Journal of Anxiety Disorders 63 (2019) 1–8

Contents lists available at ScienceDirect

Journal of Anxiety Disorders

journal homepage: www.elsevier.com/locate/janxdis

Inverse reasoning processes in obsessive-compulsive disorder: Replication in a clinical sample

Shiu F. Wong[a,*], Frederick Aardema[b,c], Jessica R. Grisham[d]

[a] Department of Psychology, Concordia University, 7141 Sherbrooke Street West, Montréal, QC, H4B 1R6, Canada
[b] Centre de recherche de l'Institut universitaire en santé mentale de Montréal, Montréal, QC, Canada
[c] Department of Psychiatry and Addictology, University of Montréal, Montréal, QC, Canada
[d] School of Psychology, UNSW Sydney, NSW, Australia

ARTICLE INFO

Keywords:
Inference-based approach
Inverse reasoning
Inferential confusion
Obsessive-compulsive disorder

ABSTRACT

The inference-based approach (IBA) is one cognitive model that aims to explain the aetiology and maintenance of obsessive-compulsive disorder (OCD). IBA theory suggests that certain reasoning processes lead an individual with OCD to confuse imagined possibilities with actual probabilities, a process termed inferential confusion. One such reasoning process is inverse reasoning, where hypothetical causes form the basis of conclusions about reality. Recently, we developed a task-based measure of inverse reasoning. In an online sample, we reported significant and positive associations between endorsement of inverse reasoning on this task and OCD symptomatology. We concluded that there was some support for the role of inverse reasoning in OCD but these results required extension using a between-groups design in a clinical sample. Therefore, the present study compared endorsement in inverse reasoning on this task between individuals diagnosed with OCD, anxiety and/or mood disorder (clinical controls), and healthy individuals (healthy controls). Relative to both control groups, the OCD group demonstrated significantly greater endorsement in inverse reasoning on scenarios where OCD relevant concerns were prompted. When non-OCD relevant concerns were involved, the OCD group only evidenced greater endorsement in inverse reasoning relative to the healthy control group. Implications for IBA theory are discussed.

1. Introduction

Much of our understanding of obsessive-compulsive disorder (OCD) has been influenced by the cognitive appraisal model, which proposes that obsessions originate from catastrophic misappraisals of the personal significance of one's thoughts, impulses, or images (Rachman, 1997). An important assumption of this model is that the content of the intrusions experienced by those with and without OCD are similar, and although there is strong support for this assumption (Rachman & de Silva, 1978; Radomsky et al., 2014; Salkovskis & Harrison, 1984), there are other parameters than content that appear to differentiate between clinical and non-clinical obsessions. For instance, Audet, Aardema, and Moulding (2016) found that abnormal intrusions, relative to normal intrusions, were more likely to occur without an obvious relationship to their immediate environment or without any direct evidence for their validity. In other words, normal intrusions are directly linked to observations in the here-and-now (e.g., while inside their house, having the urge to check whether the doors are locked) whereas abnormal intrusions are grossly incompatible with the context in which they occur (e.g., having the urge to check whether the doors are locked while walking down the street).

The cognitive appraisal model further proposes that dysfunctional beliefs held by the individual with OCD drives his or her appraisal of intrusions as being personally meaningful. For example, an individual who believes that they are responsible for preventing negative outcomes (i.e., inflated responsibility; Salkovskis, 1985) might interpret an intrusive thought of them harming a child as a sign that he is a dangerous individual. According to the model, the personal significance of the intrusion causes it to acquire obsessional qualities such as increased intensity, duration, frequency, and anxiety evoked (Rachman, 1997; Salkovskis, 1985). The role of these dysfunctional appraisals based on these beliefs have been empirically-validated in individuals with OCD (Julien et al., 2008); however, some studies have since reported that 25–73% of individuals diagnosed with OCD do not report high levels of dysfunctional appraisals (Calamari et al., 2006; Polman, O'Connor, & Huisman, 2011; Taylor et al., 2006). These findings suggest that

* Corresponding author.
E-mail address: shiu.wong@concordia.ca (S.F. Wong).

https://doi.org/10.1016/j.janxdis.2019.01.005
Received 11 July 2018; Received in revised form 10 January 2019; Accepted 12 January 2019
Available online 29 January 2019

Table 1
Examples from the Inverse Reasoning Task.

OCD relevant scenario	Non-OCD relevant scenario
Andy is jogging along the street and reaches a pedestrian crossing. As he is waiting to cross the road, he observes a recently installed bench across the road. He arrives at the bench and is about to rest on it when he suddenly thinks to himself, "This bench could have been touched by a lot of people, so it's most likely to be dirty". He decides that the bench is dirty and does not sit on it.	Juliet is out doing field work when her mother calls about this skirt she saw online and wants to buy for her. Since she has no internet access, Juliet asks her mother to buy the skirt in blue. After hanging up the call, Juliet immediately thinks "My mother probably took down my order wrong in her rush, so my skirt could be the wrong colour". She calls her mother to change the order.

dysfunctional beliefs and appraisals may not completely account for the aetiology of OCD (Julien, O'Connor, & Aardema, 2016).

The inference-based approach (IBA) is an alternate cognitive model of OCD that can be combined in practice with the cognitive appraisal model, and together may improve our understanding of the aetiology of OCD. Importantly, IBA theory reconceptualises obsessions as pathological doubts or imagined possibilities about reality that are grossly incompatible with the actual state of the world (O'Connor, Ecker, Lahoud, & Roberts, 2012), but are inferred to be true via a process termed inferential confusion (Aardema, O'Connor, & Emmelkamp, 2006; Aardema, O'Connor, Emmelkamp, Marchand, & Todorov, 2005; O'Connor & Robillard, 1995). Specifically, when typically benign doubts (e.g., 'the car *might be* unlocked') are inferred to be true (e.g., 'the car *is* unlocked'; primary inference; O'Connor et al., 2012) because of inferential confusion, any consequences are also inferred to be true (e.g., 'my car *will be* stolen'; secondary inference; O'Connor et al., 2012). This process generates anxiety and distress which individuals with OCD attempt to reduce via compulsive behaviours (e.g., constantly checking on the car). According to the IBA, the dysfunctional OCD beliefs and metacognitions identified by the cognitive appraisal model (e.g., 'I am *solely responsible* for the safety of my car') further exacerbates and maintains obsessional anxiety and distress following the development of the primary inference.

