \text{ and } .02, \ \text{respectfully}) \). Further, the OC checkers showed the greatest increase in response time from trials without checking behavior to trials with checking
behavior. No significant group differences on accuracy were found, $F_{(2,97)} = .04, p > .05$. The task was successful in measuring checking behavior in a mixed sample. OC checkers engaged in a higher number of checks and had longer response times than healthy controls, though all groups displayed similar accuracy. The results of this study indicate that checking behavior can be measured efficiently in both time and cost, as well as eliminate some of the limitations of other behavioral measures, including the difficulty of getting participants to believe the task is real (e.g. turning off a stove so that the building does not burn down).

The current body of research indicates that IU is related to checking behavior. Behavioral checking tasks indicate that checking perseveration can be measured, though the task itself tends to be more successful when it is meaningful and provides some consequence for failing to check (Radomsky & Alcolado, 2010). However, most of the current research relies on self-report measures of IU, and the correlational nature of this research makes it difficult to make conclusions about causality or maintaining factors. In order to further understand the relationship between IU and checking symptoms, a necessary step is to experimentally measure IU and its impact on a behavioral checking task. If Rachman’s (2002) theory is correct, IU should be highly correlated with repeated checking on a behavioral task.

**IU and Worry**

As a construct, IU cannot and should not be thought of as operating in isolation. In other words, because IU is considered to be an underlying dysfunctional belief in both GAD and OCD, it is considered to be strongly related to additional major components of these disorders, including threat estimation and worry.
Worry is defined as “negatively valenced verbal thought activity” that interferes with emotional processing and serves as a cognitive avoidance response to potential threats (Borkovec, Ray, & Stober, 1998). Individuals may view worry as an adaptive attempt to problem solve, when in reality it may be impeding habituation and extinction of the feared outcome (Borkovec et al., 2004). Though worry and IU seem similar conceptually, IU is considered a cognitive vulnerability for the manifestation of anxiety symptoms, which include worry (Freeston et al., 1994). It has been suggested that IU may be instrumental in the etiology and maintenance of worry (Ladouceur, Gosselin, & Dugas, 2000), though the nature of this relationship is still under investigation. Worry has been consistently correlated with IU in both clinical and non-clinical samples, even when levels of anxiety and depression are controlled (Dugas, Freeston, & Ladouceur, 1997; Freeston et al., 1994). In one study of these constructs, worry, as measured by the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990), was strongly correlated with IU, as measured by the IUS, $r = .70, p < .001$ (Dugas et al., 1997). Dugas, Gosselin, and Ladouceur (2001) examined the specificity of the relationship between worry and IU via hierarchical regression. They found that IU accounted for 42% of the variance in worry scores beyond what was accounted for by other variables, such as responsibility and anxiety sensitivity.

These constructs have also been measured beyond questionnaire-based studies. Research has indicated that experimentally increasing levels of IU leads to increases in worry (Kelly, 2009; Ladouceur et al., 2000). As such, it has been speculated that IU and worry are causally linked; in essence, IU leads to worry (Bredemeier & Berenbaum, 2008; Meeten, Dash, Scarlet, & Davy, 2012). In fact, cognitive-behavioral models of worry include IU as an essential component (Dugas, Gagnon, Ladouceur, & Freeston, 1998). Because worry is a core feature of GAD, the
relationship between worry and IU primarily has been examined in the GAD literature (APA, 2013). The strong relationship between the two constructs indicates that it may be valuable to include a measure of worry in any experimental manipulation of IU. If the experimental manipulation of IU increases worry, it is a sign that the experiment is manipulating the same construct that is being examined in the GAD literature, and supports the theory that IU causes worry.

**IU and Overestimation of Threat**

It has been hypothesized that the causal relationship between IU and worry occurs through two paths. First, increases in IU lead to negative problem orientation (i.e., dysfunctional attitudes regarding problem solving), mental avoidance, and views that worry is an effective coping strategy with positive consequences. Second, IU may lead to worry by increasing threat estimation (Dugas, Buhr, & Ladouceur, 2004). Overestimation of threat is defined as “exaggeration of the probability or severity of harm” (OCCWG, 1997, p. 678) and it is considered a dysfunctional belief in OCD. In fact, Carr (1974) considered overestimation of threat to be one of the main causal factors of the disorder, hypothesizing that errors in judgment of cost and probability estimates of negative outcomes lead to OCD.

It has been suggested that IU and threat estimation are highly related (OCCWG, 2003). Steketee et al. (1998) created a questionnaire to assess six cognitive domains in OCD (responsibility for harm, control of thoughts, threat estimation, tolerance for uncertainty, beliefs about discomfort/anxiety, and beliefs about coping), called the Obsessive-Compulsive Beliefs Questionnaire (OCBQ). The OCBQ consists of 90 items and each of the six subscales
demonstrated internal consistency, including threat estimation ($\alpha = .88$) and tolerance for uncertainty ($\alpha = .87$). The threat estimation subscale and the IU subscale were highly correlated ($r = .82$), though this may have been a result of construct overlap in the measure (correlations between subscales ranged from .57-.82). The relationship between IU and threat estimation has implications for OCD. Individuals with OCD tend to be excessively fearful of harm and view situations as dangerous until proven safe (Steketee et al., 1998). In addition, research has found that anxious individuals, compared to non-anxious controls, view future negative events as being more likely to occur and having greater consequences (Butler & Matthews, 1983; McNally & Foa, 1987). It is possible that IU may be contributing to the maintenance and severity of both GAD and OCD through overestimation of threat, and in turn, exacerbating worry, or obsessions and compulsions.

In the GAD literature, there have also been findings that IU and threat estimation are related. Bredemeier and Berenbaum (2008) suggested that threat estimation consists of both increased probability estimates of a negative event occurring and increased cost estimates of negative outcomes. They examined two components of IU in a non-clinical sample and administered a 7-item desire for predictability subscale and a 7-item uncertainty paralysis subscale consisting of items from the IUS. Previous research has demonstrated convergent and discriminant validity for these scales (Berenbaum, Bredemeier, & Thompson, 2008). Threat estimation was also examined using a 39-item measure consisting of possible future negative events. Participants were asked to rate “how bad” it would be if these events occurred and “how likely” they thought the events were to occur on two separate 1-6 scales. Higher scores indicated higher cost estimates and higher probability estimates for future negative events and therefore higher threat estimation. Results of a multiple regression analysis indicated that the desire for
predictability subscale and uncertainty paralysis subscale were significantly associated with cost estimates of future negative events ($R^2 = .15, p < .01$). Both subscales were also significantly associated with probability estimates of future negative outcomes in the overall regression model ($R^2 = .10, p < .01$). The results of this study suggest that individuals high in desire for predictability and uncertainty paralysis, core components of IU, tend to overestimate the probability and cost of negative consequences of uncertain outcomes. These findings indicate that IU and threat estimation are related, though further examination of the components of threat estimation is needed.

Threat estimation is thought to be enhanced through IU by allowing individuals to misjudge the probability of negative events occurring, and also misinterpret the consequences of those events (Bredemeier & Berenbaum, 2008; Dugas et al., 2004; MacLeod, Williams, & Bekarian, 1991). These factors may have a more complex relationship with OCD than previously thought. In order to understand how threat estimation relates to IU and the maintenance of OCD, it is important to have an understanding of its components. Woods, Frost, and Steketee (2002) examined threat estimation in OCD patients and college students. Participants were asked to complete an idiographic questionnaire about future negative events and rate how likely they thought the event would be to occur, how severe the consequences would be, and how well they believed they could cope with the event. They found a significant relationship between OC symptoms and each of the severity, probability, and coping subscales in the student sample, and significant correlations between OC symptoms and the severity and coping subscales in the patient sample. Severity estimations increased as OC symptoms increased, with a large effect size ($d = .51$) for the student sample and a moderate effect size ($d = .34$) for the patient sample. The results of this study suggest that there is a strong relationship between cost estimates of
negative events and OC symptom severity. Probability estimates, however, showed a more complex relationship with OC symptoms: in the student sample, probability estimates and OC symptoms were significantly related, but this relationship did not hold in the clinical sample. These findings indicate that probability estimates in OC patients may be more complex than previously thought. Even if individuals are aware that the probability of a negative event occurring is low, they may still be troubled by it. This study provides evidence that a relationship between OC symptoms and cost estimates in threat estimation exists in both clinical and student samples. Finally, Rachman (2002) proposed uncertainty of danger or threat as a factor in compulsive checking. IU and threat estimation may be contributing to checking behaviors. For example, individuals may engage in checking and ritualistic behavior to reestablish certainty and reduce the distress caused by potentially dangerous situations (Tolin et al., 2003a).

Current IU and threat estimation research has limitations. Woods et al. (2002) had participants write down future negative events that were salient to them and then rate the cost and probability of their chosen events. Although this may have increased ecological validity, internal validity was reduced by increasing the variation in negative events. The relationship between OC symptoms and future negative events may appear different when a meaningful nomothetic approach is taken and participants are asked to rate identical outcomes. Furthermore, many of these studies collected data using questionnaires and written responses. Whereas current studies on threat estimation and IU are useful in determining a positive relationship between IU and cost estimates, they do not provide evidence of causality. Additionally, much of the current literature was conducted in the context of GAD. Further examination of the relationship between threat estimation and IU by utilizing an OCD framework is warranted and will allow for a more complete understanding of IU.
Current IU Manipulations

Although there have been a number of behavioral tasks used to assess checking behavior, experimental manipulations involving IU are relatively scarce, and those involving OCD are scarcer still. In the GAD literature, a handful of IU manipulations have been created. Ladouceur, Gosselin, and Dugas (2000) developed the first manipulation to determine if a causal relationship existed between IU and worry. In their IU manipulation, participants were asked to play a computerized roulette game. They were told that money would be donated to a (fictitious) Foundation if they made a certain amount of money on the game, though in actuality the game was fixed and all participants ended with the same amount. Throughout the game, researchers would make comments intended to increase IU (noting that the chances of winning were lower and that most participants were not doing well) 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. The results of the study indicated that there were significantly higher levels of worry and concern about the Foundation in the high IU group ($M = 37.81, SD = 7.58$) than the low IU group ($M = 19.71, SD = 8.55$), $t_{(40)} = 7.26, p < .05$. Experimentally manipulated greater IU also led to higher levels of worry.

