



# Assessing Human Performance in Recognition of Spatial and Temporal Patterns

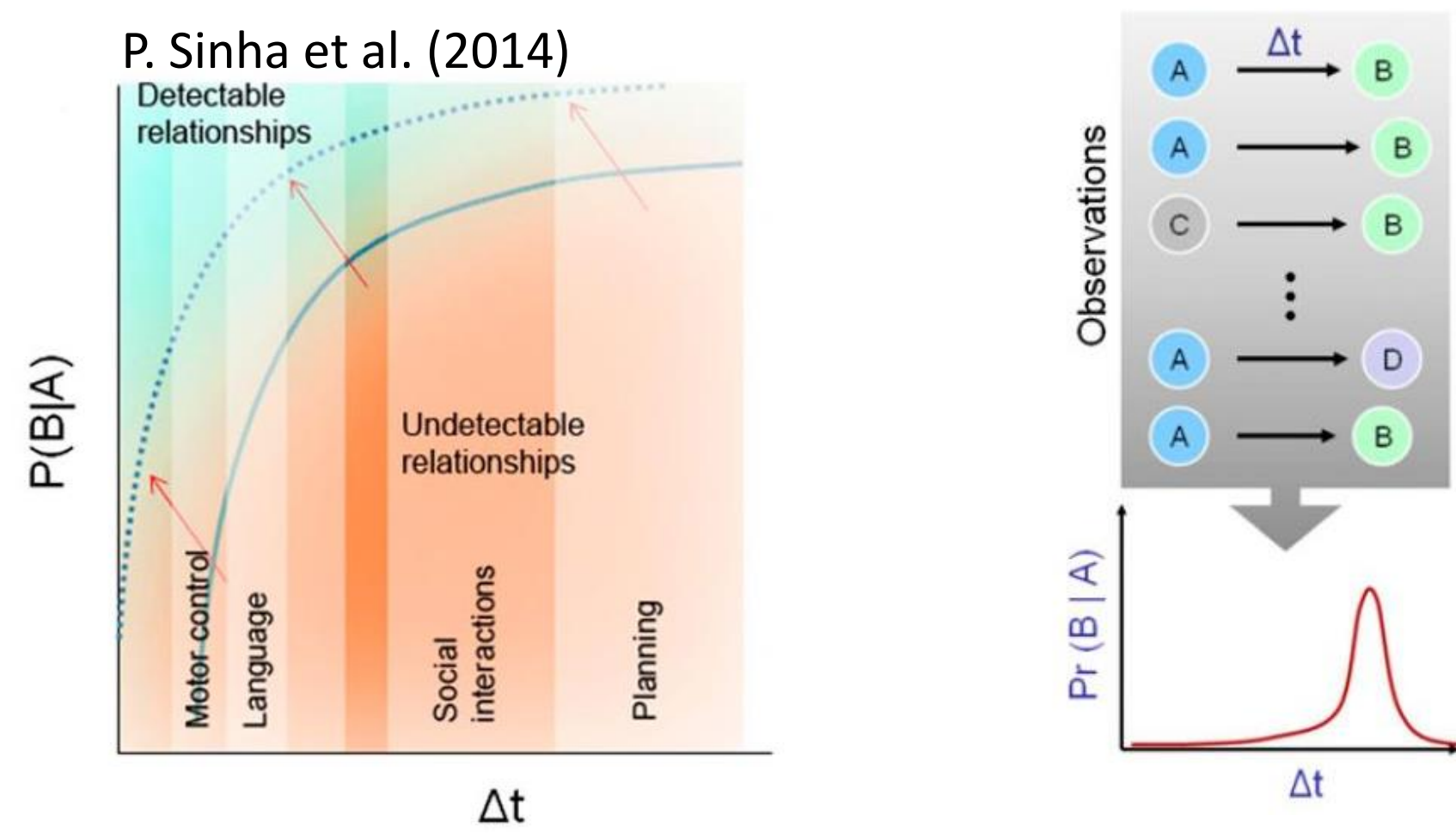
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## Introduction

- People with autism spectrum disorder (ASD) exhibit a wide variety of behavioral symptoms, including impaired communication skills and inclination towards repetitive actions.
- Children with ASD live in a seemingly magical world, where events occur without a cause.

