ATP ASSIGNMENT- 2

1. Introduction

This project is about how our attention is affected by emotion faces and it uses a method which is Posner cueing paradigm. In this experiment, first participants will see faces (happy, angry, or neutral) which appears in different positions (-16, -8, -4, 0, 4, 8, 16) on the screen, and there will be cues (cued, uncued) which will come before the target appears 80% the cue will be valid and 20% the cue will be invalid. In this experiment they measures how fastly a participant responded to stimulus (faces). It is mainly to understand how emotions and attention work together in the brain. This study is important as this is helpful in areas like psychology and even in systems like machines, robots that give response according to human emotion.

2. Plotting The Average Pupil Diameter

These plots show how the pupil diameter changes with time for different emotions at different cues on the screen.

Note: E1- Happy
E2 - Sad
E3 - Neutral

4 = (-4, 4) 8 = (-8, 8) 16 = (-16, 16)

Each line in below graph is the average of each time column of their respective emotion block and eccentricity of all the participants. For example, for E1 emotion at 0 eccentricity stored in separate csv and each time column(from t87) is averaged across all participants and plotted as you can see above. And same for E2 emotion at 0 eccentricity and so on. Total 12 combinations will be there as there are 3 emotion blocks and 4 eccentricities. This is for both cued and uncued conditions.
Note that in these plots in the y-axis from t87 to so on it is the converted version of actual time in milliseconds(so time will increase in milliseconds).

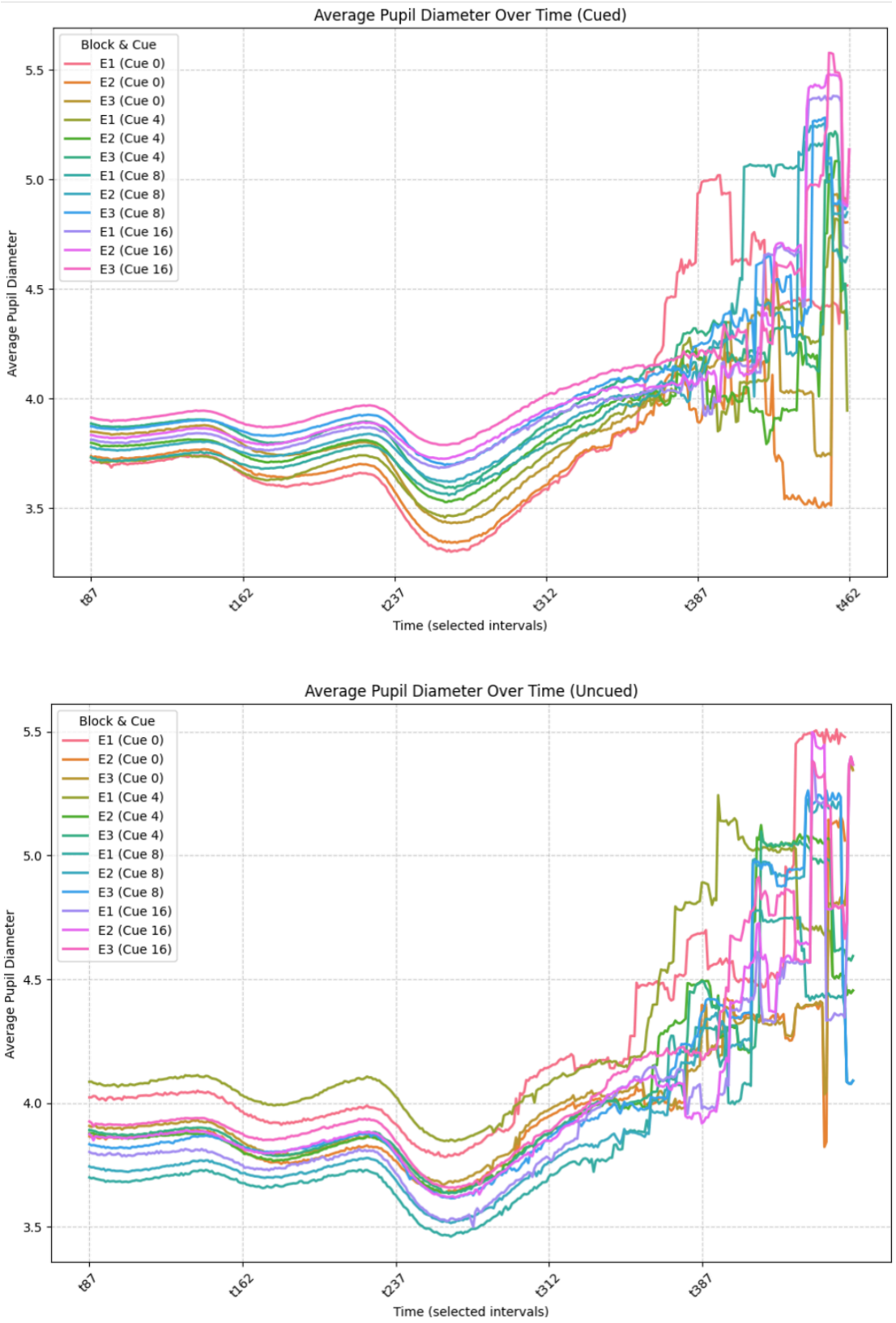
Average Pupil Diameter Over Time (Cued)
Block & Cue
E1 (Cue 0)
E2 (Cue 0)
E3 (Cue 0)
E1 (Cue 4)
E2 (Cue 4)
E3 (Cue 4)
E1 (Cue 8)
E2 (Cue 8)
E3 (Cue 8)
E1 (Cue 16)
E2 (Cue 16)
E3 (Cue 16)
Average Pupil Diameter
5.5
5.0
4.5
4.0
3.5
t87
t162
t237
t312
t387
t462
Time (selected intervals)
Average Pupil Diameter Over Time (Uncued)
Block & Cue
E1 (Cue 0)
E2 (Cue 0)
E3 (Cue 0)
E1 (Cue 4)
E2 (Cue 4)
E3 (Cue 4)
E1 (Cue 8)
E2 (Cue 8)
E3 (Cue 8)
E1 (Cue 16)
E2 (Cue 16)
E3 (Cue 16)
Average Pupil Diameter
5.5
5.0
4.5
4.0
3.5
t87
t162
t237
t312
t387
Time (selected intervals)

