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28th April 2023

Dear Editor,

**Bayesian multi-level modelling for predicting single and double feature visual search**

We would be grateful if you could consider our Stage 2 Registered Report for publication in *Cortex*.

Visual search, where participants are asked to find a target within a cluttered scene, has long been a popular topic of study in cognitive psychology, and several models have been developed that are able to generate testable predictions about how different types of distractors and targets affect search efficiency. However, in the main, these have been relatively descriptive models. We believe that the use and development of quantitative, mathematical models is highly important for advancing the field: they allow us to make testable predictions and enable us to consider the limitations and assumptions of our theories with greater clarity. Thus, in the current work, we focus on the recently proposed Target Contrast Signal (TCS) theory, a rare example of a model that attempts to quantitatively predict search slopes during visual search.

We develop an improved version of the TCS model by extending it to a Bayesian multi-level framework and demonstrate that moving to a shifted-lognormal distribution for reaction times leads to a better the model fit. We also show that the previous datasets used to test the model are not sufficient to distinguish between the various contrast contribution models that have been hypothesized to operate in the TCS model. In the current manuscript, we have carried out the proposed replication study to a) attempt to replicate the key original findings and b) test some small modifications to help distinguish between theories. By making our data and code open source, we also hope to encourage other scientists to start testing the model on their own datasets and questions.

Thank you very much in advance for considering our paper.

Yours sincerely,



Anna Hughes