This study has limitations, especially regarding the experimental manipulation of IU. Though the manipulation check of IU was successful, it is unclear if IU as a construct was in fact being manipulated. It is possible that group differences on the manipulation check were caused by variations in expectations of success, rather than IU. In the study, it appears that researchers either downplayed the importance of success or tried to increase it, but this may not have
affected uncertainty at all. It is possible that researchers were actually manipulating
responsibility levels, rather than certainty/uncertainty. As with Bredemeier and Berenbaum
(2008), this study’s main focus was on GAD and worry. Experimental manipulations of IU in the
context of other disorders will expand the knowledge base and may uncover facets of IU not
apparent through a GAD-specific lens. Because relatively few experiments on IU have been
conducted, this study provides important insight into the difficulties of manipulating this
variable.

Another experimental manipulation of IU was developed by Kelly (2009). In this
manipulation, 60 Australian undergraduate participants were told they were completing a
memory task. They were randomly sorted into a high IU group or a low IU group. In the high IU
group, participants were asked to read two vignettes about a character (Sarah or Sean) in
uncertain situations regarding dating and finances. They were then asked to write a story about a
time in their own lives when they were uncertain of the outcome of a situation. Afterward,
participants were asked to memorize the story they just wrote from the perspective of Sarah or
Sean from the vignettes. Following the IU manipulation, participants completed questionnaires
intended to measure worry and IU. Kelly (2009) found that the manipulation was successful in
that there was a significant difference in IU levels following the manipulation between the high
group \(M = 30.00, SD = 8.60\) and the low group \(M = 24.70, SD = 6.01\), \(t_{(58)} = 2.77, p < .05\).
This study was an important step in expanding the scope of research conducted on IU. By
instructing participants to write a personally relevant description of uncertainty, it provided a
new framework for manipulating IU that eliminates artificial scenarios and thus increases
ecological validity. However, the manipulation, conducted in Australia, likely is not
generalizable to American populations because of certain cultural differences in the vignettes.
For example, in the finance vignette, the Sarah/Sean must face uncertainty regarding superannuation (an Australian system set up to allow citizens to save for retirement), which does not directly translate to financial opportunities in the United States. The manipulation is also time-consuming—nearly 50 minutes—and therefore may not be ideal for a study incorporating additional tasks.

Meeten, Dash, Scarlet, and Davy (2012) examined IU in an attempt to determine if a causal relationship between worry and IU exists. After obtaining consent, the authors presented participants with baseline measures, including the IUS short form (Carleton, Norton, & Asmundson, 2007), the PSWQ, the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983), and a visual analogue scale (VAS) mood measure. The authors experimentally manipulated IU using the procedure created by Kelly (2009). Participants were then given a manipulation check consisting of three VAS questions designed to assess negative beliefs about uncertainty regarding the situation they described in the Kelly (2009) procedures, general beliefs about uncertainty, and current level of uncertainty. After the manipulation check, participants received two more VAS mood measures, and then participated in a catastrophizing interview in which they were asked a series of questions about a personal worry (i.e., “what is it that worries you about X?”). Researchers measured the number of questions participants answered before ending the interview. The more questions participants answered, the higher their worry levels. Once the catastrophizing interview was over, participants completed three more mood measures and finished with debriefing. An independent samples t test was conducted on the IU manipulation check questions, and the results indicated that the high group ($M = 171.20, SD = 55.77$) had significantly greater IU levels than the low group ($M = 122.67, SD = 75.17$), $t_{(44)} = 2.45, p < .02$. Additionally, the experimentally manipulated high IU group took significantly
more catastrophizing steps in the interview than the low IU group, $t_{(44)} = 3.37, p < .002$, and had higher levels of sadness ($M = 29.27$) than the low IU group ($M = 17.59$), $F_{(1, 44)} = 4.30, p < .04$.

Rosen and Knäuper (2009) created an IU manipulation based on a linguistic task. The protocol is based on the theory that if participants answer a question in a particular way (e.g., affirmatively) they will begin to develop cognitions that affect their attitudes or traits (Salancik & Conway, 1975). In essence, if participants endorse a number of items about a particular trait, such as IU, they will begin to believe that the trait is characteristic of them, and act in a manner consistent with that trait. Rosen and Knäuper (2009) manipulated the questionnaires participants received, so that the high IU group had a higher probability of endorsing items, while a low IU group had a lower probability of endorsing items. The IU manipulation has proven successful at altering dysfunctional beliefs in undergraduate college students at multiple universities (Bailey, Fergus, & Wu, 2013; Rosen & Knäuper, 2009). Rosen and Knäuper (2009) created $z$-standardized scores and conducted a paired samples $t$ test, and found that there was a significant increase in IU scores from baseline to post-manipulation in the high group, $t_{(56)} = 2.52, p = .02$; and a significant decrease in IU scores from baseline to post-manipulation in the low group, $t_{(87)} = -5.34, p < .01$. Bailey et al. (2013) also found that the manipulation was successful at altering IU; the high IU group had higher IU scores (as measured by the OBQ-87 IU subscale) than the low group post-manipulation, controlling for pre-manipulation IU scores [$F_{(1,80)} = 10.27, p = .002$]. This manipulation is short, cost-effective, and relatively easy to implement in an experimental setting involving other tasks for participants to complete. Because of the success of the manipulation at altering participants’ IU levels, this manipulation was incorporated into the current study.
These experiments provide an important first step in expanding research on IU beyond questionnaires and self-report data. However, further research needs to be conducted to determine if experimentally manipulated IU is related to OC symptoms, such as checking behavior, as well as to expand the scope of research and increase understanding of this dysfunctional belief domain.

Limitations to Existing Literature

The existing research on IU, threat estimation, and checking suffers from a number of limitations. First, much of the data collected on IU and checking behavior have come exclusively from self-report measures, which may be subject to bias. The experimental research that has been conducted on IU is almost entirely in the context of GAD, even though IU has been linked with numerous anxiety disorders and depression. Additionally, some of the checking tasks implemented did not have consequences for failing to check, and this may have biased the results because participants may not have felt that checking was necessary. Finally, research involving threat estimation in terms of IU has been mixed because of a paucity of psychometrically sound instruments available to measure overestimation of threat. Therefore, a study that significantly increases or decreases state IU, utilizes a behavioral checking task that is easy to use and understand, and implements a psychometrically validated measure of threat estimation is warranted.
Current Study

The current study replicated and extended previous OCD research. Specifically, this study sought to explore the relationship between IU and analog checking behavior, threat estimation, and worry. IU was experimentally manipulated utilizing Rosen and Knäuper’s (2009) procedure. The effects of the manipulation on checking behavior were measured using a computerized checking task (Rotge et al., 2008). Finally, measuring worry and threat estimation allowed for further exploration of IU as a construct.

The current study had three primary aims. First, this study sought to examine the impact of IU on checking behavior. Previous research suggests that IU is one of the primary cognitive distortions involved in the etiology and maintenance of checking compulsions (e.g., Tolin et al., 2003a). However, few studies have examined if this causal relationship or have implemented an experimental paradigm. Second, this study sought to further explore the relationship between threat estimation and IU by utilizing an OCD framework. Third, this study sought to examine the relationship between IU and worry to determine specificity among constructs. Therefore, it was hypothesized that, compared to participants manipulated to endorse lower IU, participants manipulated to endorse higher IU would demonstrate: a greater number of checks (Hypothesis 1), greater response time on the checking task (Hypothesis 2), similar accuracy on the checking task (Hypothesis 3), greater estimation of threat (Hypothesis 4), and greater worry (Hypothesis 5). Evidence substantiating these hypotheses would provide further support for cognitive models of dysfunctional beliefs as being causally related to OCD, and may have implications for the treatment of individuals with checking compulsions.
CHAPTER 2

METHOD

Participants

Participants were 122 undergraduate students recruited from an introductory psychology course at Northern Illinois University (NIU). Three participants (2% of the sample) were removed from analysis for incorrectly answering all three validity items, indicating they were responding in a careless or intentionally false manner (74% of the sample answered all three validity items correctly). Next, participants who did not believe the deception were removed from analysis; 33 participants (27% of the sample) scored a 3 or lower on the manipulation check, indicating that they did not believe the feedback. Three participants were removed from analysis for responding in such a way that they received the wrong feedback (i.e., answering too few questions as true in the high condition or too many questions as true in the low condition). One participant was removed from analysis due to technical errors that prevented completion of the E-Prime computerized task. The final sample size was 83. The sample was predominantly female (60.2%) with a mean age of 19.29 (range 18 – 30). All but two participants identified their race; of those, 44.6% identified as White/Caucasian, 31.3% identified as Black/African American, 6% identified as Asian American, 1.2% identified as Native American, 6% identified as multi-racial, and 8.4% identified as “other.” Additionally, 15.5% of the sample identified as
Hispanic or Latino/a. Participants who were removed from analysis did not differ from those retained on any demographic variable.