Inferential confusion is characterised by maladaptive reasoning processes proposed to be exclusive to OCD, with inverse reasoning being a core reasoning process (for a detailed explanation of the other reasoning devices, see O'Connor et al., 2012). Inverse reasoning is the opposite of normal or healthy reasoning, in which a conclusion follows the observation of a state of affairs (e.g., 'this pole is dirty, therefore a lot of people must have touched this pole'). In inverse reasoning, a hypothesised cause is believed to be true ('a lot of people must have touched this pole'), leading to the conclusion that the effect must be true ('therefore, it must be dirty') despite opposing sensory evidence (that the pole is clean). IBA theory suggests that individuals with OCD typically use this reasoning process in combination with other reasoning devices to justify their doubts (O'Connor et al., 2012). This justification of doubt takes the form of an inductive narrative, which is part of the obsessional process. In sum, the IBA argues that the process of inferential confusion drives the genesis of obsessions, rather than the appraisal of intrusions. Again, the IBA does concede a role for cognitive appraisal, but suggests that cognitive appraisals serve to maintain obsessions rather than cause them (Julien et al., 2016).

Aardema et al. (2010) developed the Inferential Confusion Questionnaire – Expanded Version (ICQ-EV) to measure the construct of inferential confusion. This questionnaire contains items that reflect the key reasoning processes characteristic of inferential confusion, including inverse reasoning (e.g., 'I am sometimes more convinced by what might be there than by what I actually see'). Higher scores on the ICQ-EV indicate a greater degree of reliance on these reasoning processes and consequently an increased tendency to confuse imagined possibilities with reality. There is general support for the IBA, with researchers across multiple studies having reported positive and significant associations between the ICQ-EV and OCD symptoms, even when controlling for negative mood states and the maladaptive belief domains proposed by the cognitive appraisal model (Aardema et al., 2005, 2013; Aardema, Radomsky, O'Connor, & Julien, 2008; Aardema & Wu, 2011; Aardema et al., 2010; Paradisis, Aardema, & Wu, 2015; Wong & Grisham, 2017b; Wu, Aardema, & O'Connor, 2009). Most recently, in a large clinical sample of individuals diagnosed with OCD, Aardema, Wu, Moulding, Jean-Sebastien, and Louis-Philippe (2018) found that the ICQ-EV uniquely predicted OCD symptoms related to repugnant obsessions, checking, and just right experiences. Experimental reasoning studies have also confirmed claims of the IBA model of inferential confusion in that individuals with OCD tend to overinvest in possibilities, but these studies have no specifically tested inverse reasoning.

Although inferential confusion and the IBA appear to meaningfully add to our understanding of OCD, proponents of this theory have acknowledged that only a few studies across a small number of research laboratories have investigated its key constructs and that the model requires additional empirical support using different methodological strategies (Julien et al., 2016). To address these limitations, primarily the overreliance on self-report questionnaires in the IBA literature, our laboratory designed a task-based measure of inverse reasoning or the Inverse Reasoning Task (IRT; Wong & Grisham, 2017b). On this task, participants are presented with 18 scenarios, each describing a character who uses inverse reasoning to justify their conclusions about reality. Half of these scenarios involve OCD concerns (e.g., contamination, harm to others) and the other half do not (see Table 1 for examples of an OCD relevant scenario and non-OCD relevant scenario). After reading each scenario, participants are asked to rate how much they agree with the logic of the character's (inverse) reasoning. Higher scores indicate greater endorsement in inverse reasoning by the individual. Controlling for general distress and OCD beliefs, scores on the IRT considering all scenarios and just scenarios with OCD relevant concerns were positively and significantly associated with OCD symptoms in an online community sample, but not with symptoms associated with social anxiety disorder, generalised anxiety disorder, and schizotypal personality disorder (Wong & Grisham, 2017b). Our studies offered support for the IBA claim that inverse reasoning has a unique role in OCD (especially when OCD concerns are activated), but this required further validation using between-groups designs comparing different clinical groups on the IRT.

As such, the primary aim of the current study was to compare the performance on the IRT between a group of individuals diagnosed with OCD, a group of individuals diagnosed with a mood or anxiety disorder but not OCD (i.e., clinical control group), and a healthy control group. Extending our previous results detailed in Wong and Grisham (2017b), we predicted that the OCD group, relative to both control groups, would score higher on the IRT when considering all scenarios and just the OCD relevant scenarios. No differences were expected between groups on the non-OCD relevant scenarios.

2. Method

2.1. Participants

The current study was conducted in Sydney, Australia, and the sample was recruited through previous participant databases and community advertisements. Participants received $20 AUD per hour for their participation. All participants were pre-screened via telephone on the OCD module of the Anxiety and Related Disorders Interview

Table 2
DSM-5 Axis I Diagnoses Comorbid for the OCD Group (n = 24) and the Clinical Control Group (n = 24).

Diagnosis	OCD *n* (%)	Clinical control *n* (%)
Major depressive disorder	2 (8.3)	2 (8.3)
Bipolar disorder	0	0
Social anxiety disorder	1 (4.2)	4 (16.7)
Panic disorder with or without agoraphobia	5 (20.8)	5 (20.8)
Post-traumatic stress disorder	6 (25)	3 (12.5)
Generalised anxiety disorder	13 (54.2)	18 (75)
Eating disorder	2 (8.3)	2 (8.3)
Other	2 (8.3)	2 (8.3)

Note. Other = hypomanic symptoms and agoraphobia without panic disorder.

Schedule for DSM-5 (ADIS-5; Brown & Barlow, 2014) and were questioned regarding any clinically significant anxiety or mood symptoms and other exclusion criteria. Participants who met current diagnostic criteria for OCD on this phone pre-screening were invited to come into the laboratory at the University of New South Wales, Australia, to participate in the larger study. Participants who reported current clinically significant anxiety or mood symptoms (but not OCD) were invited as part of the clinical control group. Finally, participants without current clinically significant psychopathological symptoms (or past but not current) were invited as part of the healthy control group. Participants reporting current psychotic symptoms, substance abuse, or suicidal ideation were excluded from the study.

