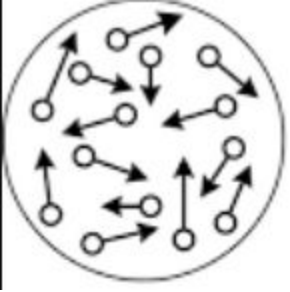
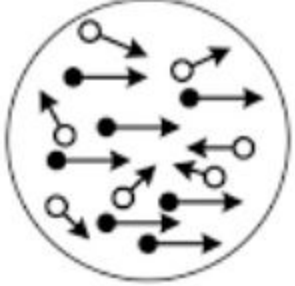




Investigating Accuracy and Bias using estimation errors in a Human Perceptual Decision-Making Task

Project by: Amin Khatami, Anushree Ganesh, Xima Ran and Xinran Liu

Introduction

- This dataset interested us since it was derived from a human perceptual decision making task.

- We were interested in understanding the biases that play a role in the decision making processes.

- To this end, we used **reaction times** and **estimation errors** across the different prior distribution standard deviations in order to map out if **prior STD** affects **the performance**.

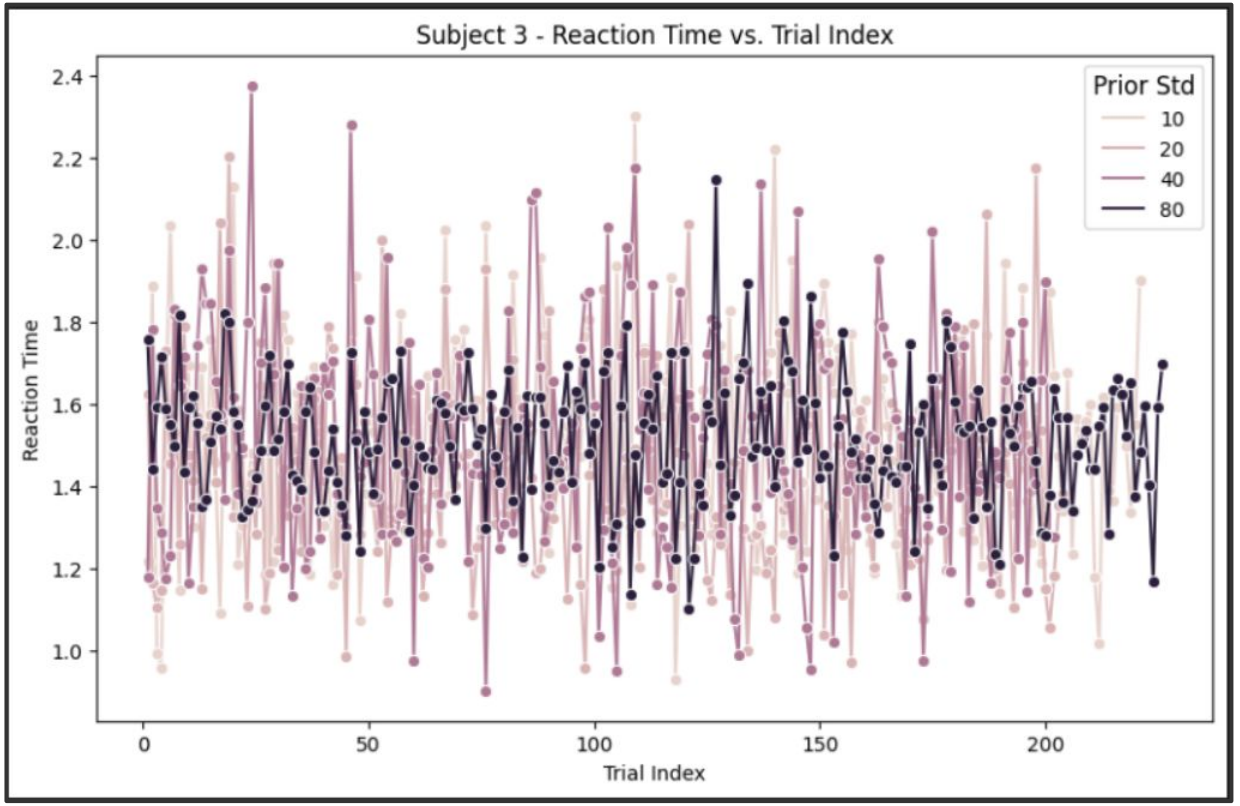
Methods

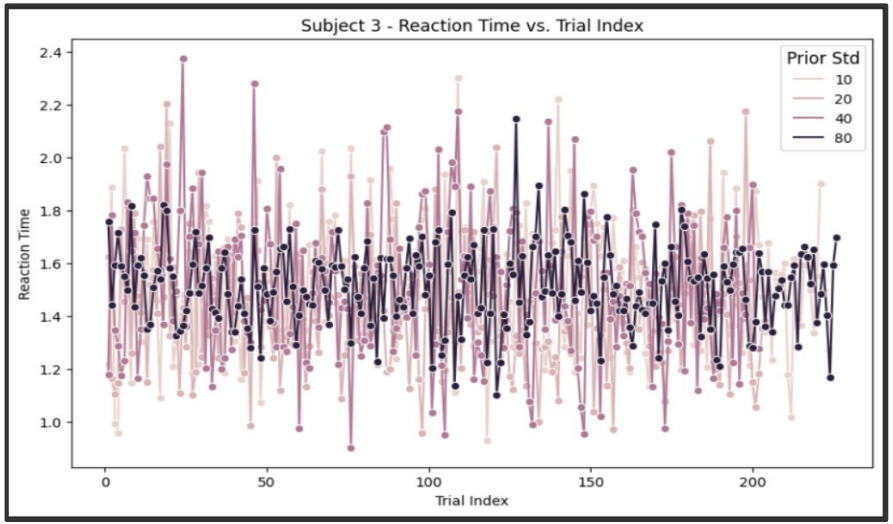
- We are using regression models to investigate the dynamics of learning and decision-making across different stimulus strengths and prior distributions (PD) variance in a perceptual decision-making task.