Measures

**OC Dysfunctional Beliefs**

The Intolerance of Uncertainty Scale (IUS; Freeston et al., 1994) and the Need for Closure Scale (NFCS, Webster & Kruglanski, 1994) were used for the current study manipulation. The current study followed the protocol of Rosen and Knäuper (2009), administering the IUS and eight items from the NFCS as part of the IU manipulation (described in the Procedure). The IUS is a 27-item questionnaire, originally developed for and validated on French speaking populations. The English version was created by using two independent translators and then back-translating it to French to ensure that problem areas had been identified (Vallerand, 1989). Once it had been translated into English, Buhr and Dugas (2002) conducted an analysis to test its psychometric properties and identified a 4-factor structure, though they found that the factors were highly intercorrelated. These four factors are: that uncertainty is stressful and upsetting, uncertainty leads to the inability to act, uncertainty should be avoided,
and uncertainty is unfair. Because of the high intercorrelations among the factors and overlap of some items, Buhr and Dugas suggest that only the total score be used.

In the original IUS, participants are asked to rate items on a 5-point scale, with 1 = not at all characteristic of me, and 5 = entirely characteristic of me (Buhr & Dugas, 2002). For the purposes of the manipulation in the current study, participants were asked to rate items as either true or false (Rosen & Knäuper, 2009). Items on the IUS include ideas about the unacceptability of uncertainty, the stress and frustration caused by uncertainty, and the inability to take action in times of uncertainty (Buhr & Dugas, 2002). Questions on the IUS include, “One should always look ahead to avoid surprises,” and “When I am uncertain, I can’t function very well” (Freeston et al., 1994). The IUS has demonstrated internal consistency (α = .94) and 5-week test-retest reliability in English-speaking samples (r = .72; Buhr & Dugas, 2002). The IUS has also demonstrated convergent validity, correlating with measures of anxiety (Beck Anxiety Inventory; r = .55, p < .001), depression (Beck Depression Inventory-II; r = .59, p < .001), and worry (PSWQ; r = .60, p < .001), but not with age (r = -.06, p > .05) or gender (r = -.10, p > .05).

Following the protocol of Rosen and Knäuper (2009), the preference for predictability subscale from the NFCS was added to the IUS. This modification was made due to criticism that the IUS evaluates the consequences of uncertainty, but does not adequately assess the unacceptability of uncertainty. The preference for predictability subscale of the NFCS was therefore added to ensure sufficient manipulation of IU. This subscale consists of eight items. Items on the subscale include “I don’t like to go into a situation without knowing what I can expect from it.” The preference for predictability subscale showed internal consistency (α = .79) and 12-week test-retest reliability for the full NFCS (r = .86; Webster & Kruglanski, 1994). Internal consistency was high for the combined NFCS/IUS pre-manipulation (α = .92) and post
manipulation (α = .86; Rosen & Knäuper, 2009). Subsequent references to the IUS include the preference for predictability subscale from the NFCS.

The Intolerance of Uncertainty Index-Part A (IUI-A; Gosselin et al., 2008; English translation, Carleton, Gosselin, & Asmundson, 2010) was developed as a 2-part scale. Part A measures an individual’s tendency to consider life’s uncertainties to be unacceptable, and Part B measures manifestations of uncertainty, such as avoidance, doubt, and worry. The IUI-A consists of 15 items with option responses ranging from 1 = not at all characteristic of me to 5 = entirely characteristic of me. Higher scores indicate higher levels of IU. Examples of items include “I find it unbearable to not have guarantees in life” and “I do not really tolerate situations in which I do not know what is going on.” The scale, developed for and validated on a French-speaking population, consists of a unifactorial structure and demonstrates internal consistency (α = .94). The scale also shows adequate test-retest reliability over a 5-week period (r = .76; Gosselin et al., 2008). The scale was later translated into English and psychometrically validated on a non-clinical population, with analyses again supporting a unitary factor structure and internal consistency (α = .96; Carleton et al., 2010). The IUS and IUI-A are also correlated (r = .68; Gosselin et al., 2008). For the purposes of this study, only Part A was necessary to measure whether the manipulation was successful at increasing or decreasing IU.

The Obsessive Beliefs Questionnaire 87, threat estimation subscale (OBQ-T; OCCWG, 2001, 2003) was used to measure threat estimation. In 1997, OCCWG identified six dysfunctional beliefs that may lead an individual to be at risk for OCD. Later, they developed the OBQ to assess these beliefs in individuals. This measure consists of 87 items in which participants are asked to rate how much they agree with an item on a 7-point scale (1 = disagree very much, 7 = agree very much). Participants are instructed to select the item that best describes
how they usually think most of the time. Subscales of the OBQ include Control of thoughts (14 items), Importance of thoughts (14 items), Responsibility (16 items), IU (13 items), Overestimation of threat (14 items), and Perfectionism (16 items). The OBQ-T was intended to measure the exaggeration of the probability and severity of harm, and higher scores on this subscale indicate higher levels of this dysfunctional belief are present (OCCWG, 1997, 2001). A sample item from this subscale is “Harmful events will happen unless I am very careful.”

OCCWG (2001) tested and validated the OBQ-87 on a number of groups, including patients with OCD, anxious controls, student samples, and community controls. A large percentage of the participants identified as White (students = 87.5%). The OBQ-T has demonstrated internal consistency for student controls ($\alpha = .88$) and OCD patients ($\alpha = .91$). The subscale also demonstrated test-retest reliability for students ($r = .75$), even though the assessments were 2 to 3 months apart. The OBQ-T was highly correlated with the IU subscale and the Responsibility subscale ($rs$ near .80). Because patients with OCD did not score higher on the OBQ-T than patients with general anxiety, overestimation of threat is considered to be OC-relevant, but not OC-specific.

The OBQ-87 was revised based on structural analyses (OCCWG 2003, 2005). The revised measure contains 44 items and three scales (reduced from six). In the OBQ-44, threat estimation and responsibility are combined into one scale. Despite the findings of the OCCWG and their psychometric analysis on the OBQ, it is theoretically relevant to measure threat estimation as distinct from responsibility, given the hypothesized role of threat estimation on checking behavior. Currently, no known threat estimation measures exist to measure this dysfunctional belief except the OBQ-T. Given the limitations, the OBQ-T provides the best
opportunity to measure threat estimation in this study. In order to examine for specificity, the full OBQ-87 was given, and subscale correlations were assessed.

**Worry**

The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) is the most widely used measure of worry (Fresco, Heimberg, Mennin, & Turk, 2002). The PSWQ is a 16-item questionnaire that measures participants’ responses on a 1-5 scale, with response options ranging from 1 = *not at all typical of me* to 5 = *very typical of me* (Meyer et al., 1990). The possible range of total scores is 16 to 80, and higher scores indicate higher levels of worry (Meyer et al., 1990). Eleven of the questions are worded so that the participant may endorse worry (“When I am under pressure, I worry a lot”), while five items are worded so that the participant may endorse lack of worry (“I tend not to worry about things”), the latter of which are reverse coded for scoring purposes. While some researchers have concluded that the PSWQ consists of a unifactorial structure (Brown, 2003), others determined that a 2-factor structure provides a superior fit (Fresco et al., 2002). These factors coincide with the way the questions are worded: the Worry Engagement Scale consists of the eleven positive endorsements of worry, while the Absence of Worry Scale consists of the five negatively endorsed worry items (Fresco et al., 2002). These factors may exist as a result of method variance, that is, participants may be answering the negatively worded items differently than the positively worded items. Further research on this structure has concluded that the PSWQ is measuring a single construct (worry), and that the five negatively-worded items do not represent a distinct factor (Hazlett-Stevens,
Ullman, & Craske, 2004). For the purposes of the current study, worry was treated as a unidimensional construct.

Estimates of internal consistency for the PSWQ total score typically are at or above .90 in student samples (\(\alpha = .94;\) Meyer et al., 1990; \(\alpha = .90,\) Fresco et al., 2002). Fresco et al. (2002) found that the Worry Engagement Scale had higher internal consistency (\(\alpha = .94\)) than the total score and suggested that the scale may be a good test of worry behavior on its own. Test-retest reliability was indicated to be quite high in student samples (\(r = .92;\) Meyer et al., 1990). Follow-up studies revealed that the PSWQ was able to distinguish between students with GAD and students with PTSD, and students with more severe GAD scored higher on the measure (Meyer et al., 1990). Additionally, the PSWQ is able to distinguish participants with GAD from other groups; participants with GAD scored significantly higher on the PSWQ than participants with other anxiety disorders as well as healthy controls, \(F(6, 341) = 21.60, p < .001\) (Brown, Antony, & Barlow, 1992). The measure has also displayed convergent and discriminant validity in both clinical and non-clinical populations (Meyer et al., 1990). It has demonstrated a correlation of .55 with the Student Worry Scale (Davey, Hampton, Farrell, & Davidson, 1992) and a correlation of .63 with the Worry Domains Questionnaire (Tallis, Eysenck, & Mathews, 1992). Brown et al. (1992) reported that the PSWQ demonstrated discriminant validity in GAD patients: scores on the PSWQ did not significantly correlate to measures of anxiety (Self-Analysis Questionnaire, Anxiety Subscale [SAQ; Lovibond, 1983], \(r = 0.11\); Hamilton Anxiety Rating Scale [Hamilton, 1959], \(r = -0.02\)) or depression (SAQ Depression Subscale, \(r = 0.15\); Hamilton Rating Scale for Depression [Hamilton, 1960], \(r = 0.04\)). The PSWQ has also been correlated with other measures, including measures of trait and state anxiety, as well as measures of low thrill-seeking and problem avoidance (Meyer et al., 1990). In student samples, correlations between the PSWQ
and other measures have been much higher than in patient samples (Fresco et al., 2002). Items in the PSWQ are not content specific, which is valuable for obtaining a general measure of worry, as opposed to a measure of worry in particular situations. Utilizing a general measure of worry may increase the ecological validity of the current study.

