

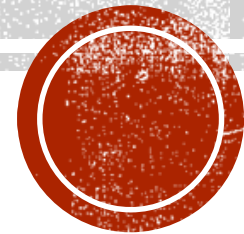


VALIDATING VISUAL EYE TRACKING TECHNOLOGY TO ASSESS ACCOMMODATIVE TECHNOLOGY FOR STUDENTS WITH DISABILITIES IN UNDERGRADUATE EDUCATION

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INTRODUCTION

- The National Center for Education Statistics (NCES) data from 2011-2012, reported that 11% of undergraduate students are identified as having a disability.
- Nearly, 38% of students with disabilities are enrolled in 2-year as compared to 9.8% at 4-year institutions.
- Students with disabilities require support services, some of which are accommodative technologies.
- Chan et al., (2017) showed that eye tracking technology is sensitive enough to pick up gender differences related to accuracy and response latency in a simple Flanker Task. They also showed that this technology is sensitive to pick up differences between visual tracking behaviors in individuals with and without disabilities.



5 MAIN CATEGORIES DESCRIBING STUDENTS WITH DISABILITIES

- Learning Disabilities (LD)
- Emotional or Psychiatric Conditions (EPC)
- Orthopedic or Mobility Impairments (EMI)
- Attention Deficit/Hyperactivity Disorder (AD/HD)
- Health Impairments (HI)



PROBLEM STATEMENT

- Little data exists on whether or not such technologies are sensitive to accommodating individual needs, that is tailored to support people with a specific or having multiple disabilities.
- The literature lacks studies:
 - 1) investigating the cognitive processing in people with multiple disabilities
 - 2) whether technologies given to these students are beneficial
 - 3) what are the educational outcomes in using such technologies
- The aim of the study was to determine whether assessing students' visual processing abilities (*i.e.*, eye gaze) through a 10-minute Flanker Task could be used as a predictive diagnostic tool to screen students with disabilities based on the type of disability from the 5 main categories described earlier.



HYPOTHESES

- We hypothesized the following:

- **Null Hypothesis # 1:**

H_0 = That eye gaze could not detect attentional differences based on the type of disability between a triple blinded Non-OSSD and OSSD student population.

- **Alternative Hypothesis # 1:**

H_1 = That eye gaze could detect attentional differences based on the type of disability between a triple blinded Non-OSSD and OSSD student population.

- **Null Hypothesis # 2:**

H_0 = That eye gaze could not be used as a predictive diagnostic tool to screen students with disabilities.

- **Alternative Hypothesis # 2:**

H_1 = That eye gaze could be used as a predictive diagnostic tool to screen students with disabilities.



METHOD: SAMPLE POPULATION

- IRB Approval was granted from SUNY-Old Westbury to conduct the study.
- Students from SUNY Old Westbury were randomly sampled by convenience.
- **Experiment 1: Assessed the sensitivity of Eye Gaze between students with and without disabilities**
 - Males $N = 6$ (*i.e.*, Non-OSSD $n = 4$ & OSSD $n = 2$)
 - Females $N = 34$ (*i.e.*, Non-OSSD $n = 26$ & OSSD $n = 8$)
- **Experiment 2: Assessed the sensitivity of Eye Gaze between students with different types of disabilities regardless of gender**
 - Non-OSSD ($n = 107$)
 - Undefined ($n = 9$)
 - ADD/ADHD ($n = 3$)
 - Learning/Processing Disorder ($n = 3$)
 - Emotional/Psychiatric Disorder ($n = 1$)
 - Occupation/Motor Impairment ($n = 2$)
 - Neurological/Health Impairment ($n = 3$)
 - Multiple Disabilities ($n = 2$)



FLANKER TASK

- Students were presented with outer arrows that were congruent (*i.e.*, arrows facing the same direction) and flanked the middle arrow



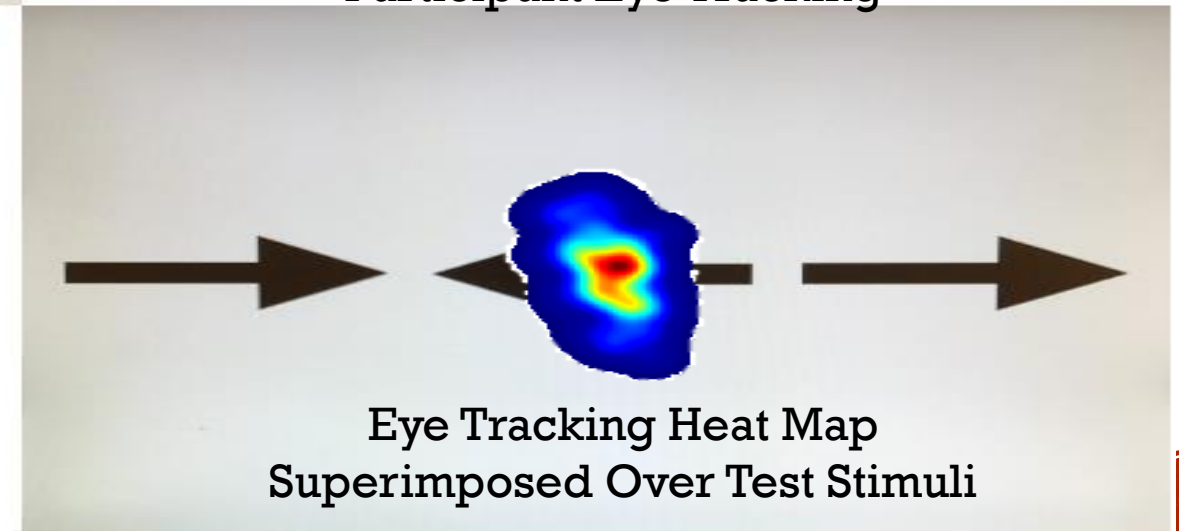
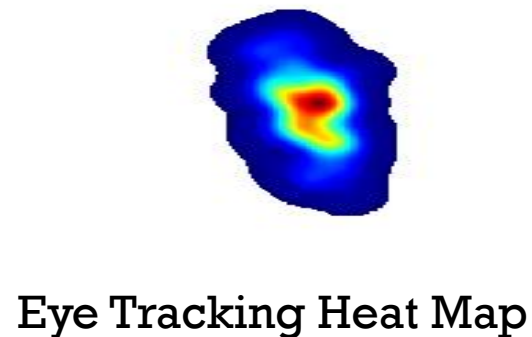
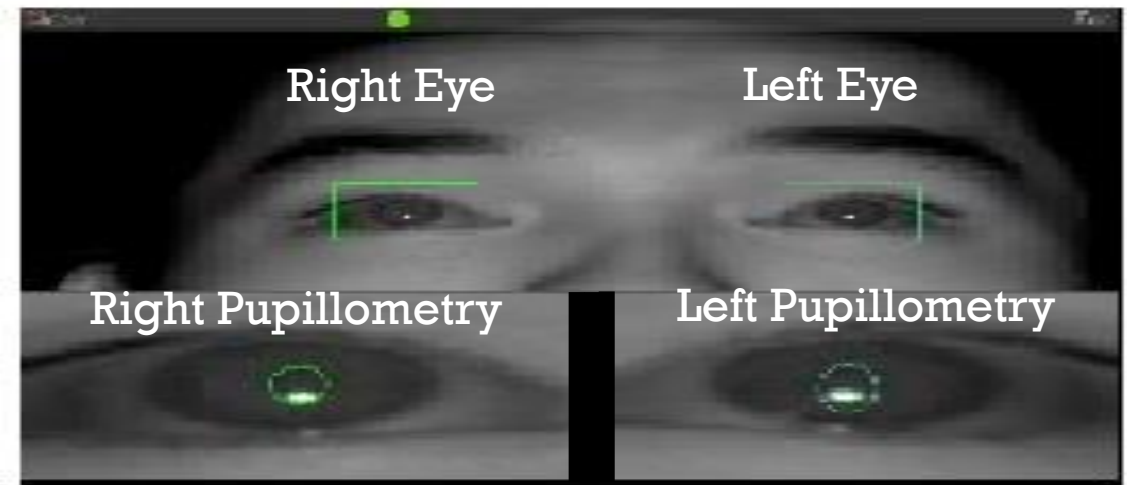
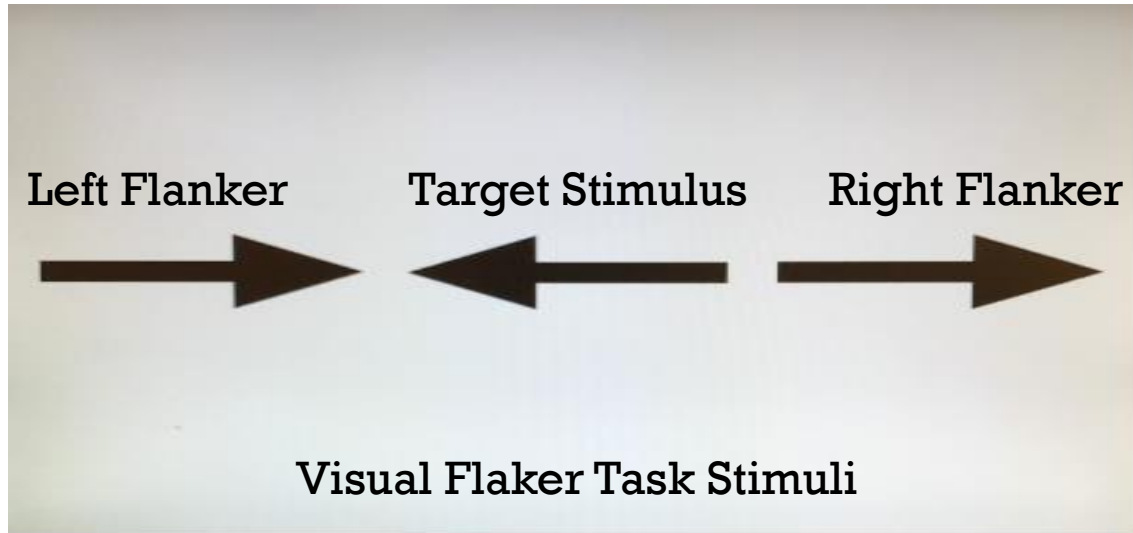
- Or Incongruent (*i.e.*, arrows facing in the opposite direction)



- Participants were given 12 practice trials before starting the experiment to familiarize themselves with what was expected.
- The test presented 50 trials (*i.e.*, 10 trials of control, left congruent, left incongruent, right congruent, and right incongruent arrows) randomly within a 10-minute time period.
- Participants % accuracy and reaction time (RT measured in microseconds) were recorded to infer cognitive attentional processing.



EYE TRACKING EXPERIMENTAL METHODS: GAZEPOINT UX-EDITION



DATA ANALYSIS:

- Data were analyzed using an ANOVA with a level of significance set at $\alpha = 0.05$ and a 95% confidence interval. Data are presented as \pm SEM.
- **Experiment # 1:** evaluated the effects of ***Gender, Student Group, and Flanker Test Condition*** and the interaction between ***Gender X Student Group X Flanker Test Condition***.
- **Experiment # 2:** evaluated the differences in the participants learning curve for the Flanker Task as an effect of ***Student Group/OSSD Condition and Flanker Task Test Condition***.



