Determining the Strategies Used in the Game "Spot the Missing Object (SMO)" by ADHD and Non-ADHD in Adults: An Eye-Tracking Technology Study

L. Aguerrevere, PhD, J. Flowers, PhD, M. Gerhold, MS, C. Martinez, BS, H. Marzolf BS,

Stephen F. Austin State University

Introduction

- Typical evaluations of ADHD consist of behavior self-report rating scales, a measure of cognitive or intellectual functioning, and specific performance measures designed to measure attention.
- However, some research shows that current performance measures of ADHD have low specificity and sensitivity and are generally not helpful in diagnosing ADHD in adults (Lipszyc & Schachar, 2010).
- This project is designed to determine if a non-verbal, user-friendly visual search task, combined with eye-tracking technology, can help increase the diagnostic utility of performance-based measures.
- The study evaluated the effectiveness of Eye-Tracking Technology as a reliable technique to discriminate ADHD in young adults. In specific, we determined if fixation rate (i.e., number of fixations per second) is different between those that have ADHD (meet criteria on the Adult ADHD Self-Report Scale; ASRS) and those with no diagnosis of ADHD while completing a visual search task "Spot the Missing Object."
- Spot the Missing Object (SMO) is an adaptation of the "Spot the Difference"

Method

Participants

- A total of 153 college students participated in this study.
- To be placed in the ADHD group, a participant must endorse four or more symptoms on the ASRS.
- To be placed in the non-ADHD, participants should have endorsed no ADHD symptoms.
- Participants that did not meet the above criteria for ADHD and non-ADHD were placed in an Indeterminate group and were not included in the analysis.
- A total of 29 participants met criteria for ADHD; 45 met criteria for non-ADHD, and 71 were classified as Indeterminate.