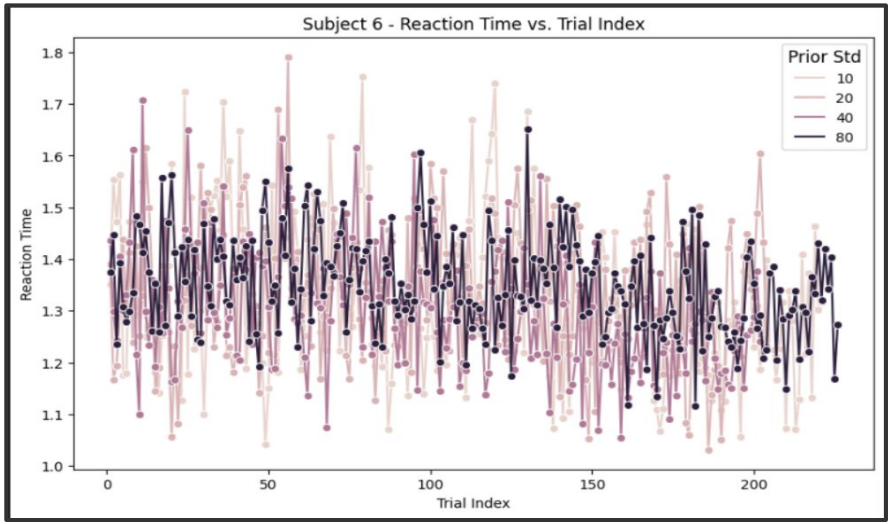
- We conducted Bartlett’s test for homoscedasticity and Kruskal-Wallis test for the difference between sets

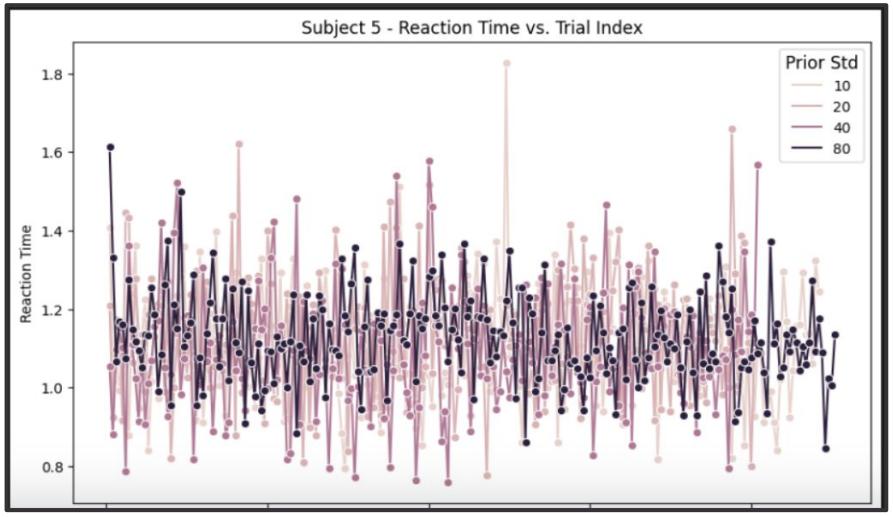
Results: reaction time dynamics

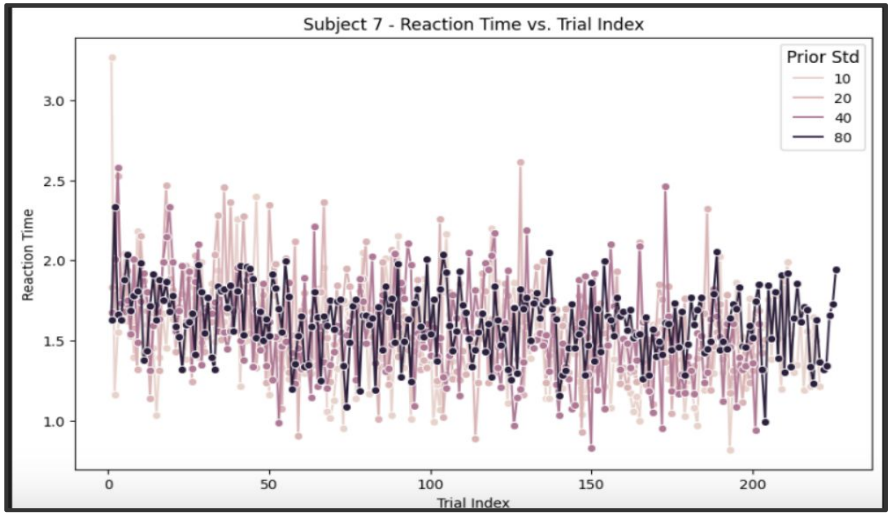
We selected 4 subjects and plotted the averaged reaction time ~ trial index graphs. Different colors represent different prior standard deviations.