EXPERIMENT # 1 RESULTS:

Males: Visual Attention Eye Tracking Sensitivity

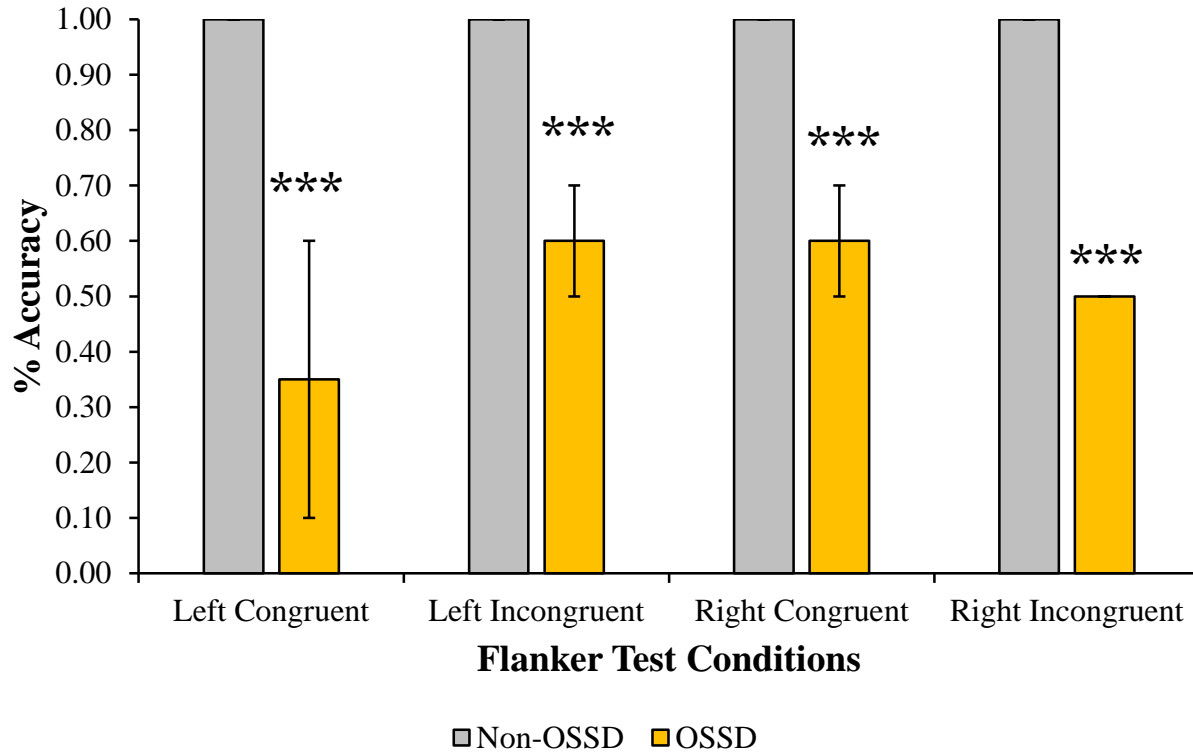


Fig. 5. Male Non-OSSD vs. OSSD accuracy differences. The data revealed a significant effect of *Group* $F_{(1)} = 122.909$, $p = 0.001$, but no significant effect of *Condition* $F_{(3)} = 1.805$, $p = 0.187$, nor a significant *Group X Condition* interaction $F_{(1,3)} = 1.805$, $p = 0.187$

Males: Visual Attention Eye Tracking Sensitivity

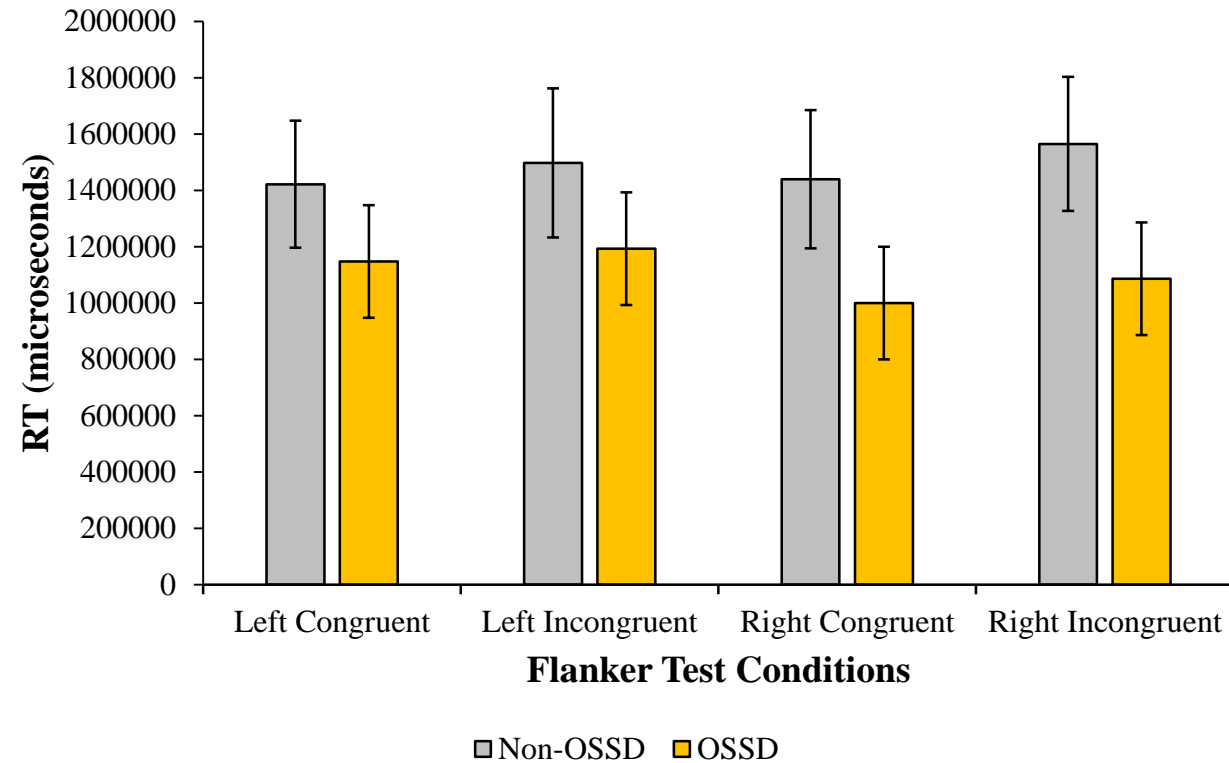


Fig. 6. Male Non-OSSD vs. OSSD RT differences. The data revealed no significant effect of *Group* $F_{(1)} = 4.142$, $p = 0.059$, *Condition* $F_{(3)} = 0.092$, $p = 0.964$, nor a significant *Group X Condition* interaction $F_{(1,3)} = 0.074$, $p = 0.973$

EXPERIMENT # 1 RESULTS (CONTINUED):

Females: Visual Attention Eye Tracking Sensitivity

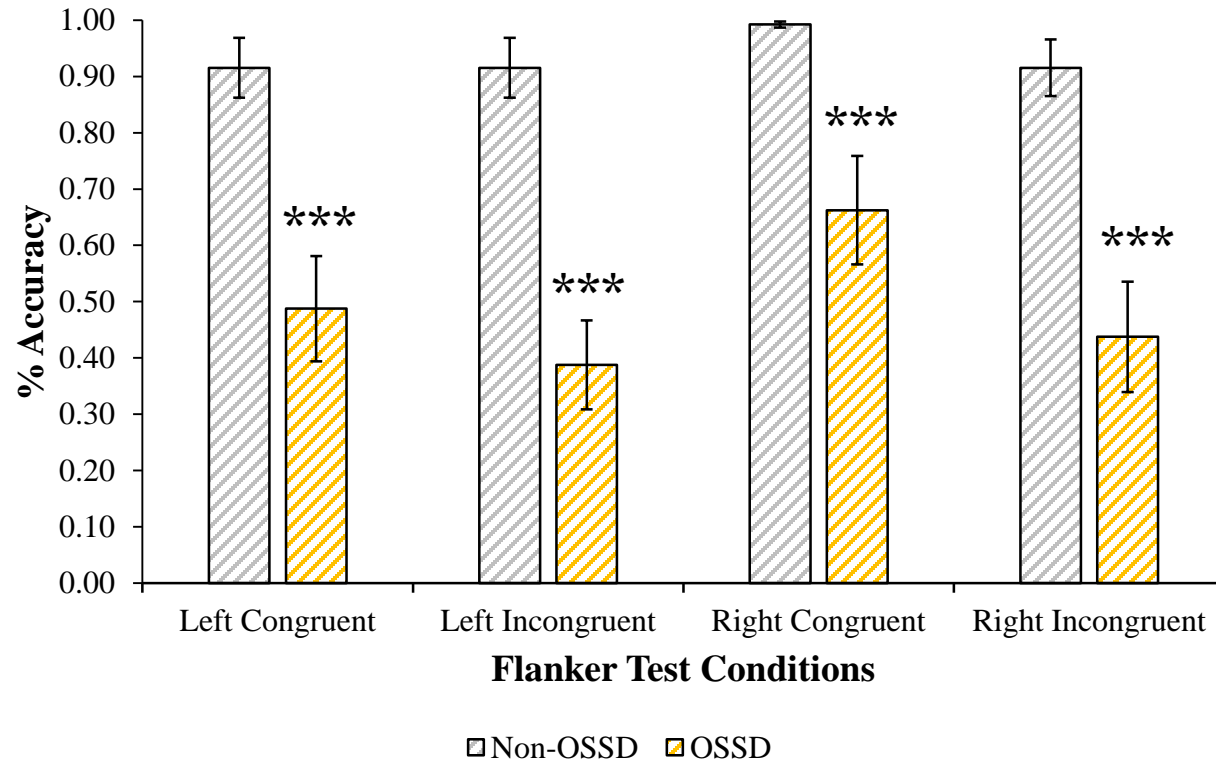


Fig. 7. Female Non-OSSD vs. OSSD accuracy differences. The data revealed a significant effect of *Group* $F_{(1)} = 84.145$, $p = 0.001$ and *Condition* $F_{(3)} = 2.647$, $p = 0.052$, but no significant *Group X Condition* interaction $F_{(1,3)} = 0.774$, $p = 0.511$