**Response Characteristics**

The Balanced Inventory of Desirable Responding (BIDR; Paulhus, 1988) is a measure created to assess for bias in participant responding, specifically, if participant responses are a function of social pressure rather than true feelings. It contains two primary subscales: self-deceptive enhancement and impression management. The BIDR consists of 40 items measured on a 7-point scale (1 = not true, 7 = very true). The self-deceptive enhancement subscale consists of twenty items that measure unconscious deception (“I am a completely rational person”), whereas the impression management subscale consists of twenty items that measure conscious deception (“Once in a while I laugh at a dirty joke”). Twenty of the items are reverse scored. The possible range of scores is 0-20, with a point added for each extreme score indicated (6 or 7). High scores indicate exaggerated socially desirable responding.

The BIDR has demonstrated internal consistency in samples of college students and religious adults (α = .83; Paulhus, 1988). It has also demonstrated 5-week test-retest reliability for the self-deception enhancement scale (r = .69) and the impression management scale (r = .65). The BIDR shows concurrent validity with the Marlowe-Crowne Scale (r = .71; Crowne & Marlowe, 1960). The self-deceptive enhancement scale (r = .43) and the impression management scale (r = .61) were found to correlate with the Minnesota Multiphasic Personality Inventory.
(MMPI; Hathaway & McKinley, 1943) lie scale in a group of 103 undergraduate students (Lanyon & Carle, 2007). The subscales have also been shown to form separate factors in factor analysis (Paulhus, 1988).

To ensure participants were not responding in a careless or intentionally false manner, three validity items were included in the current study (adapted from Bailey & Wu, 2013). The validity items were “Choose the sum of three plus three;” “I have experienced a fatal heart attack while watching television;” and “If you are paying attention right now, choose “8” 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 get fewer than three incorrect (Bailey & Wu, 2013).

**Demographic Characteristics**

**The Demographic Data Questionnaire (DDQ).** The DDQ is 9-item self-report questionnaire assessing basic demographic information. Individuals were asked questions about their sex, age, and race. Additionally, participants were asked a brief set of questions to assess their vision and to determine if they have received current or past psychological or psychiatric treatment.
Procedure

Participants were greeted by a session proctor and given information about the purpose of the study, the study procedure, and participant rights; and provided written informed consent. All participants completed the demographics questionnaire as well as the IUI-A and BIDR on a computer. After completing the questionnaires, participants were randomized into a high- or low-IU condition. Participants completed the IU manipulation following the protocol by Rosen and Knäuper (2009). The IU manipulation is as follows: all participants were given a short paragraph to read about IU. Next, participants in the high condition were given a modified version of the IUS and asked to rate each statement as “true” or “false.” The more statements that participants endorse as “true,” the higher their IU. For participants in the high IU condition, each statement was paired with the qualifier “occasionally” so that participants were more likely to endorse a greater number of items. Participants in the low IU condition received the same questionnaire, except that the statements were paired with the qualifier “almost always” to reduce the number of items they endorsed.

In the second part of the manipulation, participants were given false feedback regarding their levels of IU. This feedback was based on cut-off points for each condition; participants in the high condition needed to endorse 5 or more statements to receive the high IU feedback, while participants in the low condition had to endorse fewer than 24 statements to receive the low IU feedback. During high IU feedback, participants read that they do not tolerate uncertainty well and that they find uncertainty unfair. Feedback for the low IU manipulation was the opposite, that they are tolerant of uncertainty. Rosen and Knäuper (2009) found that this manipulation was
successful as measured by the IUS; participants in the high condition had significantly increased IU from baseline while participants in the low IU condition had significantly decreased IU from baseline. Another study conducted by Bailey, Fergus, and Wu (2013) found similar results using the same manipulation but measuring IU using the IU subscale of the OBQ-87; participants showed significant post-manipulation differences, controlling for initial IU levels.

In order to assess the effectiveness of the manipulation for altering participants’ perceptions about their IU levels, participants were asked to answer a question about how much they believed the feedback they received. Because a direct question about a participant’s view of their IU might arouse suspicion, participants were asked, “To what extent did you feel that the intolerance of uncertainty feedback you received was characteristic of you?” on a scale ranging from 1 (not at all characteristic of me) to 7 (very characteristic of me). This manipulation check is identical to the one used by Rosen and Knäuper (2009). Following the IU manipulation and manipulation check, participants completed the IUI-A, PSWQ, and OBQ-87 on the computer.

Participants then completed a delayed matching-to-sample computerized task designed to measure checking behavior (Rotge et al., 2008). The computerized task consists of six phases: (1) participants are presented a large black dot for 2 seconds on the screen to signal attention; (2) participants are presented with an image for 3.5 seconds; (3) the image disappears and there is a 3.5-second delay; (4) participants are presented with another image and must decide if it is different than the original image presented by pressing a button corresponding to the choice True (T) or False (F); (5) participants may press the left arrow to return to the study phase an unlimited number of times or validate their choice by pressing the right arrow; and (6) once participants are finished checking, they receive a signal onscreen that tells them whether they were correct or incorrect. Following the protocol of Rotge et al. (2008), participants were given
an explanation of the task and 10 practice trials to complete to ensure understanding of the task. Participants were instructed to proceed “as efficiently and accurately as possible” (Rotge et al., 2008, p. 468). The actual task consisted of 50 trials, involving 25 pairs of matching stimuli and 25 pairs of non-matching stimuli. See Figure 1 for example of non-matching stimuli.

Figure 1. Example of non-matching checking task stimuli
Following the computerized task, all participants were debriefed verbally and using a written document, and given a list of counseling resources in the area that they can utilize in the event of distress. See Figure 2 for a graphical representation of the procedure steps.

Figure 2. Study Procedure
CHAPTER 3

STATISTICAL ANALYSES

Data Screening and Preliminary Analyses

All analyses were conducted using SPSS 21.0. Data were screened and participants who did not meet study criteria were removed from analysis. Next, missing data were analyzed using Little’s MCAR test (Little, 1988). Due to the small amount and random pattern of missing data, the Expectation Maximization (EM) method was used 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 under 40 iterations, the standard number of iterations before the EM algorithm levels off (Neal & Hinton, 1998).

Data from the E-Prime program were exported and merged. The first ten trials of each participant’s data were removed from analysis, consistent with the procedure used by Rotge et al. (2008). Total checks were then counted as the number of checks the participant completed during the last 50 trials. Response time was measured as the average number of seconds from when the matching image appeared to when the participant made a choice for the first time over
the last 50 trials. Accuracy was determined as the total number of correct response items selected, subtracting number of checks.

Next, data were analyzed to detect the presence of univariate outliers, defined as 3 SD from the mean (Field, 2009). Outliers were visually inspected utilizing boxplots and Q-Q plots, and identified employing linear regression statistics (e.g., studentized deleted residuals). Data were also analyzed to determine if they met the assumptions of parametric testing. To test for the normality of the distribution, skew and kurtosis values were calculated for each variable and transformed into z-scores. Variables that were significantly non-normal (i.e., z-scores greater than 2.58; Field, 2009) were logarithmically transformed. Variance was tested for homogenous spread across the predictor variable using Levene’s test. Descriptive statistics (mean, standard deviation, and psychometric properties when applicable) were calculated for all dependent variables. Zero-order correlations were calculated for the OBQ-87 to examine for specificity among dysfunctional beliefs. A series of ANOVAs were conducted to determine if conditions differed on any demographic variables, baseline IU, or levels of socially desirable responding.

**Primary Analyses**

The data were analyzed to determine if the manipulation was successful. A paired samples $t$ test was conducted to examine IU differences from baseline to post-manipulation. High IU and low IU conditions were compared with an independent samples $t$ test on IUI-A scores post-manipulation.

To test the hypothesis that participants manipulated to endorse higher IU would demonstrate a greater number of checks than participants manipulated to endorse lower IU
(Hypothesis 1), an independent samples $t$ test was conducted. Significant differences ($p < .05$) between conditions on the number of checks completed by participants during the computerized checking task would suggest that the IU manipulation altered levels of checking behavior.

To test the hypothesis that participants manipulated to endorse higher IU would demonstrate greater response time on the checking task than participants manipulated to endorse lower IU (Hypothesis 2), an independent samples $t$ test was conducted. Significant differences ($p < .05$) between conditions on the average number of seconds from when the matching image appeared to when the participants made a choice for the first time would suggest that the IU manipulation altered response time.

To test whether participants manipulated to endorse higher IU would demonstrate similar accuracy to participants manipulated to endorse lower IU (Hypothesis 3), an independent samples $t$ test was conducted. Non-significant differences ($p > .05$) between conditions on the total number of correct responses on the computerized checking task would indicate that neither condition was more accurate than the other.

To test whether participants manipulated to endorse higher IU would demonstrate greater estimation of threat for future negative events than participants manipulated to endorse lower IU (Hypothesis 4), an independent samples $t$ test was conducted. Significant differences ($p < .05$) between conditions on the OBQ-T would indicate that the IU manipulation altered levels of threat estimation.

