Mild Uncertainty Promotes Checking Behavior in Subclinical Obsessive-Compulsive Disorder: An online replication study

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**Motivation**

Previous research has shown that participants with high obsessive-compulsive tendencies (OC+) struggle when searching for an absent target. In studies supporting this notion, participants performed a visual search task in which they searched for a closed square among open squares. Results revealed no differences in target-present trials, however, in target-absent trials, OC+ participants searched longer. These findings were replicated and extended to a clinical sample, where they were found to be specific to patients with OCD and absent in those suffering from anxiety. These findings were discussed in the context of checking behavior in the face of mild uncertainty. In a recent conceptual replication study we designed, we did not find longer search times in target-absent trials for OC+ participants. That being said, our paradigm was not a direct replication of the original studies. Here we use the same stimuli from the original study, in an online sample to determine if our failure to replicate the effect was due to an overly easy task.

# Introduction

Previous work by Toffolo et al., (2013), using a visual search paradigm in high (OC+) and low (OC-) Obsessive compulsive individuals, provided evidence that OC+ participants take longer to decide that a target is absent from a visual search array. This finding has been replicated (Toffolo et al., 2014) and extended to a clinical sample of OCD patients (Toffolo et al., 2016). In these experiments, checking behavior was operationalized by search time and high and low uncertainty were operationalized by means of contrasting target-present and target-absent trials. Therefore, the longer search times for the OC+ group in target-absent trials were interpreted as perseverative checking for mild uncertainty.

An alternative account is that longer search times in target-absent trials could be viewed as revealing a specific difficulty with inference about absence. Decisions about absence are qualitatively different from decisions about presence, as they cannot be based on direct perceptual evidence, leaving them to be based on the metacognitive belief of not having missed the target (Mazor, 2021). To decide between the two accounts, we designed an experiment in which participants searched for a target among distractors in easy and hard searches (searching for an open square among closed square or a closed square among open squares). Despite the similarity between our experiment and the original paradigm, we did not find longer search time in target-absent trials for the OC+ group.

A closer look at our data reveled that search times in our paradigm were shorter than search times in the original experiment (Toffolo et al., 2013), which may indicate that our task was easier, possibly not difficult enough to elicit enough doubt to initiate a repetitive checking behavior. To test this directly, the next experiment will use the original stimuli from Toffolo et al., (2013).

We consider two possible outcomes and their respective interpretations. First, if we find a significant one tailed interaction in which the differences between search time for target-present and target-absent are larger in the OC+ group as compared to the OC- group, we can conclude that we successfully replicated the original finding in an online setting. In contrast, if we do not find an interaction in this paradigm, we will interpret our findings as a failure to replicate the original results in an online setting.

**Methods**

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

**Participants**

The research complied with all relevant ethical regulations and was approved by the Research Ethics Committee of Tel-Aviv University (study ID number 0004169-1). Participants will be recruited via Prolific. We will invite former participants whose OCI scores were in the top or bottom OCI quantile in previous experiments. We encountered graphical problems with Safari browser during the pilot study, so we will ask participants to use only other browsers.

The entire experiment will take 12 minutes to complete (the median completion time in a pilot study). Participants will be paid £1.8 for their participation, equivalent to an hourly wage of £9.

**Material**

Visual search task

The experiment described in this study uses the original stimuli used in Toffolo et al. (2014), as provided in courtesy of Dr. Marieke Toffolo. The visual search task will consist of 1 block of 50 individual search displays, each containing 25 elements. Half of the search displays will be target-absent trials, in which 25 squares with a gap in one of the four edges will be presented, and the other half of the search displays will be target present trials, in which 24 open squares will be presented and one closed square, the target. To make sure participants understand the task, a practice phase will be given first. The practice phase will consist of 4 search displays, (2 target-absent and 2 target-present). In the practice phase, participants will get feedback on their response accuracy. Participants will be able to move to the next part of the experiment only after getting all questions right (4/4). The practice phase will repeat until performance is perfect, or until it has repeated more than three times at which the experiment will terminate. Each trial will last for a maximum of 10 seconds or until a response is received. If no response is given within 10 seconds, the next trial will immediately appear. Feedback about the response will be given only in the practice phase, to help participants learn the task efficiently. In the main part of the experiment, no feedback will be given.