Females: Visual Attention Eye Tracking Sensitivity

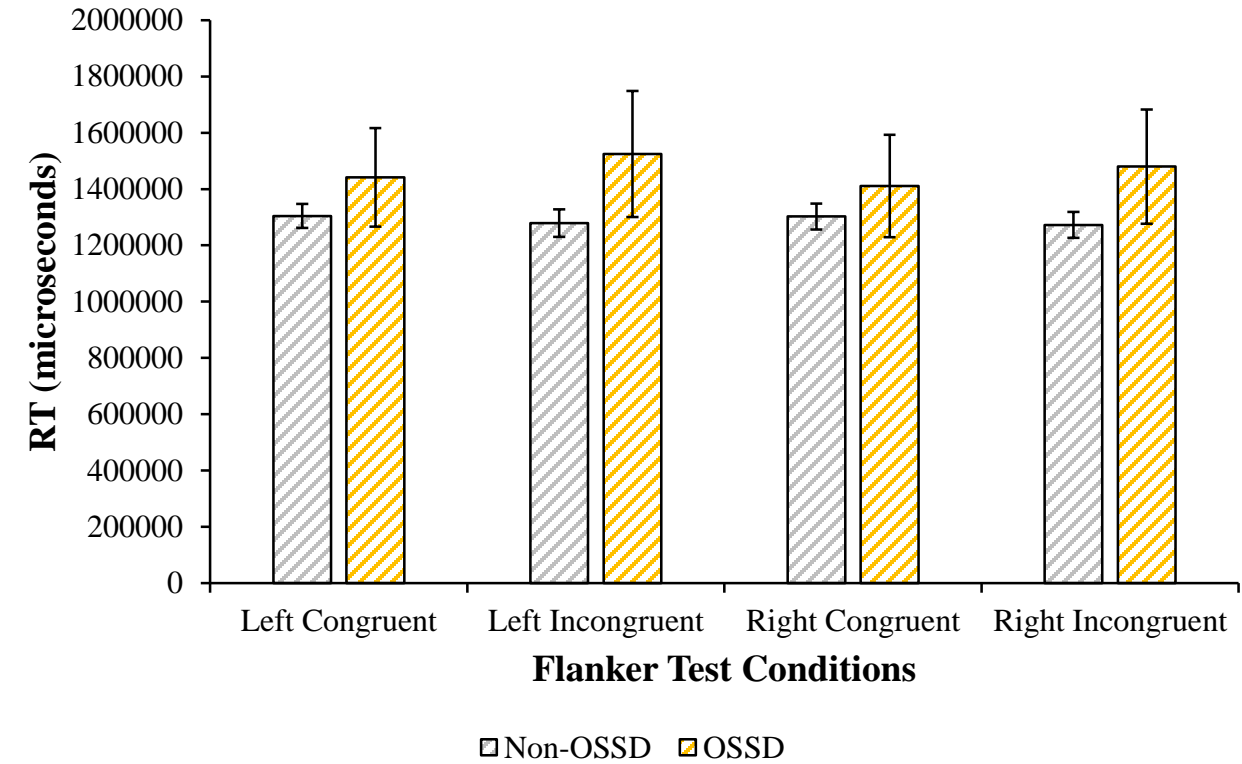


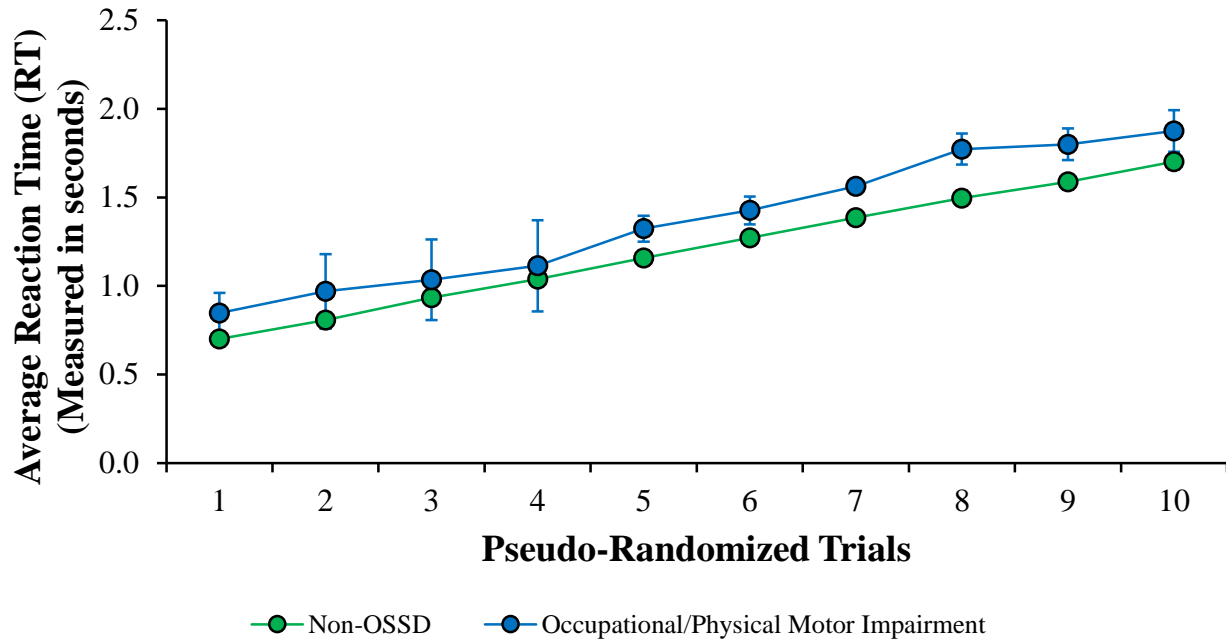
Fig. 8. Female Non-OSSD vs. OSSD RT differences. The data revealed a significant effect of *Group* $F_{(1)} = 6.765$, $p = 0.010$, but no significant effect of *Condition* $F_{(3)} = 0.077$, $p = 0.972$, nor a significant *Group X Condition* interaction $F_{(1,3)} = 0.219$, $p = 0.883$

EXPERIMENT 2:

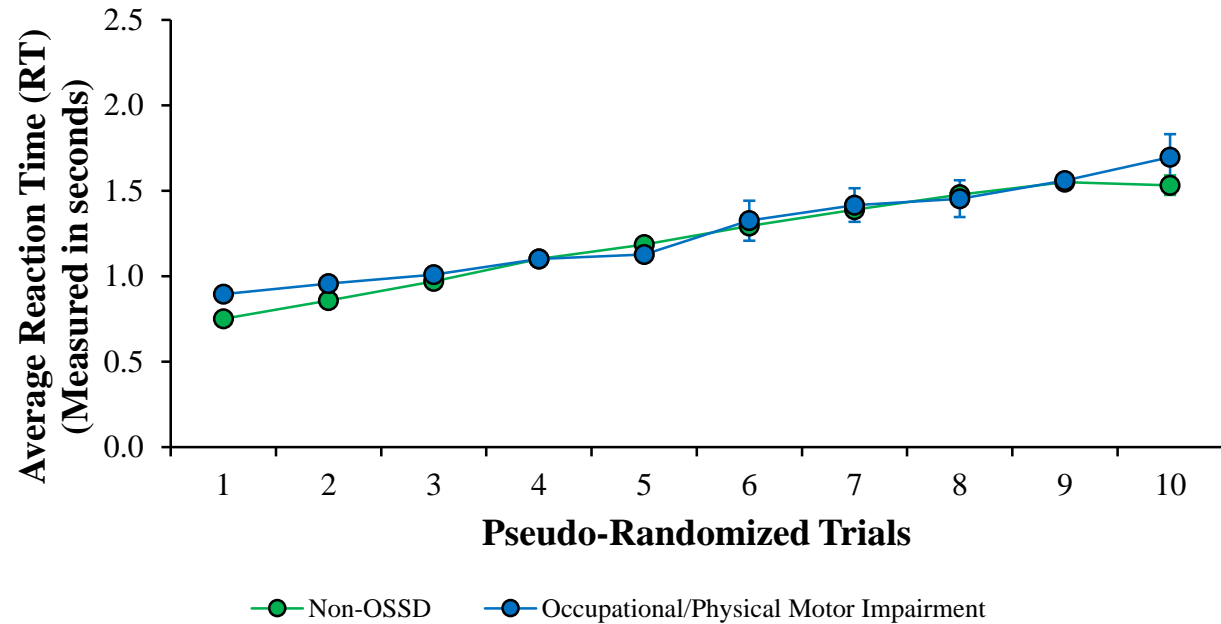
- Data were broken down by left congruent, left incongruent, right congruent, and right incongruent stimuli for the ***Flanker Task Test Conditions***.
- Each Flanker Task Test Condition was pseudo-randomly organized to show the learning curve over the course of the experiment to assess sensitivities of each ***Student Group/OSSD Condition*** in exhibiting differences in learning the task.



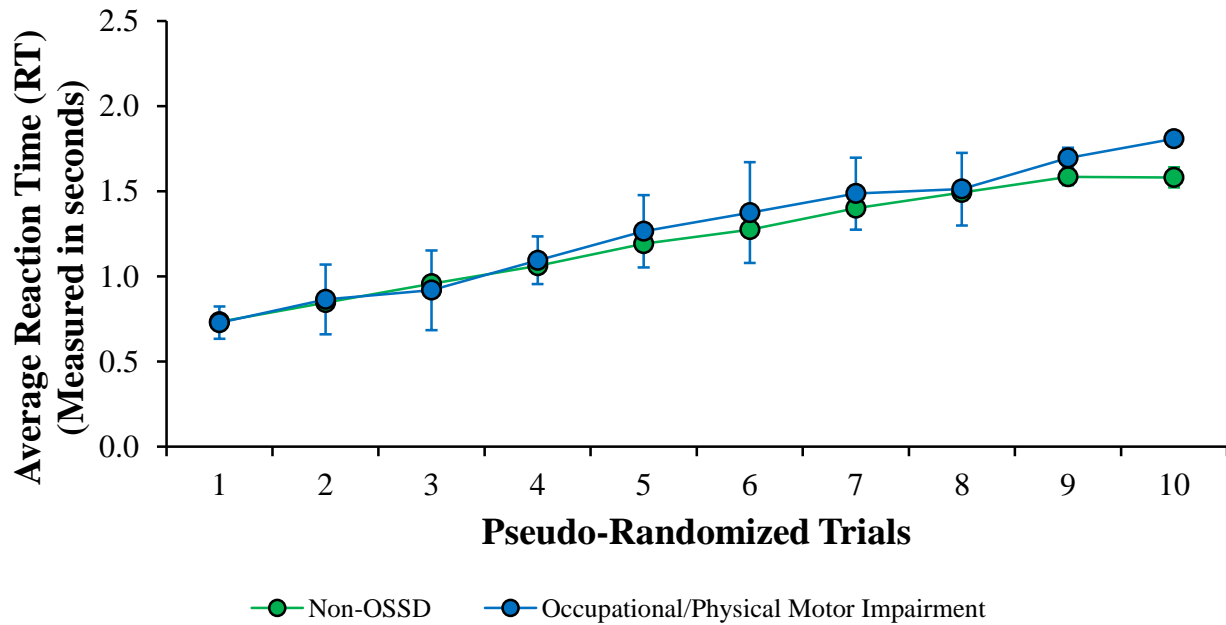
Left Congruent: Student Sensitivity Comparisons