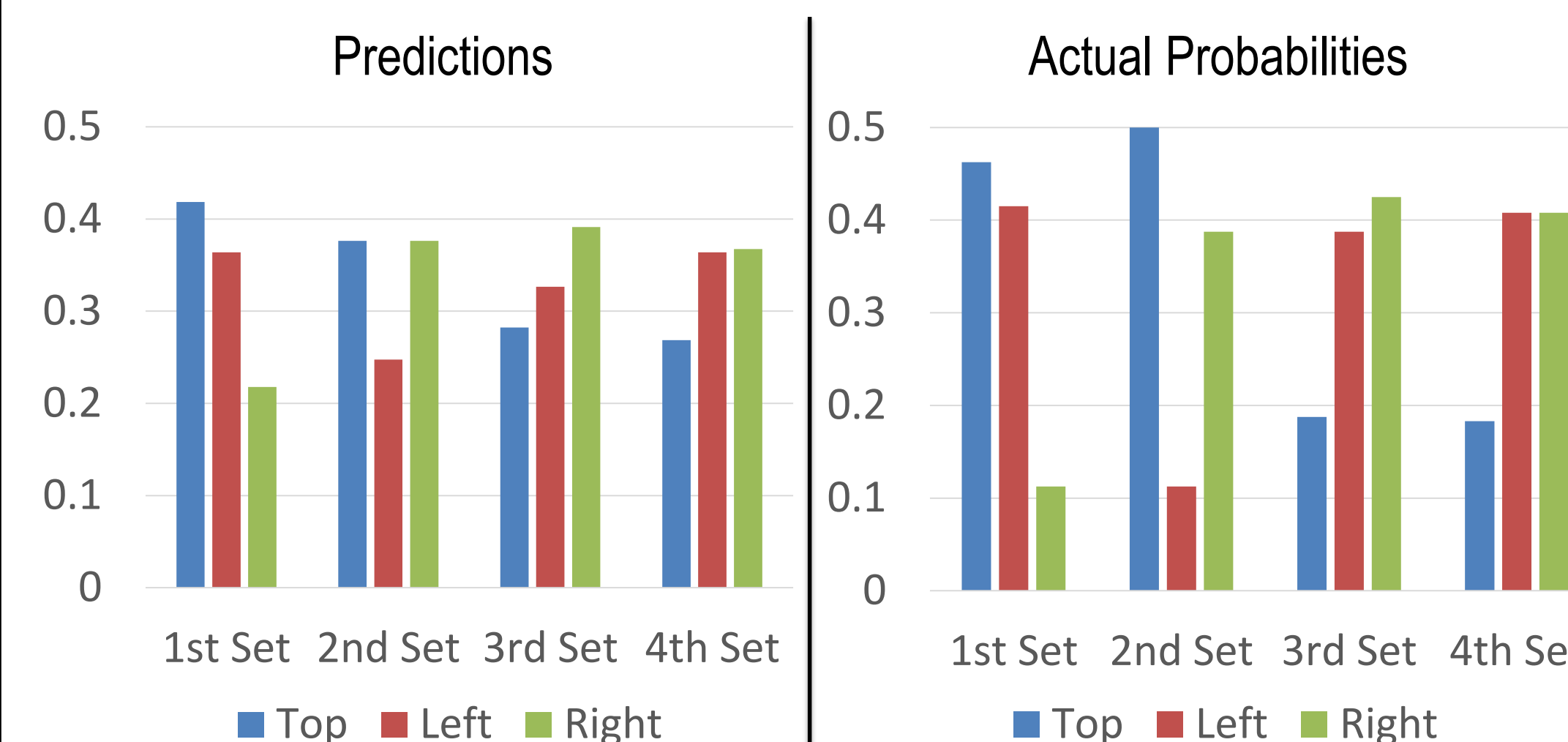


- The Predictive Impairment in Autism (PIA) hypothesis presents the idea that an inability to predict may tie the varying symptoms of autism together.<sup>1</sup>
- PIA posits that autism may be associated with inaccuracies in predicting patterns in spatial and temporal conditions.
- Specifically, people with ASD may detect fewer relationships over time in various aspects of life, including motor control and language.
- For example, without being able to predict movements based on past actions, patients have difficulty interacting with dynamic objects.
- This project was created to test the PIA hypothesis.
- An experiment was created with two parts: spatial and temporal. Both parts require the use of past events to determine future outcomes.
- As of now, this project is a pilot to test performance of neurotypical individuals and will later be expanded to test on ASD subjects.