Subject 3 - Reaction Time vs. Trial Index
Prior Std
10
20
40
80
Reaction Time
Trial Index


Subject 6 - Reaction Time vs. Trial Index
Prior Std
10
20
40
80
Reaction Time
Trial Index


Subject 5 - Reaction Time vs. Trial Index
Prior Std
10
20
40
80
Reaction Time

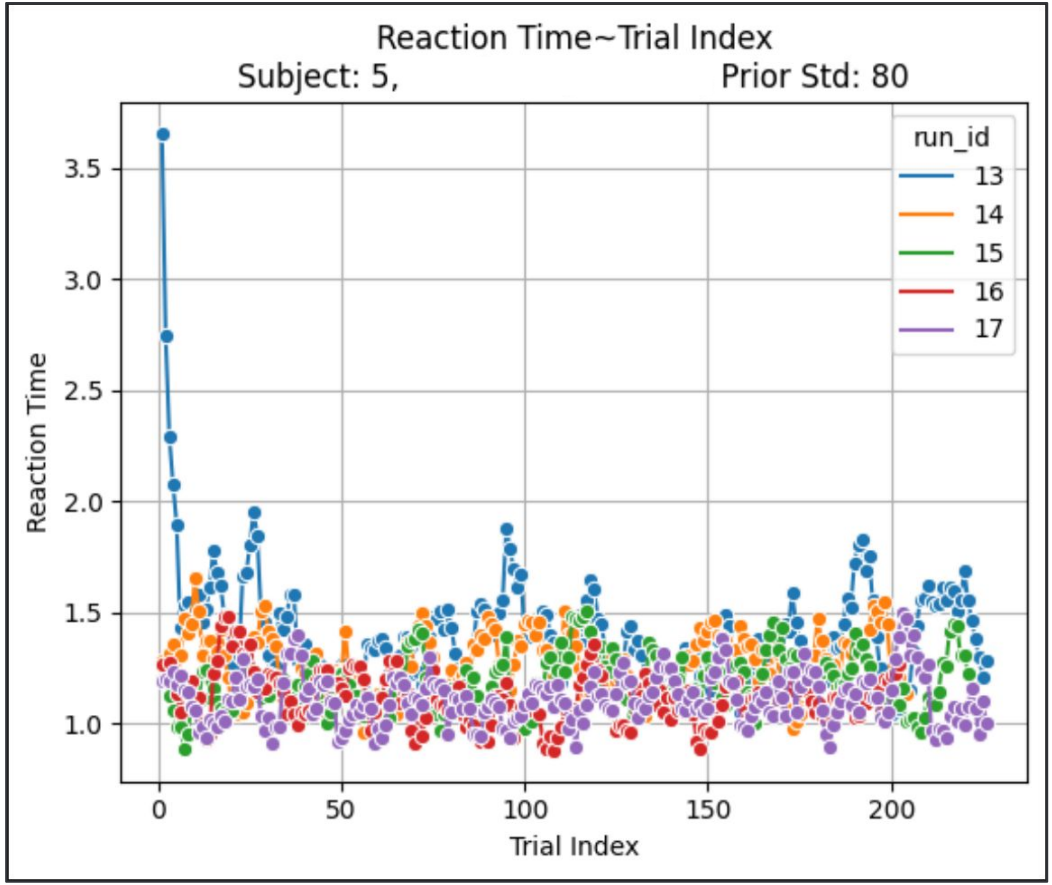

Subject 7 - Reaction Time vs. Trial Index
Prior Std
10
20
40
80
Reaction Time
Trial Index