To test whether participants manipulated to endorse higher IU would demonstrate greater worry than participants manipulated to endorse lower IU (Hypothesis 5), an independent samples $t$ test was conducted. Significant differences ($p < .05$) between conditions on PSWQ scores would suggest that the IU manipulation altered levels of worry.
CHAPTER 4
RESULTS

Data Screening

A missing values analysis determined that .06% of data were missing from this dataset. Little’s MCAR test (Little, 1988) revealed that the data were missing completely at random ($\chi^2 = 396.242$, $df = 6202$, $p = 1.0$). Patterns of missing values indicated that monotonicity was not present, meaning that the monotone method of imputation was not necessary. Participants with more than 5% missing data on a single measure were excluded pairwise from analysis. All but one dataset converged after 25 iterations, and that dataset converged within 40 iterations. Next, total scores were created from questionnaire items and data were analyzed for univariate outliers. No outliers were found on any measures. Data were not significantly skewed or kurtotic (e.g., skew and kurtosis < 2.58; Field, 2009), and met the assumption of normality and homogeneity of variance.

From the computerized checking task data, both the accuracy variable and the response time variable met the assumption of normality and were not significantly skewed or kurtotic. The total checks variable had three outliers and demonstrated a significantly positively skewed, leptokurtic distribution (skew = 7.82, kurtosis = 7.53). The total checks variable was logarithmically transformed to reduce positive skew (resulting skew = .67, kurtosis = .51).
data met the assumption of homogeneity of variance (i.e., Levene’s test indicated that variation in responding was not significantly different across conditions on these variables).

**Preliminary Analyses**

See Table 1 for sample characteristics and baseline comparisons. To test for baseline differences between the high and low IU conditions, a series of one-way ANOVAs was run on each pre-manipulation variable (sex, race, ethnicity, vision, treatment history, BIDR-SDE, BIDR-IM). The conditions did not differ significantly on any baseline variable, and therefore none was used as a covariate. Participants in the high IU and low IU conditions were excluded from analysis if they did not believe the feedback (i.e. scoring a 3 or lower on the manipulation check question; \(n = 29\) in the high condition; \(n = 4\) in the low condition) or if they answered too many or too few of the true/false IUS manipulation questions and subsequently received incorrect feedback \((n = 3)\). A series of one-way ANOVAs was employed to examine whether individuals who did not believe the feedback differed on any outcome variable; results indicated that those who did not believe the feedback had significantly lower PSWQ scores \((F_{(1,111)} = 8.79, p < .05)\).
Table 1

Sample characteristics and baseline comparisons between high and low IU conditions

<table>
<thead>
<tr>
<th>Variable</th>
<th>High IU</th>
<th>Low IU</th>
<th>Total Sample</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M (%)</td>
<td>SD</td>
<td>n</td>
<td>M (%)</td>
</tr>
<tr>
<td>IUI-A Time 1</td>
<td>39</td>
<td>41.5</td>
<td>11.2</td>
<td>43</td>
<td>36.9</td>
</tr>
<tr>
<td>BIDR-SDE</td>
<td>40</td>
<td>5.4</td>
<td>3.7</td>
<td>43</td>
<td>5.4</td>
</tr>
<tr>
<td>BIDR-IM</td>
<td>40</td>
<td>5.7</td>
<td>3.4</td>
<td>43</td>
<td>4.8</td>
</tr>
<tr>
<td>Age</td>
<td>40</td>
<td>19.3</td>
<td>1.6</td>
<td>43</td>
<td>19.4</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>(62.5)</td>
<td></td>
<td>25</td>
<td>58.1</td>
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<tr>
<td>Male</td>
<td>15</td>
<td>(37.5)</td>
<td></td>
<td>18</td>
<td>41.9</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>17</td>
<td>(42.5)</td>
<td></td>
<td>20</td>
<td>(46.5)</td>
</tr>
<tr>
<td>Black/African</td>
<td>16</td>
<td>(40.0)</td>
<td></td>
<td>10</td>
<td>(23.3)</td>
</tr>
<tr>
<td>Asian/Asian</td>
<td>1</td>
<td>(2.5)</td>
<td></td>
<td>4</td>
<td>(9.3)</td>
</tr>
<tr>
<td>Native American</td>
<td>0</td>
<td>(0.0)</td>
<td></td>
<td>1</td>
<td>(2.3)</td>
</tr>
<tr>
<td>Multi-racial</td>
<td>4</td>
<td>(10.0)</td>
<td></td>
<td>1</td>
<td>(2.3)</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>(2.5)</td>
<td></td>
<td>6</td>
<td>(14.0)</td>
</tr>
<tr>
<td>Decline to Answer</td>
<td>1</td>
<td>(2.5)</td>
<td></td>
<td>1</td>
<td>(2.3)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>4</td>
<td>(10.0)</td>
<td></td>
<td>9</td>
<td>(20.9)</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>36</td>
<td>(90.0)</td>
<td></td>
<td>34</td>
<td>(79.1)</td>
</tr>
<tr>
<td>Glasses</td>
<td>40</td>
<td>57.5</td>
<td></td>
<td>43</td>
<td>(65.1)</td>
</tr>
<tr>
<td>Tx history</td>
<td>39</td>
<td>15.0</td>
<td></td>
<td>43</td>
<td>(11.6)</td>
</tr>
</tbody>
</table>

Note. IUI-A = Intolerance of Uncertainty Inventory, part A; BIDR = Balanced Inventory of Desirable Responding; SDE = self-deceptive enhancement scale; IM = impression management scale; Glasses = individuals who wear glasses/contact lenses; Tx history = history of psychological treatment.
Descriptive statistics are reported for the total sample (Table 2) and by condition (Table 3). The median value for internal consistency was $\alpha = .88$. The PSWQ, OBQ-T, and IUI-A all had acceptable reliabilities, with Cronbach’s $\alpha$ at least .845. The current sample had similar means and ranges on the PSWQ, OBQ-T, and IUI-A to student samples in the extant literature. For example, Meyer et al. (1990) found PSWQ total sample means of 48.8-53.7 ($SDs = 12.7 – 14.2$); the current study found a total sample mean of 52.6. The BIDR scales evidenced relatively lower internal consistency; the BIDR-IM scale was below the typical estimates of internal consistency reported by Paulhus whereas the BIDR-SDE scale was on the lower end of published estimates (i.e., Paulhus reported estimates of .77-.85 and .67-.77, respectively; 1988).
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>
<th>α</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSWQ (15)</td>
<td>83</td>
<td>52.62</td>
<td>12.83</td>
<td>16 - 80</td>
<td>24 - 80</td>
<td>.92</td>
<td>.40</td>
</tr>
<tr>
<td>IUI-A Time 1 (15)</td>
<td>82</td>
<td>39.13</td>
<td>11.79</td>
<td>15 - 75</td>
<td>15 - 63</td>
<td>.91</td>
<td>.41</td>
</tr>
<tr>
<td>IUI-A Time 2 (15)</td>
<td>83</td>
<td>39.21</td>
<td>11.61</td>
<td>15 - 75</td>
<td>15 - 66</td>
<td>.92</td>
<td>.46</td>
</tr>
<tr>
<td>OBQ-87 (87)</td>
<td>83</td>
<td>265.00</td>
<td>73.07</td>
<td>87 - 609</td>
<td>99 - 448</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBQ-T (14)</td>
<td>81</td>
<td>39.25</td>
<td>13.40</td>
<td>14 - 119</td>
<td>14 - 72</td>
<td>.84</td>
<td>.28</td>
</tr>
<tr>
<td>BIDR-SDE c (20)</td>
<td>83</td>
<td>85.57</td>
<td>11.63</td>
<td>20 - 140</td>
<td>51 - 113</td>
<td>.65</td>
<td>.09</td>
</tr>
<tr>
<td>BIDR-SDE d (20)</td>
<td>83</td>
<td>5.45</td>
<td>3.44</td>
<td>0 - 20</td>
<td>0 - 14</td>
<td>.71</td>
<td>.11</td>
</tr>
<tr>
<td>BIDR-IM c (20)</td>
<td>83</td>
<td>76.19</td>
<td>14.53</td>
<td>20 - 140</td>
<td>34 - 112</td>
<td>.72</td>
<td>.11</td>
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<tr>
<td>BIDR-IM d (20)</td>
<td>83</td>
<td>5.31</td>
<td>9.06</td>
<td>0 - 20</td>
<td>0 - 13</td>
<td>.67</td>
<td>.08</td>
</tr>
<tr>
<td>Accuracy (%)</td>
<td>83</td>
<td>69.49</td>
<td>8.58</td>
<td>0 - 100</td>
<td>24 - 43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Checks</td>
<td>79</td>
<td>6.51</td>
<td>9.98</td>
<td>0 - 45</td>
<td>0 - 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response Time (s)</td>
<td>82</td>
<td>2.84</td>
<td>.86</td>
<td>1.2 - 5.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. PSWQ = Penn State Worry Questionnaire; IUI-A = Intolerance of Uncertainty Inventory, part A; OBQ = Obsessive Beliefs Questionnaire; OBQ-T = OBQ threat estimation subscale; BIDR = Balanced Inventory of Desirable Responding; SDE = self-deceptive enhancement scale; IM = impression management scale; c = continuous scoring; d = dichotomous scoring; AIC = average inter-item correlation.*
Table 3

Internal consistency and descriptive statistics (by condition)