Figure 1

2.1 Inferring Results from the Data

Results:

Observations in both the graphs:

a) Baseline pupil diameter
For all conditions the pupil diameter starts around from 3.5-4.0 units. Somewhere in between t237 and t312 the pupil diameter is increasing over time.

b) Difference between cued and uncued conditions:
In cued conditions there is the smooth increase in pupil diameter over time compared to uncued conditions. In uncued there are fluctuations at the end also which shows the inconsistency compared to cued ones.

c) Effect of Eccentricities:
From both the graphs, as cue increases (mainly cue 8 and cue 16) the diameter of pupil increases at the end of time series. Mainly we can see in cued graph.

d) Variability:
The cues condition showed less fluctuation in pupil diameter at the end of the time series as compared to the uncued condition. In uncued condition there were higher fluctuations noticed in the graph.

Findings:

a) Pupil dilation has the general trend over time:
At first the pupil constricts a little, due to the fixation period. After the stimulus is presented there is an increase in pupil size for all conditions, this means there is attentional engagement and cognitive load. The more dilation happens at a later time when participants are focused on decision making.

b) Cue effects on pupil dilation:
Cued trials resulted in high and stable pupil dilation compared to uncued, which supports the theory that valid cues facilitate processing. Uncued trials showed

higher inconsistency, because of the attention reorientation and cognitive demand is increased due to invalid cues.

c) Impact of cue eccentricity
   High cue eccentricities like 8, 16 had more pupil dilation as compared to others which shows anticipatory attentional engagement. Means our brain is getting ready to focus more on far away stimulus(i.e 8,16) that's why high dilation.
   In uncued trials the effect is weak because the target appears unexpectedly and which needs attentional correction.

d) Variability gives evidence of cognitive load:
   In uncued trials we can see that there is high variability which points to increased difficulty or effort while invalid cueing. This variability make sense because it takes cognitive cost to shift our attention from the wrong cue to correct target location.

Conclusions:

a) Valid cue enhances attentional engagement:
   Valid cues direct our attention efficiently which lead to more stable pupil dilation without any fluctuations. This tells us that there is strong attentional focus when participants correctly look at target location.

b) Invalid cue requires attentional reorientation:
   When the cue is invalid participant had to redirect their attention which requires high cognitive effort. Due to this there is variability in pupil diameter

c) Cue eccentricity modulates cognitive load:
   The cues which are far away like 8, 16 results in higher pupil dilation especially in valid cue trials. This tells that when anticipating targets at farther visual field locations there is greater preparatory processing.

d) Pupil dilation as a window into covert attention:
   The results suggest that changes in pupil size shows how our attention shifts even when we are not moving our eyes.

