Subclinical OCD and inference about absence in visual search

Noam Sarna1, Ruvi Dar1, & Matan Mazor2

1 School of Psychological Sciences, Tel Aviv University

2 Department of Psychological Sciences, Birkbeck, University of London, UK

Author note

Correspondence concerning this article should be addressed to Noam Sarna, Tel Aviv, Israel 69978. E-mail: [noamsarna@mail.tau.ac.il](mailto:noamsarna@mail.tau.ac.il)

Abstract

In previous research, obsessive-compulsive (OC) tendencies were associated with longer search times in a visual search setting. These findings, which were replicated and extended to a clinical sample, were specific to target-absent trials, with no effect on search times when a target was present in the display. Initially, this selectivity was interpreted as indicative of checking behavior in response to mild uncertainty. However, an alternative interpretation is that individuals with high OC tendencies (OC+) suffer from a more specific difficulty with inferences about absence. In two large-scale pre-registered online experiments (conceptual replication N = 1004, direct replication N = 226), we sought to replicate the original finding and shed further light on its underlying cause: an increased sensitivity to mild uncertainty, or a selective deficiency in inference about absence. In both experiments, we find no evidence of prolonged search times in target-absent trials for OC+ individuals. Taken together, our findings provide no support for the previously observed higher search times of OC+ participants in target-absent trials. We discuss potential differences relative to previous findings and implications for cognitive and metacognitive theories of OCD.

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Theories on obsessive-compulsive disorder (OCD) emphasize the pivotal role of pathological doubt in the disorder’s phenomenology (Rasmussen & Eisen, 1989; Reed, 1985; Shapiro, 1965). This persistent doubt, marked by increased uncertainty, gives rise to repetitive checking rituals that, paradoxically, serve to intensify the doubt itself. In laboratory perceptual studies, checking behavior is commonly manifested in slow reaction times, as OC participants require more evidence under high uncertainty [Banca et al. (2015); Hauser et al. (2017). Previous studies found that participants with high obsessive compulsive tendencies (OC+) take longer to decide that a target is absent from a visual search array compared to those with low obsessive compulsive tendencies (OC-; M. B. Toffolo, van den Hout, Hooge, Engelhard, and Cath (2013)). These finding have been replicated (M. B. Toffolo, van den Hout, Engelhard, Hooge, & Cat, 2014) and extended to a clinical sample, where they were found to be specific to patients with OCD and absent in those suffering from anxiety (M. B. J. Toffolo, van den Hout, Engelhard, Hooge, & Cat, 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, relatively longer search times for the OC+ group in target-absent trials were interpreted as perseverative checking behavior under mild uncertainty.

## Warning in left\_join(., demo\_prolific, by = "subj\_id"): Detected an unexpected many-to-many relationship between `x` and `y`.  
## i Row 30049 of `x` matches multiple rows in `y`.  
## i Row 581 of `y` matches multiple rows in `x`.  
## i If a many-to-many relationship is expected, set `relationship =  
## "many-to-many"` to silence this warning.

# 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 and selected based on their acceptance rate (>95%) and for being native English speakers, located in the UK, and not having participated in former study pilots. 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 14 minutes to complete (the median completion time in a pilot study). Participants will be paid £2 for their participation, equivalent to an hourly wage of £8.57.

## Material

Visual search task The experiment described in this study was adapted from (Mazor & Fleming, 2022), with stimuli created to replicate the ones used in the (M. B. Toffolo, Hout, Hooge, Engelhard, & Cath, 2013) experiment. All elements (distractors and target) and their placement on the search grid were made to replicate as closely as possible the paradigm used in M. B. Toffolo, Hout, et al. (2013). The visual search task will consist of 4 blocks, each containing 24 trials of searching for either a closed or an open square. To make sure participants understand the task, a practice phase will be given first. The practice phase will consist of one block with six trials of visual search. Elements in both practice and main part will be white on dark grey background. 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 (wrong/right) 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, as was the case in the original paradigm (M. B. Toffolo, Hout, et al., 2013).

## Procedure

Participants will first be instructed about the experiment’s structure, which comprises three parts: A visual search part, questions about the visual search part, and some more general questions. Then, they will be informed about the main part of the experiment – the visual search part. Specifically, their task is to report, as accurately and quickly as possible, whether a target stimulus was present (press ‘J’) or absent (press ‘F’). Then, practice trials will be delivered, in which the target stimulus is a rotated T, and distractors are rotated Ls. The purpose of the practice trials is to familiarize participants with the task structure. For these practice trials, the number of items will always be 4. 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 (a pilot study showed higher accuracy rates when using this method). Practice trials will be delivered in one block of 6 trials, and the main part of the experiment will start only once participants respond correctly on at least five trials.