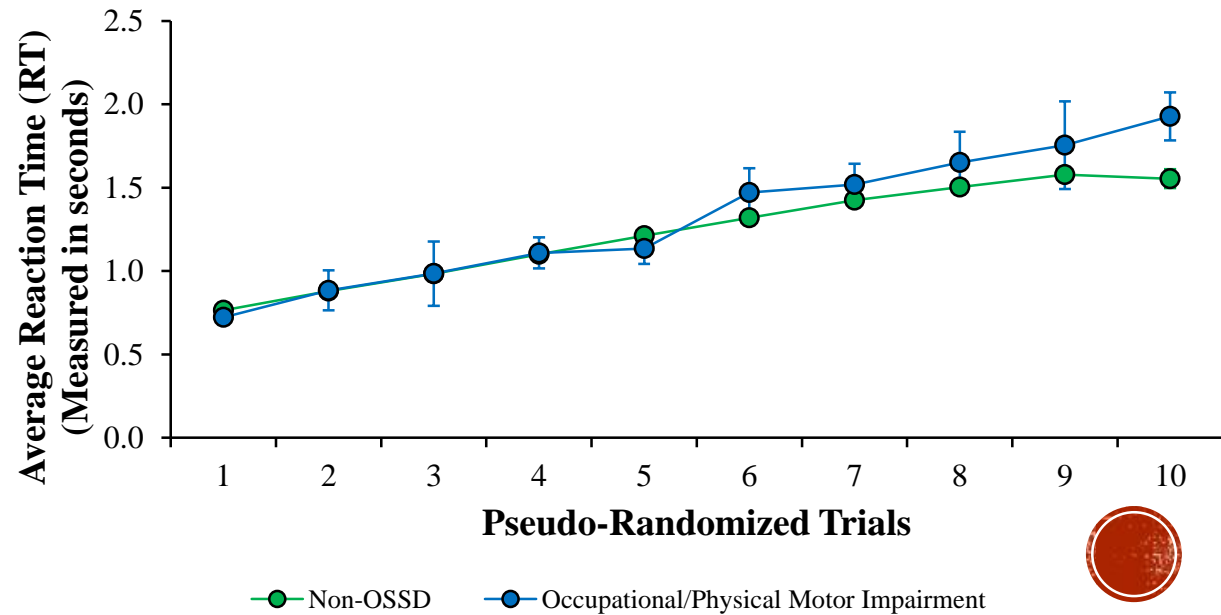
Right Congruent: Student Sensitivity Comparisons



