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Risk judgment in Obsessive–Compulsive Disorder: Testing a dual-systems account

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ABSTRACT

Dual-systems theorists posit distinct modes of reasoning. The intuition system reasons automatically and its processes are unavailable to conscious introspection. The deliberation system reasons effortfully while its processes recruit working memory. The current paper extends the application of such theories to the study of Obsessive–Compulsive Disorder (OCD). Patients with OCD often retain insight into their irrationality, implying dissociable systems of thought: intuition produces obsessions and fears that deliberation observes and attempts (vainly) to inhibit. To test the notion that dual-systems theory can adequately describe OCD, we obtained speeded and unspeeded risk judgments from OCD patients and non-anxious controls in order to quantify the differential effects of intuitive and deliberative reasoning. As predicted, patients deemed negative events to be more likely than controls. Patients also took more time in producing judgments than controls. Furthermore, when forced to respond quickly patients' judgments were more affected than controls'. Although patients did attenuate judgments when given additional time, their estimates never reached the levels of controls'. We infer from these data that patients have genuine difficulty inhibiting their intuitive cognitive system. Our dual-systems perspective is compatible with current theories of the disorder. Similar behavioral tests may prove helpful in better understanding related anxiety disorders.

1. Introduction

Most patients suffering from Obsessive–Compulsive Disorder (OCD) maintain some level of insight into the fact that their thoughts or behaviors are unreasonable or irrational[1] (Foa & Kozak, 1995); and insight itself has traditionally served as a criterion in clinical diagnosis. Patients exhibiting this trait tend to hold simultaneous, contradictory beliefs. One belief is intuitive; it can be grounded in affective reactions like fear. This sort of belief is often implicated in OCD. The other type of belief is based on a relatively dispassionate appraisal of the world, whereby patients are able to form more thoughtful assessments. Indeed, the simultaneous presence of these beliefs is a hallmark of dual-systems theory (Epstein, 1994; Evans, 2008; Evans & Over, 1996; Sloman, 1996; Stanovich & West, 2000), wherein intuition—which is fast, automatic, and inaccessible to conscious introspection—and deliberation—which is slow, effortful, and reliant on working memory—are distinct systems of the mind. During reasoning, intuition relies on similarity and contiguity to make inferences; when evaluating risk, this can lead to systematic biases as people neglect more analytic bases for judgment (Darlow & Sloman, 2010). Deliberation, on the other hand, uses rules (such as rules of logic) and is therefore more likely to result in responses that are justifiable and attuned to reality.

We explored the hypothesis that a dysfunction in the otherwise healthy cooperation of these systems explains extreme risk-sensitivity in OCD. In particular, we expected OCD patients to face greater difficulty in suppressing intuitive responses than controls. To test this, we varied the ability of patients and controls to inhibit intuition by manipulating the presence of time–pressure. When faced with time–pressure, we anticipated that patients—like controls—would respond based on intuitive processing, but that patients alone would provide severely inflated judgments of risk. When given additional time, we predicted these same patients to invoke their deliberative

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[1] Although OCD has traditionally been associated with good insight, some studies have suggested that the degree of insight is actually graded (Eisen et al., 2001).

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systems, suppressing—to a limited degree—intuitive responses in favor of more reflective estimates. In contrast, we expected our control group to suppress intuition to some extent, with or without time–pressure.

Although dual-systems models are utilized to explain myriad phenomena in reasoning, judgment and decision-making, and social cognition (see Evans, 2008, for a review), they have not generally been extended to the study of psychiatric disorders such as OCD. More often than not, however, popular models of OCD make some sort of appeal to two types of processes or systems. And accounts of OCD that allude to goal-directed behavior, error-detection, habit formation, or weakened inhibition are all compatible with the fundamental tenets of dual-systems theory.