3. Reaction Time Analysis

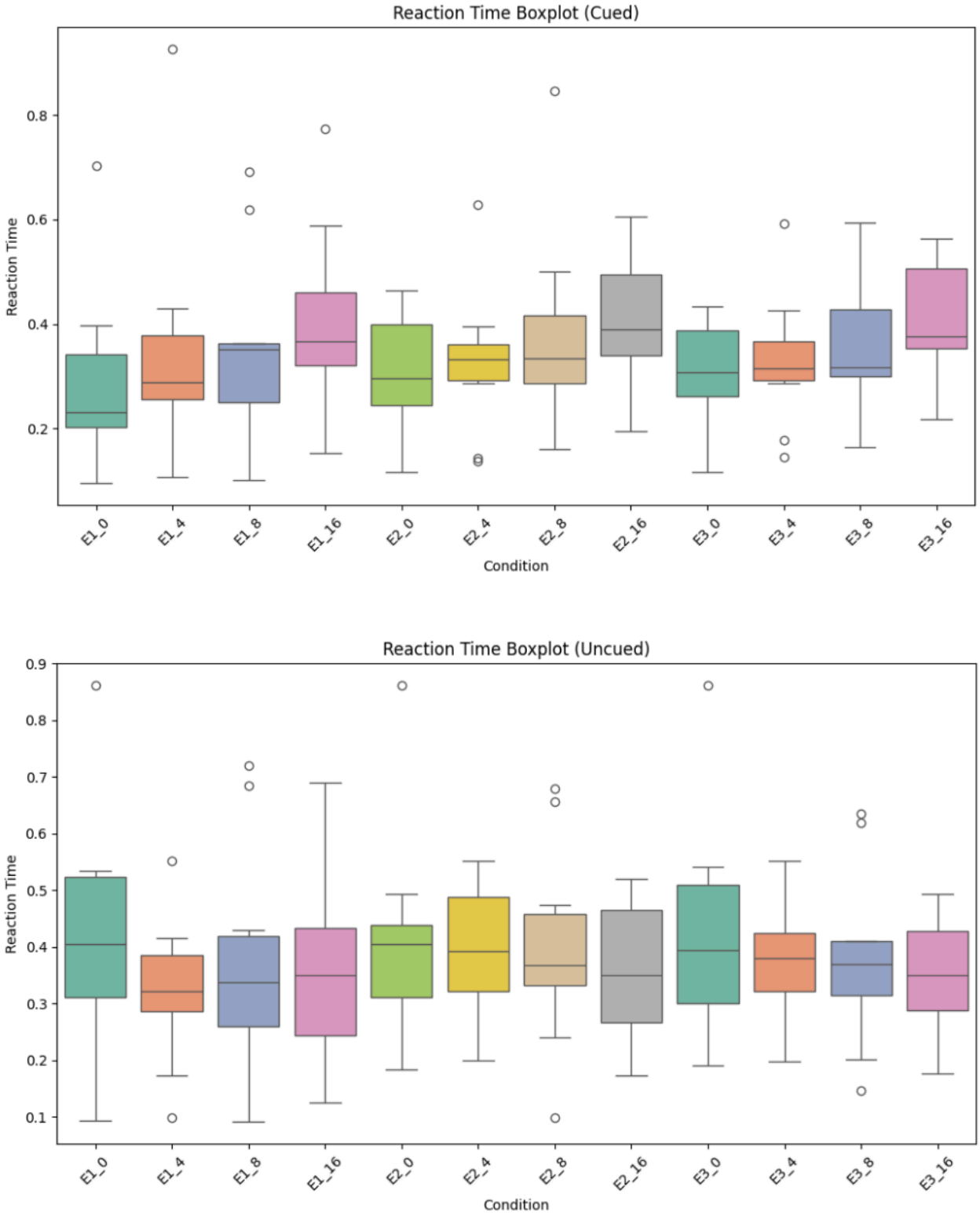

Figure 2

3.1 Inferring Results from the Data

Results:

a) From both the graphs we can see that in cued condition the reaction time is less as compared to the uncued reaction time.

b) In cued condition the median reaction time showed there is an increase in reaction time as we increase the eccentricity we can clearly see this in E1 and E2. This means that we need more cognitive resources so high rt. But in uncued it doesn't follow a clear monotonic trend for eccentricity 4 sometimes it increases and then decreases as eccentricity increases. This irregular pattern tells us greater attentional disruption. (You can see clearly in Fig 3)

c) In Both the graphs the reaction time for happy faces are less as compared to the reaction time of sad and neutral faces. In cued condition we can clearly see this trend.

