Standard of proof and intolerance of uncertainty in obsessive-compulsive disorder and social anxiety disorder

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ABSTRACT

Background and objectives: Researchers have identified intolerance of uncertainty (IU) as a dysfunctional thought that contributes to OCD. Case examples of OCD suggest that uncertainty and anxiety persist despite low likelihoods of feared outcomes. In this study we examined how people with OCD react to minimal amounts of uncertainty relative to non-anxious individuals and a clinical comparison group of people with social anxiety disorder (SAD).
Methods: We created a questionnaire to measure the distress people feel when there is only minimal uncertainty regarding a given outcome and if they prefer situations with the certainty of negative outcomes in the present versus living with uncertainty. Part two of our study tested whether IU is related to performance on neutral and idiographic versions of the Beads Task.
Results: OCD and SAD subjects reacted to hypothetical scenarios involving minimal risk with greater negative affect than did non-anxious subjects; however, after repeating analyses to account for comorbid disorders, OCD subjects' scores did not differ from those of non-anxious subjects. Only SAD subjects showed a preference for negative information in the present versus the uncertainty of a future outcome. Part two of our study revealed that self-reported IU was only marginally associated with performance on the neutral Beads Task.
Limitations: High rates of comorbidity made it difficult to identify the specific relationship of IU with other anxiety disorders.
Conclusions: IU for general, non-OCD specific scenarios may not figure prominently in all individuals with OCD, but rather may play a larger, more consistent role in anxiety disorders such as SAD. Additionally, the number of beads or words viewed on Beads Task may be an inadequate behavioral measure of IU.

1. Introduction

Cognitive-behavioral theories of psychopathology underscore the importance of dysfunctional thoughts (Beck, 2005), including intolerance of uncertainty (IU; Starcevic & Berle, 2006). Researchers have defined IU in several ways (for a review, see Carleton, 2012), but a recent review by Carleton (2016) provides a contemporary definition of IU as "an individual's dispositional incapacity to endure the aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty" (Carleton, 2016, p. 31). Initially identified as an important etiological factor in generalized anxiety disorder (GAD), IU has since been shown to be a transdiagnostic factor in other anxiety disorders (e.g., panic disorder and social phobia), obsessive-compulsive disorder (OCD), and depression (Carleton et al., 2012; McEvoy & Mahoney, 2012). Post-treatment reductions in IU are associated with symptom improvement and decreases in anxiety and fear (Talkovsky & Norton, 2016) and repetitive negative thinking (McEvoy & Erceg-Hurn, 2016) across a number of anxiety disorders. Indeed, a meta-analysis by Hong and Cheung (2015) indicated that IU is strongly associated with other cognitive vulnerabilities that, together, load onto a single latent factor that may be a shared etiological factor for depression and anxiety. Interestingly, IU was the cognitive vulnerability with the strongest factor-loading in the model. Taken together, these findings underscore the importance of clarifying the role of IU both transdiagnostically and within specific disorders (Shihata, McEvoy, Mullan, & Carleton, 2016).

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In light of both research efforts and clinical observations about the relevance of IU in mental disorders, researchers have identified IU (and perfectionism) as one of three domains of dysfunctional thinking (along with overestimation of threat/increased responsibility and significance of/need to control thoughts) contributing to the phenomenology of OCD (Hezel & McNally, 2015; OCCWG, 2005). Studies indicate that self-reported IU is associated with OCD symptoms in analogue and clinical samples. Specifically, Holaway, Heimberg, and Coles (2006) discovered similarly elevated levels of IU in people with symptoms of either GAD or OCD, and Sarawgi, Oglesby, and Cougle (2013) found that IU scores predicted unselected subjects' performance on *in vivo* tasks relevant to OCD concerns. Moreover, Steketee, Frost, and Cohen (1998) showed that people with OCD possess lower tolerance for uncertainty relative to healthy or anxious people, and that, compared to other cognitive biases, IU most strongly predicts OCD symptoms. Indeed, a low tolerance for uncertainty may motivate individuals with OCD to engage in compulsions in an attempt to decrease their doubt about a situation (Tolin, Abramowitz, Brigidi, & Foa, 2003).

Many individuals with OCD fear outcomes that are impossible, such as contracting cancer from a doorknob. Individuals with good insight often concede the improbability of such outcomes but continue to obsess about and engage in compulsions to prevent them "just in case". Though cognitive therapy for OCD challenges dysfunctional beliefs by having the patient calculate more realistic likelihoods of such outcomes (van Oppen & Arntz, 1994), simply providing people with evidence that something is implausible seldom eliminates symptoms. Hence, uncertainty and anxiety persist despite the low (or zero) likelihood of implausible negative outcomes. In the current study, we attempted to clarify this phenomenon and related aspects of IU in OCD relative to a clinical comparison group of people with social anxiety disorder (SAD) and to non-anxious individuals. We chose SAD as a comparison group given that it shares some characteristics with OCD (e.g., excessive anxiety, fear of negative outcomes, presence of avoidance behaviors, etc.) while differing in other important ways (e.g., limited scope of anxiety, ego-syntonic nature of thoughts, etc.).

To examine IU, we created a questionnaire consisting of several parts. Part one assesses standard of proof, or the level of distress a person feels when there is even minimal uncertainty (i.e., 1%) associated with a given outcome. We also examined whether individuals with OCD may possess a general bias whereby they prefer immediate negative outcomes rather than living with uncertainty, despite the feasibility of a positive outcome, as observed in people with GAD (Newman & Llera, 2011). To our knowledge, however, there is no measure of this phenomenon. Therefore, the second part of the questionnaire assesses the preference for immediate certainty of negative outcomes versus persistent uncertainty of negative *or positive* future outcomes. The inclusion of positive scenarios allowed us to determine whether IU generalizes to information about positive outcomes or is confined to information about negative ones. We predicted that relative to non-anxious individuals, subjects with OCD would experience greater distress when faced with even negligible uncertainty, would prefer the certainty of a negative outcome over any uncertainty, and would be more intolerant of uncertainty about both negative and positive outcomes.