Our proposal is that a signature element of OCD is a hyperactive intuitive system. This system is a center for the processing of primary emotions like fear. Epstein (1994), for instance, notes that affect plays a key role in his experiential system (i.e., intuition). Affective processing often takes place before cognitive processing (Zajonc, 1980) and its execution is both rapid and automatic (Slovic, Finucane, Peters, & MacGregor, 2007). We know that OCD patients are especially susceptible to particular fears (e.g., contamination, causing harm, etc.; Heyman, Mataix-Cols, & Fineberg, 2006). At the same time, patients are often aware of their exaggerated risk assessments. This awareness satisfies Sloman's (1996) Criterion S—a signifier of dual-systems—in which a person maintains two contradictory beliefs simultaneously.

2. Relevance to treatment

One of the predominant treatment models for OCD is cognitive behavioral therapy, or CBT. CBT integrates cognitive and traditional operant conditioning. The premise in CBT is that certain irrational, obsessive beliefs, including the over-estimation of risk, exaggerated perceptions of responsibility for causal outcomes, and thought–action fusion, give rise to anxiety (Foa, Rothbaum, & Furr, 2003; Rachman, 1997; Shafran & Rachman, 2004). Behavioral repertoires (compulsions) are developed to counteract these obsessions, temporarily reducing anxiety. The compulsions therefore serve as potent negative reinforcers that ultimately exacerbate both obsessive thoughts and compulsive behaviors. In CBT, the goals are twofold: (1) to challenge irrational beliefs by readjusting (reducing) cognitive appraisals of risk; and (2) to expose patients to real or imagined scenarios that are meant to temporarily increase anxiety, while simultaneously preventing them from engaging in compulsive behaviors. The eventual goal is to extinguish the stimulus–response connection linking the irrational beliefs (and concomitant anxiety) and the compulsive behaviors. Considerable empirical support speaks to the efficacy of CBT (Butler, Chapman, Forman, & Beck, 2006; Williams et al., 2010), and our growing understanding of the neural systems implicated in the pathogenesis of OCD has helped to explain this efficacy (Baxter, Schwartz, Guze, Bergman, & Al, 1990).

Dual-systems theory offers an integrative interpretation of CBT in terms of competing cognitive systems. We propose that the irrational beliefs causing such fear, anxiety, and risk-sensitivity in patients are housed in the intuitive system. But patients, like others, also have a deliberative system that represents the world in a more veridical manner. What distinguishes patients is that deliberation fails to adequately inhibit their intuitions. This failure to inhibit can itself increase anxiety, as competing cognitions—one type associative and another rule-based—prosper unabated. In non-patients, deliberative thought usually succeeds in eventually overwhelming obsessional fears. The goal of CBT then is to develop alternative pathways by which deliberation may inhibit intuition.

3. Experiment

Our experiment asks OCD patients and non-anxious controls to produce probability judgments for a series of OCD-themed, harm-related events (e.g., "I will hurt myself by acting on an unacceptable impulse."). These risk judgments are first made under time–pressure, which is intended to preclude deliberative responding, and then in the absence of time–pressure, where the ability to suppress intuitive reasoning is stronger. Our account predicts that patients will overestimate risky events under time–pressure. Without time–pressure, patients will lower their judgments. This prediction is based on the idea that patients will engage a hyperactive intuitive system that is closely coupled with primary affective responses. Only when time–pressure is eliminated do we predict that patients are able to invoke more deliberate reasoning to suppress, to a limited extent, their intuitively inflated perceptions of risk.

4. Methods

4.1. Participants

Twenty-one adults with OCD were recruited from Butler Hospital in Providence, Rhode Island. All patients were currently seeking treatment for their OCD, and the diagnostic status of each patient was previously confirmed by a practicing psychiatrist or neuropsychologist using the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (First, Spitzer, Gibbon, & Williams, 2002). In order to evaluate symptom severity, each patient completed the Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Goodman et al., 1989) via self-report.

For our control group, 26 healthy participants were recruited online from Craigslist.com in the greater Providence, RI, area. They were given the Mini International Neuropsychiatric Interview (Sheehan et al., 1998) to ensure no past or present psychiatric symptoms. These controls were also free of psychoactive medication for at least 6 months prior to participation in the experiment. The groups did not significantly differ in terms age, $t(1,45) = -0.56$, $p = 0.58$, $r = 0.08$, or sex, $U = 264.00$, $z = -0.22$, $p = 0.82$, $r = 0.03$ (see Table 1 for demographic and clinical variables). All participants were paid $50.00 for their involvement. Internal review boards for Brown University and Butler Hospital approved the study.

