



The chicken or the egg: What drives OCD?



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ABSTRACT

The prevailing conceptual model for Obsessive-Compulsive disorder (OCD) posits that obsessions drive compulsive rituals that serve to control or reduce obsessional distress. In recent years, an alternative hypothesis to explain the symptoms of OCD was suggested — the 'habit-driven' hypothesis. According to this hypothesis, compulsions are the result of aberrant dysregulation of stimulus-response habit learning and obsessions are post hoc rationalizations of otherwise unexplained compulsive behaviors. In this article, we describe this hypothesis and briefly review data presented to support it. Next, we raise four questions about this hypothesis to explore how it fits the complex phenotype of OCD: (i) What are the deficits in the goal-directed system in OCD? (ii) How should we define and measure habits in humans? (iii) Are compulsions habits in the technical sense? and (iv) Are obsessions caused by compulsions? We conclude that how an imbalance in goal-directed versus habit behaviors might contribute to the complex phenotype of OCD is yet to be revealed.

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Obsessive-Compulsive disorder (OCD) is characterized by intrusive thoughts, images, or urges (i.e., obsessions) and repetitive behaviors or mental acts that the person feels compelled to perform (i.e., compulsions; [American Psychiatric Association, 2013](#)). The prevailing conceptual model of the phenomenology of OCD posits that obsessions drive compulsive rituals, including avoidance behavior and other subtle neutralizing strategies (e.g., thought suppression) that serve to control or reduce obsessional distress ([Rachman & Hodgson, 1980](#); [Salkovskis, 1985](#); [Taylor, Abramowitz, & McKay, 2007](#)). An alternative hypothesis to explain the symptoms of OCD posits that “*compulsivity reflects the aberrant dysregulation of stimulus-response habit learning*” ([Robbins, Gillan, Smith, de Wit, & Ersche, 2012](#), p. 83; see also: [Voon & Derbyshire, 2015](#)) and that obsessions are post hoc rationalizations of compulsive behaviors. According to this alternate hypothesis, OCD is caused by an imbalance between the goal-directed and habit formation systems, in which compulsions are habits that drive obsessions ([Gillan & Sahakian, 2015](#)). In this article, we describe this hypothesis and then briefly review data presented to support it. Then, we raise several questions about this hypothesis, explore how it fits the complex phenotype of OCD, and provide directions for future research.

1. The 'habit-driven' hypothesis of OCD

The hypothesis that OCD is primarily a disorder of habit stems from several experimental studies that used response-outcome information-updating tasks. For example, [Gillan et al. \(2011\)](#)

trained OCD patients and non-psychiatric controls (NPCs) to respond to different stimuli in order to gain rewarding outcomes. Following this training stage, the authors introduced an outcome devaluation test in which responses to some stimuli that were originally associated with reward in the training stage no longer led to rewarding outcomes. Patients with OCD were found to be more prone to 'slips of action' – responding to a devalued stimulus (i.e., a stimulus that was no longer rewarded). On the other hand, NPC updated their stimulus-response association rules more quickly (e.g., learned that the devalued stimuli were no longer rewarded) and thus were more likely to avoid slips of action. From these results, the authors concluded that there is a “*selective impairment in flexible and goal-directed behavioral control in patients with OCD*” (p. 718) and that patients with OCD exhibit over-reliance on stimulus-response habits. Furthermore, the authors propose that this imbalance between the goal-directed (executive) and the habit formation (automatic) systems underlies the compulsions seen in OCD patients ([Gillan, Apergis-Schoute et al., 2014](#); [Voon & Derbyshire, 2015](#); [Watkins et al., 2005](#)). In other words, this hypothesis argues that habits underlie compulsive behaviors.

With respect to obsessions, the 'habit-driven' hypothesis of OCD suggests that obsessions are *post hoc rationalizations* ([Robbins et al., 2012](#)) of otherwise inexplicable (habitual) behaviors. The phenomenon of post hoc rationalization is well-established in social and cognitive psychology. For instance, over 100 years ago, William James described that people frequently make post hoc explanations of their own behaviors ([James, 1969, 1950](#)). Post-hoc explanations have also been used in theories of moral reasoning and cognitive dissonance (e.g., [Haidt, 2007](#)). In OCD, the idea that

obsessions are post hoc rationalizations was first proposed by Rapoport and Wise (1988), who suggested that compulsions in children with OCD are the core psychopathological process, while obsessions are secondary, post hoc rationalizations and an attempt to make sense of the compulsive behavior (see also: Rapoport, Swedo, & Leonard, 1992). In NPCs, van Uijen and Toffolo (2015) recently found that conducting repetitive checking behaviors for one week led to more cognitive intrusions, compared to participants who were not asked to conduct repetitive checking. Moreover, other studies in NPCs (van den Hout & Kindt, 2003; van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008) found that asking participants to repeatedly check gas stoves led to increased memory distrust and doubts.