As critics have noted, much research on IU in OCD has been based on self-report measures: the Intolerance of Uncertainty Scale (Buhr & Dugas, 2002), the Intolerance of Uncertainty Scale Short Form (Carleton, Norton, & Asmundson, 2007) and the perfectionism/certainty subscale of the Obsessional Beliefs Questionnaire (OCCWG, 2005). Attempting to measure IU behaviorally, researchers have examined the relationship between self-reported IU and performance on various measures (Shihata et al., 2016), including a typing speed task (Thibodeau, Carleton, Gomez-Perez, & Asmundson, 2013), a gambling task in which people have to choose between immediate small, improbable rewards or delayed large, probable rewards (Luhmann, Ishida, & Hajcak, 2011), and the Beads Task (Jacoby, Abramowitz, Buck, &

Fabricant, 2014; Ladouceur, Talbot, & Dugas, 1997). The Beads Task (Dudley, John, Young, & Over, 1997; Phillips & Ward, 1966) assesses probabilistic reasoning by prompting subjects to indicate whether different colored beads are drawn from a jar with predominantly blue or green beads. Subjects request that further beads be drawn until they feel sufficiently confident that the jar contains predominantly blue/green beads. The number of beads drawn is the primary dependent variable tapping desire for certainty. Subjects then rate their confidence in their decision. Ladouceur et al. (1997) found that self-reported IU was significantly correlated with the number of beads subjects viewed when presented with low but not high levels of ambiguity. Subsequently, Jacoby et al. (2014) found no differences in the number of beads that people with and without anxiety disorders requested to see, and there were no group differences in confidence about their answers or in the time taken to decide. However, these studies lacked a decision-making task with idiographic stimuli. Because the personal relevance of stimuli can influence performance on cognitive tasks (e.g., Radomsky & Rachman, 2004), we tested whether IU was related to performance on two versions of the Beads Task.

We asked subjects to complete a neutral version of the Beads Task with beads and a personally relevant version with positive and negative self-referent words provided by each subject. In the latter, subjects viewed idiographic positive and negative words, and chose the hypothetical survey (mostly positive or negative) from which the words were taken. We predicted that relative to non-anxious and SAD individuals, those with OCD would request to see more words, have lower confidence in their answers, and take a longer time to complete the personally relevant, but not neutral, version of the task. We predicted that the personal relevance of the self-referent words would increase the emotional salience of the task, thereby affecting how much information people with OCD would want before making a decision. Conversely, given their propensity to expect negative evaluation and to make more exaggerated valuations of what others are thinking (Hezel & McNally, 2014), we expected that the SAD group would make decisions based on fewer self-referent words than would the other two groups. We did not expect to find group differences on the neutral version of the task.

2. Material and methods

2.1. Subjects

We recruited three groups to complete the study, including people meeting criteria for OCD (*n* = 41, 26 female sex, 63%), social anxiety disorder, but not OCD (SAD; *n* = 40, 22 female sex, 55%), and no history of anxiety disorders or OCD (*n* = 42, 15 female sex, 36%) for a total of 123 adults (mean age = 31.6 years, *SD* = 13.8). Individuals with comorbid disorders were eligible to participate in the study. Several OCD subjects also had a diagnosis of SAD, but no individuals in the SAD group had a diagnosis of OCD. Consequently, the only diagnostic difference between the groups was presence of OCD, which allowed us to test whether any group differences were specifically attributable to OCD symptoms. All group assignments were based on a prescreening phone call followed by a comprehensive in-person assessment with a semi-structured clinical interview. Subjects were recruited in-person at outpatient and residential OCD treatment programs; with ads at local clinics; and via university job boards and study pools available to students and community members in the Boston metropolitan area. Individuals were compensated $10/hour for their participation or, for some students, with study pool credit.

2.2. Materials and procedures

The MINI International Neuropsychiatric Interview (version 6.0) is a semi-structured clinical interview (Sheehan et al., 1998) and the clinician-rated Yale-Brown Obsessive-Compulsive Scale (YBOCS) and

symptom-checklist catalogues specific symptoms and provides a severity rating for present symptoms (Goodman et al., 1989b). Scores on the measure range from zero to 40, with scores of 16 or higher indicating clinically significant OCD (Tolin, Abramowitz, & Diefenbach, 2005). The YBOCS has strong psychometric properties and is sensitive to symptom change (Goodman et al., 1989a; Goodman et al., 1989b).

The Obsessional Beliefs Questionnaire (OBQ-44) is a self-report survey that asks respondents to rate how much they agree or disagree with statements about beliefs that figure in the cognitive theory of OCD (OCCWG, 2001, 2003, 2005). The measure yields one total score and three subscale scores, each representing a domain of dysfunctional thinking, including intolerance of uncertainty and perfectionism. The OBQ-44 is a valid and reliable measure with both unselected and clinical samples (OCCWG, 2005). The internal consistency in our sample was α = 0.97.