4.2. Materials and procedure

4.2.1. Estimated general intelligence

All participants completed the two-subtest version (matrix reasoning and vocabulary) of the WAIS-III—Wechsler Abbreviated Scale of Intelligence (The Psychological Corporation, 1999). The groups did not differ in terms of estimated IQ, $t(1,45) = -1.41$, $p = 0.17$, $r = 0.21$ (see Table 1).

4.2.2. Risk judgment task

There exists evidence that over-estimation of subjective risk is common in OCD (see Steketee, Frost, & Cohen, 1998), and patients also tend to be averse to taking certain risks (Cicolini & Rees, 2003; Steketee & Frost, 1994). Unlike most previous studies, however, here we focus on judgments of risk for OCD-specific events alone.

Participants were presented with a variety of scenarios, and were either pressed for or encouraged to take their time. Content for the stimuli was derived from common OCD themes: checking, washing/contamination, just-rightness (ordering/arranging), and taboo thoughts. Items included statements such as, "I will hurt myself by acting on an unacceptable impulse." A smaller set of more abstract questions was also administered, although we restrict analysis to the main set.[2] The full list of the stimuli is provided in Table 2 of the appendix.

[2] Our set of original test items were augmented with a small number of abstract (less OCD-specific) items. These stimuli were intended to serve as a check since it was thought that the original stimuli were exceedingly OCD-specific—to the extent that the scenarios might not reliably evoke probability judgments in controls significantly above zero percent. However, this was not the case. In addition, and as noted previously, we sought to test risk judgments for events

Table 1
Group size, mean (SD) for age, IQ, and Y-BOCS, as well as sex and comorbid diagnoses information. Statistical tests are provided where applicable.

Demographics for the OCD and control group			
Measure	OCD group	Control group	Statistical test
N	21	26	
Age (years)	41.19 (9.94)	39.38 (11.65)	$t(1,45) = -0.56$, $p = 0.58$, $r = 0.08$
Estimated IQ (2 subtest WASI)	114.71 (11.38)	109.46 (13.67)	$t(1,45) = -1.41$, $p = 0.17$, $r = 0.21$
Y-BOCS	20.71 (SD 7.32)		
Female:male ratio	12:9	14:12	$U = 264.00$, $z = -0.22$, $p = 0.82$, $r = 0.03$
Comorbid SCID diagnoses	Major depressive disorder (27%), social anxiety disorder (10%), general anxiety disorder (10%), attention deficit hyperactivity disorder (5%), phobias (18%), dysthymia (14%), panic disorder (10%), body dysmorphic disorder (5%), alcohol abuse (14%), kleptomania (5%), separation anxiety disorder (10%)		

The task unfolded in two blocks. The first block consisted of each item administered under time–pressure (speeded). The second block presented each item again, but in the absence of time–pressure (unspeeded). The 25 items in each block were randomized, and the speeded block always preceded the unspeeded block so that speeded judgments were only made immediately after initial presentation.

Participants were asked to provide probability judgments for each statement. The instructions indicated that participants should respond according to how likely they felt or thought that certain events would happen within the following month. Participants were instructed on how to use the computer mouse to move an on-screen slider along a visual-analog scale which spanned from 0% *Likely* to 50% *Likely* to 100% *Likely*. The slider was automatically reset to the mid-point (50% *Likely*) at the start of each trial.