Once participants arrived at the laboratory, clinical diagnoses were confirmed using a structured diagnostic interview (M.I.N.I., described below) administered by a graduate student in clinical psychology who was supervised by an experienced clinical psychologist. Table 2 displays current comorbid diagnoses for the OCD group and the clinical control group. The final sample consisted of 75 participants, with 24 in the OCD group (15 females, mean age = 34.54, *SD* = 16.05, range 18–65), 24 in the clinical control group (17 females, mean age = 31.50, *SD* = 15.73, range 19–80), and 27 in the healthy control group (17 females, mean age = 43.52, *SD* = 15.94, range 21–68). The sample demographics are provided in Table 3.

Table 3
Sample Demographics (N = 75).

	Group		
	OCD (*n* = 24)	Clinical control (*n* = 24)	Healthy control (*n* = 27)
Gender	Male = 9 (37.5%)	Male = 7 (29.2%)	Male = 10 (37%)
Age	34.54 years (16.05)	31.50 years (15.73)	43.52 years (15.94)
Marital status			
Single	58.3%	79.2%	48.1%
Married/de facto	29.1%	12.5%	40.7%
Ethnicity			
Caucasian	41.7%	50%	48.1%
Other	58.3%	50%	51.9%
Employment			
Employed	81.8%	87.5%	80%
Other[a]	18.2%	12.5%	20%
Education			
Tertiary	70.8%	62.5%	77.7%
Secondary	25%	33.3%	18.5%

Note. [a] Includes individuals who are not working, retired, and unemployed.

2.2. Materials and measures

2.2.1. Mini international neuropsychiatric interview – version 7.0.0 for DSM-5 (M.I.N.I.; Sheehan et al., 1998)

The M.I.N.I. is a brief structured interview that assesses diagnostic criteria for current and past major psychiatric disorders described in the DSM-5 and ICD-10. Diagnoses determined through the M.I.N.I. are highly consistent with both the Composite International Diagnostic Interview for ICD-10 (CIDI; World Health Organization, 1990) and the Structured Clinical Interview for DSM-III-R (SCID; Spitzer, Williams, Gibbon, & First, 1990). Cohen's kappa scores range from fair to excellent (for OCD: kappa = 0.63, sensitivity = 0.62, specificity = 0.98; kappa scores for other disorders are detailed in Lecrubier et al., 1997; Sheehan et al., 1997).

2.2.2. Dimensional obsessive-compulsive scale (DOCS; Abramowitz et al., 2010)

The DOCS is a 20-item self-report questionnaire that was used to measure four dimensions of OCD symptoms (i.e., concerns regarding contamination, responsibility for harm, unacceptable obsessional thoughts, and symmetry and completeness) experienced during the past month. The DOCS total and subscale scores has high internal consistencies across varying samples, ranging from 0.83 to 0.94 (Abramowitz et al., 2010). This was comparable to the current sample (0.89 – 0.95). The DOCS has been shown to have significant positive correlations with total scores of other OCD measures (r = 0.54 – 0.71; Abramowitz et al., 2010).

2.2.3. Obsessive beliefs questionnaire – 44 item version (OBQ-44; Obsessive Compulsive Cognitions Working Group, 2005)

The OBQ-44 is a 44-item self-report questionnaire that was used to measure the beliefs associated with OCD symptomatology (i.e., responsibility and threat estimation, perfectionisms and intolerance of uncertainty, and importance and control of thoughts). The internal consistency of the total score is excellent at 0.95 for a sample with clinical and non-clinical participants (Obsessive Compulsive Cognitions Working Group, 2005) and comparable to the current sample (0.97). The OBQ-44 total score shows significant correlations with OCD symptoms (r = 0.27 – 0.59; Obsessive Compulsive Cognitions Working Group, 2005).

2.2.4. Inferential confusion questionnaire – expanded version (ICQ-EV; Aardema et al., 2010)

The ICQ-EV is a 30-item self-report questionnaire that was used to measure the broad range of reasoning devices that characterise inferential confusion (including a distrust of the senses and inverse reasoning; e.g., 'I often react to a scenario that might happen as if it is actually happening'). Higher scores indicate an overreliance on maladaptive reasoning devices and an increased tendency to confuse imagination with reality. The ICQ-EV has been validated in clinical and non-clinical samples (Aardema et al., 2010), showing significant correlations with OCD symptoms when controlling for negative affect (r = 0.38 – 0.68) and OCD belief domains (r = 0.40). The total scale has high internal consistencies ranging from 0.96 to 0.97 and was comparable to the current sample (Cronbach's alpha = 0.96).

2.2.5. Inverse reasoning task (IRT; Wong & Grisham, 2017b)

We developed the IRT as a task-based measure of inverse reasoning, in which a hypothesised cause is believed to be true despite the lack of sensory evidence. Participants are sequentially presented with 18 scenarios, 9 involving OCD relevant concerns (e.g., contamination, harm to others) and 9 scenarios reflecting non-OCD relevant concerns (e.g., punctuality). In each scenario, a character displays inverse reasoning when confronted with an object or situation. Following the presentation of each scenario, participants are asked to rate how much they agree with the character's conclusion and the logic of their (inverse)

reasoning (highlighted to participants as the part of the scenario in quotation marks), based only on the information provided in the scenarios. Ratings are made on a 1 to 7-point scale (where 1 = *strongly disagree* and 7 = *strongly agree*). Higher scores indicate greater endorsement in inverse reasoning and their subsequent conclusions. Separate subscale scores are obtained for the OCD relevant scenarios and non-OCD relevant scenarios, and a total scale score is computed for all scenarios. The IRT has been validated in a non-clinical sample (Wong & Grisham, 2017b), with OCD symptoms showing significant correlations with the IRT total scale score ($r = 0.19$) and scores on the OCD relevant scenarios ($r = 0.20$), controlling for negative affect and OCD belief domains. Internal consistencies (as indicated by Cronbach's alpha) of the IRT were acceptable and comparable to those reported in Wong and Grisham (2017b). Cronbach's alpha was 0.66 for the OCD relevant scenarios, 0.76 for the non-OCD relevant scenarios, and 0.83 for all scenarios. See Appendix A for complete task.

2.3. Procedure

Following the phone pre-screening, eligible participants were invited to the laboratory to participate in the larger study. After arriving at the laboratory, participants provided informed consent and the experimenter administered the M.I.N.I. to confirm group membership. Participants then answered a series of demographic questions and the IRT on the computer. They then completed computerised versions of the DOCS, OBQ-44, and ICQ-EV. Finally, the experimenter debriefed, thanked, and paid participants.

