

Enhanced Avoidance Habits in Obsessive-Compulsive Disorder

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Background: Obsessive-compulsive disorder (OCD) is a psychiatric condition that typically manifests in compulsive urges to perform irrational or excessive avoidance behaviors. A recent account has suggested that compulsivity in OCD might arise from excessive stimulus-response habit formation, rendering behavior insensitive to goal value. We tested if OCD patients have a bias toward habits using a novel shock avoidance task. To explore how habits, as a putative model of compulsivity, might relate to obsessions and anxiety, we recorded measures of contingency knowledge, explicit fear, and physiological arousal.

Methods: Twenty-five OCD patients and 25 control subjects completed a shock avoidance task designed to induce habits through overtraining, which were identified using goal-devaluation. The relationship between habitual behavior, erroneous cognitions, and physiological arousal was assessed using behavior, questionnaires, subjective report, and skin conductance responses.

Results: A devaluation sensitivity test revealed that both groups could inhibit unnecessary behavioral responses before overtraining. Following overtraining, OCD patients showed greater avoidance habits than control subjects. Groups did not differ in conditioned arousal (skin conductance responses) at any stage. Additionally, groups did not differ in contingency knowledge or explicit ratings of shock expectancy following the habit test. Habit responses were associated with a subjective urge to respond.

Conclusions: These data indicate that OCD patients have a tendency to develop excessive avoidance habits, providing support for a habit account of OCD. Future research is needed to fully characterize the causal role of physiological arousal and explicit fear in habit formation in OCD.

Key Words: Avoidance, cognitive neuroscience, goal-directed learning, habit, obsessive-compulsive disorder, psychophysiology

Obsessive-compulsive disorder (OCD) is a paradox. In severe cases, patients spend most of their waking hours performing repetitive compulsive behaviors and struggling with disturbing obsessive thoughts and/or anxiety (1). But patients with OCD are not deluded; most recognize that their concerns are unrealistic and that their behavior is absurd or at least excessive (2). Researchers have thus far struggled to explain this ego-dystonic phenomenon: how a patient's life can be taken over, for example, by an overwhelming compulsion to repeatedly flick a light switch, despite knowing that this action serves no real purpose.

In healthy humans, prolonged repetition of behavior instills habits, causing us to respond automatically under certain environmental situations, regardless of whether or not these actions produce useful outcomes (3). Although there is now a considerable body of literature describing appetitive habit

formation, there is, to date, no published evidence that habits (as defined by the criterion of goal devaluation) can be formed in avoidance in healthy humans or nonhuman animals. Previous research suggests that OCD patients have a bias toward appetitive habit formation at the expense of goal-directed behavior, an imbalance that might contribute to the repetitive and seemingly senseless compulsions that exemplify the disorder (4). However, compulsions in OCD are avoidant rather than appetitive; therefore, if aberrant habit formation contributes to this symptom, excessive avoidance habits should be experimentally demonstrable in OCD.

We used a shock avoidance paradigm wherein subjects could avoid receiving electric shocks by responding on the correct foot pedal in response to warning stimuli (Figure 1A). Following overtraining, we tested for habit formation using an instructed outcome devaluation procedure whereby we disconnected one of the subjects' wrists from its stimulator (devalued), while leaving the other connected (valued) (Figure 1B), and measured the number of unnecessary avoidance responses to the now safe, devalued stimulus. By using an avoidance paradigm, it was possible to explore a number of functional predictions regarding the putative role of habits in the obsessive-compulsive cycle.

One of the longest standing accounts of OCD symptomatology is that compulsions are not habits but rather are rational avoidance responses triggered by irrational beliefs (5–7). Irrational beliefs are considered the product of cognitive bias in OCD, including, for example, the overestimation of threat (8), increased personal responsibility (5), and thought-action fusion (7). These beliefs are thought by some to form the basis of obsession and, in turn, anxiety in OCD, to which compulsions are a goal-directed avoidance response (9). In this experiment, we tested one possibility inspired by this account: that excessive behavioral repetition in OCD (4) might not be evidence for habit formation but rather is driven by a failure to learn about safety.