**Procedure**

Participants will first be instructed about the structure of the experiment, which comprises two parts: a visual search part and some general questions (study questionnaires). Then, they will be informed about the main part of the experiment – the visual search part. Specifically, that their task is to report, as accurately and quickly as possible, whether a target stimulus is present (press 'J') or absent (press 'F'). Then, the four practice trials will be delivered. In the practice trials, participants will be given feedback about the accuracy of their responses. The feedback will appear right after a response is given. If the response is correct, then the word “Correct!” will immediately pop on the screen, for 1 second. If the response is wrong, the word “Wrong!” will immediately pop on the screen for 5 seconds. The extended duration of the word “wrong” is intended to feel aversive and to make sure participants are paying full attention and giving accurate responses. Practice trials will be delivered in one block of 4 trials, and the main part of the experiment will start right afterwards. Before each trial, in both the practice and the main part, a fixation cross will be presented in the center of the screen. Participants will be instructed to press the spacebar key to move to the search display screen. Once they press the space bar, the search display will appear immediately.

In the main part of the experiment, participants will look for a closed square among opened squares (figure 1) in a grid of 25 stimuli. In each trial, the target can be present or absent, with the order of trials randomized for each participant.

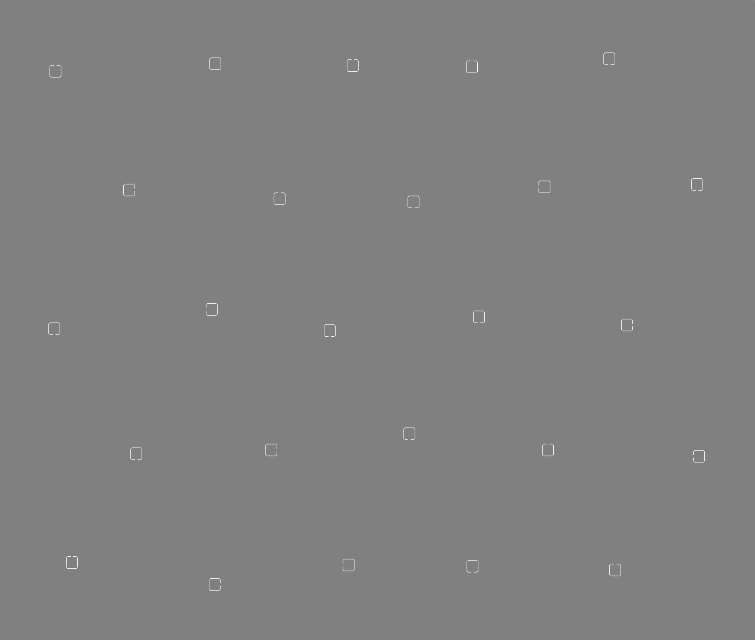
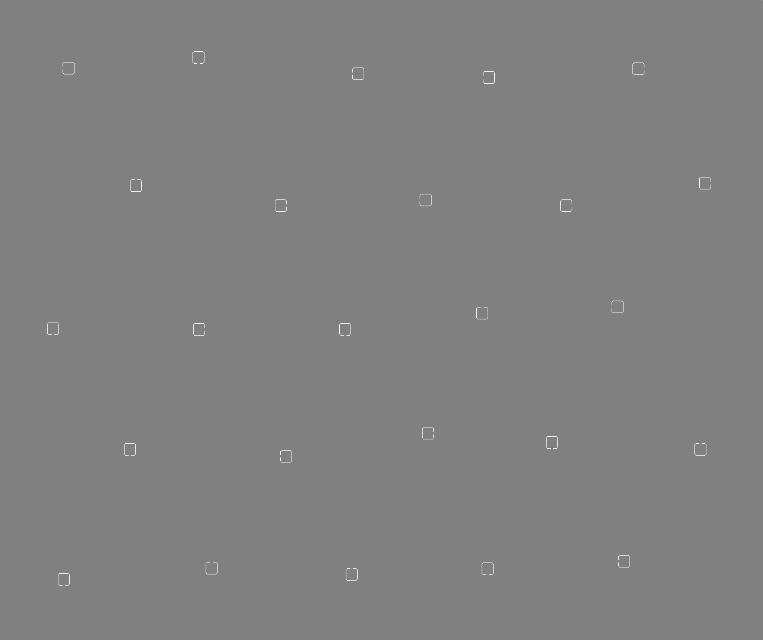