3. Results

3.1. Sample characteristics

A chi-square test confirmed that groups did not differ in gender distribution, $\chi^2(2, N = 75) = 0.47$, $p = 0.79$. A univariate analysis of variance (ANOVA) indicated that groups significantly differed in age, $F(2, 72) = 3.98$, $p = 0.02$, $\eta_p^2 = 0.10$. Bonferroni-corrected post-hoc comparisons indicated that the healthy control group was significantly older than the clinical control group ($p = 0.03$). Since the pattern of results did not differ after statistically controlling for age, and comparisons between the healthy and clinical control groups were not of primary interest, the results below are presented without this statistical control.

We conducted a multivariate ANOVA to determine whether groups differed with regards to self-reported OCD symptoms (DOCS) and the cognitive factors relevant to OCD (OBQ-44 and ICQ-EV). Using Pillai's Trace, there was a significant effect of group on these measures, $F(6, 140) = 8.06$, $p < 0.001$, $\eta_p^2 = 0.26$. Separate univariate ANOVAs on each outcome variable were also significant ($ps < 0.001$). Bonferroni-corrected post-hoc comparisons indicated that the OCD group reported more OCD symptoms than either control group ($ps < 0.05$), suggesting successful group assignment based on the diagnostic interview. Contrary to predictions and findings reported by previous studies, the OCD group scored significantly higher on measures of OC beliefs and inferential confusion relative to only the healthy control group ($ps < 0.001$). See Table 4 for all other comparisons.

3.2. Convergent validity of the IRT

To determine that the IRT and the ICQ-EV were both measuring inverse reasoning and not cognitive constructs central to alternative theoretical accounts of OCD (i.e., OC beliefs), we conducted a bivariate correlation between these measures and a partial correlation controlling for scores on the OBQ-44. Endorsement in inverse reasoning on the IRT across all scenario types was significantly and positively associated with scores on the ICQ-EV: $r = 0.62$, $p < 0.001$ (all scenarios); $r = 0.52$, $p < 0.001$ (OCD relevant scenarios); and $r = 0.60$, $p < 0.001$ (non-OCD relevant scenarios). These associations remained significant after controlling for OCD beliefs: $r = 0.45$, $p < 0.001$ (all scenarios); $r = 0.29$, $p = 0.01$ (OCD relevant scenarios); and $r = 0.49$, $p < 0.001$ (non-OCD relevant scenarios).

To explore the relationship between inverse reasoning and OCD symptoms, we conducted an additional bivariate correlation between the IRT and the DOCS and a partial correlation controlling for scores on the OBQ-44. Endorsement in inverse reasoning on the IRT across all scenario types was significantly and positively associated with scores on the DOCS: $r = 0.55$, $p < 0.001$ (all scenarios); $r = 0.52$, $p < 0.001$ (OCD relevant scenarios); and $r = 0.48$, $p < 0.001$ (non-OCD relevant scenarios). These associations remained significant after controlling for OCD beliefs: $r = 0.33$, $p = 0.004$ (all scenarios); $r = 0.31$, $p = 0.01$ (OCD relevant scenarios); and $r = 0.28$, $p = 0.02$ (non-OCD relevant scenarios).

3.3. Between-group differences on the IRT

To examine differences between the OCD group and the control groups on scores for the IRT total scale (all scenarios) and both subscales (OCD and non-OCD relevant scenarios), we first conducted a multivariate ANOVA. Using Pillai's Trace, there was a significant effect of group on endorsement of inverse reasoning for the IRT total scale and subscales, $F(4, 144) = 3.15$, $p = 0.02$, $\eta_p^2 = 0.08$. Separate univariate ANOVAs for the total scale and subscales were also significant ($ps < 0.05$). Given our *a priori* hypotheses, we examined two planned contrasts for each univariate ANOVA (i.e., OCD vs. clinical controls, OCD vs. healthy controls). When considering all scenarios on the IRT, endorsement in inverse reasoning was significantly higher for the OCD group relative to the healthy control group ($p = 0.001$) and the clinical control group ($p = 0.04$). For OCD relevant scenarios, endorsement in inverse reasoning was significantly higher for the OCD group relative to the healthy control group ($p = 0.002$) and the clinical control group ($p = 0.02$). Finally, for non-OCD relevant scenarios, endorsement in inverse reasoning was significantly higher for the OCD group relative to the healthy control group ($p = 0.003$) but not the clinical control group ($p = 0.14$). Although we had no a priori predictions about the differences between the control groups on the IRT total scale and subscales, we explored these using Bonferroni-corrected post-hoc comparisons. None of these comparisons were significant ($ps > 0.43$), further highlighting the specificity of inverse reasoning in OCD. See Table 5 for group means, standard deviations, and test statistics for the IRT.

4. Discussion

The current study aimed to extend on Wong and Grisham (2017b) by comparing clinical groups on their performance on a tasked-based measure of inverse reasoning. We found strong support for our hypotheses. Individuals with OCD endorsed greater levels of inverse reasoning compared to both clinical and healthy controls on the IRT when considering all scenarios and just scenarios which activated OCD relevant concerns. Contrary to prediction, the OCD group also scored higher than the healthy controls on the IRT for non-OCD scenarios. Furthermore, exploratory analyses revealed that the clinical controls did not score significantly higher than the healthy controls on these scenarios. Together, these findings echo the conclusions made in our previous study and the general IBA literature (Julien et al., 2016), with a significant addition: that inverse reasoning has a distinct role in OCD *regardless* of whether or not OCD concerns are activated. In other words, inverse reasoning appears to be particularly elevated in individuals with OCD and may be a reasoning process they apply to a diverse range of situations, not just disorder-specific. These results, while promising, need to be replicated in larger clinical studies before definitive conclusions can be drawn.

Although the current results do not speak to the central IBA assertion that inverse reasoning and inferential confusion *cause* OCD, our

Table 4
Group Means, Standard Deviations, and Test Statistics for Questionnaire Responses (N = 75).