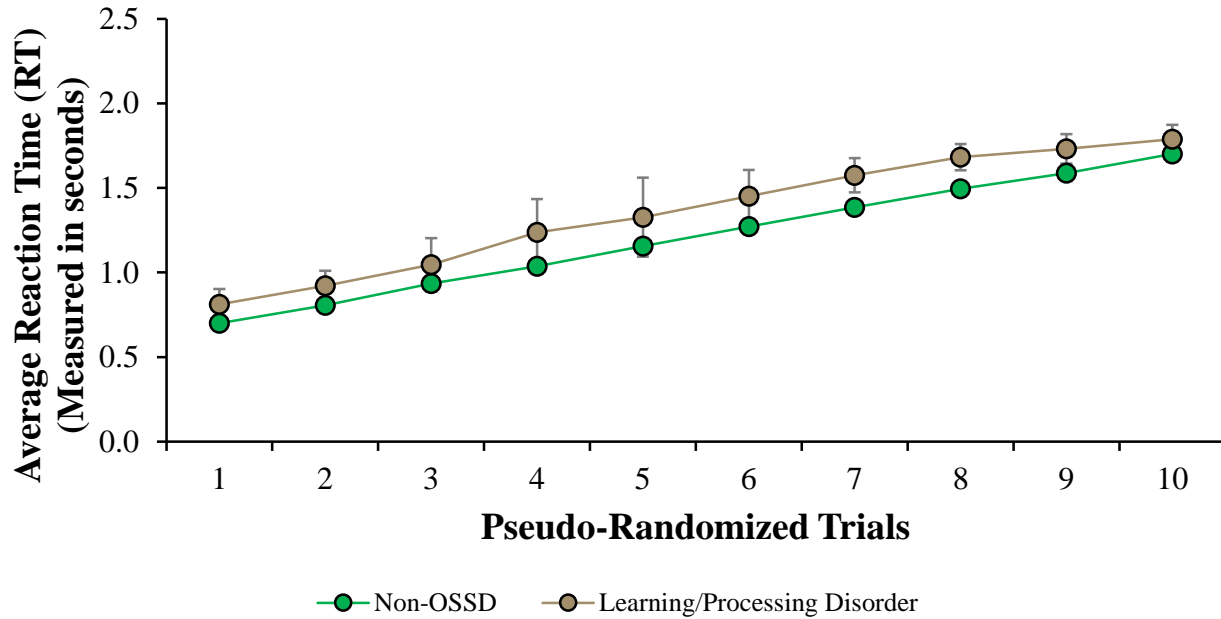
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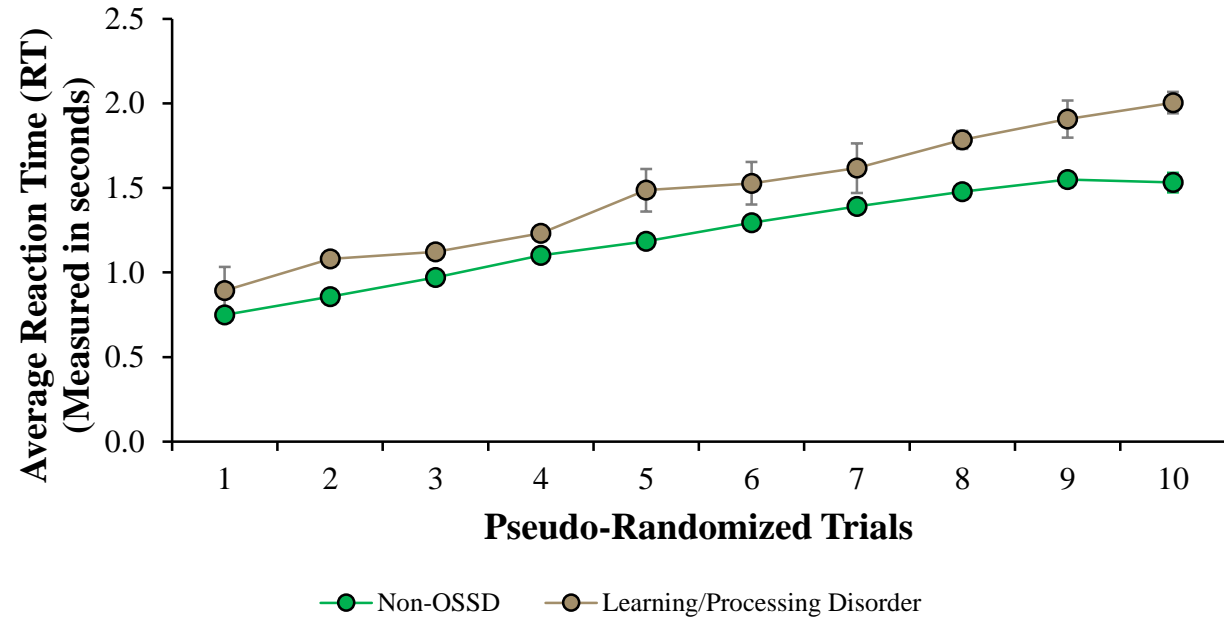
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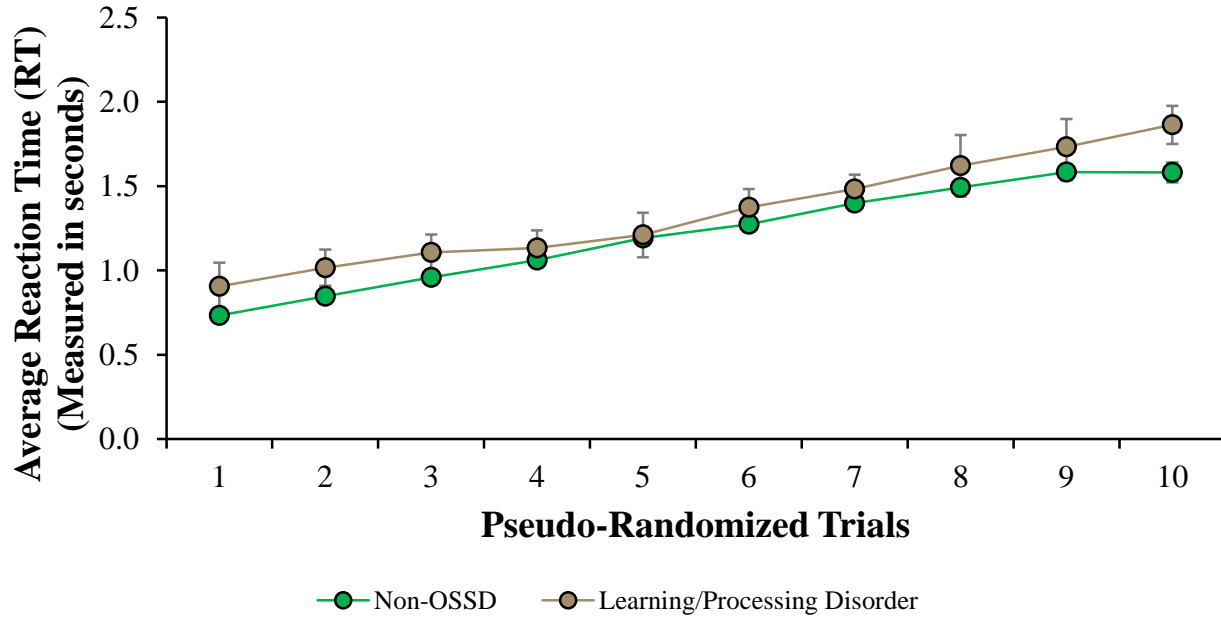
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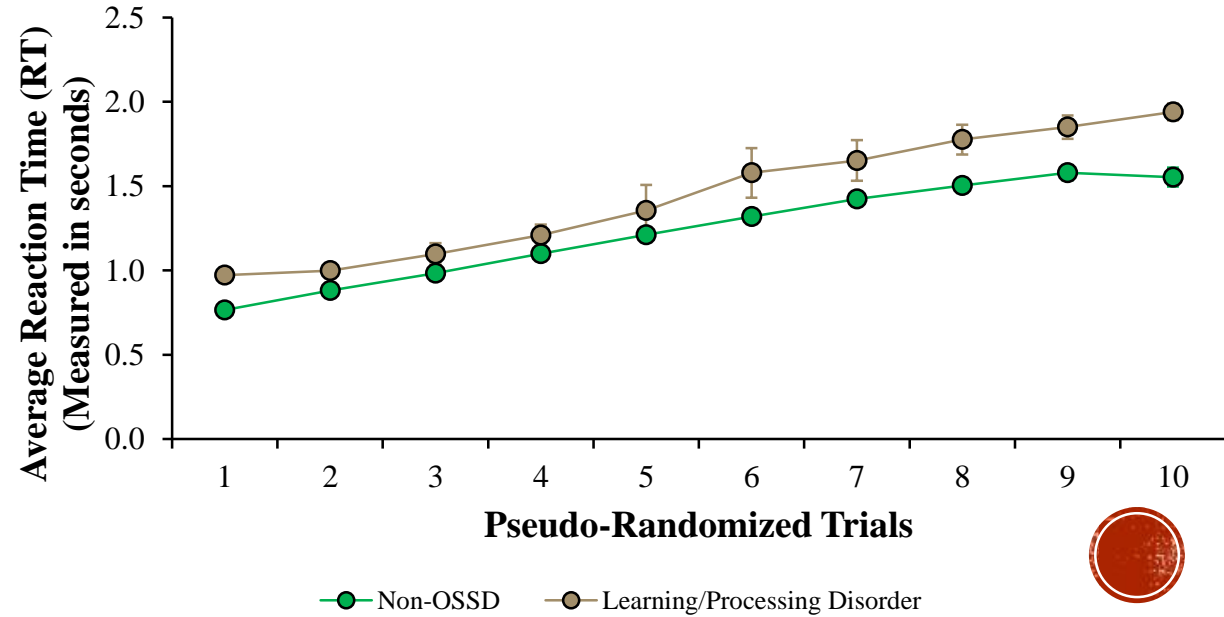
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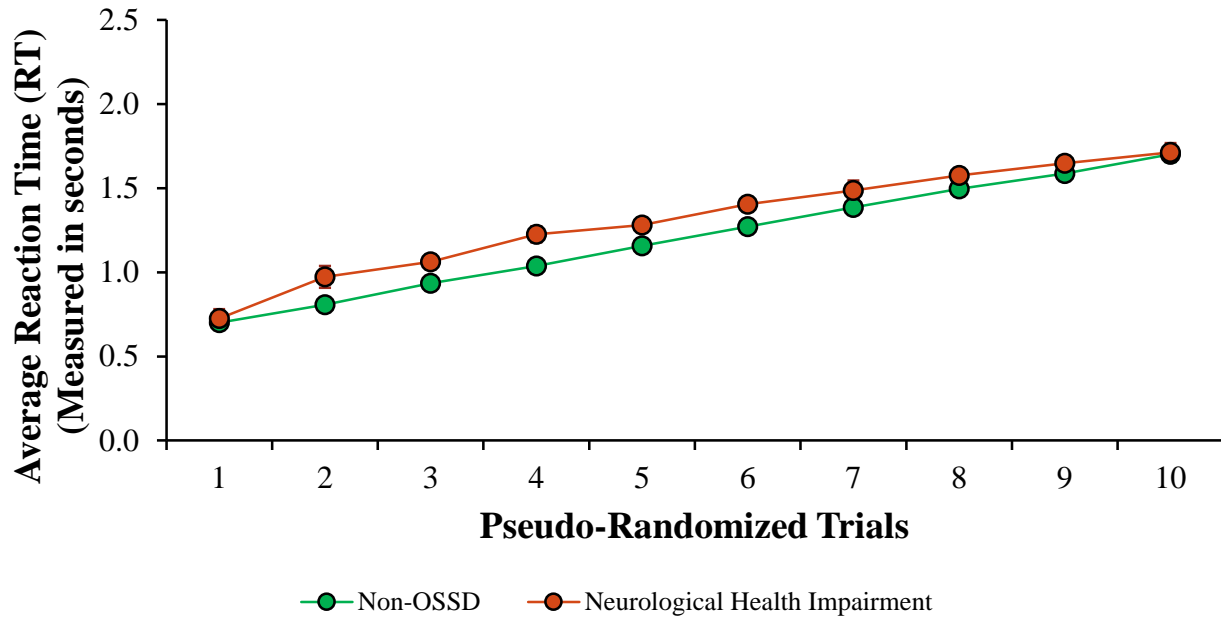
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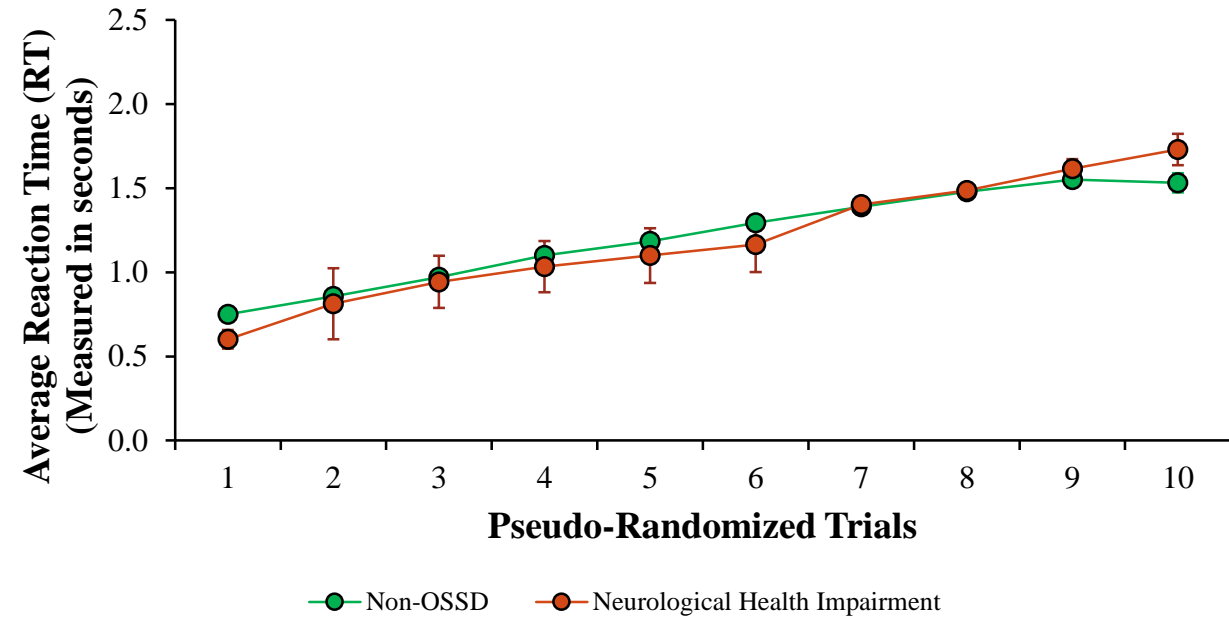
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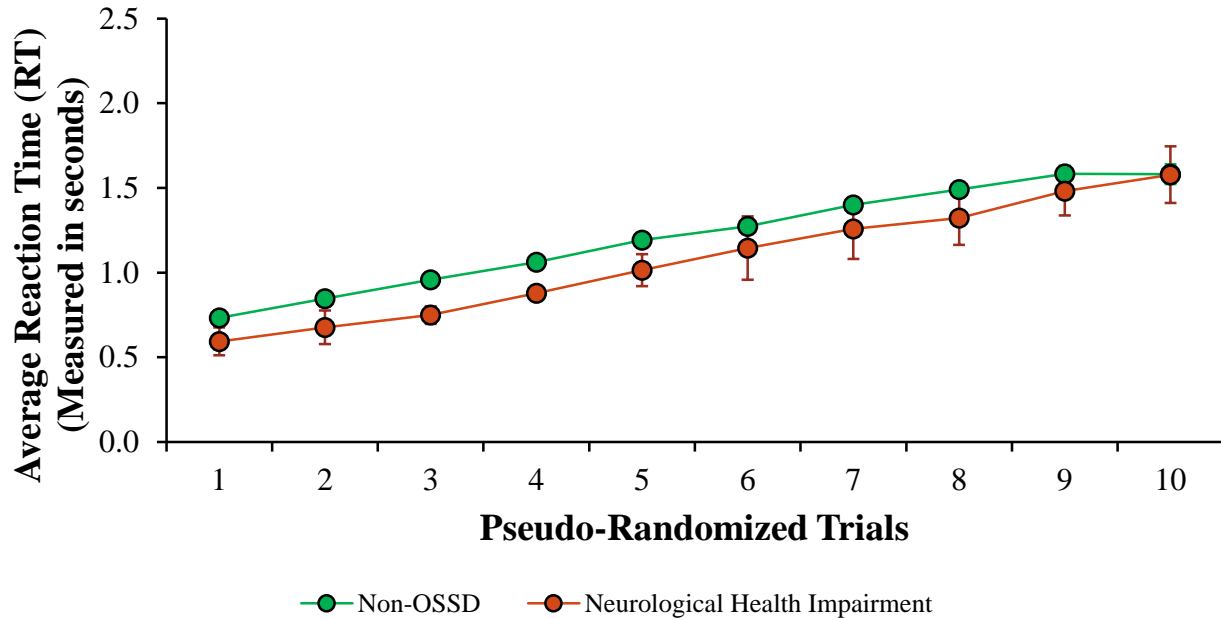
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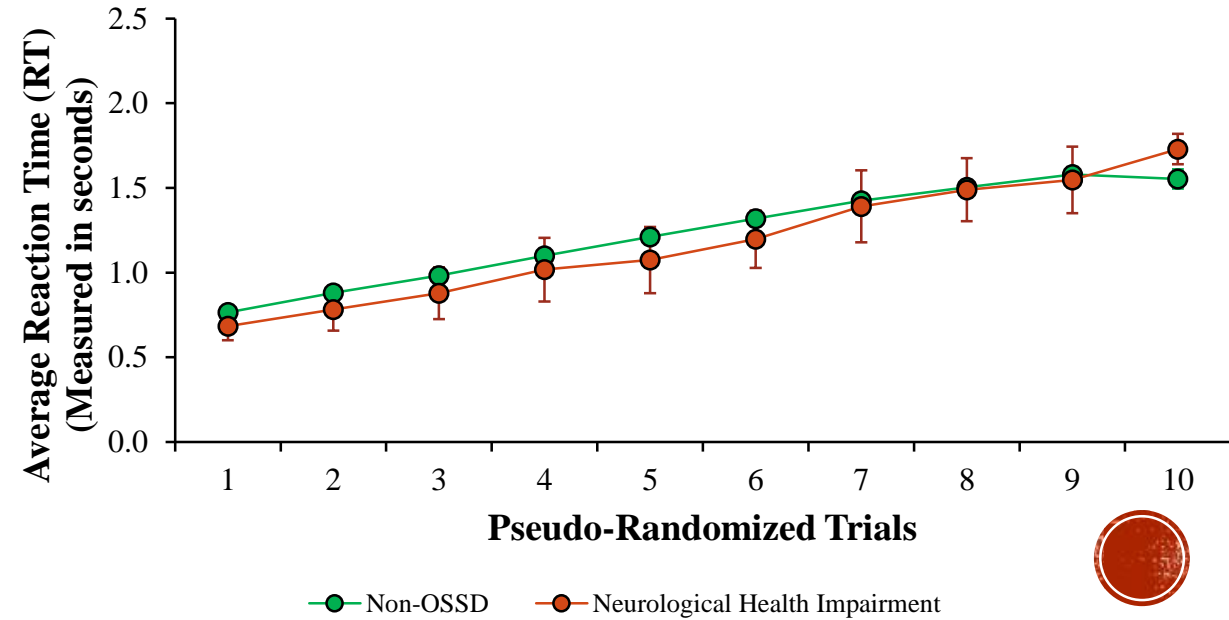
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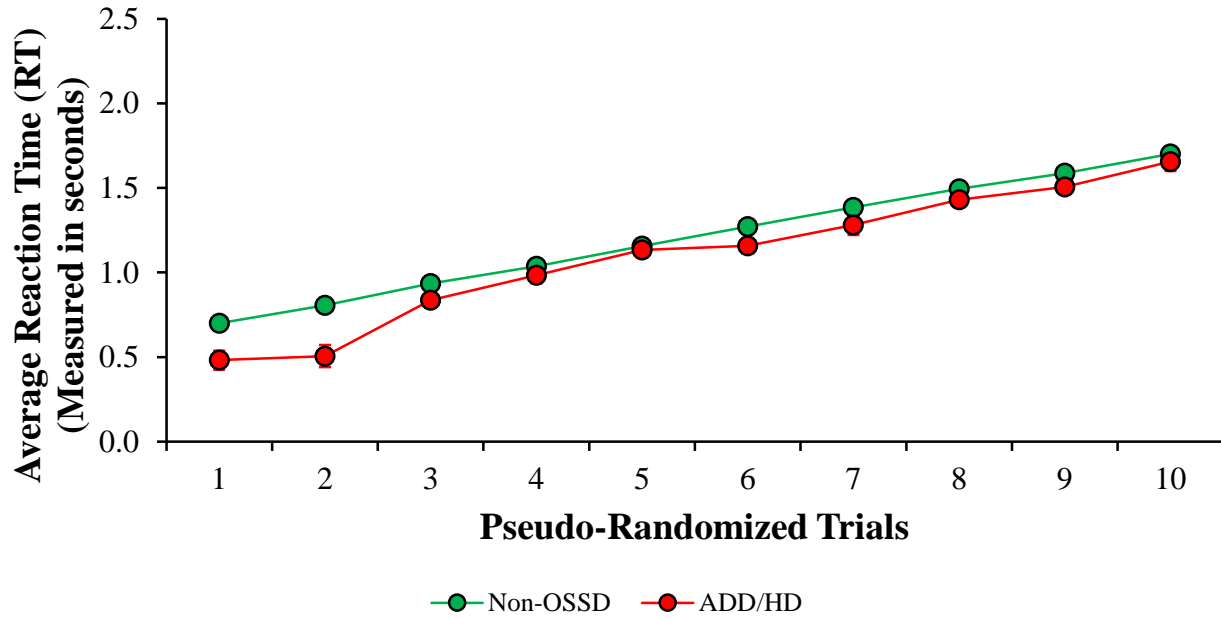
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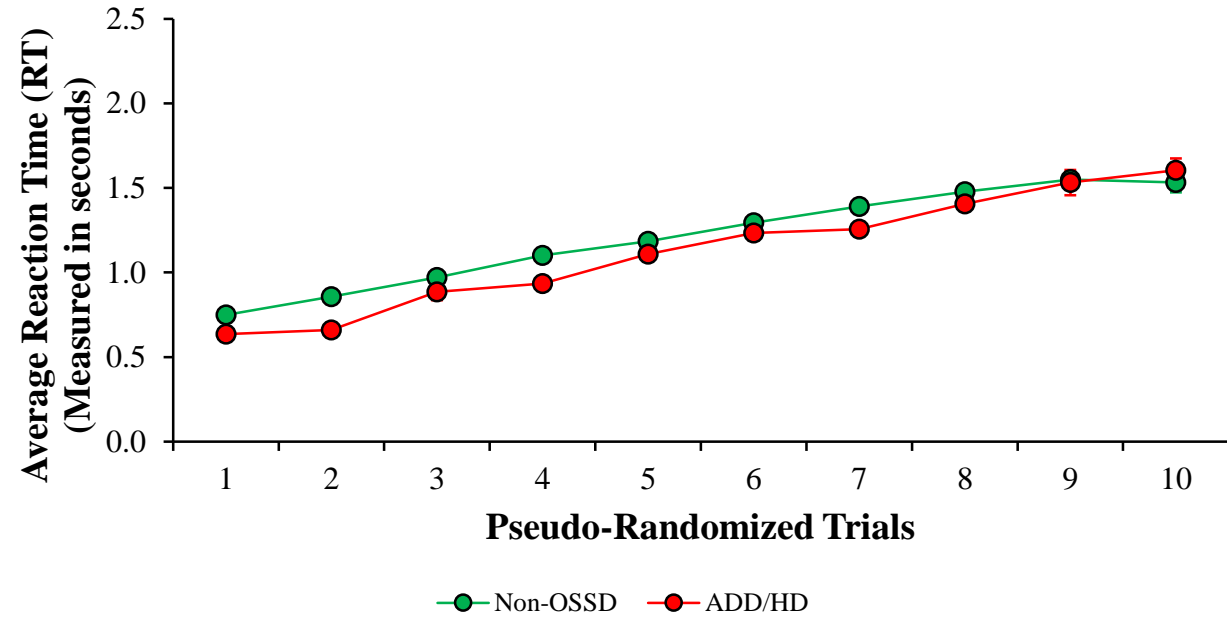
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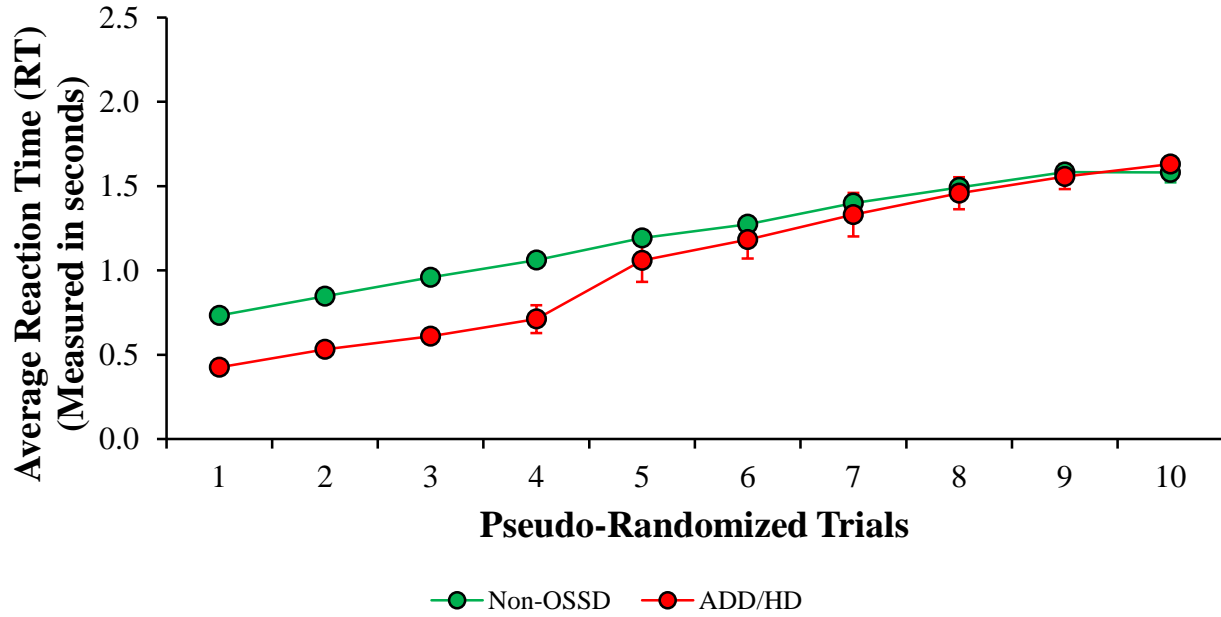
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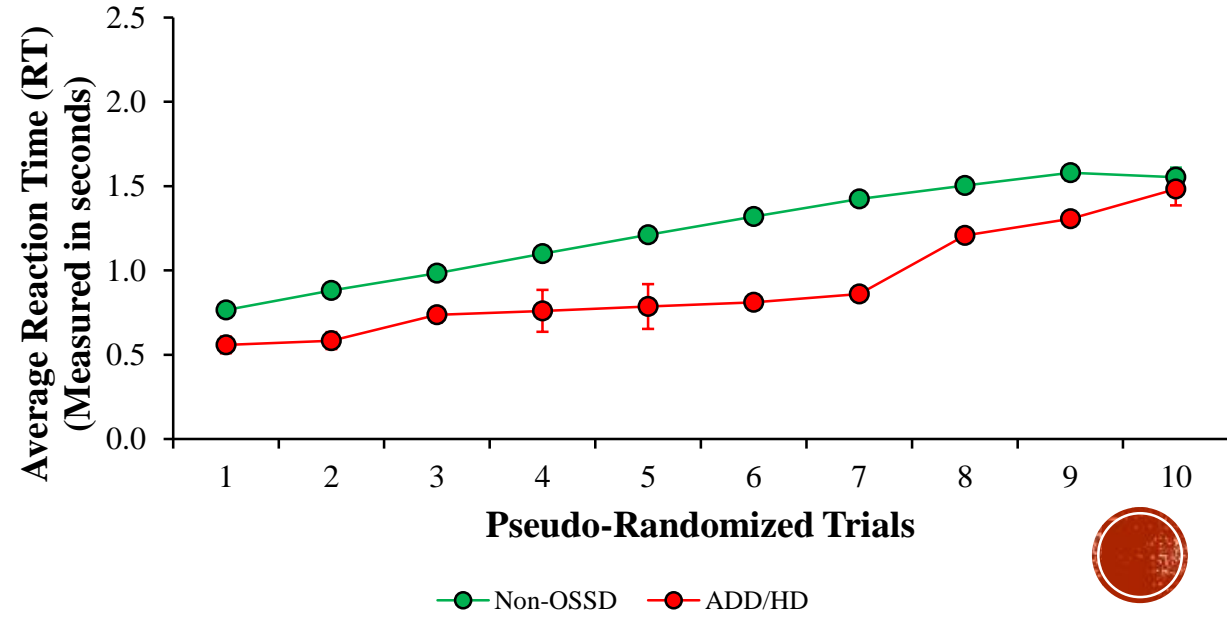
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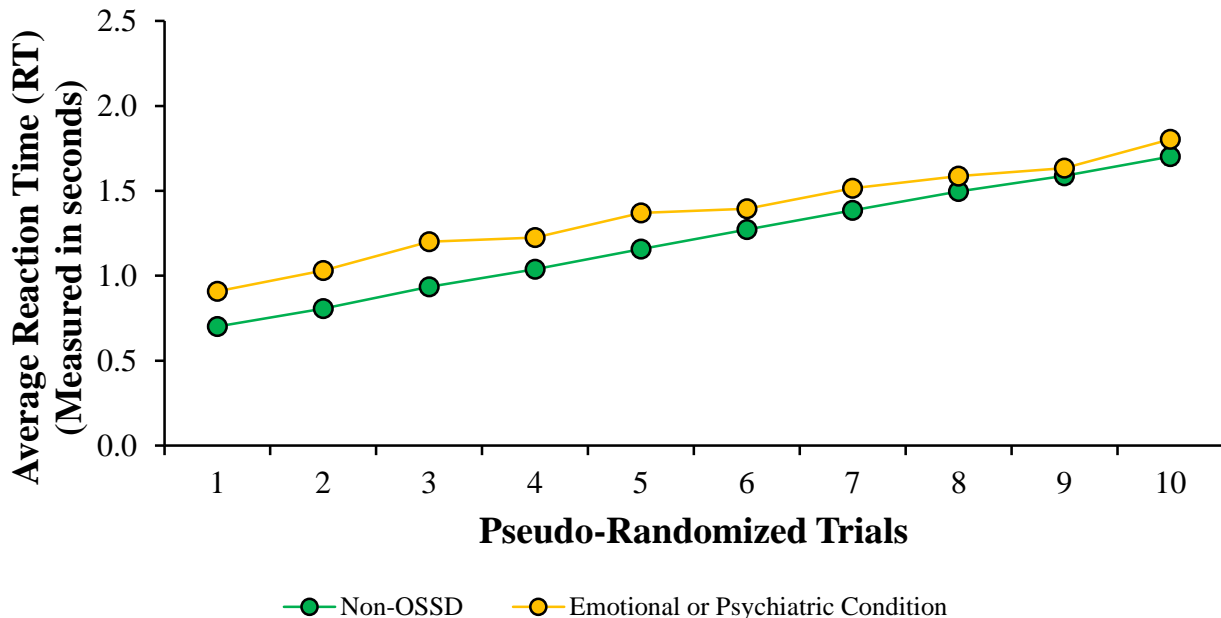
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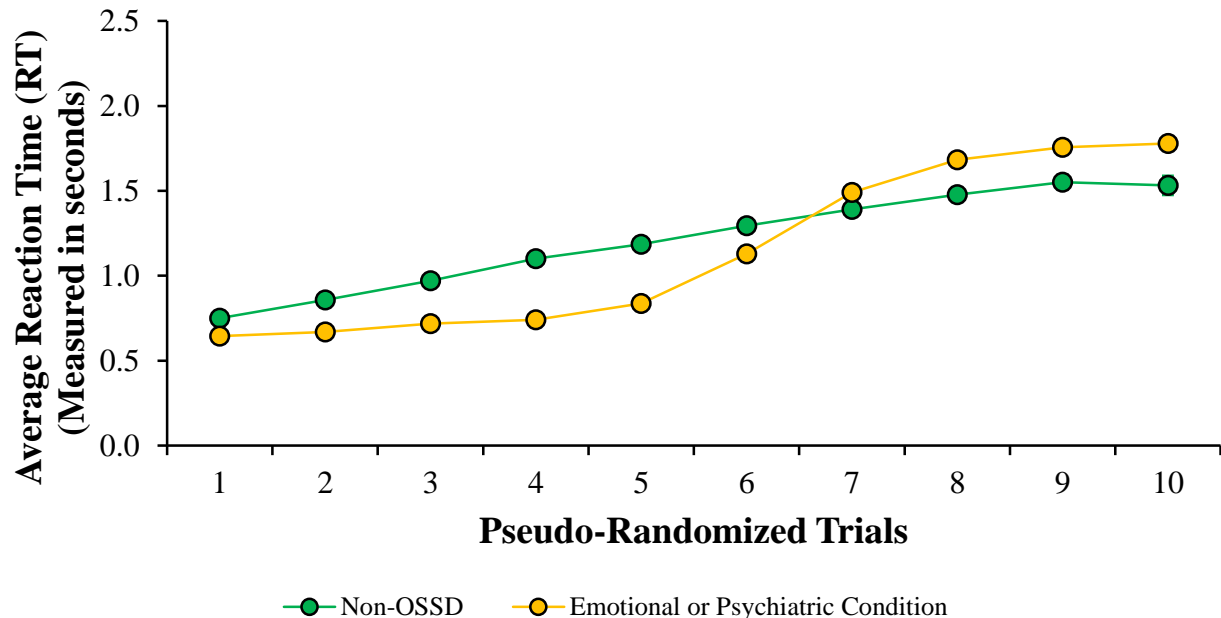
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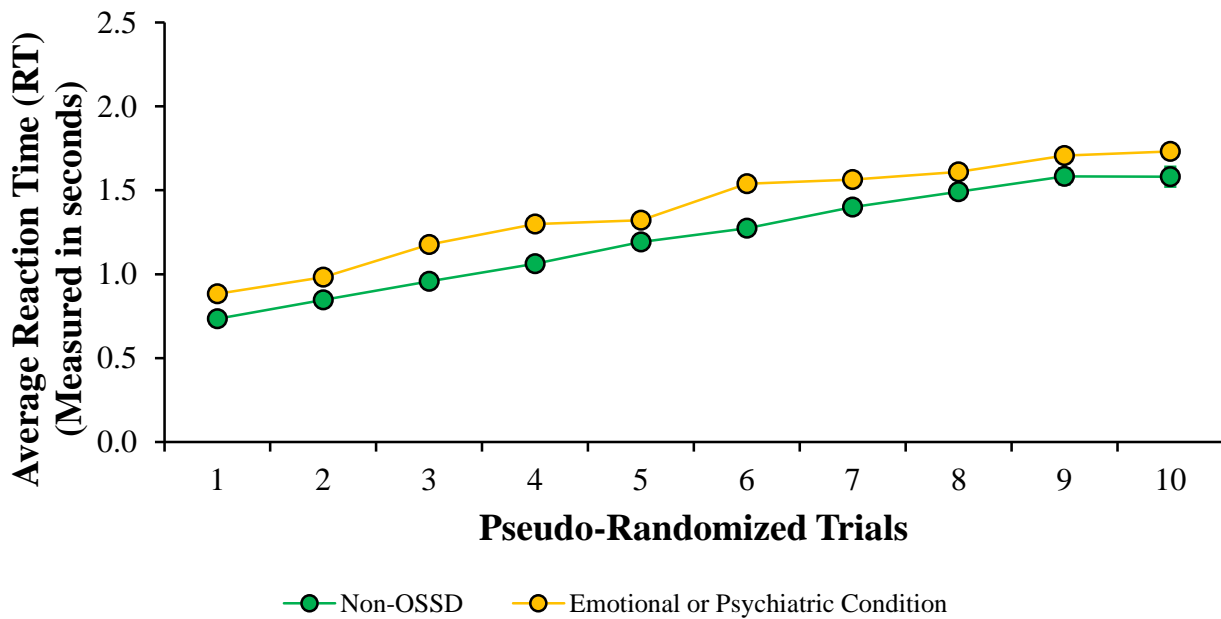
Left Congruent: Student Sensitivity Comparisons