The Liebowitz Social Anxiety Scale (LSAS) is a self-report measure of social anxiety symptoms (Liebowitz, 1987). By evaluating a person's fear and avoidance of a range of social activities, the LSAS yields a total score ranging from zero to 144, with 30 representing clinical levels of social anxiety (Mennin et al., 2002; Rytwinski et al., 2009). It has strong internal consistency, and convergent and divergent validity (Fresco et al., 2001). The internal consistency in our sample was excellent at α = 0.98.

Depressive symptoms were measured with the Center for Epidemiologic Studies Depression Scale Revised (CESD-R; Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). It consists of 20 questions assessing the presence and severity of depressive symptoms over the past week, and a score of 16 (out of a maximum of 60) is the suggested clinical cutoff for depression. Shown to have strong psychometric properties (Radloff, 1977), the scale's internal consistency in our sample was α = 0.95.

The Intolerance of Uncertainty Scale – Short Form (IUS-12) is a 12-item measure assessing the extent to which people fear and avoid uncertainty (Carleton et al., 2007). The scale yields a total score (ranging from 12 to 60), with high scores indicating high IU (McEvoy & Mahoney, 2011, 2012). Research supports the validity of the measure's two subscale scores, including prospective IU (uncertainty about the future) and inhibitory IU (inaction when faced with uncertainty (Hong & Lee, 2015). High scores indicate high IU. Both the total and subscale scores have high internal consistency (Carleton et al., 2007), including in our sample, α = 0.93. In addition, the IUS-12 has good convergent and discriminant validity, with comparable scores to longer versions of the scale (Carleton et al., 2007; McEvoy & Mahoney, 2011).

We created a self-report measure to measure IU in two ways (see Appendix). Part one assesses standard of proof, or the level of distress a person feels when there is even minimal uncertainty associated with a given outcome. Using a visual analogue scale ranging from 1 to 100, subjects rated how happy, upset, and anxious they would feel in response to eight scenarios, four framed as a positive outcome (e.g., you have a 99% chance of getting promoted), and four framed as a negative outcome (e.g., you have a 1% chance of losing your job). Subjects also estimated how likely they were to experience a given outcome (e.g., actually losing their job) irrespective of the probability provided in the question. We scored part one by calculating a mean score for each emotion (happy, upset, and anxious) and probabilities; separate means were calculated separately for positively and negatively framed outcomes.

Part two assesses whether people prefer the certainty of negative outcomes in the present over the uncertainty of either positive or negative outcomes in the future. Part two consists of 15 questions, five concerning negative events (e.g., immediately opening an envelope from the IRS to learn that you are being audited vs. waiting several months to find out whether you may or may not be audited, or immediately finding out that you have the gene for a devastating illness vs. waiting to learn if you have it) and five concerning the possible loss of a positive outcome (e.g., finding out immediately that you did not

receive a prize for which you were a finalist vs. waiting several months to find out whether you did or did not win the prize, or finding out immediately that you did not get an early promotion vs. waiting several months to find out that you may have). The remaining five questions ascertain how people make decisions in situations where they know the outcome will be positive. That is, do they prefer learning the outcome immediately or waiting to learn the outcome later (e.g., peeking at a present prematurely or waiting until your birthday to open the present, or reading the spoiler alert for the finale of your favorite show vs. waiting until it airs to see the end). Each item of part two was scored as either zero (learning the outcome immediately) or one (waiting with the possibility of a more positive outcome). Consequently, low scores indicate lower tolerance of uncertainty. Because we were interested in whether people with OCD exhibit *generalized* biases to uncertainty (e.g., need a higher standard of proof or prefer negative outcomes to certainty across various situations unrelated to their symptoms), we did not include OCD-specific scenarios in the questionnaire, but rather experiences broadly relevant to most people. Parts one and two of the measure had internal reliabilities of α = 0.75 and α = 0.72, respectively.

Testing of SAD, non-anxious, and 24 OCD subjects was completed at our lab and testing of 17 obsessive-compulsive patients was completed at a private room in the hospital where they were receiving treatment. However, all procedures were held consistent across the sample. Specifically, all subjects were first assessed with the MINI International Neuropsychiatric Interview. OCD subjects were also assessed with the YBOCS checklist and severity scale before completing the self-report measures described above, as well as tasks related to other studies on dysfunctional thinking associated with OCD (sample characteristics therefore also appear in Hezel, Stewart, Riemann, & McNally, in press).

Finally, subjects completed a neutral version and a self-referent version of the Beads Task. Following the procedures of Reese, McNally, and Wilhelm (2011), we asked all subjects to complete two easy conditions (proportion = 85/15) and two hard conditions (proportion = 60/40) of both versions. Following Reese et al. (2011), we presented the tasks on a computer and used their directions and order of beads/words. In the easy neutral condition, participants were told that a bead would be selected, one at a time from a jar of mostly blue beads or mostly green beads before being returned to its original jar. The subjects' job was to decide from which jar the marbles were being drawn. If subjects did not make a decision after viewing 20 beads, they were prompted to do so. They were then asked to rate how confident they were in their decision. The dominant bead color and color sequence were counterbalanced across easy and hard conditions.

Subjects then completed the self-referent version of the task. They first provided the experimenter with 10 positive and 10 negative words describing themselves. After selecting the words, they were instructed to imagine that people took two surveys about them, one of which contained mostly positive comments and the other mostly negative comments. Subjects viewed one word a time and their job was to decide which survey the words came from. Word valence and sequence were counterbalanced across subjects. Average time to complete the study ranged from one and a half to two hours; subjects had the option of completing the Beads task during a second visit.