	Group								
	OCD (n = 24)		Clinical control (n = 24)		Healthy control (n = 27)				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*(71)	*p*	η_p^2
DOCS	28.74	14.02	17.33[a]	11.95	8.22[b]	7.01	20.34	< 0.001	0.36
OBQ-44	210.35	50.52	182.46	50.81	135.93[a]	43.06	15.45	< 0.001	0.30
ICQ-EV	119.35	23.42	110.33	29.42	74.78[a]	23.81	21.54	< 0.001	0.38

Note. DOCS = Dimensional Obsessive-Compulsive Scale, OBQ-44 = Obsessive Beliefs Questionnaire – 44, ICQ-EV = Inferential Confusion Questionnaire – Expanded Version. Within rows, means with differing alphabetical superscripts indicates differences significant at $p < .05$ (Bonferroni-corrected post-hoc comparisons).

Table 5
Group Means, Standard Deviations, and Test Statistics for the IRT (N = 75).

	Group								
	OCD (n = 24)		Clinical control (n = 24)		Healthy control (n = 27)				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*(72)	*p*	η_p^2
Total Lgc	3.96	0.97	3.45	0.89	3.16	0.62	6.01	0.004	0.14
Non-OCD Lgc	4.15	1.11	3.72	1.09	3.30	0.81	4.56	0.01	0.11
OCD Lgc	3.77	0.93	3.18	0.93	3.01	0.67	5.44	0.01	0.13

Note. Total Lgc = endorsement in inverse reasoning on all scenarios, Non-OCD Lgc = endorsement in inverse reasoning on non-OCD relevant scenarios, OCD Lgc = endorsement in inverse reasoning on OCD relevant scenarios.

laboratory has recently provided preliminary evidence to this effect (Wong & Grisham, 2017a). In this study, we trained inverse reasoning in an undergraduate sample through an adapted version of the cognitive bias modification paradigm. Individuals trained in a bias towards inverse reasoning, relative to those who received control training, self-reported more OCD symptoms and evidenced increased contamination-related avoidance on a behavioural approach task (Najmi, Tobin, & Amir, 2012). Of note, we were able to specifically train this bias towards inverse reasoning without concurrently increasing bias towards threat or general negativity, which is in contrast to one speculative critique of inverse reasoning (Gangemi, Mancini, & Dar, 2015). In sum, we have used a variety of methodological strategies in providing converging empirical support for the role of inverse reasoning in OCD. These findings also suggest that it may be beneficial to target inverse reasoning in treatments for OCD, such as the treatment based on the IBA (Inference-Based Treatment; for a description see O'Connor, Koszegi, Aardema, van Niekerk, & Taillon, 2009).

Similar to Wong and Grisham (2017b), current results highlight the specificity of the IRT over other self-report measures of inferential confusion and OCD beliefs. That is, scores on the IRT successfully differentiated individuals with OCD from clinical controls whereas the ICQ-EV and the OBQ-44 did not, despite the pattern of means being in the expected direction. Small group sizes may have led to the lack of significant differences between the clinical groups on these self-report questionnaires, again emphasising the need to replicate the current study in a larger sample. However, the lack of differences on the OBQ-44 was not entirely unexpected, as some findings in the literature have cast doubt on whether these belief domains are unique to OCD. For example, Tolin, Worhunsky, and Maltby (2006) reported no significant differences between a group diagnosed with OCD and a non-obsessional anxious control group on most of these belief domains when controlling for depression and trait anxiety.

In the same vein, the lack of significant differences between the clinical groups on the ICQ-EV may be due to it being a measure of inferential confusion, an overall tendency to confuse imagined possibilities with reality (not just inverse reasoning), which is perhaps elevated in disorders other than OCD. Indeed, using an earlier version of the ICQ-EV, Aardema et al. (2005) found that individuals diagnosed with delusional disorder reported elevated levels of inferential confusion relative to groups a non-obsessional anxiety disorder or no disorders. We have previously also found positive and significant associations between this measure of inferential confusion (but not inverse reasoning on the IRT) and symptoms of social anxiety disorder and generalised anxiety disorder, when controlling for general distress and OCD beliefs (Wong & Grisham, 2017b). These findings together with the observation that generalised anxiety disorder was highly comorbid in both the current study's OCD group (54.2%) and the clinical control group (75%), may partially explain the lack of significant differences on the ICQ-EV. Again, however, small group sizes may have precluded us from finding significant differences between the clinical groups on this measure, especially since the IRT was significantly associated with the ICQ-EV, the OCD group had numerically higher scores on the ICQ-EV relative to the clinical control group, and previous research has shown the ICQ-EV to reliably differentiate between those with OCD and non-OCD anxiety disorders (e.g., Aardema et al., 2010).

4.1. Limitations and future directions

Since inferential confusion may be implicated in other psychological disorders, it is similarly possible that inverse reasoning is not unique to OCD and may be a transdiagnostic factor (O'Connor, Ouellet-Courois, & Aardema, 2018). Although there were no significant differences between the clinical and healthy control groups on any of the IRT scales, perhaps significant differences would have been found if the clinical control group rated their endorsement in inverse reasoning on scenarios with concerns relevant to their primary diagnosis. Clinically-speaking, inverse reasoning may present in some other psychological disorders. For instance, an individual with social anxiety disorder may find themselves in a social interaction and experience the following thought process: 'I *might* have said something inappropriate to her, therefore they *must* think poorly of me'. Following an argument with their significant other, an individual with depression may think: 'I *might* be a terrible partner, therefore she will *definitely* leave me'. In both these examples, inverse reasoning may only manifest when the individual is confronted with their disorder-specific threat (i.e., fear of negative evaluation or abandonment). As such, future studies could investigate the precise role of inverse reasoning in different psychological disorders by matching the stimuli on the IRT to the disorder being investigated.

5. Conclusions

The current study has provided further converging evidence for the IBA proposition that inverse reasoning is distinct to OCD. Future research could modify this task to investigate the role of inverse reasoning in other psychological disorders, perhaps leading to additional treatment targets and interventions for these disorders.

Funding

This research was supported by an Australian Postgraduate Award of the Australian Federal Government awarded to the first author and an Australian Research Council Future Fellowship FT140100207 awarded to the third author.

Contributors

All authors made significant contributions to the conception of the study. Shiu Wong designed and conducted the research, analysed the data, interpreted and drafted the results, and prepared the manuscript. Frederick Aardema contributed to the interpretation of results and to the writing of the manuscript. Jessica Grisham contributed to the design of the research, interpretation of results, and to the writing of the manuscript.

Conflict of interest

None of the authors have any conflict of interest to report.

Appendix A. Inverse Reasoning Task

Instructions:

Please read the following scenarios as quickly and accurately as you can. Then rate your agreement with the conclusions and the logic of the reasoning, which is provided in quotation marks (“”). Please only use the information provided in the scenario to guide your ratings.