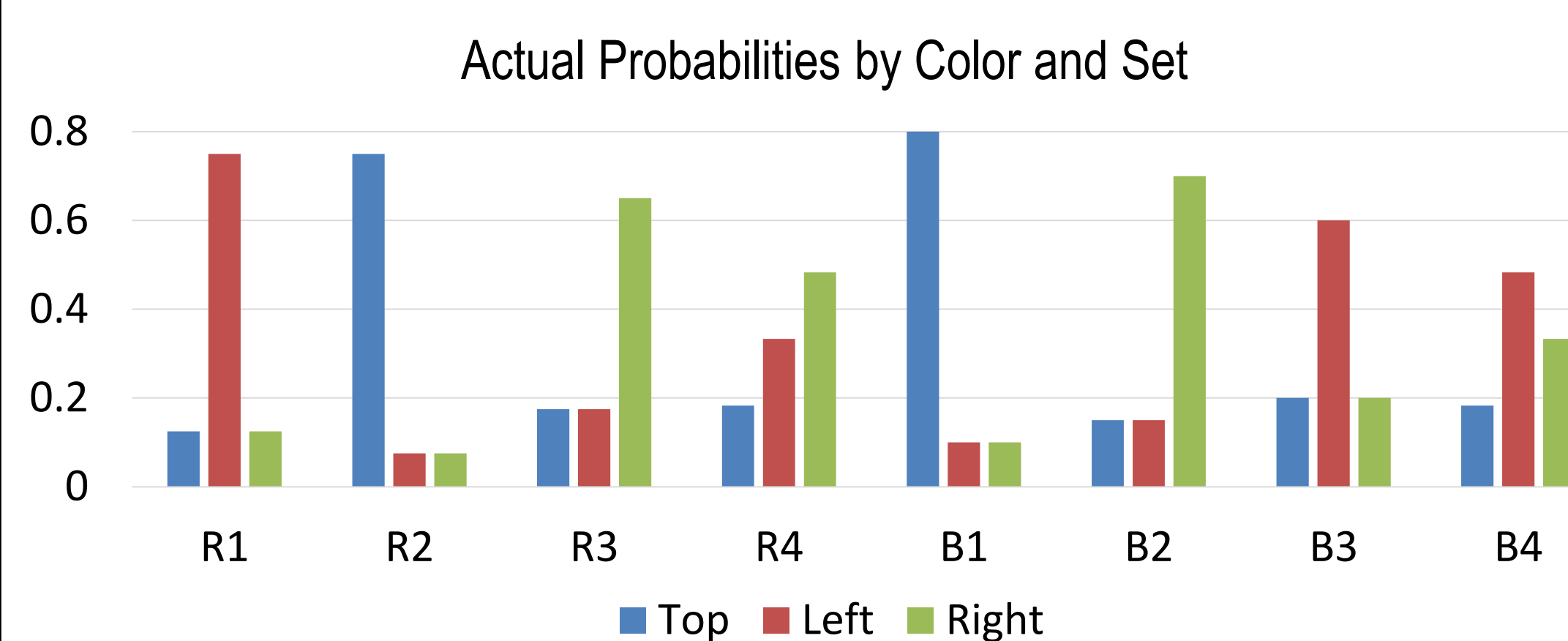