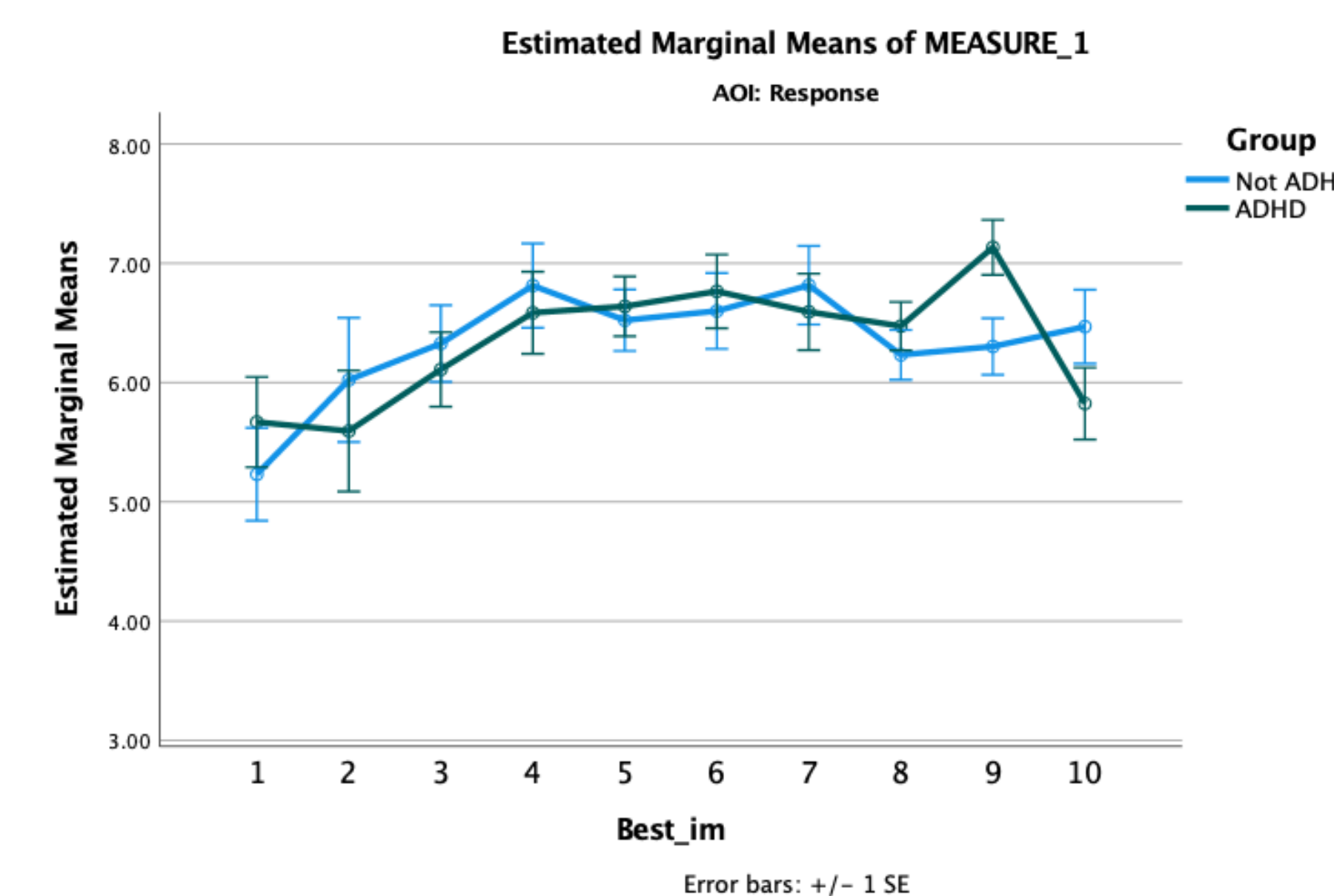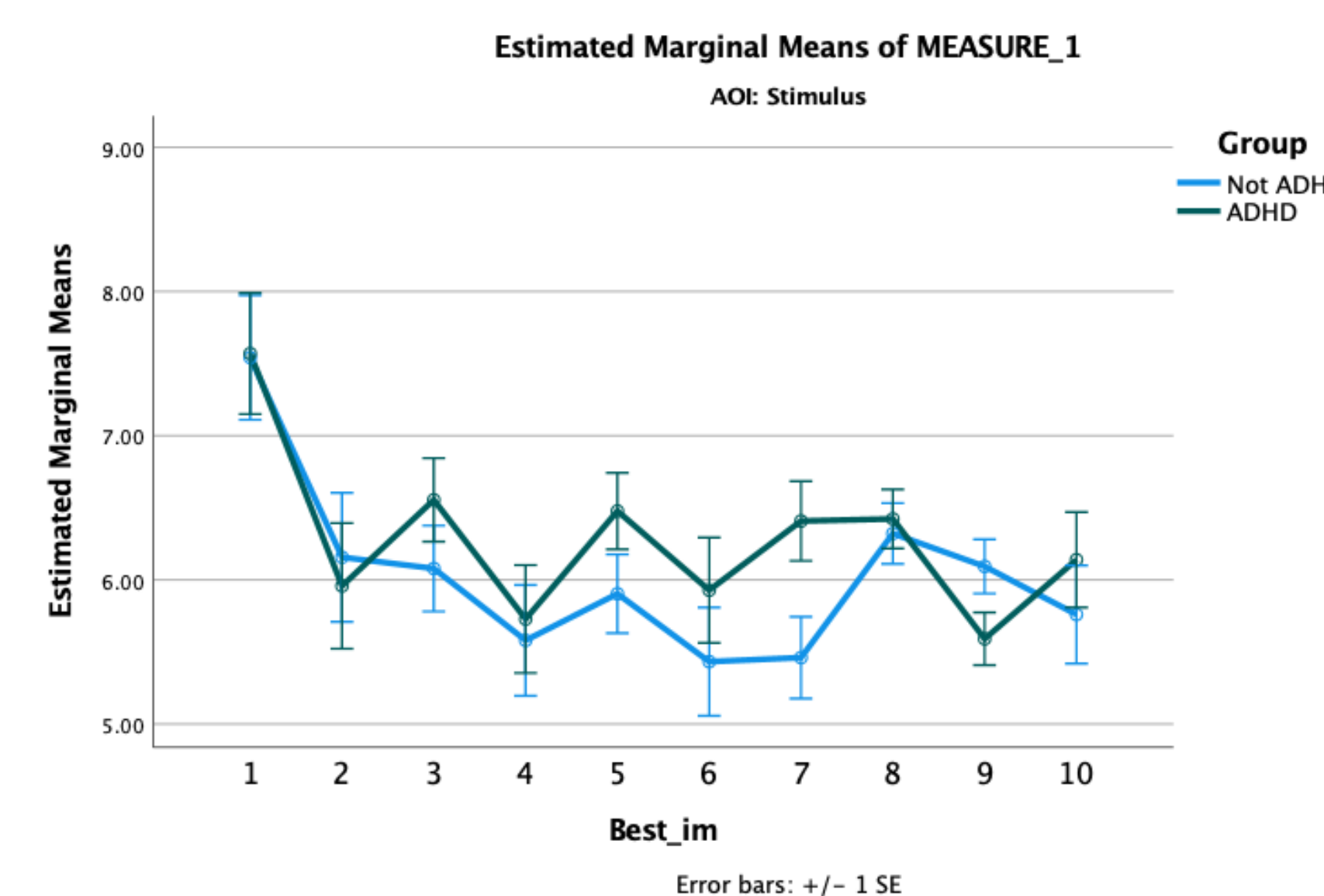### Spot the Missing Object (SMO).