3. Results

3.1. Preliminary results

The OCD and SAD groups did not differ in severity of depressive symptoms, social anxiety symptoms, or dysfunctional beliefs, but had significantly higher scores relative to the non-anxious group (Table 1). Subjects with OCD had moderately severe OCD symptoms, evinced by a mean YBOCS score of 21.0 (SD = 5.45; Goodman et al., 1989b) and were significantly younger (m = 26.1, SD = 8.4) than non-anxious (m = 37.6, SD = 16.1) subjects (p < .001). There were no age differences between the OCD and the SAD (m = 31.0, SD = 13.6) groups

Table 1
Group characteristics.

	OCD M (SD)	SAD M (SD)	Non-Anxious M (SD)	F (2,122)	p
Dysfunctional Beliefs (OBQ Total Score)	177.46 (53.29)[a] range: 44–297	181.10 (37.20)[a] range: 110–252	121.83 (43.15)[a] range: 44–212	22.50	< .001 *
Heightened Responsibility/Overestimation of Threat (OBQ Subscale)	63.71 (21.49)[b] range: 16–101	66.50 (14.89)[b] range: 30–94	45.05 (17.96) range: 16–84	16.76	< .001 *
Significance of/Need to Control Thoughts (OBQ subscale)	41.95 (16.98)[c] range: 12–84	38.78 (12.05)[c] range: 19–62	26.57 (10.79) range: 12–50	14.97	< .001 *
Intolerance of Uncertainty/Perfectionism (OBQ subscale)	71.80 (21.98)[d] range:16–112	75.83 (18.73)[d] range: 36–112	50.21 (18.99) range: 16–92	19.71	< .001 *
IUS-12 (Total Score)	36.51 (11.31)[e] range: 15–56	35.90 (10.52)[e] range: 17–59	24.38 (9.43) range: 12–45	17.79	< .001 *
Prospective Anxiety (IUS-12 subscale)	21.83 (6.36)[f] range: 10–33	21.58 (6.28)[f] range: 9–35	15.79 (6.28) range: 7–32	12.19	< .001 *
Inhibitory Anxiety (IUS-12 subscale)	14.68 (5.89)[g] range: 5–24	14.33 (5.41)[g] range: 5–24	8.60 (3.81) range: 5–17	18.61	< .001 *
Social anxiety severity (LSAS)	61.95 (31.92)[h] range: 0–128	71.18 (25.71)[h] range: 14–128	19.95 (15.74) range: 0–56	48.23	< .001 *
Depression severity (CESD)[a]	21.59 (13.26)[i] range: 1–50	22.28 (14.22)[i] range: 4–52	4.62 (6.12) range: 0–24	30.26	< .001 *

Note. * = $p \leq .05$ criteria; OBQ = Obsessive Beliefs Questionnaire; LSAS = Liebowitz Social Anxiety Scale; CESD = Center for Epidemiologic Studies Depression Scale.
Means that have the same superscript letter do not significantly differ from one another.
[a] We repeated analyses on the CESD after omitting six items whose validity and psychometric properties have been questioned (Carleton et al., 2013). Results did not differ from analyses using the full scale.

Table 2
Psychiatric diagnoses.

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

($p = .29$), or between the SAD and non-anxious groups (despite a trend, $p = .08$). The sample included 36 OCD subjects and 34 SAD subjects who met criteria for at least one comorbid disorder and nine non-anxious subjects who met criteria for at least one non-anxiety disorder. Rates of comorbidity appear in Table 2. The proportion of OCD subjects with a comorbid diagnosis of GAD did not differ from the proportion of SAD subjects with this comorbid diagnosis $\chi(1) = 0.33$, $p = .57$.

3.2. Intolerance of uncertainty

Relative to non-anxious individuals, the OCD and SAD groups had elevated scores on self-reported IU. Specifically, a one-way analysis of variance (ANOVA) indicated that the groups had higher scores on the IU/perfectionism subscale of the OBQ ($F (2,120) = 19.71$, $p < .001$, $r = 0.50$, 90% CI [0.37, 0.58]). Likewise, a multivariate analysis of variance (MANOVA) showed the same pattern for the total score ($F (2,120) = 17.79$, $p < .001$, $r = 0.48$, 90% CI [0.12, 0.32]) and both subscales ($F (2,120) = 12.19$, $p < .001$, $r = 0.41$ 90% CI [0.26, 0.51] and ($F (2,120) = 18.61$, $p < .001$, $r = 0.49$, 90% CI [0.36, 0.57]) of the IUS-12. The OCD and SAD groups were indistinguishable on these measures (all Bonferroni-corrected ps = 1.00).

To examine how individuals react to minimally uncertain situations, we completed a MANOVA on the groups' mean ratings of happiness, distress, and anxiety on part one of our scale. Findings indicated a main effect of group, such that people with OCD and those with SAD felt more upset (negative frame: $F (2,120) = 6.86$, $p = .002$, $r = 0.32$, 90% CI [0.17, 0.42]; positive frame: $F (2,120) = 4.19$, $p = .02$, $r = 0.26$, 90% CI [0.08, 0.37]) and anxious (negative frame: $F (2,120) = 8.59$, $p < .001$, $r = 0.35$, 90% CI [0.20, 0.46]; positive frame = $F (2,120) = 11.92$, $p < .001$, $r = 0.41$, 90% CI [0.26, 0.51]) than did non-anxious individuals in situations involving a very low probability of a negative outcome (e.g., losing one's job) or a high probability of a positive outcome (e.g., getting promoted). There were no differences between SAD and OCD groups for these emotions (all Bonferroni-corrected ps ≥ .38). There were also no significant differences in how any of the groups rated their happiness to negatively ($F (2,120) = 2.30$, $p = .11$) or positively framed scenarios ($F (2,120) = 2.46$, $p = .09$), or in the probability of experiencing the negatively framed ($F (2,120) = 1.57$, $p = .21$) or positively framed ($F (2,120) = 1.91$, $p = .15$) outcomes. Interestingly, all groups rated the likelihood of outcomes differently from the probability explicitly stated in the question. In questions that stated there was a 1% chance of a negative outcome, all groups believed that the actual probability of the feared outcome was much higher ($m = 18.78\%$, $SD = 19.99$). Conversely, in scenarios that stated there was a 99% chance of a positive outcome, all groups believed the likelihood was lower than stated ($m = 81.20$, $SD = 17.51$).