All ratings are provided on the following scale:

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree

1. Scenario: Andy is jogging along the street and reaches a pedestrian crossing. As he is waiting to cross the road, he observes a recently installed bench across the road. He arrives at the bench and is about to rest on it when he suddenly thinks to himself, “This bench could have been touched by a lot of people, so it’s most likely to be dirty”. He decides that the bench is dirty and does not sit on it. *(OCD – contamination).*

How much do you agree with Andy’s conclusion that the bench is dirty?
How much do you agree with the logic of his reasoning?

2. Scenario: Nick is sitting in his office at work when he remembers that he had left an important document in his car in the car park. He returns to his car, retrieves the document, and then locks his car. As he is walking back towards the office he thinks, “I bet my car’s locking mechanism might be faulty, and so my car is probably unlocked”. He goes back to his car to lock it. *(OCD – checking).*

How much do you agree with Nick’s conclusion that his car door is unlocked?
How much do you agree with the logic of his reasoning?

3. Scenario: William is meeting with friends at the local café when he realises that he needs to rush home and prepare dinner for his girlfriend before she gets home from work. He picks up his bag and runs for home, which fortunately is close by. He is almost home when he suddenly has the thought, “I might have dropped my keys in my rush, so it’s most likely that my keys are not in my bag”. He searches his bag thoroughly for his keys. *(OCD – checking)*

How much do you agree with William’s conclusion that his keys are not in his bag?
How much do you agree with the logic of his reasoning?

4. Scenario: Stephanie is sitting at a table in the food court. She becomes very tired while waiting for her friend to bring back food. She folds up her bare arms on the table to rest her head for a while when she has the sudden thought, “I reckon this table might have been cleaned with harmful chemicals, and so my arms are probably contaminated”. She makes a mental note to wash her arms thoroughly when she returns home. *(OCD – contamination).*

How much do you agree with Stephanie’s conclusion that her arms are contaminated with harmful chemicals?
How much do you agree with the logic of her reasoning?

5. Scenario: Calvin is printing off the course outline for him and his friend Amy. He collects the course outlines from the printer and goes to Amy’s office to hand her a copy. He is reading through the outline in his own office when he has the sudden thought, “The paper in that course outline might have given Amy a paper cut, so her hand could be bleeding at the moment”. He finds a Band-Aid and takes it up to her office. *(OCD – harm).*

How much do you agree with Calvin’s conclusion that Amy’s hand is bleeding?
How much do you agree with the logic of his reasoning?

6. Scenario: Diana recently moved into an apartment with a roommate and is setting up for a housewarming party for tonight. After she pours out some chips in a bowl and sets it on the table, she realises that she forgot to buy cake and heads out quickly to the nearby bakery. While shopping for a cake, she suddenly has the thought, “My roommate could be hungry, so some of my chips are most likely missing from the bowl”. She hurries home to make sure her food is still there. *(Non-OCD).*

How much do you agree with Diana’s conclusion that some chips are missing?
How much do you agree with the logic of her reasoning?

7. Scenario: Steve is at a party waiting for his best friends, Sam and John, to arrive. Sam and John are roommates and told Steve that they would travel to the party together and arrive at 7 p.m. Steve glances at his watch, which says it is five minutes to seven, and then thinks, “The train Sam and John are on could be broken down, so they might be late for the party”. He takes out his phone to check if any trains have been delayed. *(Non-OCD).*

How much do you agree with Steve's conclusion that his friends are late for the party?
How much do you agree with the logic of his reasoning?

8. Scenario: Brandon is with his girlfriend Lucy at her sister's wedding dinner. He knows that Lucy has prepared a speech for her sister to deliver before dessert is served. He leaves the table to let her prepare in quiet when he thinks, "Lucy is probably very nervous, so her hands could be quite moist with sweat". He takes some serviettes from another table for Lucy to dry her hands on. *(Non-OCD)*.

How much do you agree with Brandon's conclusion that Lucy's hands are moist with sweat?
How much do you agree with the logic of his reasoning?

9. Scenario: Chris lives together with his roommate, Tim. It is 9 p.m. and he wants to call Tim out to watch a movie together. He is about to knock on Tim's closed door when he thinks to himself, "Tim most likely has to wake up early the next morning, so he's probably sleeping early tonight". He decides to watch the movie with Tim another night. *(Non-OCD)*.

How much do you agree with Chris' conclusion that Tim is sleeping early tonight?
How much do you agree with the logic of his reasoning?

10. Scenario: Melinda lives by herself in an apartment in Parramatta. She leaves her house and waits for a shuttle bus outside her apartment to take her to the airport as she needs to fly to Melbourne for a five-day business trip. She is still waiting for the bus when she thinks, "The lights in my house might not be working properly, so they are probably still on". She walks back towards her apartment to switch off the lights. *(OCD – checking)*.

How much do you agree with Melinda's conclusion that the lights in her house are still on?
How much do you agree with the logic of her reasoning?

11. Scenario: Sophia made a cake for the Christmas party in the office. Everyone in the office is eating the cake, even Alex the janitor, who Sophia did not know was coming to the party. She suddenly remembers that Alex has a peanut allergy and thinks, "It is possible that I accidentally used peanuts in that cake, so Alex might have an allergic reaction". She dials for medical assistance using her phone. *(OCD – contamination)*.

How much do you agree with Sophia's conclusion that Alex will have an allergic reaction?
How much do you agree with the logic of her reasoning?

12. Scenario: Matthew is a devout Christian. He knows that his church is planning to build a new prayer hall and has already donated some money. He is making an online booking for an expensive holiday in Europe when he suddenly thinks, "I might not have contributed enough money for the new prayer hall, so my church is most likely cancelling the building". He quickly calls up the church to try and convince them not to cancel the building. *(OCD – religious)*.

How much do you agree with Matthew's conclusion that his church is cancelling the building?
How much do you agree with the logic of his reasoning?

13. Scenario: Eric works as a research assistant at a university and lives with both his parents. He arrives home from work and notices that his mother's door is closed and that the house is quiet. He sees his father sleeping in the lounge room and thinks, "I bet my mother is not in the mood to talk to anyone, so she'll most likely not leave her room today". He decides to cook dinner and leave it in front of her door. *(Non-OCD)*.