- Different images were used to assess group differences.
- The original and modified versions were displayed side by side to create one full picture. Participants then clicked the missing object
  - Left side: original version
  - Right side: modified picture - In the modified picture, one object was deleted
- Of interest for this study were group differences for "Fixation Rate", which is the time during which the eye stay fixed on one point to accumulate information (Mohamad Shahimin & Razali, 2019)

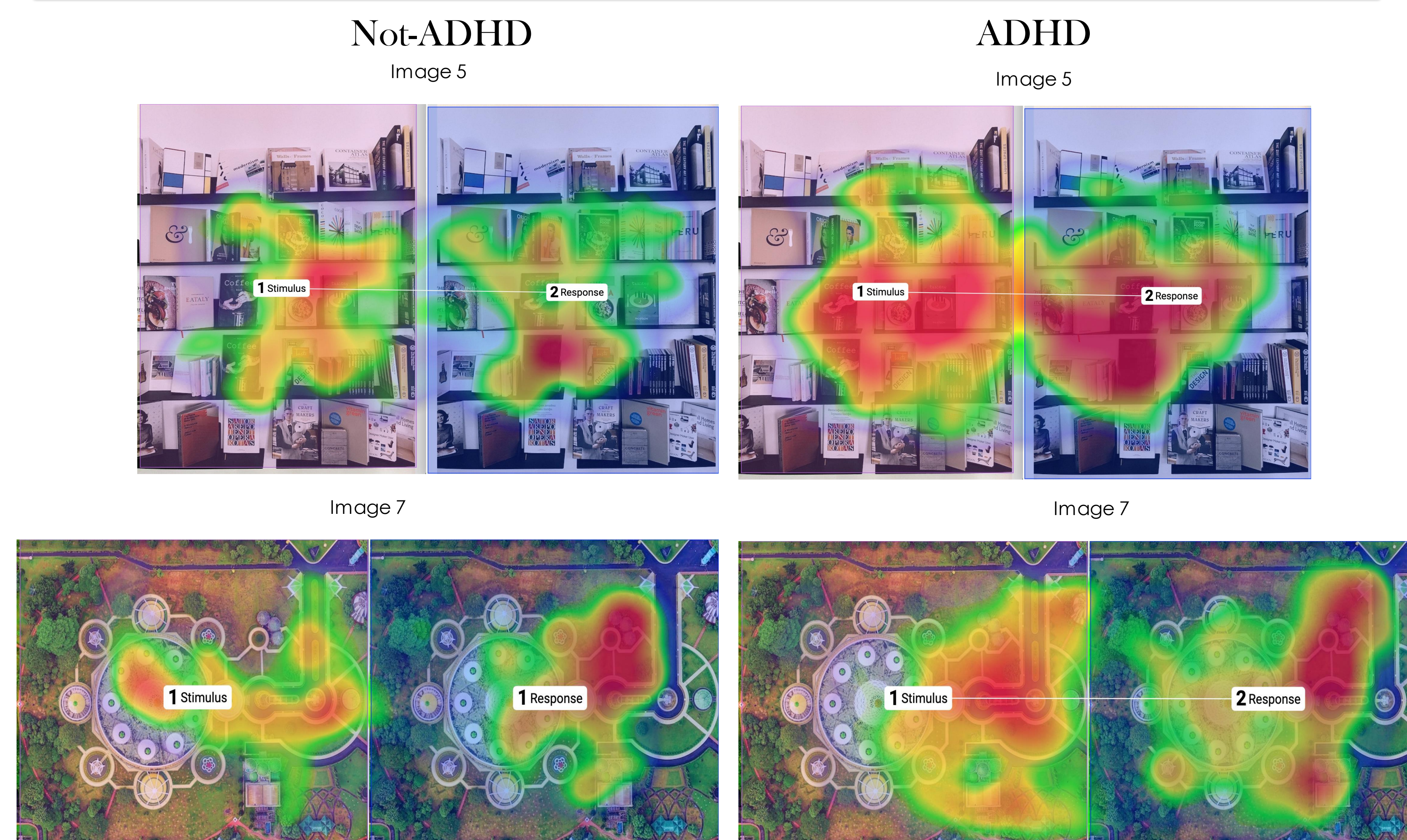### Apparatus and Stimuli Display.

- The Adult ADHD Self-Report Scale (ASRS) was used to group participants into ADHD and nonADHD groups.
- Sticky by Tobii Pro (2020) for the collection of eye-movement data was utilized. Sticky by Tobii Pro is an online self-service platform that combines online survey questions with webcam eye-tracking.