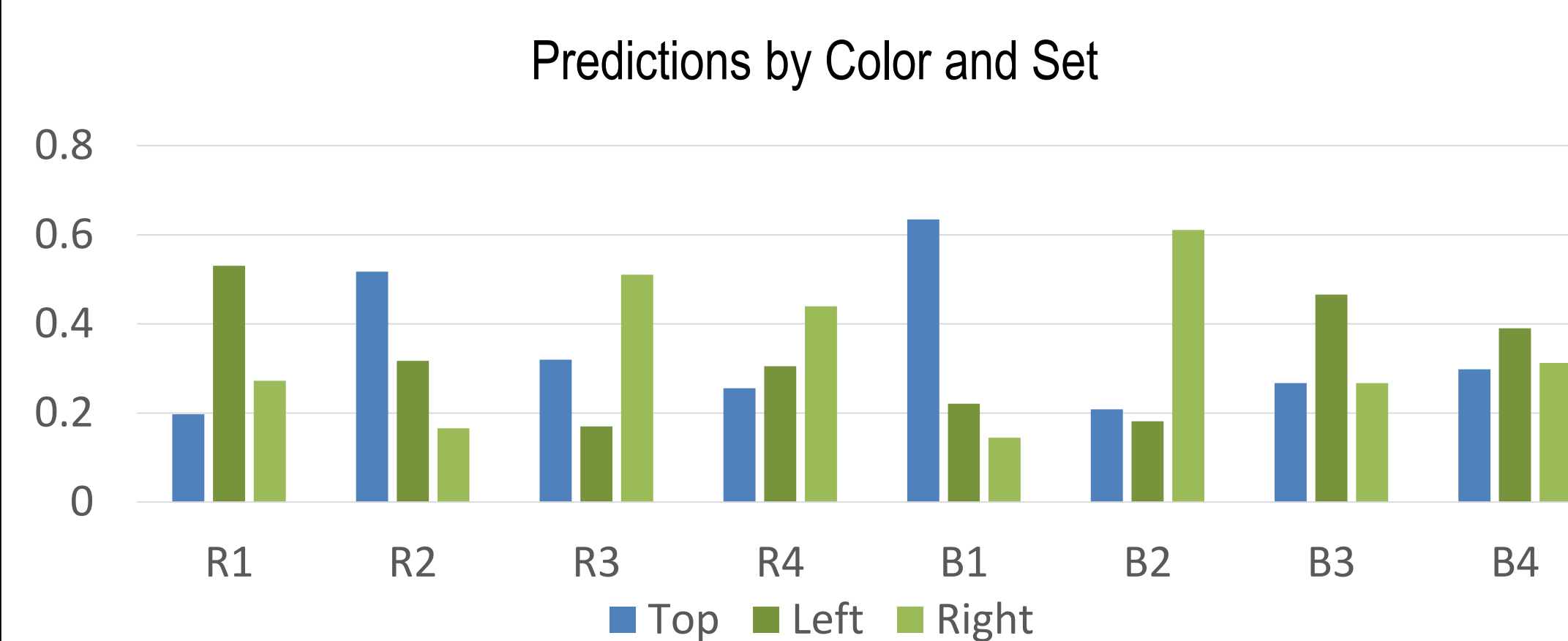
## Results/Analysis - Spatial