<table>
<thead>
<tr>
<th>Scale (### of items)</th>
<th>High IU</th>
<th></th>
<th>Low IU</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>Range</td>
<td>α</td>
</tr>
<tr>
<td>PSWQ (15)</td>
<td>40</td>
<td>55.83</td>
<td>12.83</td>
<td>25 - 80</td>
<td>.92</td>
</tr>
<tr>
<td>IUI-A Time 1 (15)</td>
<td>39</td>
<td>41.57</td>
<td>12.35</td>
<td>25 - 61</td>
<td>.90</td>
</tr>
<tr>
<td>IUI-A Time 2 (15)</td>
<td>40</td>
<td>43.78</td>
<td>11.68</td>
<td>15 - 66</td>
<td>.92</td>
</tr>
<tr>
<td>OBQ-87 (87)</td>
<td>39</td>
<td>271.59</td>
<td>73.14</td>
<td>99 - 448</td>
<td>.92</td>
</tr>
<tr>
<td>OBQ-T (14)</td>
<td>39</td>
<td>40.94</td>
<td>14.67</td>
<td>14 - 72</td>
<td>.86</td>
</tr>
<tr>
<td>BIDR-SDE c (20)</td>
<td>40</td>
<td>85.69</td>
<td>11.69</td>
<td>51 - 113</td>
<td>.64</td>
</tr>
<tr>
<td>BIDR-SDE d (20)</td>
<td>40</td>
<td>5.42</td>
<td>3.71</td>
<td>0 - 14</td>
<td>.75</td>
</tr>
<tr>
<td>BIDR-IM c (20)</td>
<td>40</td>
<td>78.66</td>
<td>15.19</td>
<td>45 - 112</td>
<td>.74</td>
</tr>
<tr>
<td>BIDR-IM d (20)</td>
<td>40</td>
<td>5.76</td>
<td>3.44</td>
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<td>.75</td>
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<tr>
<td>Accuracy (%)</td>
<td>40</td>
<td>70.00</td>
<td>9.30</td>
<td>48 - 86</td>
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<tr>
<td>Total Checks</td>
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<td>5.70</td>
<td>9.98</td>
<td>0 - 45</td>
<td></td>
</tr>
<tr>
<td>Response Time(s)</td>
<td>40</td>
<td>2.70</td>
<td>.86</td>
<td>1.2 - 4.3</td>
<td></td>
</tr>
</tbody>
</table>

Note. PSWQ = Penn State Worry Questionnaire; IUI-A = Intolerance of Uncertainty Inventory, part A; OBQ = Obsessive Beliefs Questionnaire; OBQ-T = OBQ threat estimation subscale; BIDR = Balanced Inventory of Desirable Responding; SDE = self-deceptive enhancement scale; IM = impression management scale; c = continuous scoring; d = dichotomous scoring; AIC= average inter-item correlation.
Table 4 presents zero-order intercorrelations among the OBQ-87 subscales. All subscales were significantly ($p < .01$) intercorrelated, which is consistent with the published literature (OCCWG, 2003). It is notable that the intercorrelations among all of the OBQ-87 subscales were at or above .60, with three of the intercorrelations above .80, indicating that the constructs some of the scales are measuring may not be distinct. Because the OBQ-T and OBQ-IU were highly correlated ($r = .74$), it may be an indicator that the scales are not measuring well-differentiated beliefs, and therefore it becomes relatively more difficult to determine the unique contribution of each variable.
Table 4

Zero-order intercorrelations among OBQ-87 subscales in the total sample

<table>
<thead>
<tr>
<th>Subscale</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Threat Estimation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Perfectionism</td>
<td>.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Responsibility</td>
<td>.65</td>
<td>.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Importance of Thoughts</td>
<td>.79</td>
<td>.67</td>
<td>.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Control of Thoughts</td>
<td>.81</td>
<td>.63</td>
<td>.62</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>6. Intolerance of Uncertainty</td>
<td>.74</td>
<td>.66</td>
<td>.63</td>
<td>.66</td>
<td>.81</td>
</tr>
</tbody>
</table>

Note. N = 81; All values are significant at p < .01.
Primary Analyses

A paired samples $t$ test was conducted to examine condition scores on the IUI-A from baseline to post-manipulation. Results indicated that there were no significant changes from pre to posttest in the high IU condition ($t_{(38)} = -1.13, p = .26$), but the direction of the effect was as predicted (i.e., IU scores increased). Significant reductions in IU were found in the low IU condition ($t_{(42)} = 2.49, p = .01$). An independent samples $t$ test revealed a significant effect of condition on IUI-A time 2 scores ($t_{(80)} = 3.711, p < .001, d = .80$), but not IUI-A time 1 scores ($t_{(80)} = 1.91, p = .06, d = .42$). Overall, IU was significantly altered, but only for the low condition. The combination of condition IU differences at Time 1 in addition to reductions in IU for the low condition may be driving the significant post-manipulation Time 2 results. These results indicate that the manipulation was only partially successful. When participants who did not believe the manipulation (i.e. those individuals scoring a 3 or lower on the manipulation check) were retained in the analysis, no significant changes were found from baseline to post-manipulation in the high condition ($t_{(70)} = .178, p = .86$) or low condition ($t_{(48)} = .425, p = .67$), nor were there any differences between conditions on IUI-A time 1 scores ($t_{(118)} = 1.26, p = .21, d = .23$) or IUI-A Time 2 scores ($t_{(118)} = 1.38, p = .17, d = .25$).

To test the first hypothesis, an independent samples $t$ test was conducted between the high and low conditions on the number of checks variables. Participants did not evidence significantly different checking behavior ($t_{(77)} = -.728, p = .46$). With the outliers retained, the results were similarly non-significant ($t_{(80)} = -.40, p = .69$). These results do not support Hypothesis 1, which proposed that participants in the high IU condition would check more than participants in the low IU condition.
Participants did not spend longer making a choice on the checking task whether they were in the high or low IU condition \( (t_{80}) = -1.51, p = .14 \). This does not support Hypothesis 2, which proposed that participants in the high IU condition would display greater response times than participants in the low IU condition.

Participants in the high IU condition did not differ significantly from participants in the low IU condition in terms of accuracy \( (t_{80}) = .601, p = .55 \). These results support Hypothesis 3, that there would be no differences in accuracy between conditions.

The high and low IU conditions did not differ significantly on OBQ-T scores \( (t_{81}) = 1.08, p = .283 \). These results do not support Hypothesis 4, which proposed that participants in the high IU condition would display greater levels of threat estimation than participants in the low IU condition.

Participants differed significantly in their worry scores \( (t_{81}) = 2.25, p = .027 \). Participants in the high IU condition had higher worry scores \( M = 55.83, SD = 12.83 \) than participants manipulated to endorse lower levels of IU \( M = 49.63, SD = 12.23 \). These results offer support for Hypothesis 5.
CHAPTER 5
DISCUSSION

The primary goal of this study was to examine the effects of IU on threat estimation, worry, and checking behavior to further clarify its relationship with OCD. In essence, this study sought to examine the effects of experimentally manipulated IU on checking behavior in a student sample. Although IU has been conceptualized as a contributing factor in OCD, there is a dearth of experimental research available and the research that does exist is almost entirely in the context of GAD. Additionally, there is mixed experimental evidence linking IU to checking behavior and threat estimation.

The current results suggest that IU was partially manipulated using a false feedback experimental paradigm. Results indicated that the majority of participants believed false feedback about their level of IU based on an altered questionnaire and that IU scores in the high condition ($M = 43.7$) were significantly higher than the low condition ($M = 35.6$). These results replicate previous studies utilizing this manipulation that found significant condition differences on a measure of IU following the manipulation (i.e., Bailey, Fergus, & Wu, 2013; Rosen & Knäuper, 2009). In particular, the IU manipulation significantly decreased IU in the low condition, although it did not significantly increase IU in the high condition. Condition differences in baseline IU (although non-significantly different) appear to have contributed to post-manipulation IU differences. Although the false feedback, rated on a 7-point scale, was considered “similarly characteristic” of participants in the high condition ($M = 5.33$, $SD = 1.09$)
and the low condition \((M = 5.51, SD = 1.03)\), it may be that the high IU manipulation was not manipulating IU as effectively or in the same way as was the low IU condition, especially given the number of participants who did not believe the feedback in the high condition. This pattern of findings is inconsistent with previous studies utilizing this manipulation, in which IU scores were significantly increased and decreased for the respective IU conditions.

Additionally, this study extended previous research by examining the effects of manipulated IU on a delayed matching-to-sample task designed to measure analog checking behavior. Whereas a number of studies have used behavioral checking measures, such as noting errors in a math-based text (MacDonald & Davey, 2005), or using virtual reality to check a stove (e.g., Kim et al., 2009; van den Hout & Kindt, 2003), the current task was selected as a low-cost, believable, and easily implemented measure for a college student population.

The primary aim of this study was to determine the effect of IU on checking behavior. Contrary to Hypothesis 1, the manipulation did not have a significant effect on amount of checking completed. That is, participants performed a similar number of checks during the checking task regardless of their level of IU. One possible explanation for this finding is that the IU manipulation did not provide a strong enough “dose” to elicit significant alterations in checking behavior. The range of number of checks for 50 trials was large (0-45), but the modal number of checks was 0, which could be an indication of participant apathy. Additionally, the mean number of checks in the current sample \((M = 6.5)\) was far below that of the Rotge et al. (2008) sample of OC checkers \((M = 14.75)\). Although this checking task was successful at distinguishing OC checkers from OC non-checkers in a clinical sample, the current IU manipulation may not have been powerful enough to elicit significantly different checking behavior in a student sample, in which the majority of individuals do not display high levels of
OC cognitive vulnerabilities. The OBQ-44 scores in this sample ($M = 140.0, SD = 37.4$) were consistent with other student samples, but below that of a clinical sample ($M = 164.3, SD = 50.2$; OCCWG, 2003), which may have resulted in less checking on the checking task.