Using a stimulus-response task with negative reinforcement (i.e., electric shock), Gillan and Morein-Zamir et al. (2014) recently trained participants diagnosed with OCD and NPC to avoid shocks by responding according to a specific pattern of stimulus-response. Researchers then disconnected the shock electrode while explaining that shocks will no longer be delivered, in essence devaluing the learned response. At this point, OCD patients not only had more slips of action (i.e., continued to respond to devalued stimuli even though instructed not to and shock was not possible), but they also estimated that the risk for shock was higher compared to NPCs (even though all participants estimated that the risk for shock was very low). The researchers concluded that patients "...erroneously deduc[ed] that if they felt driven to perform an act of (habitual) avoidance, they must have had something to fear" (Gillan & Sahakian, 2015, p. 248; see also: Robbins et al., 2012).

Taken together, these findings have led to the 'habit-driven' hypothesis of OCD. However, four important questions need to be addressed: (i) What are the deficits in the goal-directed system in OCD? (ii) How should we define and measure habits in humans? (iii) Are compulsions habits in the technical sense? and (iv) Are obsessions caused by compulsions?

2. What are the deficits in the 'goal directed' system in OCD?

The 'habit-driven' hypothesis of OCD posits that an imbalance in the goal-directed and habit systems is the underlying cause of OCD. However, to date, the 'habit-driven' hypothesis of OCD does not specify which aspects of the goal-directed system might be dysfunctional.

According to the executive functioning and cognitive control literatures, numerous mechanisms are involved in achieving and maintaining goal-directed behaviors. For example, response inhibition, working memory, task switching, and proactive task-control all play a role in goal-directed behaviors (e.g., Banich, 2009). Evidence for poor performance on tasks assessing those constructs has been reported in OCD (e.g., Shin, Lee, Kim, & Kwon, 2014), although for some constructs the literature is inconsistent, characterized by small to moderate effect sizes, and may point to clinically insignificant underperformance (e.g., Abramovitch, Abramowitz, & Mittelman, 2013; Kalanthroff et al., 2016). Theoretically, deficits in any of the processes involved in goal directed behavior could lead to greater reliance on the habit system. Hence, the concept of goal directed behavior is too broad and encompasses multiple interacting executive function processes. Indeed, in a recent meta-analysis, Snyder, Kaiser, Warren, and Heller (2015) concluded that "investigating how specific aspects of OCD are related to specific executive components is critical for elucidating the cognitive, neural, and genetic mechanisms involved" (p. 19). It is important to elucidate what are the specific deficits in the goal-directed system in OCD.

3. How should we define and measure habits in humans?

The 'habit-driven' hypothesis of OCD adopts a definition of 'habits' that is drawn from animal models; that habits are continuous and perseverative responses to devalued stimuli, more commonly known as stimulus-response/stimulus-driven habits (Griffiths, Morris, & Balleine, 2013). According to this definition, the term 'habit' (in OCD and in general) refers to impaired ability to control urges triggered by external stimuli. This definition had led to experimental procedures in humans where habits are often operationalized by a very brief learning procedure, as was done in the experiments reviewed above.

However, this laboratory definition is quite different from common definitions of habits in humans—that habits are well-learned schema that are conducted automatically due to extensive learning processes (Limayem, Hirt, & Cheung, 2007; Mixon, 1980). Developing laboratory tasks that can assess this type of habit formation in humans will advance the study of habit formation.

4. Are compulsions habits?

Demonstrating an imbalance in OCD patients on laboratory tasks between goal-directed versus stimulus-response habitual systems (regardless of how these terms are defined) cannot alone prove that compulsions are habits. First, shifting from goal-directed to more habitual behavior might not be a *fundamental* feature of OCD, but simply a sequela of stress or anxiety (Otto, Raio, Chiang, Phelps, & Daw, 2013). Indeed, goal-directed behavior has been shown to be compromised by elevated anxiety (e.g., Berggren, Richards, Taylor, & Derakshan, 2013; Kalanthroff, Henik et al., 2016) and by threatened morality (Kalanthroff, Aslan, & Dar, 2016) — two fundamental features of OCD (e.g., Rachman & Hodgson, 1980). Furthermore, Voon, Baek, and colleagues (2015) have recently shown that over-reliance on stimulus-response habits is influenced by motivation and outcome value. Specifically, they administered two versions of the two-step reinforcement task (which assesses goal-directed vs. habitual behaviors) to OCD and NPC samples. In the first version, rewards were provided for efficient performance whereas in the second version, poor performance led to losses. The researchers found that: (a) in the reward task, the OCD sample performed more habitually than the NPC sample; (b) in the loss task, the OCD sample shifted towards a more goal-directed style, and did not differ from NPCs. Hence, performance on stimulus-response updating tasks in individuals with OCD is influenced by motivation to receive rewards or avoid losses, both of which might be atypical in people with OCD (e.g., Figeo et al., 2011; Kaufmann et al., 2013). Taken together, these lines of evidence suggest that reduced goal-directed behavior and greater reliance on the habitual system on stimulus-response updating task in OCD patients could be the *result* of other OCD characteristics (e.g., anxiety, reward and loss processing) rather than the *cause* of OCD.