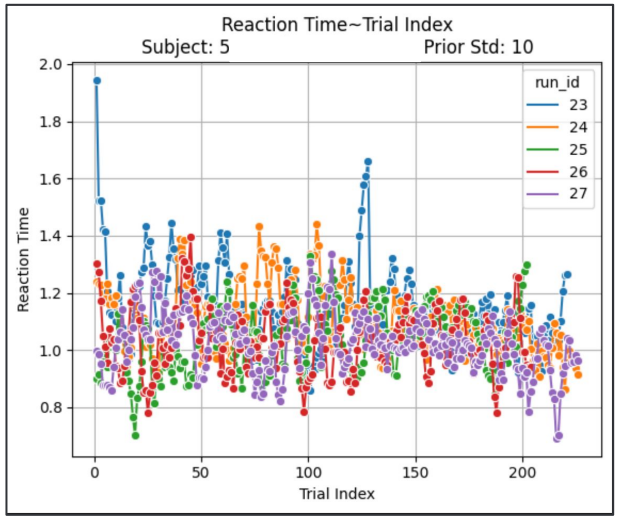
Conclusion - Reaction time dynamics

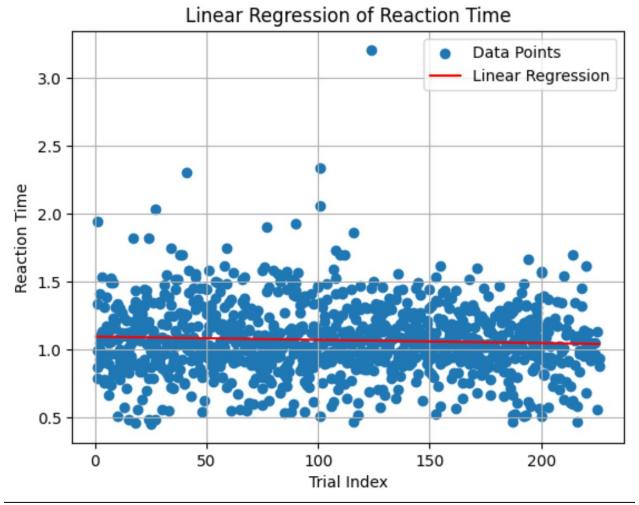
- The prior std group 80 has faster reaction times compared to the other three prior standard deviations.
- This is incongruent with our expectations. We thought that prior std 10 would have faster reaction times than the other three.
- This might be due to prior std of 10 has greater motion coherence compared to prior std of 80.
- Bias may play a bigger role in prior std 80, but this will need to be evaluated through further research.

Results: Learning effects

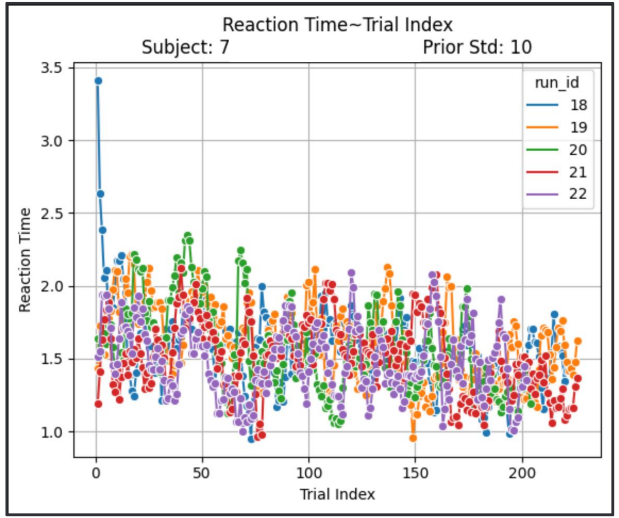
We plotted all the runs for one subject with a particular prior standard deviation in order to check for learning over different trials.

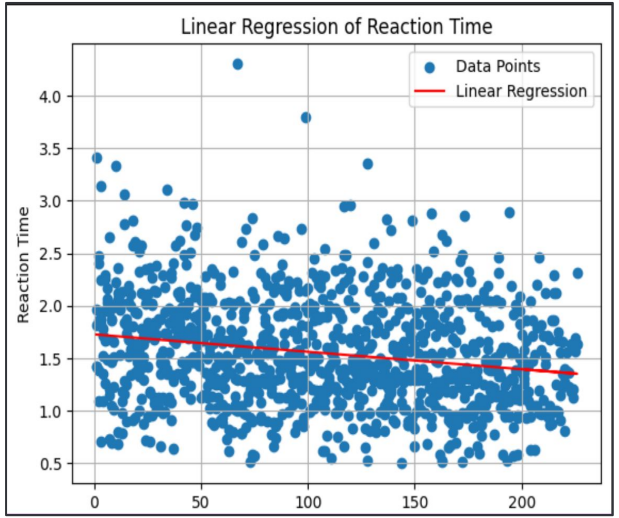






Intercept: 1.094004924429369
Coefficient: [-0.00023527]
R-squared: 0.0031963738008041753





Intercept: 1.7266175196335807
Coefficient: [-0.00166063]
R-squared: 0.03982000993687729

Conclusion - Learning effects

- Reaction time of the first few trials in the first run was the longest.

  Reaction time becomes faster as runs progresses

  Finally, reaction stablizes around a straight line.

  Average reaction time can show individual differences

- There seems to be a positive learning effect, but further evaluation over a longer timescale will be needed to ascertain.

- R-squared value is small, suggesting linear regression may not be a good model, other models should be considered for future analysis.

Future Directions

1. Learning effects can be evaluated by plotting the trends over all the subjects and all the trials.
2. Some other models such as Drift-Diffusion Model and Long-range temporal correlation models could be applied.
3. Checks can be made specifically for biases, like the cardinal bias or waterfall aftereffect illusion.
4. We also think that the experiment procedure can lead to some bias as well since the response wheel is preset to a random position and has to be rotated in order to get the response which could affect the response time.