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

their desire for negative outcomes in the present even if a better outcome could occur later (F (2,120) = 4.22, p = .02, r = 0.27, 90% CI [0.08, 0.37]); follow-up comparisons with Bonferroni corrections revealed no significant differences between the non-anxious and OCD groups on the total scale score (p = 1.00). To determine whether IU also applies to uncertainty of situations with two positive outcomes, we compared group scores on the subscales of part two of our measure (Table 3). These analyses revealed that the socially anxious group had higher preference for certainty of a negative outcome when there was something positive at stake (e.g., immediately learning they did not win a prize instead of waiting several months to see if they did or did not win); however, this difference was only marginally statistically significant, (F (2,120) = 2.82, p = .06). There were no group differences on the subscale examining IU of negative outcomes (e.g., immediately learning they would get audited by the IRS instead of waiting to see if they would get audited or not), F (2,120) = 2.45, p = .09, r = 0.33, 90% CI [0.17, 0.44] or the subscale examining IU of positive outcomes (e.g., peeking at a present vs. waiting to open it), F (2,120) = 1.20, p = .31.

Given the association of IU with GAD, we repeated the above analyses after omitting subjects with comorbid GAD, leaving 42 non-anxious subjects, 22 subjects with OCD, and 24 with SAD. Levene's test of homogeneity confirmed that the variance did not differ among these new groups with one exception: the inhibitory subscale of the IUS (F (2,85) = 4.2, p = .02). Relative to non-anxious subjects, those with OCD and SAD had higher scores on the total and inhibitory subscale scores of the IUS-12, but only SAD subjects had higher scores (ps ≤ .005) on the prospective uncertainty subscale. Moreover, the SAD group had higher scores than non-anxious subjects on the IU/Perfectionism Subscale of the OBQ-44 (p < .001), the level of anxiety in response to positively framed scenarios (p < .001), and how upset (p = .03) and anxious (p = .001) they felt in response to negatively framed scenarios. OCD subjects' scores on these measures differed from neither the non-anxious nor the SAD groups, with one exception: the OCD group had significantly lower scores than the SAD group in how anxious they would feel in response to negatively framed situations (p < .02). There was a trend toward significance on part two of the scale such that, relative to other groups, SAD subjects preferred negative outcomes in the present to the uncertainty of future outcomes (p = .07).

We also repeated all analyses after separating individuals with a diagnosis of comorbid OCD and SAD into a fourth group. The new groups consisted of non-anxious (n = 42), OCD-only (n = 17), SAD-only (n = 40), and comorbid OCD/SAD (n = 24). Overall, the OCD group did not differ significantly from the non-anxious group on any measures. However, these additional analyses were exploratory and should thus be repeated in a larger, adequately powered sample. Finally, we examined the association between OCD symptoms and IU as well as social anxiety symptoms and IU (Table 4). OCD severity correlated with the IUS-12 total scale score (r = 0.36, p = .02). However, LSAS severity was more strongly associated than were OCD symptoms with the IUS-12 within the OCD group (r = 0.64, p < .001), and a test of the difference between the two dependent correlations was significant at p = .02. Social anxiety symptoms were also correlated with total score IUS-12 in the non-anxious group (r = 0.54, p < .001) and nearly so in the SAD group (r = 0.29, p = .07). Whereas LSAS scores were largely correlated with both the inhibitory and prospective subscales of the IUS-12 in both the non-anxious and OCD groups (all rs ≥ 0.50), only the inhibitory subscale was correlated with SAD severity in the socially anxious group (r = 0.34, p = .03).

3.3. Beads task

A total of 118 people who participated in part one of the study also completed both versions of the Beads Task.[1] We performed a 3 (group: OCD, SAD, non-anxious) by 2 (difficulty: easy, hard) x 2 (valence:

beads, words) mixed ANOVA for each of the following dependent variables: number of beads viewed and confidence in answer. There was a main effect of difficulty, such that all subjects asked to view more beads/words (F (1,115) = 147.74, p < .001, r = 0.75, 90% CI [0.68, 0.80]) and were less confident in their answers (F (1,115) = 148.93, p < .001, r = 0.75, 90% CI [0.68, 0.80]) during the hard versions of the tasks. There was also a main effect of valence, such that subjects requested to see fewer beads/words and were more confident in their answers when completing the self-referent version. There were no group differences in number of beads viewed or confidence in answers, and there were no interactions between group, difficulty, or valence (all ps ≥ .18). Additionally, there were neither differences in accuracy of groups' answers on easy or hard trials (all χ(4) ≤ 3.78, ps ≥ .43) nor in the total time groups took to complete the tasks (F (2,115) = 0.56, p = .57).

Correlational analyses within each group between self-reported IU and performance on both versions of the task revealed only two significant effects: between non-anxious subjects' scores on the IUS-12 and the number of beads they viewed in the easy (r = 0.34, p = .03) and the hard (r = 0.30, p = .05) versions of the neutral Beads Task (Table 4). Performance on the IUS-12 was not associated with number of beads viewed or confidence in any of the other groups or conditions, and the OBQ IU/Perfectionism subscale was not significantly correlated with any outcome on either neutral or self-referent version of the Beads Task.