We used R (Version 4.1.2; R Core Team, 2021) and the R-packages *}lvmisc* [@}R-lvmisc], *broom* (Version 1.0.5; Robinson, Hayes, & Couch, 2021), *caret* (Version 6.0.94; Kuhn, 2021), *citr* (Version 0.3.2; Aust, 2019), *cowplot* (Version 1.1.1; Wilke, 2020), *devtools* (Version 2.4.5; Wickham, Hester, Chang, & Bryan, 2022), *dplyr* (Version 1.1.2; Wickham, Fran?ois, Henry, & M?ller, 2021), *forcats* (Version 1.0.0; Wickham, 2021a), *GGally* (Version 2.1.2; Schloerke et al., 2021), *ggplot2* (Version 3.4.2; Wickham, 2016), *ggpubr* (Version 0.6.0; Kassambara, 2020), *lattice* (Version 0.20.45; Sarkar, 2008), *lme4* (Version 1.1.32; Bates, Mächler, Bolker, & Walker, 2015), *lmerTest* (Version 3.1.3; Kuznetsova, Brockhoff, & Christensen, 2017), *Matrix* (Version 1.5.4; Bates & Maechler, 2021), *nlme* (Version 3.1.162; Pinheiro & Bates, 2000), *papaja* (Version 0.1.1; Aust & Barth, 2022), *piggyback* (Version 0.1.4; Boettiger & Ho, 2022), *purrr* (Version 1.0.1; Henry & Wickham, 2020), *readr* (Version 2.1.4; Wickham & Hester, 2021), *shiny* (Version 1.7.4; Chang, Cheng, Allaire, Xie, & McPherson, 2020), *stringr* (Version 1.5.0; Wickham, 2019), *tibble* (Version 3.2.1; M<U+00FC>ller & Wickham, 2021), *tidyr* (Version 1.3.0; Wickham, 2021b), *tidyverse* (Version 2.0.0; Wickham et al., 2019), *tinylabels* (Version 0.2.3; Barth, 2022), and *usethis* (Version 2.2.0; Wickham, Bryan, & Barrett, 2022) for all our analyses.

# Results

*Hypotheses 1 and 2 - Task validation*  - To validate our paradigm structure and to assess whether we successfully created an easier search by leveraging search asymmetries (i.e., switching between the target and distractors), we first examined the difference in slopes between the two search types (easy/hard), regardless of target presence (pre-registered hypothesis H1). As anticipated, a one-tailed paired t-test demonstrated a steeper slope for the difficult search 104.76 ms/item compared to the easy search 39.19 ms/item, , . Furthermore, a one-tailed paired t-test revealed that target-present slopes in the hard search 75.73 ms/item were steeper than target-absent slopes in the easy search 58.64 ms/item, , (pre-registered hypothesis H2).

The initial two control comparisons served to validate that we successfully designed a target-absent condition that was easier than a target-present condition, thereby experimentally decoupling decision certainty from target presence, and enabling to measure their independent effects on search time as a function of obsessive-compulsive tendencies.

*Hypothesis 3 - Replication of Toffolo et al. (2013), mean RT* To directly replicate the findings of Toffolo et al. (2013, 2014, 2016), we focused on the difficult search with the larger set size (set size = 25). We conducted a mixed-effects ANOVA, with mean response time (RT) as the dependent variable, group (OC+ vs. OC-) as a between-subjects variable, and target presence (present vs. absent) as a within-subjects variable. Specifically, we tested for an interaction between group and target presence, wherein the mean RT difference between the OC+ and OC- groups would be significantly larger in target-absent trials. Contrary to our expectations, the analysis did not reveal a significant interaction between group and target presence, , , suggesting no difference in mean RT between the OC+ and OC- groups in either target-present or target-absent trials (figure 3).

# Discussion

# References

Aust, F. (2019). *Citr: ’RStudio’ add-in to insert markdown citations*. Retrieved from <https://github.com/crsh/citr>

Aust, F., & Barth, M. (2022). *papaja: Prepare reproducible APA journal articles with R Markdown*. Retrieved from <https://github.com/crsh/papaja>

Banca, P., Vestergaard, M. D., Rankov, V., Baek, K., Mitchell, S., Lapa, T., … Voon, V. (2015). Evidence Accumulation in Obsessive-Compulsive Disorder: The Role of Uncertainty and Monetary Reward on Perceptual Decision-Making Thresholds. *Neuropsychopharmacology*, *40*(5, 5), 1192–1202. <https://doi.org/10.1038/npp.2014.303>

Barth, M. (2022). *tinylabels: Lightweight variable labels*. Retrieved from <https://cran.r-project.org/package=tinylabels>

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>

Bates, D., & Maechler, M. (2021). *Matrix: Sparse and dense matrix classes and methods*. Retrieved from <https://CRAN.R-project.org/package=Matrix>

Boettiger, C., & Ho, T. (2022). *Piggyback: Managing larger data on a GitHub repository*. Retrieved from <https://CRAN.R-project.org/package=piggyback>

Chang, W., Cheng, J., Allaire, J., Xie, Y., & McPherson, J. (2020). *Shiny: Web application framework for r*. Retrieved from <https://CRAN.R-project.org/package=shiny>