Group: Believers

Pod: haplocheirus_shout

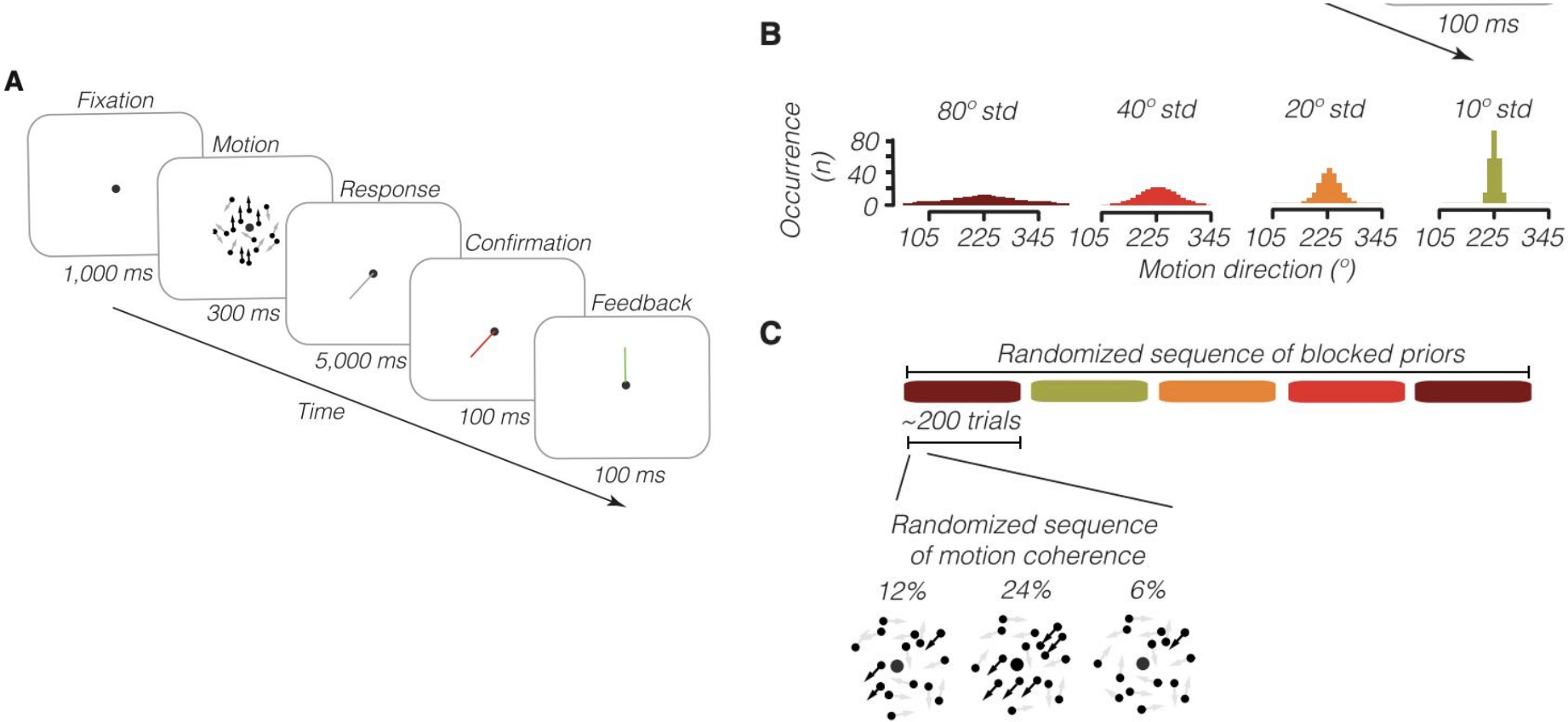
Group Members: Amin Khatami, Anushree Ganesh, Xima Ran, Xinran Liu