4. Discussion

Our first aim was to better understand individuals' emotional response to situations that involve minimal uncertainty. Relative to non-anxious individuals, the OCD and SAD groups reported similarly elevated levels of IU on the IUS-12 and the IU/perfectionism subscale of the OBQ-44. In addition, both groups reported feeling more upset and more anxious when confronting hypothetical situations that involve minimal uncertainty. The same pattern emerged regardless of the frame of the question: either a 1% possibility of a bad outcome or a 99% chance of a good one. There were no differences in how groups rated how happy they would feel in these scenarios. This null finding suggests that subjects' differential emotional responses to outcomes are due to predicted increased negative affect, as opposed to lower positive affect, in OCD and SAD.

Importantly, however, the differences between OCD and non-anxious subjects did not remain after removing individuals with comorbid GAD from the analyses. Though people with OCD still had higher levels of *self-reported* IU as measured by the IUS-12, relative to the non-anxious group, only SAD individuals predicted higher levels of negative affect in response to the scenarios on the first part of our scale. OCD subjects' scores did not differ significantly from either the non-anxious or the SAD groups' scores. Similarly, we observed no differences between obsessive-compulsive and non-anxious subjects after separating subjects with comorbid OCD and SAD into a fourth group. Taken together, these findings suggest that different measures of IU of general, non-OCD-specific scenarios may be more strongly associated with anxiety disorders than with OCD. These findings are supported by a correlational analysis which showed that within the OCD group, social anxiety symptom severity was more strongly related to total, inhibitory, and prospective IU than was OCD severity. It is possible that OCD is more related to IU about situations related to OCD-specific, idiographic fears, whereas SAD is related to IU more generally. Another possible explanation is that subjects with OCD had inflated scores on the LSAS because they were taking into account their OCD-related fears while completing the scale (e.g., indicating that they avoid using public restrooms because of contamination concerns as opposed to social

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[1] Time constraints prevented five subjects from completing the beads/words task.

Table 3
Group differences on novel IU questionnaire.

	OCD M (SD)	SAD M (SD)	Non-Anxious M (SD)	F (2,120)	p
Part 1: Standard of Proof					
Positive Frame (99% Chance of a Positive Outcome)					
Happy	75.71 (20.13)	79.44 (19.34)	84.12 (11.16)	2.46	.09
Upset	14.77 (13.49)[a]	15.73 (15.35)[a]	8.20 (9.18)	4.19	.02*
Anxiety	49.14 (22.16)[b]	55.59 (28.64)[b]	30.07 (22.95)	11.92	< .001*
Likelihood	78.70 (15.87)	79.31 (17.33)	85.43 (18.80)	1.91	.15
Negative Frame (1% Chance of a Negative Outcome)					
Happy	34.36 (24.72)	29.85 (27.84)	42.03 (25.58)	2.30	.11
Upset	46.06 (22.09)[c]	51.43 (24.25)[c]	33.33 (22.03)	6.86	.002*
Anxiety	57.16 (22.45)[d]	65.19 (24.39)[d]	43.95 (23.56)	8.59	< .001*
Likelihood	21.89 (21.97)	20.10 (19.80)	14.48 (17.76)	1.57	.21
Part 2: Certainty vs. Uncertainty					
Part 2 Total	8.02 (3.16)[e]	6.40 (2.97)	8.24 (3.21)[e]	4.22	.02*
Subscale 1: Negative Outcomes	2.73 (1.23)	2.25 (1.28)	2.79 (1.09)	2.45	.09
Subscale 2: Loss of Positive Outcomes	2.66 (1.98)	1.73 (1.84)	2.57 (2.03)	2.82	.06
Subscale 3: Two positive Outcomes	2.63 (1.43)	2.43 (1.32)	2.88 (1.25)	1.20	.31

Note. * = p ≤ .05 criteria.
Means that have the same superscript letter do not significantly differ from one another.

anxiety) even though the scale's instructions specifically state it is designed to test social anxiety. However, given the range of OCD symptoms in our sample, it is unlikely that this possibility alone could account for such high LSAS scores. Moreover, anxiety severity scores were also highly correlated with all subscales of the IUS-12 in the non-anxious group. However, only inhibitory IU was correlated with severity within the SAD group. This finding is consistent with research suggesting that SAD may be more strongly related to inhibitory IU than to prospective IU (McEvoy & Mahoney, 2011, 2012). Indeed, a study by Carleton, Collimore, and Asmundson (2010) revealed that inhibitory IU significantly predicted social anxiety symptoms in a community sample.

The lack of differences between the non-anxious and OCD groups on some IU measures may be explained by studies that show that low tolerance for uncertainty is especially relevant to certain subtypes of OCD. For example, Tolin et al. (2003) detected elevated levels of IU in individuals with checking compulsions and repeating compulsions only. Likewise, Lind and Boschen (2009) found that IU mediates the relationship between other dysfunctional thoughts associated with OCD and checking symptoms. We did ask obsessive-compulsive subjects to identify their most distressing obsession, but did not possess sufficient statistical power to analyze the relationship between specific subtypes and dependent variables. Therefore, IU may be a more important cognitive factor in some cases OCD than in others – a possibility that merits further research.

