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Causal role for inverse reasoning on obsessive-compulsive symptoms: Preliminary evidence from a cognitive bias modification for interpretation bias study

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ABSTRACT

Background and Objectives: The inference-based approach (IBA) is a cognitive account of the genesis and maintenance of obsessive-compulsive disorder (OCD). According to the IBA, individuals with OCD are prone to using inverse reasoning, in which hypothetical causes form the basis of conclusions about reality. Several studies have provided preliminary support for an association between features of the IBA and OCD symptoms. However, there are currently no studies that have investigated the proposed causal relationship of inverse reasoning in OCD.

Methods: In a non-clinical sample ($N = 187$), we used an interpretive cognitive bias procedure to train a bias towards using inverse reasoning ($n = 64$), healthy sensory-based reasoning ($n = 65$), or a control condition ($n = 58$). Participants were randomly allocated to these training conditions. This manipulation allowed us to assess whether, consistent with the IBA, inverse reasoning training increased compulsive-like behaviours and self-reported OCD symptoms.

Results: Results indicated that compared to a control condition, participants trained in inverse reasoning reported more OCD symptoms and were more avoidant of potentially contaminated objects. Moreover, change in inverse reasoning bias was a small but significant mediator of the relationship between training condition and behavioural avoidance. Conversely, training in a healthy (non-inverse) reasoning style did not have any effect on symptoms or behaviour relative to the control condition.

Limitations: As this study was conducted in a non-clinical sample, we were unable to generalise our findings to a clinical population.

Conclusions: Findings generally support the IBA model by providing preliminary evidence of a causal role for inverse reasoning in OCD.

The inference-based approach (IBA) is a recent cognitive theory of the aetiology of obsessive-compulsive disorder (OCD). The IBA conceptualises obsessions as pathological doubts or imagined possibilities about reality that do not reflect the true state of the world (O'Connor, Ecker, Lahoud, & Roberts, 2012). According to the IBA, these imagined doubts and their consequences are nonetheless inferred to be true because of a state termed inferential confusion (e.g., from 'the car might be unlocked' to 'the car is unlocked' and therefore 'my car will be stolen'; Aardema, O'Connor, & Emmelkamp, 2006; Aardema, O'Connor, Emmelkamp, Marchand, & Todorov, 2005; O'Connor et al., 2012; O'Connor & Robillard, 1995). This process produces obsessional anxiety and distress in individuals with OCD who then attempt to relieve their anxiety via the performance of compulsions (e.g., constantly checking on the car).

Inferential confusion is characterised by dysfunctional reasoning processes proposed to be exclusive to OCD, which in turn increase the credibility of the initial doubt. The IBA proposes that inverse reasoning is a core reasoning process (for a detailed explanation of the other reasoning processes, see O'Connor et al., 2012). Inverse reasoning is the opposite of healthy reasoning, the latter being where 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

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must be dirty') despite opposing sensory evidence that the pole is clean. Individuals with OCD typically use one or more of these reasoning processes to justify their doubts (O'Connor et al., 2012). Together, this justification of doubt takes the form of an inductive narrative, which is part of the obsessional process. According to the IBA, it is precisely the presence of these unusual reasoning processes that explains consistent clinical observations of qualitative differences between OCD obsessions and non-clinical obsessions (O'Connor et al., 2012; O'Connor, Koszegi, Aardema, van Niekerk, & Taillon, 2009). In sum, the IBA argues that the cognitive process of inferential confusion drives the genesis of obsessions (Julien, O'Connor, & Aardema, 2016).

An alternative cognitive model of OCD, the influential cognitive appraisal model, proposes instead that obsessions are caused by misinterpretations of intrusions as personally significant or meaningful (Rachman, 1997; Salkovskis, 1985). Importantly, the cognitive appraisal model has identified a number of maladaptive cognitive beliefs about intrusions which drive their misinterpretation (e.g., overestimation of threat, inflated responsibility; Obsessive Compulsive Cognitions Working Group, 2005). Proponents of this model have often argued that the construct of inferential confusion is no different to these cognitive beliefs (O'Connor, Aardema, & Pelissier, 2005). However, the IBA makes the distinction between cognitive *processes* such as inferential confusion and the cognitive beliefs or *content* described by the cognitive appraisal model (O'Connor et al., 2005).