Findings:

a) Across all emotional contexts, the cues conditions had faster and consistent reaction times, supporting the theory that valid cues facilitate attention position.

b) In cued trials there is an increase in RT with greater cue eccentricity which suggests that spatial distance affects the attentional processing even when the cue is valid.

c) People's brains are made in such a way that they respond to emotions fastly, especially Happy faces because they feel safe, friendly and pleasant when we look. So that's why the reaction time is less detecting Happy faces.

Conclusion:

- Valid cues improve performance by reducing RT which indicates efficient attentional engagement. But invalid cues disrupt processing, increasing both cognitive load and RT.

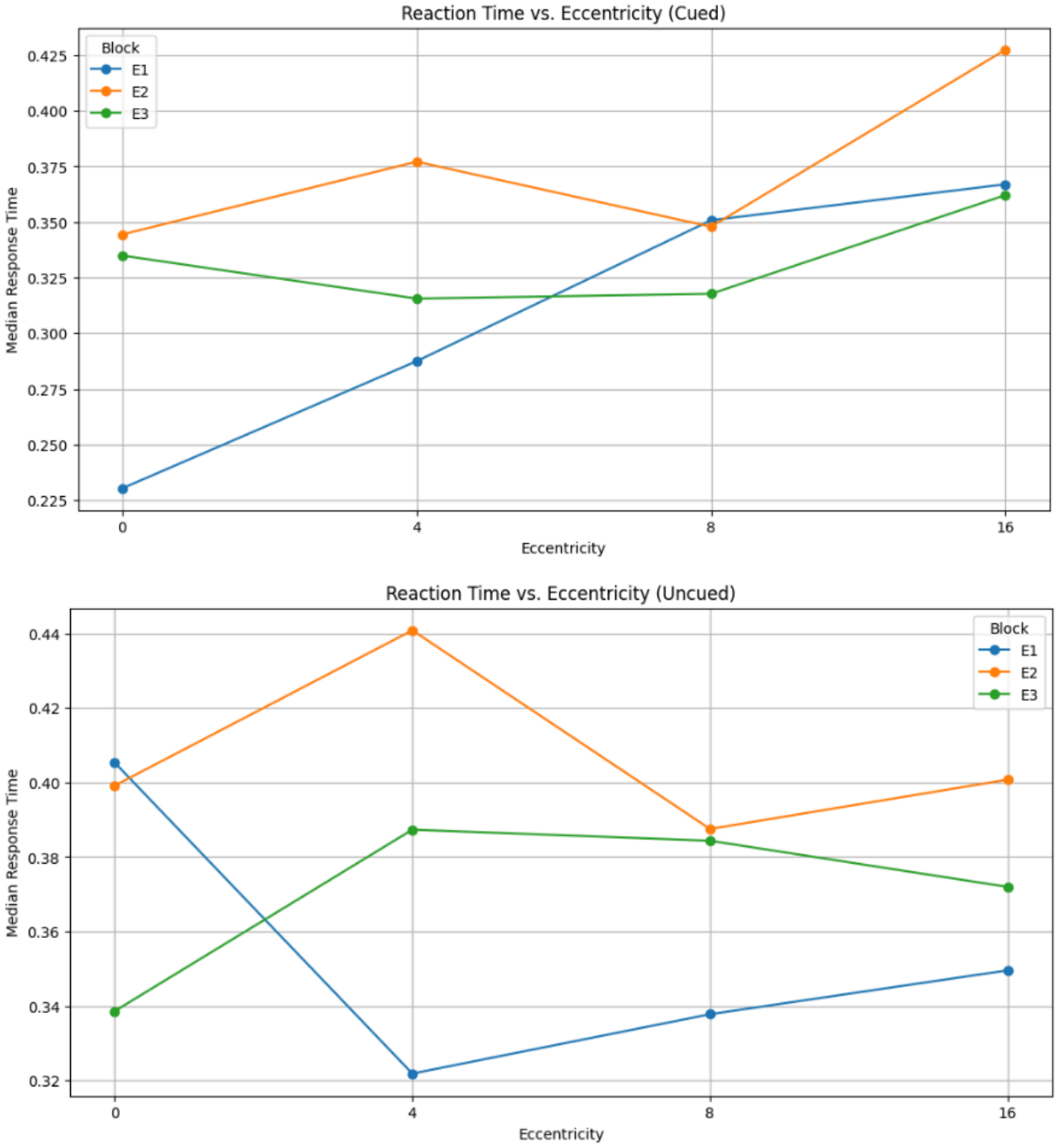
Reaction Time vs. Eccentricity (Cued)
Block
E1
E2
E3
Median Response Time
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0
4
8
16
Eccentricity
Reaction Time vs. Eccentricity (Uncued)
Block
E1
E2
E3
Median Response Time
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0
4
8
16
Eccentricity