Interestingly, when asked to indicate likelihoods of different scenarios, irrespective of the probability given, all groups answered similarly. That is, when the question indicated a 99% chance of a positive outcome, subjects stated the actual likelihood was 81%; when the question indicated a 1% probability of a negative outcome, subjects rated the likelihood as 19%. Thus, people may feel more vulnerable to negative outcomes than they are. This bias was not limited to the clinical groups – a finding consistent with research on common decision-marking biases. For example, Baron (2000) describes probability neglect, defined as a failure to consider the relevance of probabilities when making decisions. This finding may have treatment implications. Cognitive treatments of OCD ask patients to estimate the likelihood of a feared situation in order to help individuals realize that they may be vastly overestimating its probability. However, our findings suggest that even if people are explicitly told the outcome's probability, they will continue to overestimate its likelihood. It may therefore make sense to focus on strategies other than estimating probabilities, such as challenging beliefs about the feasibility of obtaining complete certainty

about anything and the cost of attempting to do so (Foa, Yadin, & Lichner, 2012). Moreover, by engaging in exposure and response prevention, which entails intentionally confronting feared situations while refraining from engaging in compulsions, patients can learn not only that their feared outcomes are unlikely to occur, but also that they are able to tolerate negative emotions, including distress from uncertainty.

Our second aim was to investigate whether people with OCD prefer negative outcomes in the present to uncertainty, even if a better future outcome is possible. Part two of our scale showed that relative to others, people with SAD were more likely to prefer negative outcomes to the uncertainty of future possibilities; individuals with OCD did not show this same bias. This difference continued to trend toward significance after we removed subjects with GAD from the sample. This finding lends further support to the idea that people suffering from OCD may be more tolerant of uncertainty in situations that are not specific to their own OCD-related fears.

Our final aim was to examine the relationship between a behavioral measure of and self-reported IU. Results from the neutral and self-referent Beads Task are consistent with prior studies that found no differences in performance (as measured by the number of beads or words viewed) between non-anxious individuals and those with other forms of psychopathology (Jacoby et al., 2014; Reese et al., 2011). The lack of differences between the SAD and non-anxious group on the idiographic version of the task is partially consistent with a study using a different self-referent version of the probabilistic reasoning task (Schlier, Helbig-Lang, & Lincoln, 2016). The authors observed no differences in the number of socially relevant stimuli non-anxious and subjects with SAD viewed before making a decision. Moreover, Schlier et al. (2016) also found that both non-anxious and SAD subjects requested less information before making decisions about self-relevant stimuli than about neutral information. This phenomenon may arise because people may tend to respond to social evaluation with "threat confirmatory reasoning," the propensity to look for evidence that a real or imagined threat exists (as opposed to trying to disconfirm its existence; Schlier et al., 2016, p. 53; Dudley & Over, 2003).

We found no association between self-reported IU and either version of the probabilistic reasoning task, except for non-anxious subjects. In both easy and difficult versions of the Beads Task, total IUS-12 scores were significantly correlated with the number of beads non-anxious subjects viewed. It is unclear why this association was specific to the non-anxious group, but the lack of generalizability to other groups is further evidence that the number of beads viewed during the Beads

Table 4
Correlations.

Part 1: OCD

	YBOCS	LSAS	IUS Total	IUS Prospect	IUS Inhibit	OBQ IU/Perf	Beads Easy	Beads Hard	Words Easy	Words Hard
YBOCS	1									
LSAS	.45*	1								
IUS Total	.36*	.64*	1							
IUS Prospect	.31*	.53*	.93*	1						
IUS Inhibit	.34*	.65*	.92*	.71*	1					
OBQ IU/Perf	.33*	.53*	.67*	.65*	.57*	1				
Beads Easy	-.30	-.06	.13	.03	.22	.24	1			
Beads Hard	-.40*	-.07	.04	-.06	.13	.08	.79*	1		
Words Easy	-.41*	-.11	.09	-.002	.17	.19	.77*	.80*	1	
Words Hard	-.37*	-.09	.07	.008	.12	.08	.72*	.85*	.83*	1

Part 2: SAD

	LSAS	IUS Total	IUS Prospect	IUS Inhibit	OBQ IU	Beads Easy	Beads Hard	Words Easy	Words Hard
LSAS	1								
IUS Total	.29	1							
IUS Prospect	.19	.91*	1						
IUS Inhibit	.34*	.88*	.62*	1					
OBQ IU/Perf	.13	.44*	.39*	.40*	1				
Beads Easy	-.02	-.13	-.05	-.19	.03	1			
Beads Hard	.01	-.08	.04	-.19	.08	.83*	1		
Words Easy	-.02	-.09	-.01	-.17	.14	.92*	.76*	1	
Words Hard	-.10	-.10	-.01	-.17	.04	.85*	.87*	.85*	1

Part 3: Non-Anxious

	LSAS	IUS Total	IUS Prospect	IUS Inhibit	OBQ IU/Perf	Beads Easy	Beads Hard	Words Easy	Words Hard
LSAS	1								
IUS Total	.54*	1							
IUS Prospect	.50*	.96*	1						
IUS Inhibit	.52*	.89*	.73*	1					
OBQ IU/Perf	.57*	.72*	.71*	.61*	1				
Beads Easy	-.03	.34*	.42*	.16	.01	1			
Beads Hard	.10	.30*	.33*	.21	.08	.74*	1		
Words Easy	-.11	.29	.39*	.07	.04	.86*	.76*	1	
Words Hard	-.01	.27	.34*	.12	.001	.78*	.90*	.85*	1

Note. * = $p \leq .05$ criteria.
IUS = Intolerance of Uncertainty Scale; IUS Prospect = IUS Prospective Anxiety Subscale; IUS Inhibit = IUS Inhibitory Anxiety Subscale; OBQ IU/Perf = OBQ-44 Perfectionism/Certainty Subscale; Beads Easy = Easy version of the neutral beads task; Beads Hard = Hard version of the neutral beads task; Words Easy = Easy version of the beads task using self-referent words; Words Hard = Hard version of the beads task using self-referent words.