Results

- Out of the 29 participants who met the criteria for ADHD, 14 completed the study with acceptable eye-tracking data.
- Out of the 45 participants that met the criteria for non-ADHD, 14 were able to complete the task with acceptable eye-tracking data.
- Results indicated significant statistical differences in the total fixation rates for the groups. Results indicated on the Stimulus picture that participants classified as ADHD had observably higher fixation rate (FR) (M = 6.01; SD= .92) compared to the non-ADHD (M =5.64; SD=.72). On the contrary, those classified as ADHD demonstrated no significant FR on the Response pictures (M=6.70; SD = 1.35) compared to the not-ADHD (M = 6.77; SD=.77). Results showed statistical significance for images 5, 7, and 9 (p-value range .02 to .05) and showed large effect sizes (Cohen's D range 0.81 to 0.97).

Estimated Marginal Means of MEASURE_1 — AOI: Stimulus

Estimated Marginal Means of MEASURE_1 — AOI: Response

Heat Maps

Not-ADHD	ADHD
Image 5	Image 5

Image 7

Discussion & Conclusion

- The results of this study suggest that eye-tracking technology can potentially help understand the processes that occur during an effortful visual search task and the difference between individuals who have difficulty with attention. In specific to this study, ADHD individuals spent significantly more mental effort (as measured by fixation rate) on learning the image's details (stimulus) than those who do not have ADHD.
- This result supports the idea that individuals with ADHD generally demonstrate less efficient and slower serial search than the typically developing group, which hinders appropriate responding.
- This result also supports the idea that individuals with ADHD rely less on working memory when completing a complex task.
- The study also found that images that show an array of similar patterns (e.g. squares, circles) tend to better discriminate between the groups.

Limitations
- Spot the difference needs stronger support for its psychometric properties.
- Many exclusions due to technical issues with eye-tracking camera (e.g., lighting, movement of head)
- Limited age range
- Tobii has limited research functions and limited our research
  - Editing questions/images is difficult
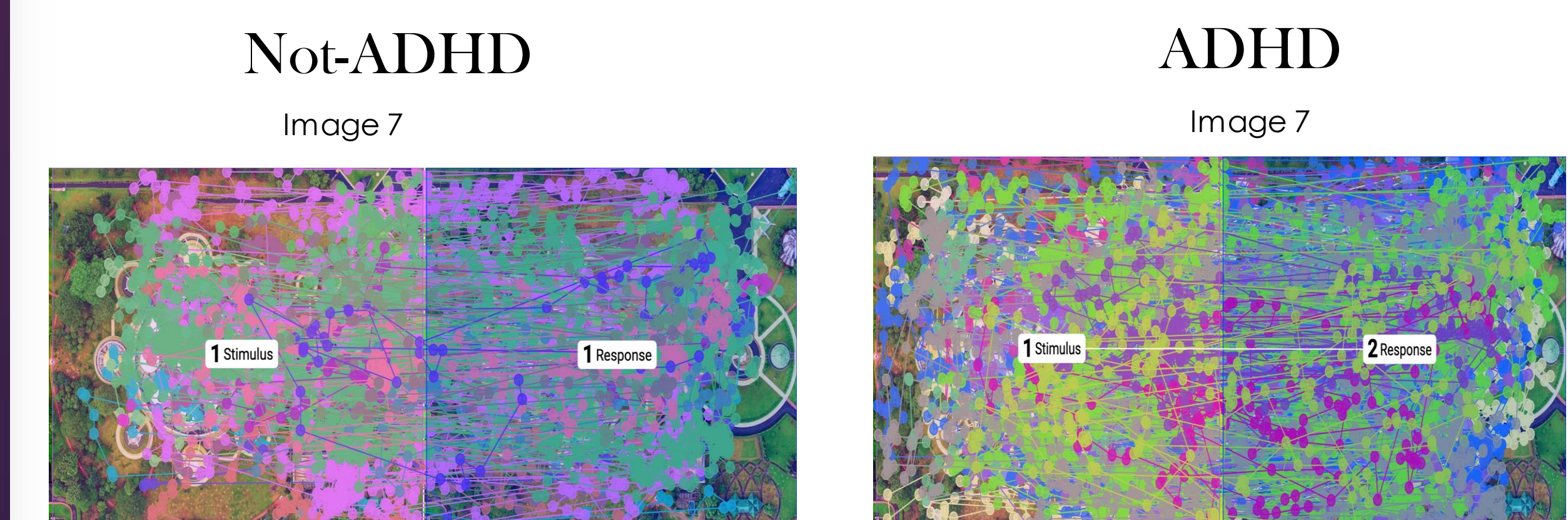 - Only works with limited amount of images

Future research
- Refinement of images.
- Determination of the role of effort.

Conclusion
- Eye-tracking technology could be a potentially useful tool to assist with and improve psychology assessments.
- Particularly to determine ADHD in adults.

Gaze Plots

Not-ADHD	ADHD
Image 7	Image 7

Acknowledgement