Mentor: Dr. Maria Nazarova

Regular TA: Harsh Arora

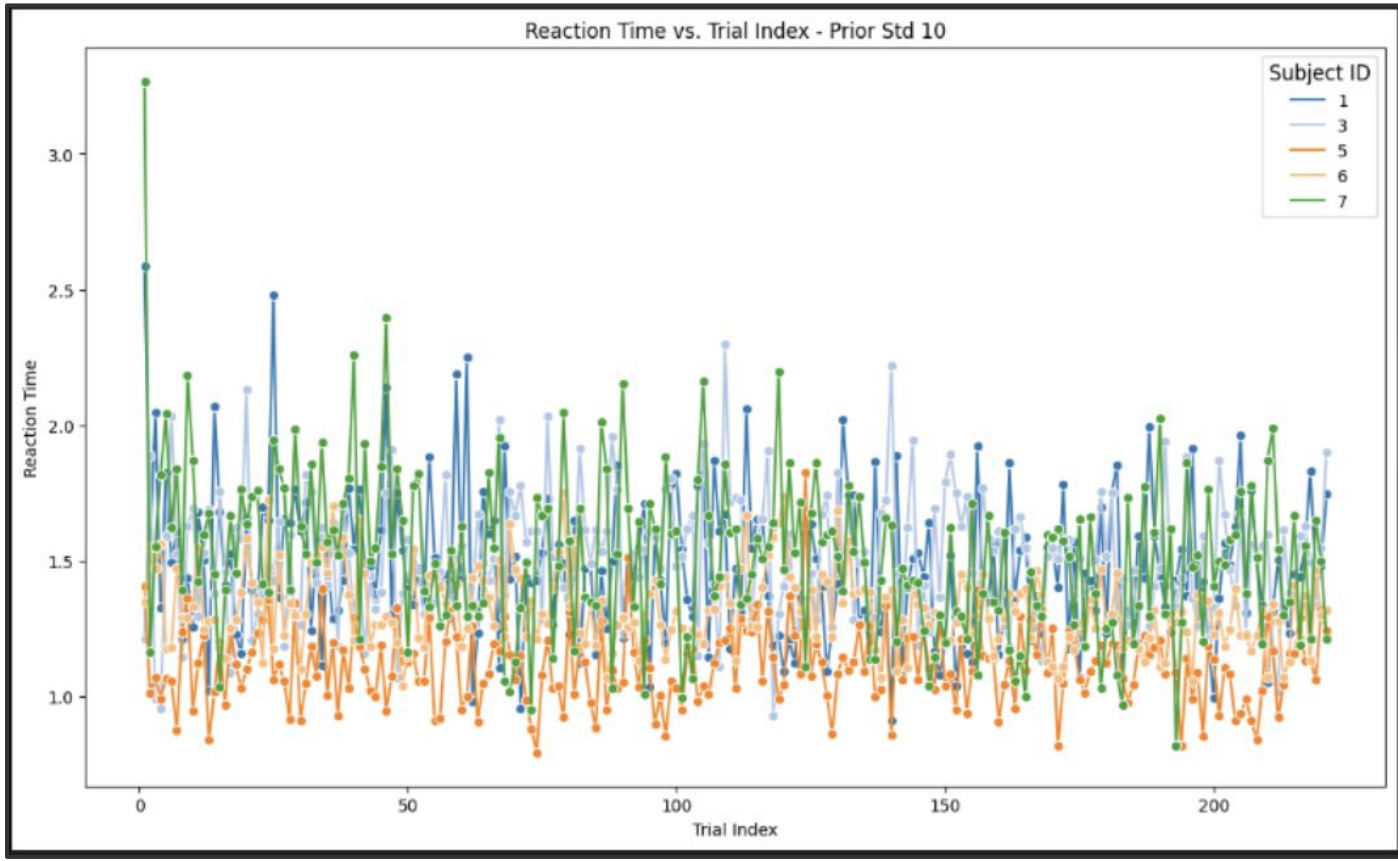
Project TA: Weina (Helena) Chen

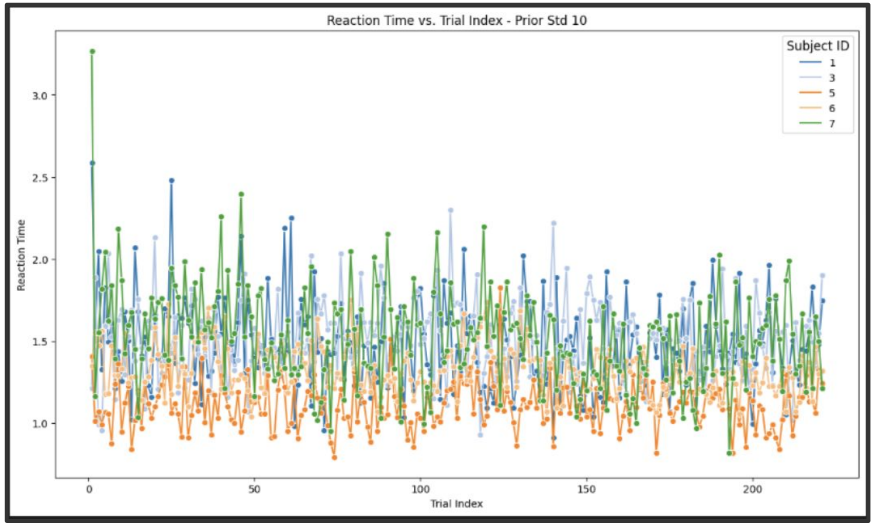
Additional Figures: Trial design - Block design