How much do you agree with Eric's conclusion that his mother will not leave her room today?
How much do you agree with the logic of his reasoning?

14. Scenario: Christina is packing for a hiking expedition. Since it is an extremely hot day, she packs two full bottles of water to prevent dehydration. She is looking for her hiking shoes when she thinks, "My water bottle could be leaky, and so it is probably not full with water". She looks for another bottle to fill up with water. *(Non-OCD)*.

How much do you agree with Christina's conclusion that her water bottle is not full?
How much do you agree with the logic of her reasoning?

15. Scenario: Jacky's father asked him to sharpen all the knives in the kitchen. After sharpening all the knives, Jacky placed them back into the cutlery cupboard. He is sitting in the lounge room and can hear his father rummaging in the cutlery cupboard when he thinks, "One of the knives I sharpened could have cut my father's hand, so his hand is probably injured". He rushes into the kitchen to help his father. *(OCD – harm)*.

How much do you agree with Jacky's conclusion that his father's hand is injured?
How much do you agree with the logic of his reasoning?

16. Scenario: Wilson and his roommate David are both studying the same subject at university. Wilson had ordered the textbook for this subject and agreed to share with David. He reads a text sent three hours ago notifying him that the textbook has been delivered and thinks, "David could have needed to use the textbook, and so it is most likely open". He sends David a text to ask how long it is taking to read the first chapter. *(Non-OCD)*.

How much do you agree with Wilson's conclusion that his textbook is open?
How much do you agree with the logic of his reasoning?

17. Scenario: Esther is moving to Germany permanently and is having a farewell party at her house. Towards the end of the party, she moves around to each friend to exchange farewells. After her guests all leave, she begins to tidy up the house when she thinks, "I bet my friends might have spilt their drink onto my carpet, so there is probably a stain on it somewhere". She makes a mental note to buy some stain remover the next day. *(Non-OCD)*.

How much do you agree with Esther's conclusion that there is a stain on her carpet?
How much do you agree with the logic of her reasoning?

18. Scenario: Juliet is out doing field work when her mother calls about this skirt she saw online and wants to buy for her. Since she has no access

to internet, Juliet asks her mother to buy the skirt in blue. After hanging up the call, Juliet immediately thinks, “My mother probably took down my order wrong in her rush, so my skirt could be the wrong colour”. She calls to tell her mother to change the order. *(Non-OCD)*.

How much do you agree with Juliet’s conclusion that her skirt is the wrong colour?
How much do you agree with the logic of her reasoning?

References

Aardema, F., & Wu, K. D. (2011). Imaginative, dissociative, and schizotypal processes in obsessive-compulsive symptoms. *Journal of Clinical Psychology, 67*, 74–81. https://doi.org/10.1002/jclp.20729.

Aardema, F., Moulding, R., Radomsky, A. S., Doron, G., Allamby, J., & Souki, E. (2013). Fear of self and obsessionality: Development and validation of the Fear of Self Questionnaire. *Journal of Obsessive-compulsive and Related Disorders, 2*, 306–315. https://doi.org/10.1016/j.jocrd.2013.05.005.

Aardema, F., O’Connor, K. P., & Emmelkamp, P. M. G. (2006). Inferential confusion and obsessive beliefs in obsessive-compulsive disorder. *Cognitive Behaviour Therapy, 35*, 138–147. https://doi.org/10.1080/16506070600621922.

Aardema, F., O’Connor, K. P., Emmelkamp, P. M. G., Marchand, A., & Todorov, C. (2005). Inferential confusion in obsessive-compulsive disorder: The inferential confusion questionnaire. *Behaviour Research and Therapy, 43*, 293–308. https://doi.org/10.1016/j.brat.2004.02.003.

Aardema, F., Radomsky, A. S., O’Connor, K. P., & Julien, D. (2008). Inferential confusion, obsessive beliefs and obsessive-compulsive symptoms: A multidimensional investigation of cognitive domains. *Clinical Psychology & Psychotherapy, 15*, 227–238. https://doi.org/10.1002/cpp.581.

Aardema, F., Wu, K. D., Careau, Y., O’Connor, K. P., Julien, D., & Dennie, S. (2010). The expanded version of the Inferential Confusion Questionnaire: Further development and validation in clinical and non-clinical samples. *Journal of Psychopathology and Behavioral Assessment, 32*, 448–462. https://doi.org/10.1007/s10862-009-9157-x.

Aardema, F., Wu, K. D., Moulding, R., Jean-Sebastien, A., & Louis-Philippe, B. (2018). The relationship of inferential confusion and obsessive beliefs with specific obsessive-compulsive symptoms. *Journal of Obsessive-compulsive and Related Disorders*. https://doi.org/10.1016/j.jocrd.2018.03.004.

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

Audet, J. S., Aardema, F., & Moulding, R. (2016). Contextual determinants of intrusions and obsessions: The role of ego-dystonicity and the reality of obsessional thoughts. *Journal of Obsessive-compulsive and Related Disorders, 9*, 96–106. https://doi.org/10.1016/j.jocrd.2016.04.003.

Brown, T. A., & Barlow, D. H. (2014). *Anxiety and related disorders interview schedule for DSM-5.* New York, NY: Oxford University Press.

Calamari, J. E., Cohen, R. J., Rector, N. A., Szacun-Shimizu, K., Riemann, B. C., & Norberg, M. M. (2006). Dysfunctional belief-based obsessive-compulsive disorder subgroups. *Behaviour Research and Therapy, 44*, 1347–1360. https://doi.org/10.1016/j.brat.2005.10.005.

Gangemi, A., Mancini, F., & Dar, R. (2015). An experimental re-examination of the inferential confusion hypothesis of obsessive-compulsive disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 48*, 90–97. https://doi.org/10.1016/j.brat.2005.10.005.

Julien, D., Careau, Y., O’Connor, K. P., Bouvard, M., Rheaume, J., Langlois, F., ... Cottraux, J. (2008). Specificity of belief domains in OCD: Validation of the French version of the Obsessive Beliefs Questionnaire and a comparison across samples. *Journal of Anxiety Disorders, 22*, 1029–1041. https://doi.org/10.1016/j.janxdis.2007.11.003.

Julien, D., O’Connor, K. P., & Aardema, F. (2016). The inference-based approach to obsessive-compulsive disorder: A comprehensive review of its etiological model, treatment efficacy, and model of change. *Journal of Affective Disorders, 202*, 187–196. https://doi.org/10.1016/j.brat.2005.10.005.