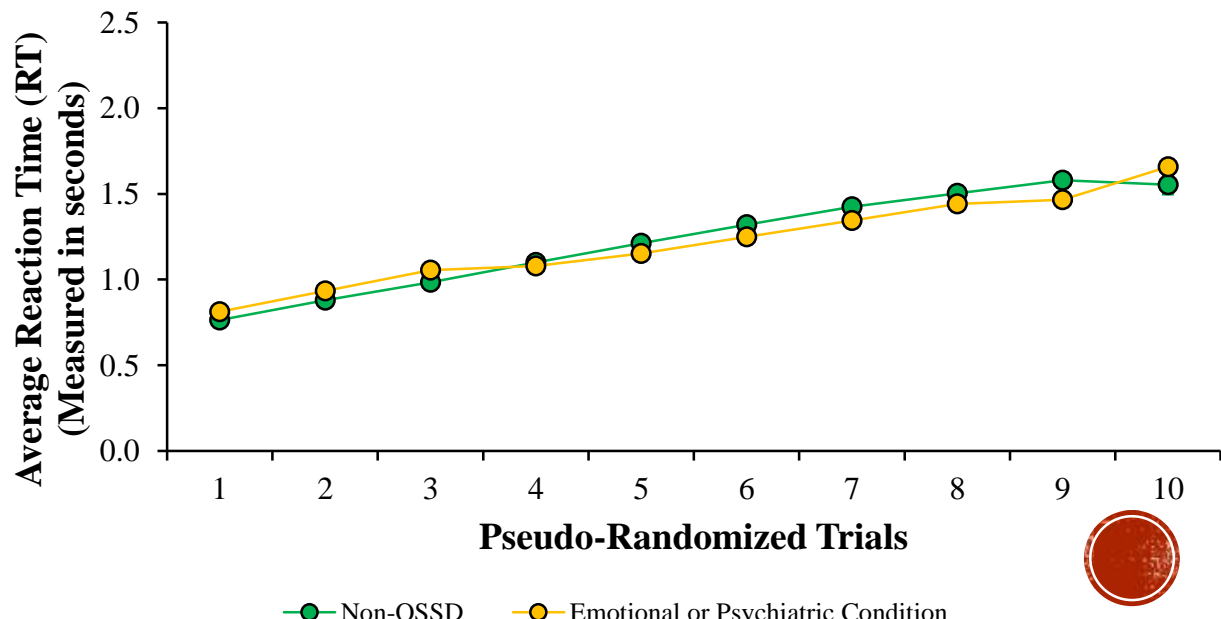
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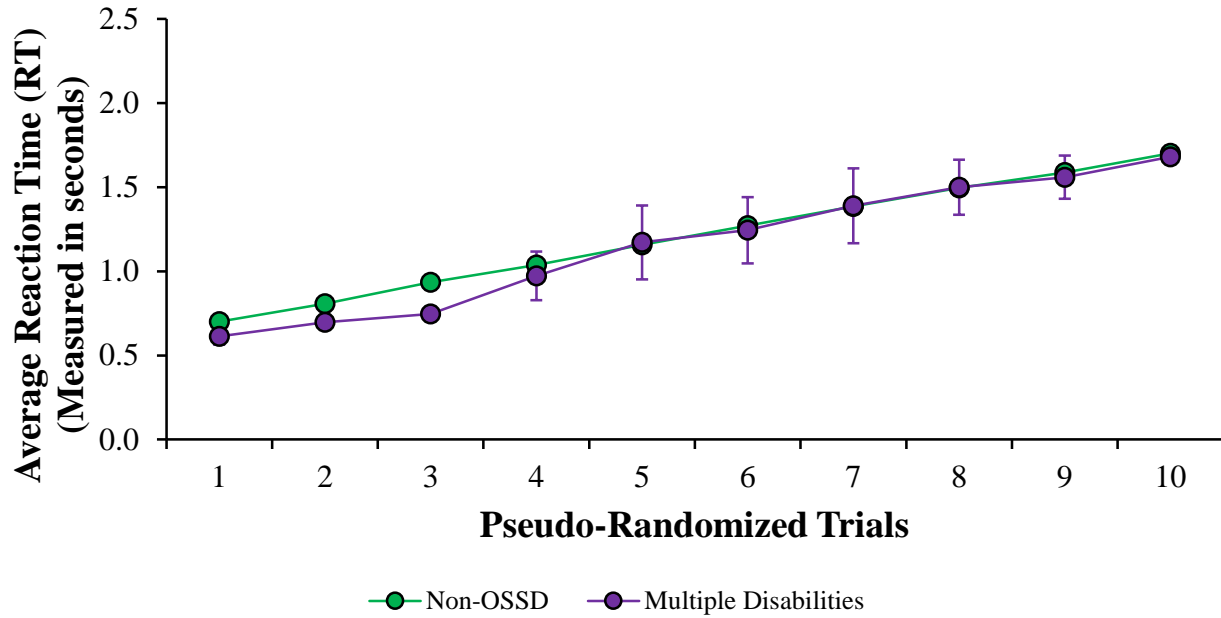
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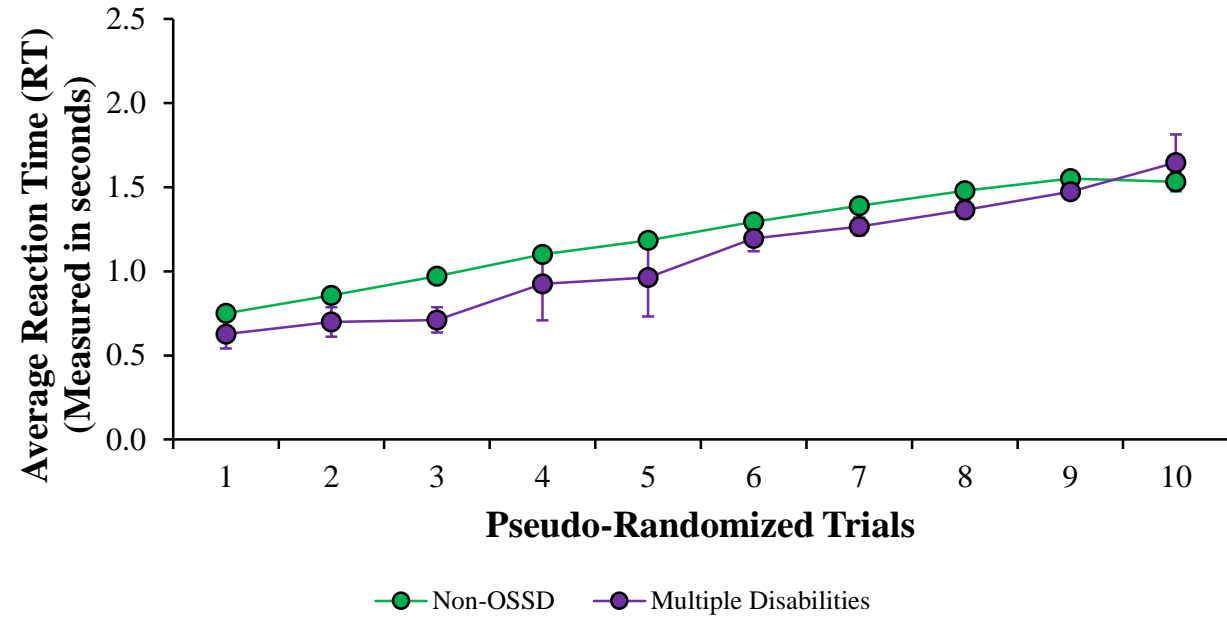
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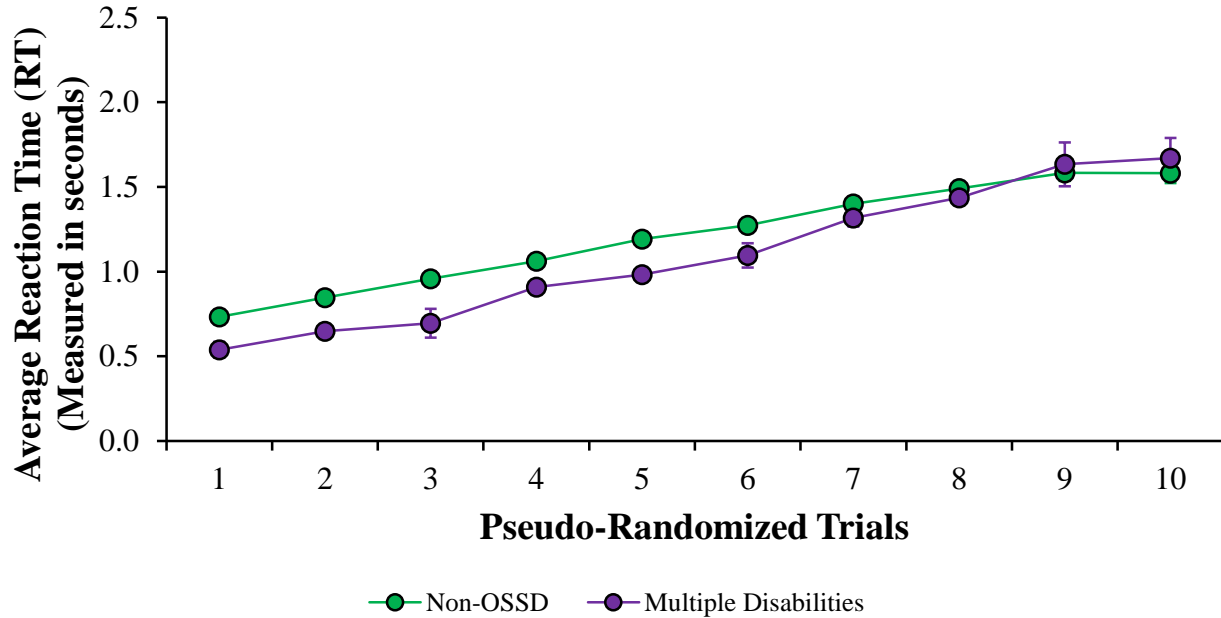
Left Congruent: Student Sensitivity Comparisons