4.3. Procedure

In the speeded trial block, participants were instructed to respond quickly. They were given the following instructions:

> *You will soon be presented with some statements. A typical statement might look like:*
> *'I will fall and hurt myself.'*
> *As quickly as possible, indicate your "gut reaction" as to how likely you FEEL these statements are to happen within the following month by sliding the red "X" with your mouse and clicking somewhere along the line below.*
> *Please give the first response that comes to your head.*
> *There is no wrong answer and you will have the chance to think about the statements more carefully and change your mind if you want to later.*

In the unspeeded block, participants were shown:

> *Now you will be given the same set of statements.*
> *This time however, take your time and THINK carefully about each statement.*
> *Respond with what you THINK the actual risk is that the following statements will happen within a month.*

Response time (RT) comprised the span between the on-screen appearance of a stimulus and the participant's response in the form of a mouse-button click. Participants completed four practice trials to ensure that they understood the task.

5. Results

We analyzed our data using a repeated-measures ANOVA with group (patients vs. controls) as a between-subjects variable and time–pressure as our within-subject factor (speeded vs. unspeeded).

As predicted, patients gave higher risk judgments ($M = 34.17\%$; $SD = 22.32\%$) than controls ($M = 8.36\%$; $SD = 13.31\%$), $F(1,45) = 24.20$, $p < 0.001$, $r = 0.59$, and they took longer to do so ($M = 6.89$ s; $SD = 2.19$ s vs. $M = 5.00$ s; $SD = 1.61$ s), $F(1,45) = 11.61$, $p = 0.001$, $r = 0.45$, see Fig. 1.

In light of our focal hypothesis, we observed that time–pressure did lead to an overall greater perception of risk ($M_{Speeded} = 22.86\%$; $SD_{Speeded} = 25.19\%$ vs. $M_{Unspeeded} = 19.15\%$; $SD_{Unspeeded} = 21.17\%$), $F(1,45) = 6.72$, $p = 0.01$, $r = 0.36$. Furthermore, this effect was driven by differences in patient judgments; the time–pressure ∗ group interaction was significant, $F(1,45) = 5.92$, $p = 0.02$ (see Fig. 2), and a simple effects analysis reveals significance within the patient group, $F(1,20) = 5.45$, $p = 0.03$.

Within our OCD population, patients' total Y-BOCS scores correlated with their overall risk judgments, $r = 0.61$, $p < 0.01$ ($r_{speeded} = 0.62$, $p < 0.01$; $r_{unspeeded} = 0.54$, $p = 0.01$).

6. Discussion

These findings support our predictions: (1) patients produce higher risk judgments than controls; (2) patients take longer to produce risk judgments than controls; (3) patients show a larger difference in speeded and unspeeded risk judgments than controls; and (4) patients do not lower their judgments to the levels of controls.

The dual-systems view that we have articulated is compatible with a variety of neurophysiological models of OCD. Although the genesis of OCD is unclear, research has implicated a number of neural structures in its pathophysiology including the orbital, dorsolateral and anterior cingulate cortices, the basal ganglia (particularly the striatum), and the thalamus. Together, this network constitutes the cortical–striatal–thalamo-cortical loop, often referred to as the OCD circuit (Huey et al., 2008; Rauch et al., 2007; Saxena, Brody, Schwartz, & Baxter, 1998).[3]

Might a dysfunction in dual-systems within OCD patients map onto a dysfunction in the OCD circuit? Several research programs have aimed to explicate the neural bases of dual-systems theories. For example, in Lieberman's (2003) reflexive–reflective model, part of the X-system's (refleXive) functionality entails linking

(*footnote continued*)
specific to OCD themes. While the abstract items are generally relatable to typical OCD symptoms, their conclusions are still rather abstract (e.g., "I won't be able to focus") when compared to the more targeted set (e.g., "I will hurt myself by acting on an unacceptable impulse"). Test items also varied in terms of event structure and person affected, as seen in Table 2.

[3] Recently, Milad and Rauch (2012) review evidence that elaborates the roles of the medial orbitofrontal cortex (mOFC) and the lateral orbitofrontal cortex (lOFC) areas within the PFC. They suggest that classic descriptions of the OCD circuit may serve as an insufficient model of OCD. Namely, they pinpoint hyperactivity in mOFC (which is correlated with symptom severity and implicated in emotion regulation), and hypoactivity in lOFC (which is inversely correlated with symptom severity and implicated in inhibitory control).