Second, cross-sectional studies cannot determine whether an increased reliance on habit (versus goal directed) systems is the cause or the result of compulsions. It is plausible that years of repeating OCD behaviors have strengthened the habit system in general. In fact, research on the phenomenology of checking rituals, for example, demonstrates that the more one checks, the more doubt they experience (Radomsky, Gilchrist, & Dussault, 2006; van den Hout & Kindt, 2003) which in turn increases the urge to recheck (Kalanthroff & Linkovski, 2016; Linkovski, Kalanthroff, Henik, & Anholt, 2013).

Third, although some OCD rituals may appear automatic and habit-like, many compulsions are deliberate, complex, carefully executed and timed, and not habitual or automatic in the technical

sense (Abramovitch & Abramowitz, 2014; Abramovitch & Cooperman, 2015). Moreover, patients with OCD are often able to curtail their rituals if performing them would lead to embarrassment or when directed to do as a part of cognitive-behavioral therapy by exposure and response prevention (e.g., Abramowitz & Jacoby, 2015).

Fourth, continued responses in face of a devaluated stimuli can be viewed as perseverative responses—defined as “an inappropriate repetition of an earlier response” (McNamara & Albert, 2004). Perseveration is a tendency seen not only in OCD, but also in multiple psychiatric and neurological conditions, many of which, such as attention deficit disorders, are not typically characterized by compulsive behaviors. Thus, perseveration might represent a more general vulnerability to various psychiatric disorders rather than a specific vulnerability to OCD or to pathological compulsivity (Griffiths et al., 2013; Moritz et al., 2002).

5. Are obsessions caused by compulsions?

Demonstrating that individuals diagnosed with OCD make post hoc rationalizations of their habit-like behaviors on laboratory tasks cannot alone prove that obsessions are always post hoc rationalizations. First, the post hoc explanations (i.e., rationalizations of ‘slip-of-actions’ in the stimulus-response updating task) lack the complexity and severity of irrational beliefs typically seen in OCD, and the anxiety that intrusive thoughts commonly cause (Frost & Steketee, 2002). In addition, post hoc rationalizations also cannot explain the full range of obsessions, such as excessive, intrusive images or urges that frequently precede compulsions.

Second, if obsessive thoughts are indeed “post hoc rationalizations,” why do OCD patients commonly have negative intrusive thoughts, as opposed to neutral or positive intrusive thoughts? Researchers that described and investigated the notion of post hoc rationalization, such as William James (James, 1969, 1950) and other moral reasoning and cognitive dissonance researchers (e.g., Haidt, 2007), never implied that these post hoc cognitions are mostly negative. In fact, they have shown that these cognitions can be positive, if the situations invite positive interpolations (e.g., Strack, Martin, & Stepper, 1988).

Third, unwanted, intrusive repetitive thoughts are a prominent symptom of other disorders, which are also characterized by deficient goal-directed system (e.g., social anxiety, post-traumatic stress disorder; Clark, 2005). However, these disorders are not necessarily characterized by compulsive behaviors. This suggests that at least some obsessions are ‘independent’ from compulsions, and thus raises questions about the hypothesis that intrusive thoughts arise only as post hoc rationalization of compulsions.

6. Conclusions

The proposal that an imbalance between the goal-directed executive system and the stimulus-driven habitual system underlies OCD spurs interesting debate. However, more research is needed to further evaluate this hypothesis. We recommend that future research: (i) clarify what (if any) deficits in the ‘goal-directed’ system are associated with OCD, (ii) develop additional tasks to study habit systems in humans, (iii) determine whether stimulus-response ‘habitual behavior’ seen in individuals with OCD on laboratory tasks is the result of other factors (e.g., anxiety or stress at the time of testing, the stage of illness), and (iv) determine longitudinally whether a bias toward habitual behavior is a cause or an effect of compulsive behavior, and (v) if and when obsessions are post hoc rationalization of compulsive behaviors. Heuristically, patients with OCD certainly seem to have an

imbalance in goal-directed versus stimulus-driven habitual behavior. However, this imbalance may not be ‘the goose that laid the golden eggs’ and further research into the cause of obsessions and compulsions is required. Importantly, future research should consider the possibility that there is more than one way to develop OCD.

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Eyal Kalanthroff*

Anxiety Disorders Clinic and the Center for OCD and Related Disorders at the New York State Psychiatric Institute, New York, NY, USA
Department of Psychiatry, Columbia University Medical Center, New York, NY, USA
Department of Psychology, The Hebrew University of Jerusalem, Israel
E-mail address: eyalkant@gmail.com

Amitai Abramovitch

Department of Psychology, Texas State University, San Marcos, TX, USA

Shari A. Steinman

Anxiety Disorders Clinic and the Center for OCD and Related Disorders at the New York State Psychiatric Institute, New York, NY, USA
Department of Psychiatry, Columbia University Medical Center, New York, NY, USA

Department of Psychology, West Virginia University, WV, USA

Jonathan S. Abramowitz

Department of Psychology, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Helen B. Simpson

Anxiety Disorders Clinic and the Center for OCD and Related Disorders at the New York State Psychiatric Institute, New York, NY, USA
Department of Psychiatry, Columbia University Medical Center, New York, NY, USA

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* Correspondence to: The Hebrew University of Jerusalem, Mt. Scopus, Jerusalem, 91905, Israel.