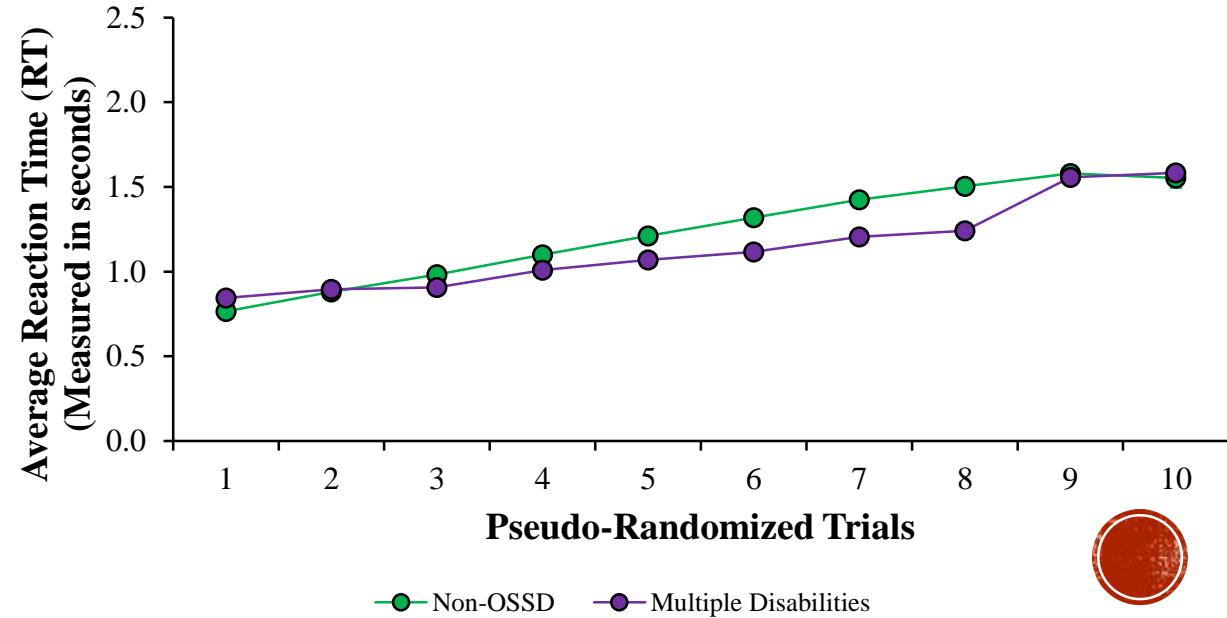
Right Congruent: Student Sensitivity Comparisons