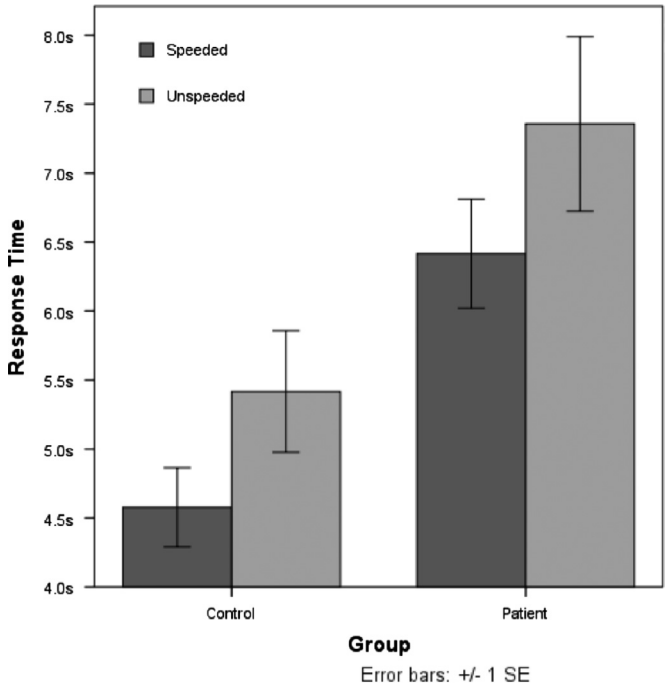

Fig. 1. Response times for controls and patients both with and without time–pressure.

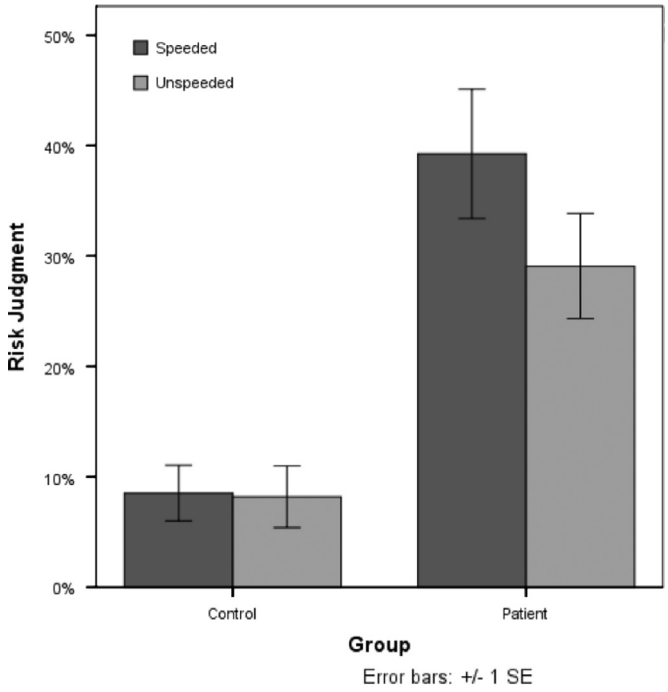

Fig. 2. Risk judgments for controls and patients both with and without time–pressure.

affect to represented stimuli. Neural regions associated with this system are the amygdala, the basal ganglia, and the lateral temporal cortex. The C-system (refleCtive) houses the anterior cingulate cortex, the prefrontal cortex (PFC), and the medial temporal lobe. Parts of the C-system serve as an alarm system (the anterior cingulate cortex) that alerts the prefrontal cortex that controlled processes are needed. The C-system then serves to intervene on the X-system when appropriate.