Similarly, and contrary to Hypothesis 2, participants did not differ as to time spent on the checking task. That is, participants spent a similar amount of time deciding whether the second picture matched the first picture regardless of their IU level. As noted above, this lack of difference could be due to the IU manipulation not providing enough “dose” to have a meaningful impact on behavior. It also could indicate that individuals with checking compulsions do not differ from the general population with regard to the amount of time spent to make a check, but rather spend more time on a task overall due to the sheer number of verifications they make. For example, it may take an individual with OCD the same amount of time as an individual without OCD to verify that a door is locked; however, the individual with OCD may spend more time overall due to making more checks. A final possibility is that only clinical levels of checking behavior elicit greater response time. In Rotge et al. (2008), individuals with checking OCD differed significantly from non-anxious controls on response time during the checking task, regardless of number of checks completed. In the current student sample, it is possible that subclinical levels of checking behavior may not have elicited greater response time.

Hypothesis 3, which predicted that participants would not differ significantly with regard to the number of items they correctly matched, was corroborated by the data. Although memory deficits have been theorized to play a role in compulsive checking (Sher, Frost, & Otto, 1983) the current finding supports more recent literature that memory or task accuracy is not reduced in individuals with higher IU. It may be that meta-memory, rather than actual memory capacity, is
distorted in individuals with OCD (e.g., Radomsky, Dugas, Alcolado, & Lavoie, 2014). That is, checking behavior may be a result of distorted perceptions of one’s view of his or her memory capacity. An evaluation of meta-memory was not included in this study, but it is possible that individuals in the high IU condition may have endorsed lower memory capacity than individuals in the low IU condition, despite similar accuracy scores. Future studies may wish to examine this hypothesis.

The second aim of this study was to determine the effect of experimentally manipulated IU on threat estimation. However, Hypothesis 4, that threat estimation would be significantly different between conditions following the IU manipulation, was not supported. This result could be due to several factors. First, as noted, when this study was designed there were no known measures of state threat estimation. Therefore, the OBQ-87 threat estimation subscale was used despite being a trait measure (i.e., the instructions read, “To decide whether a given statement is typical of your way of looking at things, simply keep in mind what you are like most of the time.”). Had a state measure been available or state instructions used, participants may have been more likely to endorse greater levels of threat estimation in response to the manipulation. Additionally, the OBQ-T and IU subscales were highly correlated in the present study ($r = .74$), indicating that the constructs being measured may not be distinct. Although the intercorrelation in the current study is below that of the OCCWG’s (2003; $r = .85$), it displays a high level of overlap across these dimensions. The IU manipulation, not developed in the context of OCD, may not have affected scores on the OBQ subscales in the predicted direction, particularly if IU as it is conceptualized in the OCD literature was not being adequately manipulated. The OBQ-T, rather than the OBQ-44 RT, was included in this study as a way to examine the specific content of threat estimation on specific OC symptoms (i.e., checking) without the influence of
responsibility, but the use of this subscale may have come at the cost of reduced validity. When participants who did not check were removed from analysis, condition significantly predicted threat estimation (i.e., individuals in the high condition endorsed higher levels of threat estimation, $t_{(57)} = 2.51, p = .01$) but no other variables. Participants who checked on the checking task were more likely to endorse higher threat estimation in the high condition and lower threat estimation in the low condition, consistent with Hypothesis 4.

The final aim of the study was to determine if IU is associated with worry. This study sought to examine whether conditions would differ on worry scores as a result of their IU levels (Hypothesis 5). The results corroborate both correlational and experimental literature that IU and worry are closely related and support cognitive-behavioral models of IU as an essential component of worry (Dugas et al., 1998). Specifically, the high IU condition endorsed significantly greater levels of worry than the low IU condition. In addition, in this study PSWQ scores were significantly correlated with IUI-A time 2 scores ($r = .55, p < .001$), further supporting the association between the two constructs. The inclusion of a measure of worry in this study primarily was for the purpose of assessing IU as a construct. That is, because this study found that individuals with higher levels of IU have higher worry scores, it is one indication that this study manipulated a similar construct that is being examined in the GAD literature, and adds support to the theory that IU causes worry. However, it is important to note that worry only was assessed at one time point in this study. To further support the theory that IU leads to worry, future studies should assess worry at multiple time points to evaluate change over time as a result of changes in IU.
Limitations and Future Directions

The current study replicated and extended the OC literature by providing information about the use of a modified questionnaire to manipulate dysfunctional beliefs, the use of a computerized checking task to measure checking behavior, and the relationship between IU and checking, worry, and threat estimation. However, this study is not without limitations. Unfortunately, it appears that the experimental manipulation was only partially successful; IU was significantly reduced for the low condition but was not significantly increased in the high condition. As such, it may be possible that the manipulation was not in fact altering IU or not altering it as intended. It is possible, for example, that beliefs about IU may have been manipulated, rather than IU itself. This may be particularly true for the high IU condition, which did not evidence significant changes in pre to post IUI-A scores and in which a large number of participants did not believe the feedback. The possibility that the feedback may not have been wholly consistent with OCCWG’s (1997) definition of IU also should be considered. For example, in the high condition, participants read about unfairness (“You feel that being uncertain is unfair and can lead to the inability to take action”) when that is not one of the core features of OCCWG’s three-part definition. Because the manipulation was not developed in the context of OCD, it may not have effectively manipulated an OC-relevant belief in the current study. Further, some items on the IUI-A may have been confusing for some participants (e.g. “I do not really tolerate situations in which I do not know what is going to happen”), which may have skewed some of the results.

Moreover, although conditions differed significantly on IUI-A time 2 scores, there were no significant differences on OBQ-87 IU scores ($t_{(81)} = 1.59, p > .05$) which suggests that the IU
manipulation altered beliefs about the unacceptability of uncertainty more than beliefs about one’s coping abilities or ability to function in ambiguous situations. It is unsurprising then, that threat estimation was not affected by the IU manipulation, given the high correlation with OBQ-87 IU subscale. If the IU constructs are defined somewhat differently in the respective contexts of OCD and GAD, then OC-relevant outcomes may not have been affected by a GAD-influenced manipulation. The primary GAD-relevant outcome assessed in this study—worry—was significantly different between conditions. Future research may consider altering the current manipulation to encompass beliefs about the inability to cope in the face of unpredictable change or inadequate functioning when confronted with ambiguity. Further, it may be important to reconcile the disparate definitions in the OCD and GAD literatures to help ease non-specificity in future studies.

It is possible—in fact, likely—that other factors play a role in checking behavior other than IU. For example, uncomfortable sensations of things being not quite right (Not Just Right Experiences, NJRE; Coles et al., 2003) may drive an individual to check until the sensation is gone. NJRE have been correlated with checking behavior in a student sample (Coles et al., 2003). It is possible that for some individuals, checking does not occur because of a fear of harm, but rather to increase feelings that everything is where it should be; instead of reducing feelings of doubt, checking behavior may be a result of feelings of incompleteness. However, it has been suggested that attitudes about NJRE, rather than NJRE themselves, lead to greater levels of checking behavior (Fergus, 2014). For example, research has found that although the majority of students endorse having experienced NJRE in the past month, they do not tend to find NJRE distressing (Coles et al., 2003). Beliefs about need for certainty or perfectionism may be the driving factors in the relationship between NJRE and the onset of compulsive behavior. By
reducing IU, it may be possible to decrease distress of NJRE and, in turn, diminish checking behavior. Further, like IU, NJRE are strongly correlated with worry and other symptoms of GAD (Fergus, 2014). Future studies may wish to develop more complex models to assess how the presence of IU and NJRE may lead to the manifestation of specific disorders such as OCD and GAD.

It also is important to note that none of the available studies that have employed this IU manipulation used the same measure of IU. For example, the current study measured IU with the IUI-A; Bailey, Fergus, and Wu (2013) measured IU with the OBQ-87; and Rosen and Knäuper (2009) used an unaltered version of the IUS (the manipulation questionnaire) to assess IU scores following the manipulation. For the purposes of this study, a state measure of IU may have more accurately measured the effects of the manipulation. However, nearly all known measures examine IU as a trait-like, trans-situational concept. Future studies may wish to conceptualize IU as more state-like or situation-specific variable, particularly for student samples that may evidence range restriction on the current trait measures.

In this study, the estimates of internal consistency for the BIDR were lower than expected, given previous estimates of these scales (e.g., Paulhus, 1988). The range of scores for the BIDR scales in the current sample (0-15) demonstrated a relative floor effect and may indicate that participants were less likely to endorse certain items. Moreover, in the low condition, none of the participants endorsed the item (“I never swear”) as “very true,” leading all responses on that item to be coded as “0” and removed from the reliability analysis due to zero item variance. The scoring system used by the BIDR also may have contributed to inconsistency in this sample. By dichotomizing all responses “5” and below into 0s and all responses “6” and above into 1s, some of the variance of the item responses was removed, which may have
contributed to negative item correlations. It is notable that although Paulhus (1988) recommended that dichotomous scoring be used, others have argued that the continuous scoring procedure provides a better estimate of socially desirable responding because: (1) socially desirable responding may not be an “all or nothing” process, (2) it captures individuals who may not endorse extreme ends of the scale but have a tendency toward desirable responding, and (3) dichotomous scoring may lead to a loss of information, thereby reducing reliability and validity (Stöber, Dette, & Musch, 2002). When continuous scoring was used, the BIDR-IM scale displayed higher reliability ($\alpha = .72$) whereas the BIDR-SDE displayed slightly lower reliability ($\alpha = .65$). The BIDR-IM scale in particular evidenced very low inter-item correlations, indicating that it likely was not measuring a unidimensional construct. This scale appears to be influenced by certain items that may not be applicable to a college student population (e.g., the item “I always declare everything at customs” was negatively correlated with the other items). The continuous scoring procedure was implemented as a potential resolution for some of the scoring concerns; however, in the total sample internal consistency improved only for the IM scale. In the current study, the BIDR appeared to provide a poor estimate of socially desirable responding and may not have been measuring what it was intended to measure.