Specifically, O'Connor et al. (2005) suggest that the confusion between process and content variables is largely due to cognitive beliefs being phrased in terms of cognitive distortions or processes. For example, the Obsessive Compulsive Cognitions Working Group (2005) defines overestimation of threat as 'beliefs indicating an exaggeration of the probability and severity of harm'. While the *content* of this 'belief' centres on harm, it also describes the cognitive *process* of a tendency to exaggerate probabilities and severity. Beck's theory of psychopathology (which the cognitive appraisal model is based) also makes explicit distinctions between cognitive processes and beliefs (Beck, 1976). For example, he identified how all-or-nothing/black-and-white thinking is a cognitive process which can manifest in depression as depressive beliefs (e.g., 'I am a failure at *everything*') or even in eating disorders (e.g., 'I *must* be thin to be accepted'). In this vein, inferential confusion is a cognitive process which describes a tendency to confuse imagined doubts and possibilities with an actual probability, and can operate with or separately from specific cognitive content/beliefs about harm or responsibility.

There is increasing empirical support for some components of the IBA model and its distinction from the cognitive appraisal model. Aardema, O'Connor, et al. (2005) developed the Inferential Confusion Questionnaire (ICQ) to measure the construct of inferential confusion, which consists of items that reflect two key reasoning processes, inverse reasoning and a distrust of the senses (e.g., 'I am sometimes more convinced by what might be there than by what I actually see'). Higher scores on the ICQ indicate a greater degree of reliance on these reasoning processes and consequently an increased tendency to confuse imagined possibilities with reality (Aardema, O'Connor, et al., 2005). Multiple studies have reliably demonstrated significant associations between scores on the ICQ and obsessive-compulsive (OC) symptoms, independent of scores measuring general distress and notably the maladaptive beliefs outlined by the cognitive appraisal model (Aardema, O'Connor, et al., 2005; Aardema & Wu, 2011; Paradisis, Aardema, & Wu, 2015; Wong & Grisham, 2016). Further highlighting the difference between the IBA and the cognitive appraisal model, O'Connor, Koszegi, Goulet, and Aardema (2013) have found that both novice and expert judges provided with obsessional narratives generated by individuals with OCD were able to identify and differentiate between the IBA reasoning processes and the maladaptive appraisals driven by OC beliefs.

In further support for the IBA model, researchers have consistently demonstrated that individuals diagnosed with OCD report significantly higher levels of inferential confusion on the ICQ compared to those diagnosed with another anxiety disorder (e.g., social phobia) and non-clinical individuals (Aardema, O'Connor, et al., 2005; Aardema et al., 2010; Yorulmaz, Dirik, Karaali, & Uvez, 2010). In addition, Aardema and Wu (2011) and Paradisis et al. (2015) found through a series of hierarchical multiple regression models that scores on the ICQ was the strongest and most consistent predictor of OC symptoms, controlling for general distress and OC beliefs. Finally, treatment studies comparing the efficacy of cognitive behaviour therapy for OCD and the treatment based on the IBA model (inference-based therapy) have found that a decrease in ICQ scores was significantly associated with a decrease in OC symptoms following both types of treatment (Aardema, O'Connor, Delorme, & Audet, 2016; Del Borrello & O'Connor, 2014; Visser et al., 2015). These studies together support the relevance of inferential confusion in OCD specifically.

Empirical evidence for the IBA is limited in that only a few studies across a small number of research labs have investigated the model's key premises (Julien et al., 2016). One component of the model that particularly suffers from this limitation is the concept of inverse reasoning. There is currently no experimental evidence that supports the IBA proposal that inverse reasoning causes OC symptoms, which would provide additional support for targeting this process in OCD treatment.

1. Aims and hypotheses

We aimed to provide evidence for the causal influence of inverse reasoning on OC symptoms by training participants to use inverse reasoning via a modified version of the cognitive bias modification for interpretation procedure (CBM-I; Clerkin & Teachman, 2011; Holmes, Lang, & Shah, 2009). Given the ease in which interpretive biases can be trained using CBM-I, this procedure is an appropriate tool for experimentally testing the premises of cognitive models of psychological disorders such as OCD (Beadel, Smyth, & Teachman, 2013; Clerkin, Magee, & Parsons, 2014; Williams & Grisham, 2013).

We first examined whether we could successfully train interpretive bias toward inverse reasoning, using recall bias for ambiguous scenarios as a manipulation check. For our primary outcome, we then contrasted the OC symptoms and avoidance behaviour of participants trained in inverse reasoning with control participants who were not trained in any reasoning and those trained in 'healthy' reasoning (i.e., relying on sensory evidence rather than hypotheticals when drawing conclusions about reality). We hypothesised that those trained in inverse reasoning would exhibit increased avoidance of potentially contaminated objects on a behavioural approach task and score higher on self-report measures of OC symptoms. In addition, as a secondary outcome, we predicted that individuals trained in inverse reasoning (compared to control and healthy training) would report higher inferential confusion. Finally, we expected that change in inverse reasoning bias would mediate the relationships between reasoning training condition and performance on both the behavioural approach task and the OCD self-report measures.