Figure 1- The visual search task: participants are looking for a closed square that can be absent (left panel) or present (right panel, top row, second square from the left).

After finishing this part, participants will be informed that they have reached the second part of the experiment. In the second part, they will fill out the OCI-R (Foa et al., 2002) and DASS-21 (Lovibond & Lovibond, 1995) questionnaires. We inserted two attention checks questions between the regular OCI items, asking participants to select a certain answer (‘If you read this question, check the option ‘Not at all’). As part of an exploratory analysis, we added an additional item to the OCI asking specifically about problems with inference about absence (‘I sometimes go back and check that I didn’t do something bad unintentionally’).

Upon completion, participants will receive a message thanking them for their participation.

**Randomization**

The order and timing of experimental events will be determined pseudo-randomly by the Mersenne Twister pseudorandom number generator, initialized to ensure registration time-locking (Mazor et al., 2019)

**Data analysis**

**Rejection criteria**

Participants will be excluded for making a number of errors that are higher than 2.5 standard deviations from the mean error rate for the entire sample (same rejection criterion used in the original study). Participants will also be excluded from the analysis if they are wrong in one or more of the attention checks questions (asking them to mark a specific answer in the questionnaire). No-response trials will be excluded from analyses.

**Hypothesis and analysis plan**

Participants will be recruited from a former sample in which we divided the sample based on the OCI-R scores to 1st/4th quartiles. Only participants in the 1st and 4th quartile will be invited to participate in the current experiment. Then we will split the sample into OC+/OC- groups based on cut-off scores from Toffolo et al., 2013, which are: OCI-R total score ≥ 17 for the OC+ group; OCI-R total score ≤ 5 for the OC- group.

Hypothesis 1- We expect to find an effect of condition (target-absent/target-present) on mean search times, beyond the groups, in which overall search time in target-absent will be longer than search time in target-present trials. We will perform a one-tailed t-test with mean search time as our dependent variable and condition as our independent variable, predicting a higher search time in target-absent trials.

Hypothesis 2 – This experiment is designed to mainly test the group (OC+/OC-) by condition (target-absent/target-present) interaction. To that end, we will use a planned contrast approach, since our hypothesis about the interaction is one tailed. We will perform a one-tailed t-test with the difference between search times as a dependent measure (mean RT absent - mean RT present), and group (OC+/OC-) as our independent measure, predicting a higher difference score for the OC+ group.

**Statistical power**

To run a statistical power analysis, we focused on our planned contrast in hypothesis 2. We ran a bootstrap power analysis with the data from the original study (Toffolo et al., 2013). We sampled n participants from each group (OC-/OC+) in each repetition and performed the one-tailed t-test detailed above. We performed 1000 repetitions for n= 60, n=80, and n=100 and report that with 100 participants in each group, we will have 92.5% power to detect a significant one-tailed interaction effect. This sample size (n=200, entire sample) should be achieved after applying our pre-registered exclusion criteria.

**Sample size**

Our target sample is 100 participants in each group after applying our pre-registered exclusion criteria. We will stop data collection once we reach 100 included participants in each group, or once we have invited all participants in the first and fourth quartiles from our previous experiment (n=250; n=239, respectively) participants in each group, respectively): the first of the two.

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