Lecrubier, Y., Sheehan, D. V., Weiller, E., Amorim, P., Bonara, L. I., Sheehan, K., ... Dunbar, G. C. (1997). The Mini International Neuropsychiatric Interview (MINI) – A short diagnostic structured interview: Reliability and validity according to the CIDI. *European Psychiatry, 12*, 224–231. https://doi.org/10.1016/S0924-9338(97)83296-8.

Najmi, S., Tobin, A. C., & Amir, N. (2012). Psychometric properties of a behavioral test of contamination-related obsessive-compulsive symptoms. *Cognitive Therapy and Research, 36*, 228–233. https://doi.org/10.1007/s10608-010-9332-0.

O’Connor, K. P., & Robillard, S. (1995). Inference processes in obsessive-compulsive disorder: Some clinical observations. *Behaviour Research and Therapy, 33*, 887–896. https://doi.org/10.1016/0005-7967(95)00042-V.

O’Connor, K. P., Ecker, W., Lahoud, M., & Roberts, S. (2012). A review of the inference-based approach to obsessive compulsive disorder. *Verhaltenstherapie, 22*, 47–55. https://doi.org/10.1159/000333414.

O’Connor, K. P., Koszegi, N., Aardema, F., van Niekerk, J., & Taillon, A. (2009). An inference-based approach to treating obsessive-compulsive disorders. *Cognitive and Behavioral Practice, 16*, 420–429. https://doi.org/10.1016/j.cbpra.2009.05.001.

O’Connor, K. P., Ouellet-Courois, C., & Aardema, F. (2018). Innovative cognitive-behavioural treatments for obsessive-compulsive disorder. In L. F. Fontenelle, & M. Yucel (Eds.). *A transdiagnostic approach to obsessions, compulsions, and related phenomena.* United Kingdom, UK: Cambridge University Press.

Obsessive Compulsive Cognitions Working Group (2005). Psychometric validation of the obsessive belief questionnaire and interpretation of intrusions inventory - part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy, 43*, 1527–1542. https://doi.org/10.1016/j.brat.2004.07.010.

Paradisis, S. M., Aardema, F., & Wu, K. D. (2015). Schizotypal, dissociative, and imaginative processes in a clinical OCD sample. *Journal of Clinical Psychology, 76*, 606–624. https://doi.org/10.1002/jclp.22173.

Polman, A., O’Connor, K. P., & Huisman, M. (2011). Dysfunctional belief-based subgroups and inferential confusion in obsessive–compulsive disorder. *Personality and Individual Differences, 50*, 153–158. https://doi.org/10.1016/j.paid.2010.09.017.

Rachman, S. (1997). A cognitive theory of obsessions. *Behaviour Research and Therapy, 35*, 793–802. https://doi.org/10.1016/S0005-7967(97)00040-5.

Rachman, S., & de Silva, P. (1978). Abnormal and normal obsessions. *Behaviour Research and Therapy, 16*, 233–248. https://doi.org/10.1016/0005-7967(78)90022-0.

Radomsky, A. S., Alcolado, G. M., Abramowitz, J. S., Alonso, P., Belloch, A., Bouvard, M., ... Wong, W. (2014). Part 1. You can run but you can’t hide: Intrusive thoughts on 6 continents. *Journal of Obsessive-compulsive and Related Disorders, 3*, 269–279. https://doi.org/10.1016/j.jocrd.2013.09.002.

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy, 23*, 571–583. https://doi.org/10.1016/0005-7967(85)90105-6.

Salkovskis, P. M., & Harrison, J. (1984). Abnormal and normal obsessions: A replication. *Behaviour Research and Therapy, 22*, 549–552. https://doi.org/10.1016/0005-7967(84)90057-3.

Sheehan, D. V., Lecrubier, Y., Harnett-Sheehan, K., Amorim, P., Janavs, J., Weiller, E., ... Dunbar, G. C. (1998). The Mini International Neuropsychiatric Interview (MINI): The development and validation of a structured diagnostic psychiatric interview. *The Journal of Clinical Psychiatry, 59*, 22–23.

Sheehan, D. V., Lecrubier, Y., Harnett-Sheehan, K., Janavs, J., Weiller, E., Bonara, L. I., ... Dunbar, G. C. (1997). The validity of the Mini International Neuropsychiatric Interview (MINI) according to the SCID-P and its reliability. *European Psychiatry, 12*, 232–241. https://doi.org/10.1016/S0924-9338(97)83297-X.

Spitzer, R. L., Williams, J. B. W., Gibbon, M., & First, M. B. (1990). *Structured clinical interview for DSM-III-R.* Washington, DC: American Psychiatric Press.

Taylor, S., Abramowitz, J. S., McKay, D., Calamari, J. E., Sookman, D., Kyrios, M., ... Carmin, C. (2006). Do dysfunctional beliefs play a role in all types of obsessive-compulsive disorder? *Journal of Anxiety Disorders, 20*, 85–97. https://doi.org/10.1016/j.janxdis.2004.11.005.

Tolin, D. F., Worhunsky, P., & Maltby, N. (2006). Are “obsessive” beliefs specific to OCD?: A comparison across anxiety disorders. *Behaviour Research and Therapy, 44*, 469–480. https://doi.org/10.1016/j.brat.2005.03.007.

Wong, S. F., & Grisham, J. R. (2017a). Causal role for inverse reasoning on obsessive-compulsive symptoms: Preliminary evidence from a cognitive bias modification for interpretation bias study. *Journal of Behavior Therapy and Experimental Psychiatry, 57*, 143–155. https://doi.org/10.1016/j.jbtep.2017.06.001.

Wong, S. F., & Grisham, J. R. (2017b). Inverse reasoning processes in obsessive-compulsive disorder. *Journal of Anxiety Disorders, 47*, 75–82. https://doi.org/10.1016/j.janxdis.2016.12.005.

World Health Organization (1990). *The composite international diagnostic interview (CIDI).* Geneva, CH: World Health Organization.

Wu, K. D., Aardema, F., & O’Connor, K. P. (2009). Inferential confusion, obsessive beliefs, and obsessive-compulsive symptoms: A replication and extension. *Journal of Anxiety Disorders, 23*, 746–752. https://doi.org/10.1016/j.janxdis.2009.02.017.