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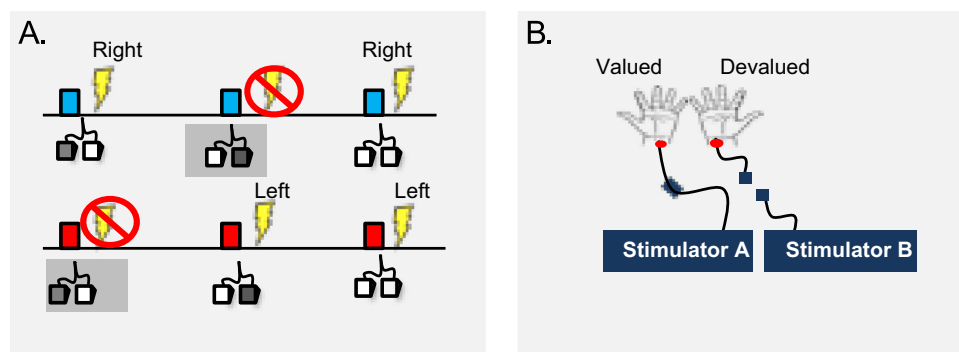


Figure 1. Task design. **(A)** Warning stimuli. The blue stimulus predicts a right shock, the red stimulus a left shock. If the correct avoidance response (e.g., left pedal to avoid left shock) is produced on time, subjects avoid shock. **(B)** Devaluation procedure. The electrodes on one side are disconnected from their connector (devalued), and the electrodes on the other side are unchanged (valued).

To this end, we conducted a devaluation test before overtraining to assess if OCD patients exhibit a general failure to learn that what was once dangerous is now safe. Moreover, we recorded levels of self-report shock expectancy following the habit test to determine if responding could be defined as habitual, i.e., was evident in spite of low expectancy of shock. In addition to these two tests of safety learning, we used questionnaires to test explicit knowledge of task contingencies. This allowed us to test if a cognitive, specifically an instrumental learning, deficit in the OCD group might better explain habit-like responding in spite of outcome devaluation.

Beyond irrational belief, conditioned fear and anxiety are also thought to be important for OCD (10) and indeed can bias healthy individuals to behave habitually (11,12). To test if OCD patients showed stronger conditioned arousal to warning stimuli during the devaluation test and whether this might cause overactive habit formation, we recorded skin conductance responses (SCRs) throughout the experiment. We predicted that OCD patients would be no more fearful of the conditioned stimuli than control subjects and that their behavioral habits would not be mediated by any such difference.

After the experiment, we recorded subjective accounts of why participants felt compelled to respond to the devalued stimulus during the critical habit test. Finally, to assess the ecological validity of overactive habit formation as a model of compulsivity, we asked subjects to rate the experiential urge to respond to the devalued stimulus in our critical habit test. If habits are more than just action slips, subjects should not only perform them following overtraining but also feel compelled to do so.

The primary hypothesis of this study was that OCD patients would show more behavioral habits than healthy control subjects following overtraining and these habits would be associated with a subjective urge to perform them. The secondary hypotheses were 1) both groups would show similar general sensitivity to devaluation (before overtraining), contingency knowledge, and shock expectancy following devaluation between groups; and 2) skin conductance responses, a putative proxy for physiological fear, would not differ between groups.

Methods and Materials

Twenty-Five OCD patients (11 male patients) and 25 healthy control subjects (11 male subjects) matched for age, IQ, handedness (left handed: four OCD patients, five control subjects), and years in education participated in this study (Table 1). Control subjects were recruited from the community, were unmedicated, and had never suffered from a psychiatric disorder. Obsessive-compulsive disorder patients were screened by a psychiatrist using an extended clinical interview to ensure they met the DSM-IV-Text Revision criteria for OCD, exceeding 12 on the Yale-Brown Obsessive Compulsive Scale (Y-BOCS) (13), and had no comorbid psychiatric disorders, past or present. The only exceptions to this were two patients who had been previously diagnosed with depression and one patient who had prior alcohol dependence. We did not screen subjects for Axis II personality disorders, save for obsessive-compulsive personality disorder (OCPD), which was assessed using the Compulsive Personality Assessment Scale (14).

Table 1. Demographic Information

Measures	Control Subjects	OCD Patients	<i>t</i>	<i>df</i>	<i>p</i>
Age	41.04 (13.22)	40.6 (13.45)	.127	1,48	.899
Years in Education	16.4 (2.19)	15 (3.04)	1.865	1,48	.068
NART	36 (7.31)	34.88 (7.14)	.548	1,48	.587
Y-BOCS	0	22.76 (5.27)			
MADRS	.96 (3)	6.6 (3.7)	5.875	1,48	<.001
STAI-State	30.16 (5.83)	44 (9.03)	6.437	1,48	<.001
STAI-Trait	32.44 (7.33)	60 (8.67)	12.140	1,48	<.001
OCI-R Total	8.68 (8.4)	33.16 (11.22)	8.733	1,48	<.001
CPAS	3.08 (3.81)	10.28 (6.13)	4.991	1,48	<.001

Standard deviations are in parentheses.

CPAS, Compulsive Personality Assessment Scale; MADRS, Montgomery-Åsberg Depression Rating Scale; NART, National Adult Reading Test; OCD, obsessive-compulsive disorder; OCI-R, Obsessive-Compulsive Inventory-Revised (40); STAI, State-Trait Anxiety Inventory (39); Y-BOCS, Yale-Brown Obsessive Compulsive Scale.

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