Task alone may be an inadequate behavioral measure of IU. The lack of association between self-reported and behavioral measures of IU in the SAD group is especially compelling given the relevance of the stimuli to people with the disorder. Future research would benefit from testing other behavioral measures of IU, such as the box task, a new paradigm designed to address a number of limitations of the beads task (for a full explanation of the task, see Moritz et al., 2017).

In conclusion, IU for general, non-OCD specific scenarios may not figure prominently in all individuals with OCD but may figure more consistently in anxiety disorders such as SAD and GAD. Interestingly, all groups showed biased estimates of probabilities, which may have implications for cognitive treatment of OCD. Finally, we found little evidence that self-reported IU is associated with performance on neutral or idiographic versions of the Beads Task. Future studies to identify behavioral measure of IU are warranted.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Acknowledgements

Appendix

Intolerance of Uncertainty Harvard University

Part 1: Standard of Proof.
Subjects will respond to each question using visual analogue scales from 1 to 100.

1. Imagine that you go to the doctor because you noticed a suspicious lump on your body. Your doctor performs a test and tells you that there is a 99% chance that you are fine.
   a. How happy do you feel?

b. How upset do you feel
c. How anxious do you feel?
d. How likely is it that something is very wrong?

2. Imagine that you receive results from a blood test that indicate you have a 1% chance of having a devastating illness.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you are ill?

3. Imagine that during your annual job review, your boss tells you that you have a 99% chance of being promoted.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you get promoted?

4. Imagine there is a wave of layoffs at your job. Your boss tells you there is a 1% chance you are going to lose your job.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you lose your job?

5. Imagine that you buy a lottery ticket and you later find out that there is 99% chance that you won.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you won the lottery?

6. Imagine that the stock market has crashed. Your stockbroker tells you there is a 1% chance you have lost all of your investments.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you have lost your money?

7. Imagine you receive a letter notifying you that you have been placed on the waitlist for your #1 choice of colleges. The letter states that you have a 99% chance of being admitted.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you will get into the school?

8. Imagine that you have been placed on academic probation and that you have a 1% chance of failing out of school.
   a. How happy do you feel?
   b. How upset do you feel
   c. How anxious do you feel?
   d. How likely is it that you will fail out of school?

Part 2: Certainty vs. Uncertainty (Negative Outcomes)
Please select (a) or (b).

1. Imagine you are applying to colleges. You receive a letter from your #1 choice of schools informing you of their decision on your application. Would you rather
   a. Receive a rejection immediately.
   b. Be placed on the waitlist for several months, after which you may or may not be rejected.

2. Imagine that you and your significant other have been having serious relationship trouble. Would you rather
   a. Break up immediately.
   b. Wait several months in the hope of improving the relationship, after which time you may or may not break up.

3. Imagine that you have received a poor performance review at work. Would you rather
   a. Be fired immediately.
   b. Be placed on "probation" for several months, after which you may or may not be fired.

4. Imagine that you may have the gene for an untreatable disease. Would you rather
   a. Get tested immediately and find out that you have the gene.
   b. Wait several months before getting tested, after which time you may or may not test positive for the gene.

5. Imagine that you have received a scary looking document from the IRS. Would you rather
   a. Open the envelope immediately to find out you are being audited.
   b. Wait several months to open the envelope, after which you may or may not be audited.

Part 2a: Certainty vs. Uncertainty (Positive Outcomes)

6. Imagine that you bought a lottery ticket and that the jackpot is worth several million dollars. Would you rather
   a. Find out immediately that you lost.
   b. Wait several months, after which you may or may not have lost.

7. Imagine that you are house-shopping and that you placed a bid on the house of your dreams. Would you rather
   a. Find out immediately that you did not get the house.
   b. Wait several months, after which you may or may not get the house.

8. Imagine that you have been nominated for a major prize at school or work. Would you rather
   a. Find out immediately that you did not receive the prize.
   b. Wait several months, after which you may or may not receive the prize.

9. Imagine that you are being considered for an early promotion at work. Would you rather
   a. Find out immediately that you did not receive the promotion.
   b. Wait several months, after which you may or may not receive the promotion.

10. Imagine that you are a finalist in a contest, and the prize is an all-expenses paid trip to a destination of your choice. Would you rather
    a. Find out immediately that you lost the contest.
    b. Wait several months, after which you may or may not lose the contest.

Part 3: Intolerance of Uncertainty (Positive Information)

1. Imagine that you and your spouse are expecting a baby. Would you rather
   a. Know the sex of the baby immediately.
   b. Wait several months until the baby is born to find out the sex.

2. Imagine that you are told you that you won one of three different prestigious awards at work/school. Would you rather
   a. Find out immediately which award you won.
   b. Wait several months for the awards ceremony to find out which award you won.

3. Imagine that your loved one is really good at buying you gifts. Your birthday is in several months and you find a birthday gift from him/her hidden in the closet. Would you rather
   a. Open the gift immediately.
   b. Wait several months to open it when your loved one gives it to you on your birthday.

4. Imagine that your fiancé(e) is planning your honeymoon to a tropical island that he/she knows you would like. Would you rather
   a. Find out immediately where you are going.
   b. Wait several months until after the wedding to find out where you are going.

5. Imagine that series finale of your favorite television show is airing in several months. Would you rather
   a. Read online spoilers immediately to find out how it ends.
   b. Wait several months until the finale is on television to see how it ends.

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