Huey et al. (2008) provide a model that attempts to reconcile such neuroanatomical findings with behavioral observations. In their proposal, deemed the structured event complex (SEC) model of OCD, "abnormal interactions of representations of complex behaviors in the PFC [prefrontal cortex], reward information in the OFC [orbitofrontal cortex], error-detection in the ACC [anterior cingulate cortex], and reward and limbic structures can result in the symptoms of OCD" (p. 401). SECs are representations of hierarchical behavioral sequences (e.g., eating in a restaurant) stored in the prefrontal cortex, an area associated with executive function. Huey et al.'s model claims that the patient's cognitive interpretation of an incomplete SEC results in anxiety (and concomitant obsessions). The source of this feeling is non-conscious, as it is presumed to reside in intuition, and is usually followed by patients' attempts to deliberately reduce anxiety via a wide range of behaviors (i.e., compulsions). These phenomena result in a dissociation between the *knowledge* that, for example, "one's hands are clean, and the 'feeling' that they are not" (p. 402).

Gillan et al. (2011) go further in hinting at a dual-systems account when referring to goal-directed versus habitual action. They claim that a dysfunction in orbitofrontostriatal circuitry—which houses flexible, goal-directed (deliberate) behavior—leads to an overreliance on habit-based (intuitive) actions. And in their account of OCD, Boyer and Lienard (2008) propose that error-detecting networks are hyperactive, the urge to engage in compulsions is excessively strong, and the systems that usually suppress these urges are incapable of doing so (see also Evans, Lewis, & Iobst, 2004). Their conception of the intuitive system comprises error-detection and obsessive thoughts, while the deliberative system functions as an inhibitor.

Similar models of OC behavior have been posited for the obsessions and compulsions that emerge in typical populations. Typical children for example engage in repetitive and compulsive-like behavior as part of their normal behavioral repertoire (Evans et al., 1997). This work has also noted that the habit system, driven by the striatum, is not yet under orbitofrontal control, leaving the execution and perseveration of learned behaviors largely unchecked by the executive functions that govern the deliberative system (Evans, Lewis, & Iobst, 2004; Pietrefesa & Evans, 2007).

7. Conclusions

We take these findings to support a dual-systems characterization of OCD. Our main manipulation of time–pressure was intended to limit access to higher-level cognitive resources (i.e., deliberation) that support conscious reasoning strategies, while encouraging a reliance on affect- and heuristic-based processes (i.e., intuition; Maule & Edland, 1997). The fact that patients lowered their judgments when given more time serves as the crucial evidence that deliberation functions as a corrective on initial risk assessments. Thus, patients' dread of risk is not fixed, as merely thinking may attenuate it. However, as noted, patients did not lower their judgments to the levels of controls; and so simply deliberating is not enough. Finally, that patients took longer to respond than controls suggests that they tend to be weighed down in rumination.

Thus, compatible with our results are multiple models that implicate a failure in OCD to fully inhibit intuition. At a cognitive level, four mechanisms are possible. On one hand, it may be the case that intuition is too strong to be suppressed by deliberation. On the other hand, deliberation may be too weak to suppress intuition. It is also possible that a combination of these mechanisms is culprit. The remaining option then entails that the deliberative-inhibition-of-intuition mechanism is otherwise broken.

Table 2
Complete set of stimuli. Note that we restrict our analysis to the non-abstract data set.