Left Incongruent: Student Sensitivity Comparisons



Right Incongruent: Student Sensitivity Comparisons



DISCUSSION:

- Our experimental methods employing Eye Gaze Technology was sensitive in detecting attentional differences in participants who were grouped after following a triple blind procedure when testing for Non-OSSD vs. OSSD students. Results showed that both genders exhibited reduce accuracy, but there were no noticeable differences in RT regardless of disability.
 - We reject the Null Hypothesis, and accept the Alternative Hypothesis that eye gaze technology could detect attentional differences between a Non-OSSD and a OSSD students visual attention.
- Additionally, our experimental methods employing Eye Gaze Technology was sensitive in detecting attentional differences in participants who were grouped after following a triple blind procedure with OSSD student groups (*i.e.*, learning processing, ADD/ADHD, etc.). Results showed that students with learning processing, ADD/ADHD., neurological, and emotional psychiatric disorders show differences in learning the Flanker Task as evidenced by the learning curves.
 - We reject the Null Hypothesis, and accept the Alternative Hypothesis that eye gaze technology could not detect attentional differences between a triple blinded OSSD student groups.



CONCLUSION & LIMITATIONS:

Conclusion & Limitations:

- Our study indicates through a simple Flanker Task, our methods are sensitive enough to detect changes between Non-OSSD and OSSD students.
- Eye Gaze Technology is sensitive enough to detect accuracy and reaction time changes in real time of individuals with disabilities, even while being triple blinded to the participants.
- Our study is limited due to small sample sizes within OSSD student populations. However, our preliminary data show that OSSD-students visual processing issues can be assessed with a 10-minute Flanker Task.

Future Outlooks:

- We are now increasing our triple blinded sample size to further assess the subtype of OSSD student disabilities (*i.e.*, LD, EPC, EMI, AD/HD, HI) to determine which populations would benefit most from visual accommodative software/technology to support their education.
- Future analysis of OSSD student attentional differences will help us to develop an evidenced-based approach to determine which visual aid and/or accommodative technologies match our OSSD students needs.
- Such databased/evidenced-based supports will help our OSSD department advocate for an increased budget for accommodative resources that match student needs and, in turn, will promote academic achievement for OSSD student in college.



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