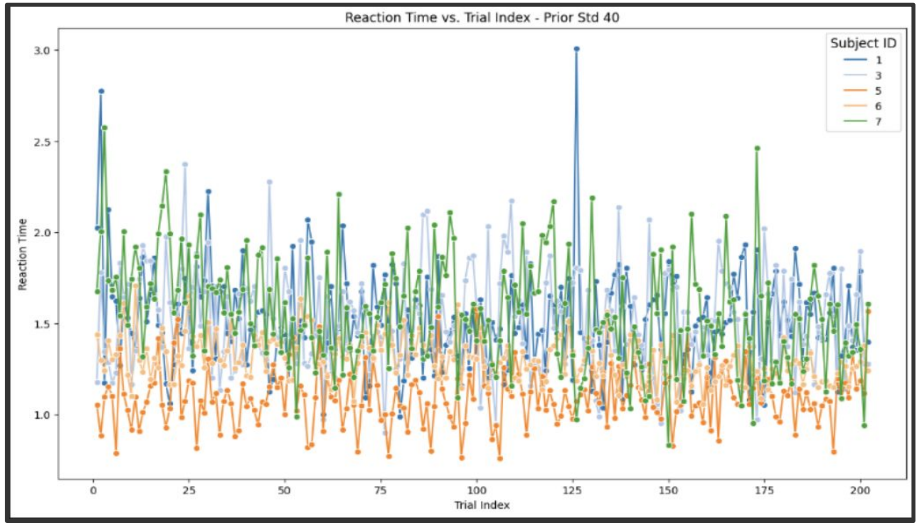


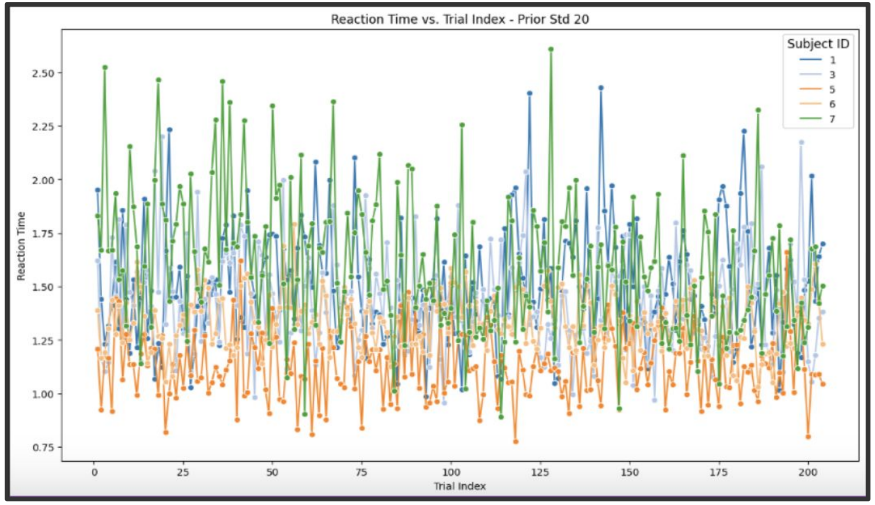
Additional Figures: Reaction Time-Trial Index for each STD prior

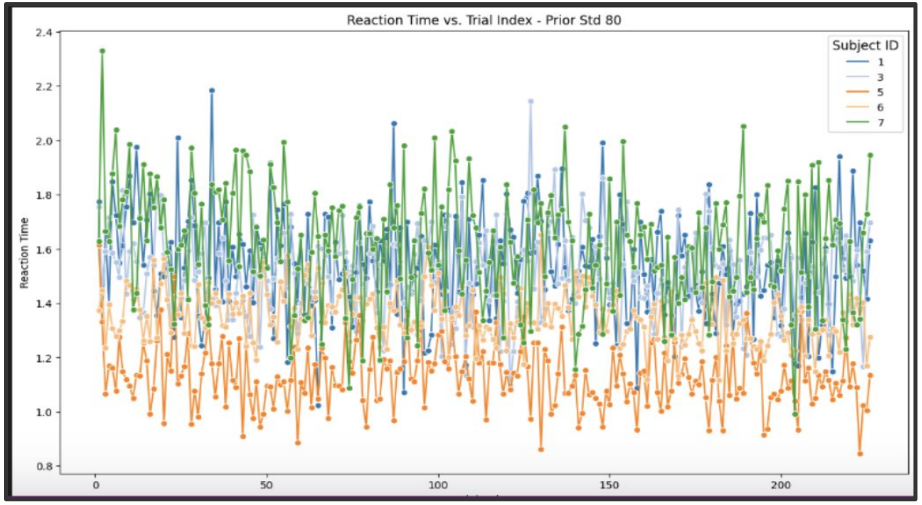
Color code represents different subjects. 4 subplots are 4 different standard deviation levels.



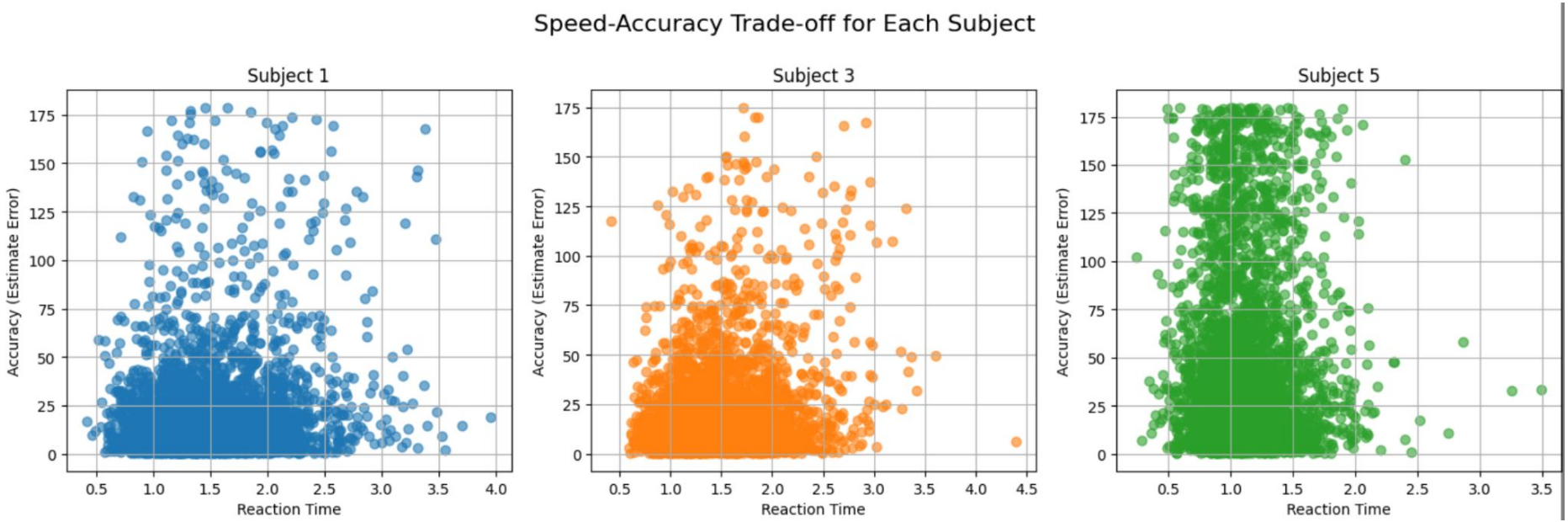

Reaction Time vs. Trial Index - Prior Std 10
Subject ID
1
3
5
6
7
Reaction Time
Trial Index