Another study limitation is the lack of a clinical sample. Although student samples can provide useful information when examining preliminary hypotheses regarding psychological symptoms, they are limited in several ways. For example, it is unlikely that they were motivated to complete the checking task as would a clinical sample. The effort level of each participant during the computerized checking task was not measured, and the length of the study (1.5 hours) may have increased fatigue toward the end when participating in the checking task, thereby reducing overall engagement in the study in an effort to finish sooner. Finally, several unforeseen
environmental factors (e.g., drilling noises, power outages during data collection) may have reduced some participants’ ability to concentrate on the checking task.

Relatedly, several procedural decisions regarding the IU manipulation may have affected the outcome of the study. During the IU manipulation, participants were asked to first read a paragraph about IU research, after which they completed the modified questionnaire and then read a paragraph about their results. It is impossible to know if participants read or understood the false-feedback they received. In an effort to replicate Rosen and Knäuper’s (2009) manipulation as closely as possible, fake references were included in both the informational and feedback IU paragraphs. However, the inclusion of these fake references may have confused participants, taking their attention away from the actual content of the paragraph. In addition, for many students in introductory psychology, it is their first or second semester in college. The informational items may have been at a reading level too high for this sample; an analysis of the text using the Flesch-Kincaid readability test formula (Kincaid, Fishburne, Rogers, & Chissom, 1975) resulted in a reading ease score of 34.6 (“difficult to read”) and a grade level score of 13.2. Though the reading levels of NIU’s incoming freshman may be at or above this threshold, a less difficult text may have mitigated some of these concerns, especially in the context of research participation when attention may be low. Finally, it also should be noted that both the high and low false-feedback items were included on the same page, and it was the participants’ responsibility to read the correct one. Although participants indicated in writing which paragraph they read, it is possible that some may have read the wrong paragraph, or read both, thereby reducing some of the potency of the task.

Although the current study used a low-cost and easy-to-implement task to measure checking behavior, the task (as stimuli themselves) may have affected the current outcomes. For
example, the images used in the Rotge et al. (2008) study were inconsistent in terms of complexity, and some images may have been easier for participants to correctly identify, thereby negating the need for many checks. Rotge et al. (2008) updated the task in a 2013 study by utilizing checkerboards. However, the checkerboards, consisting of 100 squares with one square misplaced in the non-matching sets, appeared to be extremely difficult to use in a delayed matching-to-sample paradigm; the decision to not use the updated stimuli was based on the concern that doing so may have increased frustration and boredom in the current student sample. Related, there was no tangible consequence for not checking during the task. Although participants were given feedback about whether they had answered correctly, their overall accuracy on the task had no bearing on whether they would obtain course credit. Perhaps the lack of importance involved in this task incited participants to check less than they would with a task they deemed more meaningful. Checking tasks tend to be more successful when tasks are meaningful or when there are consequences for failure to check (Radomsky & Alcolado, 2010); although this is inherently difficult to achieve, future studies may aim to incorporate meaningful incentives or genuine consequences within checking tasks.

Another procedural decision that may have affected findings was the inclusion of 60 trials in the computerized checking task. In the current study, 60 trials were used for several reasons; the first ten trials were considered “practice trials” where participants learned to use the computer program (and thus these trials were removed from analysis), and more trials lessened the impact of the non-uniformity of the image complexity. Although the previous studies employed the same number of trials during the task (e.g., Lambrecq et al., 2014; Rotge et al., 2008), these studies also used clinical samples that may have been more highly motivated to perform well on the task. For the current student sample, the checking task length averaged 22.5
minutes (range = 17.8-66.0 minutes). The number of trials may have increased fatigue and frustration, thereby confounding the effects of the IU manipulation. Future studies may wish to assess the possibility of gaining an accurate assessment of checking with fewer trials.

Limitations notwithstanding, the current study provides a basis upon which future research can build. Future studies could examine other individual difference variables, such as perfectionism or NJRE, to determine if they have an influence on checking behavior. Additionally, future studies could streamline the IU manipulation and checking task to reduce the potential for participant fatigue or confusion. For example, the information about IU and subsequent feedback could be read aloud to participants to ensure contact with the material as well as offer the potential to clarify any questions. Alternatively, vignettes about IU—similar to those used in Kelly (2009)—may provide a more powerful “dose” of IU than the current manipulation and should be considered. The current study used a low-responsibility task that may not have had a significant effect on participant behavior. Future studies may consider taking steps to make checking tasks more meaningful for participants or providing an incentive for increased checking behaviors (e.g. being entered into a raffle for getting a certain number of items correct). As a preliminary experiment examining the causal effects of IU on checking behavior, the current study incorporated relatively few outcome variables. Future studies may wish to consider more complex models. For example, it may be that inflated responsibility leads to checking compulsions, but only through IU. A study utilizing a similar student sample found that IU, as measured by the OBQ-87, mediated the relationship between perfectionism and checking symptoms as measured by the Schedule of Compulsions, Obsession, and Pathological Impulses ([SCOP]) Watson & Wu, 2005; Faleer, Bailey, Rogers, & Wu, 2014). That study focused on questionnaire data, but it suggests that interactions between dysfunctional beliefs may
be likely paths from beliefs to compulsions. Another avenue for investigation may be to assess whether IU is causally linked to other OC compulsions, such as cleaning or ordering. Finally, for the multiple reasons noted, future studies would benefit from utilizing a clinical sample.

Conclusions

Although further research on IU in a clinical sample is needed, the current study examined the relationship between a cognitive vulnerability factor and behavioral outcomes. Currently, the majority of research on IU is correlational and the current experimental procedure improves upon existing research designs and answers the call for more investigations into IU as a causal risk factor for specific anxiety disorders and OCD. Although the hypotheses regarding checking behaviors and IU were not supported, the current study provides a foundation for future studies seeking to experimentally manipulate cognitive vulnerabilities or assess compulsions through behavioral measures.
REFERENCES


Costa and McCray, 1992


APPENDIX A

CONSENT FORM
INFORMED CONSENT FORM

I agree to participate in the research project titled “Picture Perception” being conducted by Hannah Faleer, a graduate student at Northern Illinois University (NIU). I have been informed that the purpose of this study is to learn about how students perceive images on the computer.

I understand that if I agree to participate in this study, I first will be asked to complete questionnaires related to demographics, and thoughts and feelings I may have experienced. Next I will be asked to complete a computerized task, which will require my full effort and concentration. In total, this study will require approximately 90 minutes of my time.

I have been informed that potential risks and/or discomforts I could experience during this study include finding some of the questionnaire items to ask about sensitive information. Additionally, I may experience momentary distress or discomfort during the assessments or behavioral tasks. Feedback regarding my performance on the computerized task may also cause minor distress. As such, although I am encouraged to answer all questions and participate to the best of my ability in each part of the study, I may omit any questions that I do not wish to answer, decline to complete any task, and/or discontinue participation at any time.

I understand that all information gathered during this study will be kept confidential and that my name or personal identifier will not appear on any of the data forms. After PSYC 102 credit has been assigned, all information that could identify me will be removed from the data. I have been informed that any subsequent presentations or publications that include these data will report only group-level data.

I understand that there may be no direct benefit to me for participating in this study. Its main purpose is research. I am aware that my participation in this study is voluntary and may be withdrawn at any time without penalty, and that if I have additional questions concerning this study, Hannah Faleer (630-621-6071) or her research advisor, Dr. Kevin Wu (815-753-1605). I also understand that if I wish to learn about one’s rights as a research participant, I may contact the NIU Office of Research Compliance at 815-753-8588.

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 will receive a copy of this consent form should I request one.

_____________________________  ________________________
Signature                           Date

_____________________________
Printed Name
APPENDIX B

DEMOGRAPHICS QUESTIONNAIRE
1. What is your sex?
   a. Male
   b. Female

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. Do you wear glasses or contact lenses to correct your vision?
   a. Yes
   b. No

6. Do you have 20/20 vision?
   a. Yes, I do not need glasses/contact lenses
   b. Yes, when I am wearing glasses/contact lenses
   b. No
   c. Other (please explain)

7. Are you wearing glasses/contact lenses right now?
   a. Yes
   b. No, I have them but am not currently wearing them
   c. No, I do not need glasses/contact lenses

8. Have you ever been treated by a psychologist or psychiatrist for an emotional problem?
   a. Yes
   b. No
   c. Prefer not to answer

9. Are you currently in psychological or psychiatric treatment?
   a. Yes
   b. No
   c. Prefer not to answer
APPENDIX C

DEBRIEFING FORM
Thank you for participating in our study entitled Picture Perception. You were told that the study involved the perception of pictures on the computer. That was true, but we also wanted to know whether students would perform differently under different circumstances. Specifically, we wondered whether students who were told they were highly intolerant of uncertain situations would work on the task differently. For example, would they check the pictures during the computerized task more frequently? For this study, the feedback you received about your tolerance for uncertainty may not have been accurate. That is, it was based on a predetermined script. A model of obsessive-compulsive disorder (OCD) suggests that people who are extremely uncomfortable with uncertain situations will perform “compulsive” checking behaviors because the unknown situation makes them feel anxious and question themselves. This study used a computerized matching task to determine whether people who felt greater discomfort would check more than people who felt less discomfort. We also collected information from you about your personal characteristics, such as your level of worry and estimation of threat, 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 the questions we asked about “preferring things to be certain” but it is only when those preferences are (1) very strong and (2) 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 at 630-621-6071 or hfaleer1@niu.edu, or Dr. Kevin Wu at 815-753-1605 or kevinwu@niu.edu. Please do not discuss your experiences in this study since we are planning to continue data collection during Fall 2014. Too much knowledge about the study will spoil the experience for subsequent students in your class!