Risk judgment stimuli			
Text	OCD theme	Event structure	Person affected
Stimuli (as used in analysis)			
I will hurt myself by acting on an unacceptable impulse	Taboo thoughts	Effect	Self
I will both lose self-control, and I will hurt myself by acting on an unacceptable impulse	Taboo thoughts	Cause & effect	Self
Given that I lose self-control, I will hurt myself by acting on an unacceptable impulse	Taboo thoughts	Effect given cause	Self
I will hurt a loved one by acting on an unacceptable impulse	Taboo thoughts	Effect	Other
I will both lose self-control, and I will hurt a loved one by acting on an unacceptable impulse	Taboo thoughts	Cause & effect	Other
Given that I lose self-control, I will hurt a loved one by acting on an unacceptable impulse	Taboo thoughts	Effect given cause	Other
I will become seriously ill	Contamination/washing	Effect	Self
I will both not wash my hands enough, and I will become seriously ill	Contamination/washing	Cause & effect	Self
Given that I do not wash my hands enough, I will become seriously ill	Contamination/washing	Effect given cause	Self
A loved one will become seriously ill	Contamination/washing	Effect	Other
I will both not wash my hands enough, and a loved one will become seriously ill	Contamination/washing	Cause & effect	Other
Given that I do not wash my hands enough, a loved one will become seriously ill	Contamination/washing	Effect given cause	Other
Something terrible will happen to me	Checking/just right (harm)	Effect	Self
I will both not check things over and over again, and something terrible will happen to me	Checking	Cause & effect	Self
Given that I do not check things over and over again, something terrible will happen to me	Checking	Effect given cause	Self
Something terrible will happen to a loved one	Checking	Effect	Other
I will both not check things over and over again, and something terrible will happen to a loved one	Checking	Cause & effect	Other
Given that I do not check things over and over again, something terrible will happen to a loved one	Checking	Effect given cause	Other
I will both not arrange things in a particular order, and something terrible will happen to me	Just right (harm)	Cause & effect	Self
Given that I do not arrange things in a particular order, something terrible will happen to me	Just right (harm)	Effect given cause	Self
I will both not arrange things in a particular order, and something terrible will happen to a loved one	Just right (harm)	Cause & effect	Other
Given that I do not arrange things in a particular order, something terrible will happen to a loved one	Just right (Harm)	Effect given cause	Other
I will feel very uneasy	Just right (distress)	Effect	Self
I will both not arrange things in a particular order, and I will feel very uneasy	Just right (distress)	Cause & effect	Self
Given that I do not arrange things in a particular order, I will feel very uneasy	Just right (distress)	Effect given cause	Self
Abstract stimuli (not used in analysis)			
I will get hurt	Taboo thoughts	Effect	Self
I will both not be careful, and I will get hurt	Taboo thoughts	Cause & effect	Self
Given that I am not careful, I will get hurt	Taboo thoughts	Effect given cause	Self
I will get sick	Contamination/washing	Effect	Self
I will both not wash my hands, and I will get sick	Contamination/washing	Cause & effect	Self
Given that I do not wash my hands, I will get sick	Contamination/washing	Effect given cause	Self
My home will be broken into	Checking	Effect	Self
I will both forget to lock my front door, and my home will be broken into	Checking	Cause & effect	Self
Given that I forget to lock my front door, my home will be broken into	Checking	Effect given cause	Self
I won't be able to focus	Just right	Effect	Self
I will both not organize my things just right, and I won't be able to focus	Just right	Cause & effect	Self
Given that I do not organize my things just right, I won't be able to focus	Just right	Effect given cause	Self

Gillan et al. (2011) claim that dysfunction in goal-directed behavior leads to an overreliance on habit-based behavior, implying that deliberation is the primary cause of OCD symptomology, but also that a secondary dysfunction resides in intuition. Thus, we take their theory to mean that together a hyperactive intuition and a hypoactive deliberation share culpability in OCD. Boyer and Lienard (2008) corroborate such an account, saying that, "vigilance networks in the brain are too loud, the spontaneous reactions to danger they suggest are too salient, and the systems that usually inhibit them are too weak." (p. 291).

The present experiment is limited in that it does not distinguish among the possible mechanisms for intuition inhibition in OCD. Natural extensions for future research would attempt to pinpoint such a mechanism, but would also include investigation into the usefulness of similar approaches in studying other anxiety-related diseases, such as body dysmorphia and major depressive disorder because these conditions also hint at dissociable systems of reasoning. Furthermore, the behavioral dimensions of OCD highlighted by our methods may prove helpful in patient examination before and after various treatment options, as accurate risk judgments are needed in order to maintain a more accurate view of the world. We have demonstrated that perceptions of risk are not as stable as may have been thought previously. In fact, judgments may be attenuated merely by requesting that participants respond slowly or quickly. This has obvious implications for any setting in which a patient is being diagnosed or treated via the elicitation of likelihood judgments, as it seems that —at least in OCD—there may be more than one way to ask a question.

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Appendix A

Risk judgment stimuli are provided in Table 2.

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