Prior to running the experiment on ASD patients, we tested the viability of the experiment on neurotypical individuals.

- From the limited pilot data of 8 samples collected, a few interesting lessons were learned.



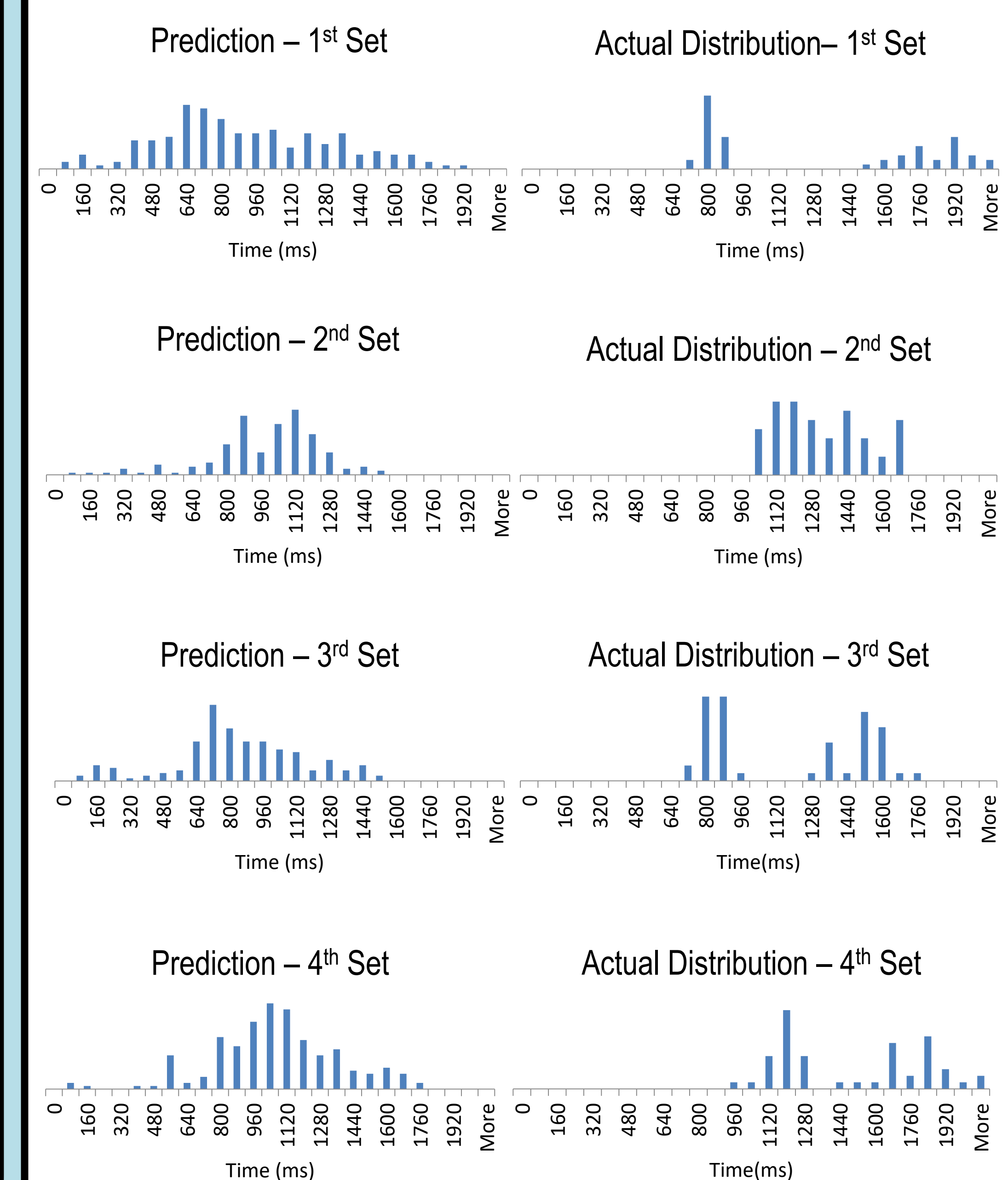
- In the spatial condition, actual keypresses aligned well with the given probabilities, demonstrating that pattern recognition is generally accurate with the current configuration.