Hauser, T. U., Allen, M., NSPN Consortium, Bullmore, E. T., Goodyer, I., Fonagy, P., … Dolan, R. J. (2017). Metacognitive impairments extend perceptual decision making weaknesses in compulsivity. *Scientific Reports*, *7*(1), 6614. <https://doi.org/10.1038/s41598-017-06116-z>

Henry, L., & Wickham, H. (2020). *Purrr: Functional programming tools*. Retrieved from <https://CRAN.R-project.org/package=purrr>

Kassambara, A. (2020). *Ggpubr: ’ggplot2’ based publication ready plots*. Retrieved from <https://CRAN.R-project.org/package=ggpubr>

Kuhn, M. (2021). *Caret: Classification and regression training*. Retrieved from <https://CRAN.R-project.org/package=caret>

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software*, *82*(13), 1–26. <https://doi.org/10.18637/jss.v082.i13>

Mazor, M., & Fleming, S. M. (2022). Efficient search termination without task experience. *Journal of Experimental Psychology: General*.

M<U+00FC>ller, K., & Wickham, H. (2021). *Tibble: Simple data frames*. Retrieved from <https://CRAN.R-project.org/package=tibble>

Pinheiro, J. C., & Bates, D. M. (2000). *Mixed-effects models in s and s-PLUS*. New York: Springer. <https://doi.org/10.1007/b98882>

R Core Team. (2021). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <https://www.R-project.org/>

Rasmussen, S. A., & Eisen, J. L. (1989). Clinical features and phenomenology of obsessive compulsive disorder. SLACK Incorporated Thorofare, NJ.

Reed, G. F. (1985). *Obsessional Experience and Compulsive Behavior: A Cognitive-structural Approach*. Academic Press. Retrieved from <https://books.google.co.il/books?id=AGHXzgEACAAJ>

Robinson, D., Hayes, A., & Couch, S. (2021). *Broom: Convert statistical objects into tidy tibbles*.

Sarkar, D. (2008). *Lattice: Multivariate data visualization with r*. New York: Springer. Retrieved from <http://lmdvr.r-forge.r-project.org>

Schloerke, B., Cook, D., Larmarange, J., Briatte, F., Marbach, M., Thoen, E., … Crowley, J. (2021). *GGally: Extension to ’ggplot2’*. Retrieved from <https://CRAN.R-project.org/package=GGally>

Shapiro, D. (1965). *Neurotic styles.*

Toffolo, M. B. J., van den Hout, M. A., Engelhard, I. M., Hooge, I. T. C., & Cat, D. C. (2016). Patients With Obsessive-Compulsive Disorder Check Excessively in Response to Mild Uncertainty. *Behavior Therapy*, *47*(4), 550–559. <https://doi.org/10.1016/j.beth.2016.04.002>

Toffolo, M. B., Hout, M. A. van den, Hooge, I. T., Engelhard, I. M., & Cath, D. C. (2013). Mild uncertainty promotes checking behavior in subclinical obsessive-compulsive disorder. *Clinical Psychological Science*, *1*(2), 103–109.

Toffolo, M. B., van den Hout, M. A., Engelhard, I. M., Hooge, I. T., & Cat, D. C. (2014). Uncertainty, checking, and intolerance of uncertainty in subclinical obsessive compulsive disorder: An extended replication. *Journal of Obsessive-Compulsive and Related Disorders*, *3*(4), 338–344.

Toffolo, M. B., van den Hout, M. A., Hooge, I. T., Engelhard, I. M., & Cath, D. C. (2013). Mild uncertainty promotes checking behavior in subclinical obsessive-compulsive disorder. *Clinical Psychological Science*, *1*(2), 103–109.

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer-Verlag New York. Retrieved from <https://ggplot2.tidyverse.org>

Wickham, H. (2019). *Stringr: Simple, consistent wrappers for common string operations*. Retrieved from <https://CRAN.R-project.org/package=stringr>

Wickham, H. (2021a). *Forcats: Tools for working with categorical variables (factors)*. Retrieved from <https://CRAN.R-project.org/package=forcats>

Wickham, H. (2021b). *Tidyr: Tidy messy data*. Retrieved from <https://CRAN.R-project.org/package=tidyr>

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., Fran<U+00E7>ois, R., … Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*(43), 1686. <https://doi.org/10.21105/joss.01686>

Wickham, H., Bryan, J., & Barrett, M. (2022). *Usethis: Automate package and project setup*. Retrieved from <https://CRAN.R-project.org/package=usethis>

Wickham, H., Fran?ois, R., Henry, L., & M?ller, K. (2021). *Dplyr: A grammar of data manipulation*. Retrieved from <https://CRAN.R-project.org/package=dplyr>

Wickham, H., & Hester, J. (2021). *Readr: Read rectangular text data*. Retrieved from <https://CRAN.R-project.org/package=readr>

Wickham, H., Hester, J., Chang, W., & Bryan, J. (2022). *Devtools: Tools to make developing r packages easier*. Retrieved from <https://CRAN.R-project.org/package=devtools>

Wilke, C. O. (2020). *Cowplot: Streamlined plot theme and plot annotations for ’ggplot2’*. Retrieved from <https://CRAN.R-project.org/package=cowplot>