Bayesian cognitive and statistical modeling applied to Signal Detection Theory and the Mirror Effect in a perceptual task.

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Introduction

The Mirror Effect is a well-established empirical result in Recognition Memory: when subjects' performance is compared between two classes of stimuli, one known to be easier to recognize (A class) than the other (B class), this difference is reflected in the identification of both target and lure stimuli (Glanzer et al., 1993), measured as hit and false alarm rates in a Signal Detection Theory framework.

$$FA(A) < FA(B) < Hits(B) < Hits(A) \qquad (1)$$

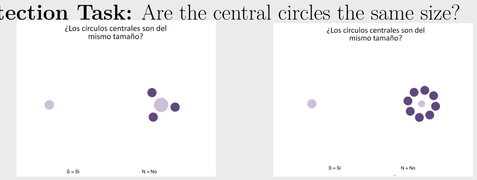
The implied order of the underlying distributions under a SDT framework is what gives these patterns the name of the "Mirror Effect".

Method: A perceptual task

To assess the generalizability of the Mirror Effect, we designed a merely perceptual task where what is known about the Ebbinghaus illusion (Massaro & Anderson 1971), is used to construct the two classes of stimuli, A and B:

- A class ("Easier"): 2 or 3 surrounding circles.
- B class ("Hard"): 7 or 8 surrounding circles.

1 **Detection Task:** Are the central circles the same size?



2 **Confidence Rating:** How certain are you of your previous response? (1-3 scale)

Two experiments:

- Experiment 1: Just the right circle was an Ebbinghaus illusion.
- Experiment 2: Both circles were constructed as Ebbinghaus illusions.

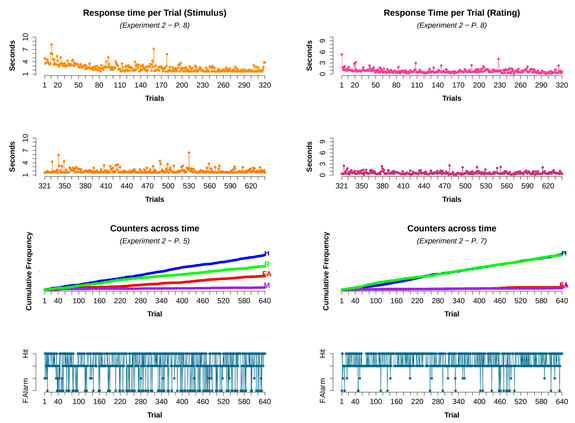
Replication of the original data analysis

We found evidence for the Mirror Effect in at least 85% of our participants: In Experiment 1 we had 17/20 in the Yes/No task and 18/20 on their Confidence ratings; 19/20 participants showed the Mirror Effect patterns in Experiment 2, in both tasks). We conducted a step by step replication of the mean-based analysis reported in the

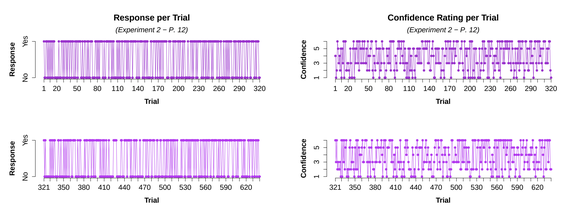
A Bayesian approximation

Given the probabilistic nature of the SDT model, it seems like the study of the Mirror Effect can benefit from the application of Bayesian statistical and cognitive modeling to evaluate the differences observed in the performance of participants across each class of stimuli.

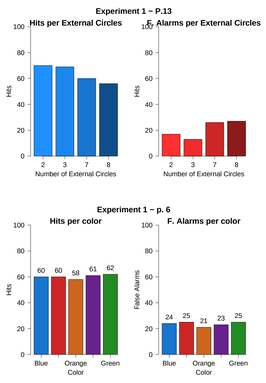
- Are there changes in participants' performance across time?



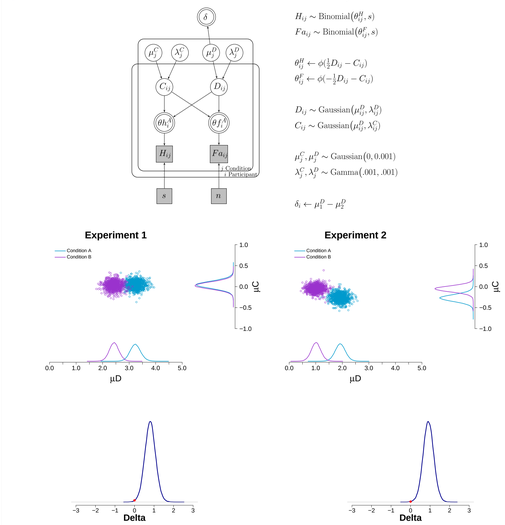
- Are participants actually paying attention?



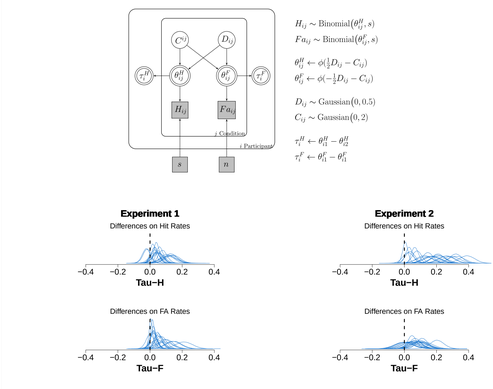
- Are the variables involved within stimuli affecting participants' responses?



1 D' differences: Are conditions actually different?



2 Hit and False Alarm Rate Differences



Classical Analysis

Discussion

The present study is the first to show evidence of the Mirror Effect patterns of response on a SD task that does not involve recognition memory.

The perceptual task here presented lacked a pre-experimental phase where participants had the chance to manipulate how powerful were the illusions elicited in each condition. This suggests that there might be a much more basic principle regulating the Mirror Effect pattern of responses.

References

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Acknowledgments & Contact Information

This project was supported by PAPIIT .

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