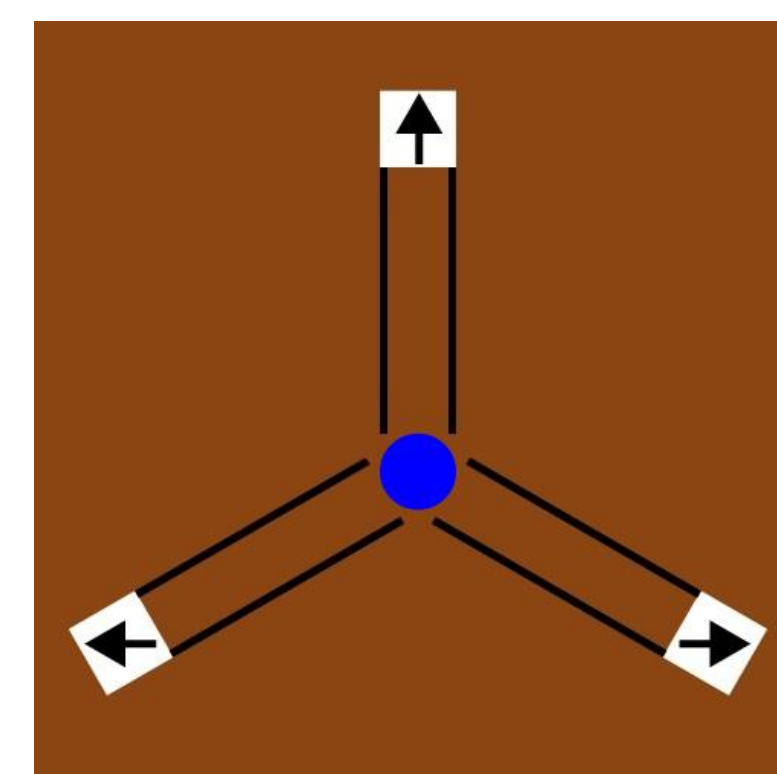
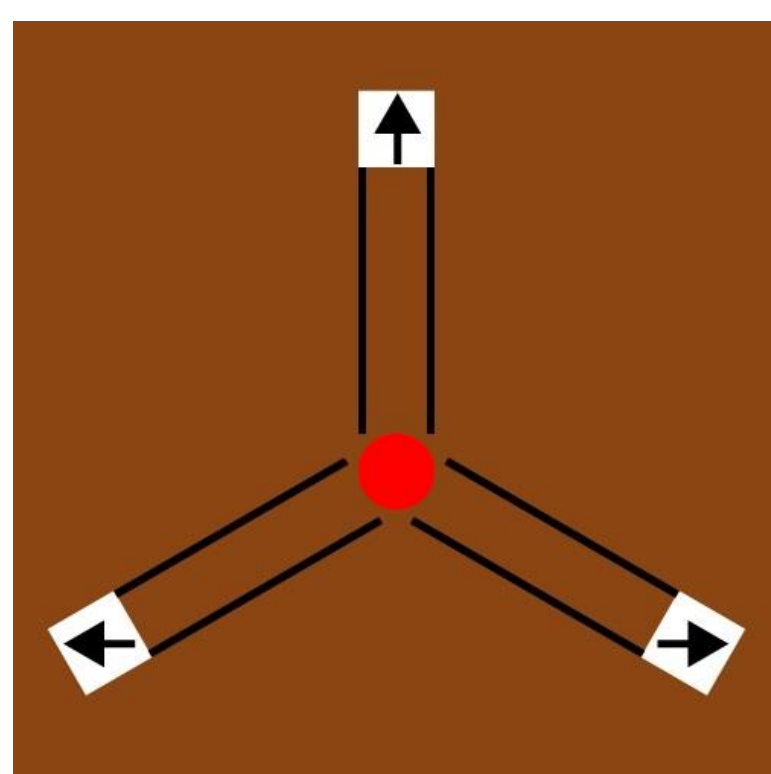
- When separating the keypresses by color, there appears to be an influence by one ball on the other.
- In the first set of 50 trials, the blue ball appeared 80% of the time on the top while the red ball only appeared 12.5% of the time there.
- However, 20% of the keypresses on red balls guessed that it would go to the top.

## Results/Analysis - Temporal

- In the temporal condition, subjects were able to differentiate between the two balls more when the differences were the largest and the smallest (sets 1 and 2).
- Further data collection and analysis will need to be completed to assess sets 3 and 4.
- In sets 1 and 2, there are two visible peaks with a large spread, with each of the peaks near where the true mean was. Similarly to the spatial condition, there appears to be an influence by one ball on the other.
- We ran t-tests to determine that people easily detect when the time changes on one ball but not the other, with this consistently switching from blue to red to blue between the 3 changes.



## Methods



- Experiment written using JavaScript, published online.
- Two conditions: Spatial and then Temporal
- Spatial:** tests subjects' abilities to predict which direction the ball will move, with 200 trials total.
  - Probabilities change every 50 trials (25 per color) and the directions are randomized based on given probability distributions.
- Temporal:** tests subjects' abilities to predict what time the ball will move, with the direction fixed. There are 200 trials, with the means, standard deviations (1/10 of the mean), and allowed prediction difference (1/3 of the mean) changing every 50 trials (25 per color).
  - Times are based on a Gaussian distribution given mean and standard deviation.
- Through statistical analysis, including t-tests and ANOVA tests, of key presses, time pressed, and scores for each of the tests, patterns of prediction that relate to behavior were assessed.

## Conclusion/Future Directions

- Our pilot study showed that human prediction and pattern recognition is generally strong but may get a little bit mixed between the two differently colored stimuli.
- In the future we hope to be able to run this experiment on ASD subjects and compare the results to be able to test the PIA hypothesis.

## References/Acknowledgements

I'd like to thank the team at the Sinha Lab this summer for providing a great environment to work and develop this project.  
<sup>1</sup> Sinha P, et al. Autism as a disorder of prediction. Proc. Natl Acad. Sci. USA. 2014, 111, 15220–15225.