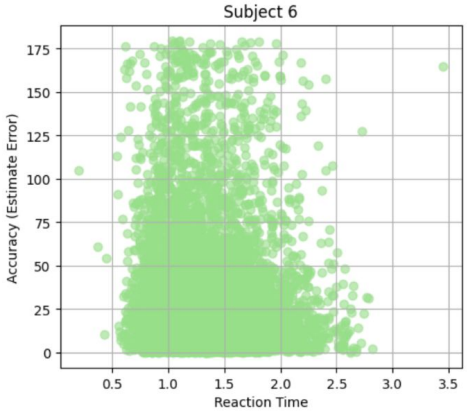

Reaction Time vs. Trial Index - Prior Std 40
Subject ID
1
3
5
6
7
Reaction Time
Trial Index

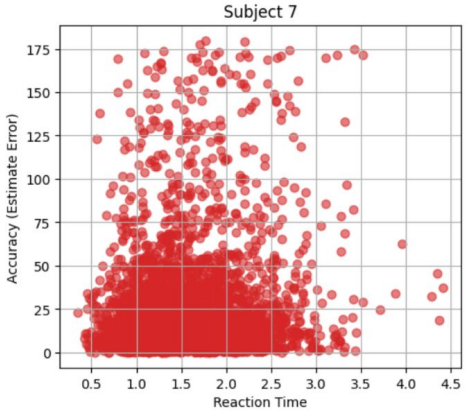

Reaction Time vs. Trial Index - Prior Std 20
Subject ID
1
3
5
6
7
Reaction Time
Trial Index

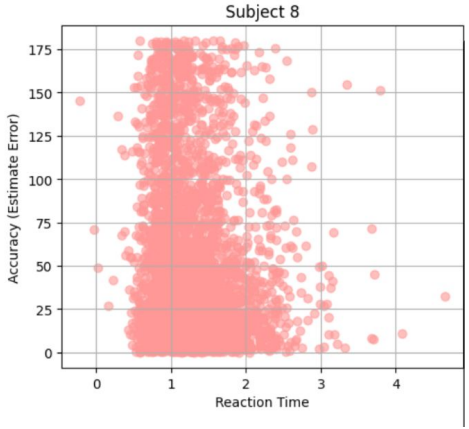

Reaction Time vs. Trial Index - Prior Std 80
Subject ID
1
3
5
6
7
Reaction Time
Trial Index

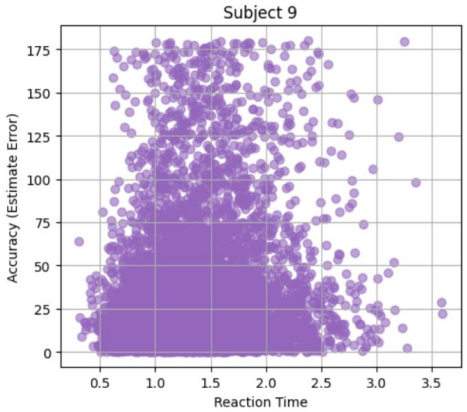
Results: Speed-Accuracy Trade-off

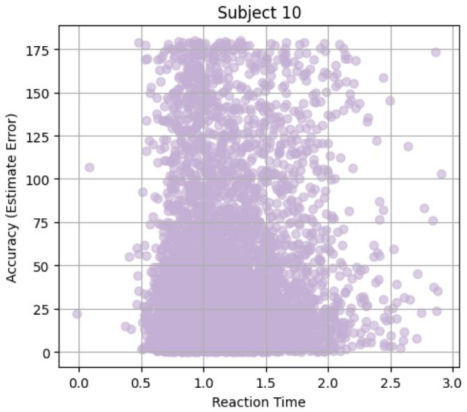


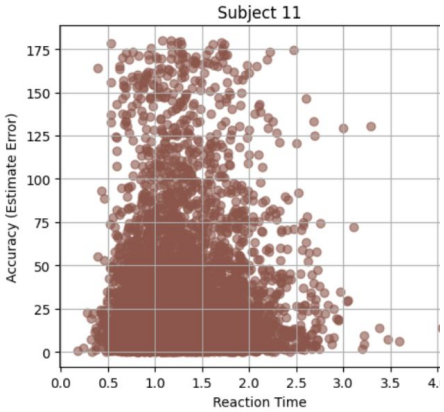

Subject 6
Accuracy (Estimate Error)
Reaction Time

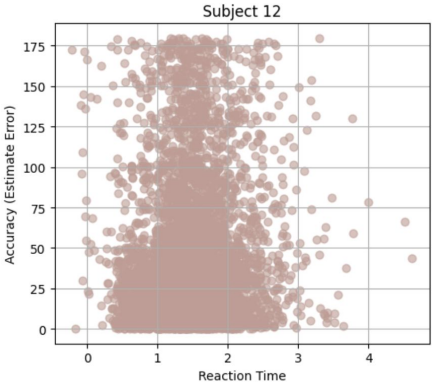

Subject 7
Accuracy (Estimate Error)
Reaction Time


Subject 8
Accuracy (Estimate Error)
Reaction Time


Subject 9
Accuracy (Estimate Error)
Reaction Time


Subject 10
Accuracy (Estimate Error)
Reaction Time


Subject 11
Accuracy (Estimate Error)
Reaction Time


Subject 12
Accuracy (Estimate Error)
Reaction Time