Doubting what you already know: uncertainty regarding state transitions is associated with obsessive compulsive symptoms 🔗

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Isaac Fradkin[1], Casimir Ludwig[2], Eran Eldar[1], Jonathan D. Huppert[1]

[1]Hebrew University of Jerusalem, [2]University of Bristol

👤 Isaac Fradkin ⚡

ABSTRACT

Obsessive compulsive (OC) symptoms involve excessive information gathering (e.g., checking, reassurance-seeking), and uncertainty about possible, often catastrophic, future events. Here we propose that these phenomena are the result of *excessive uncertainty regarding state transitions (*i.e. *transition uncertainty)*: a computational impairment in Bayesian inference leading to a reduced ability to use the past to predict the present and future, and to oversensitivity to feedback (i.e. prediction errors). Using a computational model of Bayesian learning under uncertainty in a reversal learning task, we investigate the relationship between OC symptoms and transition uncertainty. Individuals high and low in OC symptoms performed a task in which they had to detect shifts (i.e. transitions) in cue-outcome contingencies. Modeling subjects' choices was used to estimate each individual participant's transition uncertainty and associated responses to feedback. We examined both an optimal observer model and an approximate Bayesian model in which participants were assumed to attend (and learn about) only one of several cues on each trial. Results suggested the participants were more likely to distribute attention across cues, in accordance with the optimal observer model. As hypothesized, participants with higher OC symptoms exhibited increased transition uncertainty, as well as a pattern of behavior potentially indicative of a difficulty in relying on learned contingencies, with no evidence for perseverative behavior. Increased transition uncertainty compromised these individuals' ability to predict ensuing feedback, rendering them more surprised by expected outcomes. However, no evidence for excessive belief updating was found. These results highlight a potential computational basis for OC symptoms and obsessive compulsive disorder (OCD). The fact the OC symptoms predicted a decreased reliance on the past rather than perseveration challenges preconceptions of OCD as a disorder of inflexibility. Our results have implications for the understanding of the neurocognitive processes leading to excessive uncertainty and distrust of past experiences in OCD.

Instructions and training

1. Participants read instructions explaining that they will see three cues (with example given) pointing either left or right. Then they will see a black circle appearing at one side of the screen. They are told that their task is to predict the location of the circle by using the arrow keys (left,right), while learning which of the three cues predicts the location of the target via trial and error. Participants are explicitly told that only one cue predicts the location of the circle (the other two are random), and that at some point this cue will change - such that a different cue predicts the location of the circle.

2   Then participants can train with the task, while the experimenter stays in the room. The training includes 32 trials before shift and 10 trials after shift. After a few trials, the experimenter tries to verify that the participant is responding according to the relevant cue, and then asks the participant which cue is the relevant cue. If the participant is wrong, the experimenter tells the participant to check again. After the shift, the experimenter asks the participant is they have noticed that a shift has occured. If the participant was unable to learn the first or second cue during training, the experimenter explains the task again and the participant is asked to repeat the training. After the training the experimenter leaves the room

Deterministic condition

3   This part includes 88 trials overall. A shift occurs either after 40 or after 48 trials (counterbalanced across participants)
Each trial has the following timeline:
* fixation for 1000ms
* cues (until response, up to maximum of 900ms)
* target (1000-1200ms, uniform distribution). Note that the target appears regardless of whether the participant has responded, and regardless of how the participant responded

4   Break (30 seconds)

Probabilistic condition

5   First, the participant reads instructions with the experimenter present explaining that now the relevant cue will predict the location of the circle only in **most** of the trials but not all of them. The experimenter makes sure the participant has understood this change in the task, and the leaves the room

6   Then the participant performs this part of the task, without additional training. The structure of trials is similar to above, but now the relevant cue predicts the location of the circle on 75% of the trials.
A shift occurs after with 48 (for participants for whom the shift occured after 40 trials in the deterministic condition) or 40 trials (for participants for whom the shift occured after 48 trials in the deterministic condition)