Figure 3

4. Supporting Plot

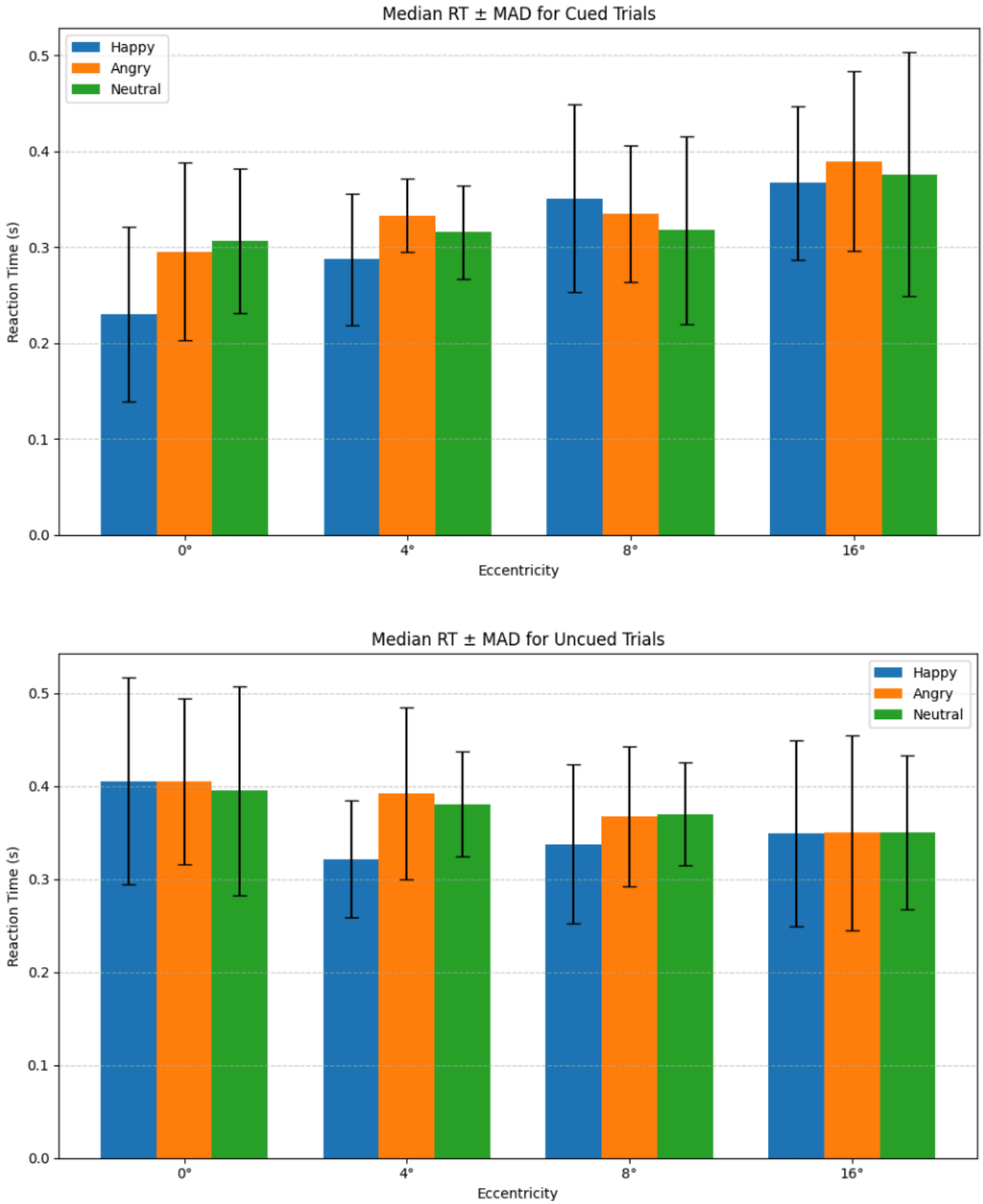

Figure 4

4.1 Inferring Results from the Data

How is this graph relevant? :

Importance of Median Absolute deviation:

- MAD basically measures variability, in this it is less affected by extreme values compared to standard deviation. In this experiment this tells about consistency of responses among participants.
- Generally there is Lower MAD in cued trials means when attention is guided there is more consistent reaction time. In most bars there is greater variability in uncued because of misdirected attention.
- MAD not just tells about the RT but also about the stability of how the participant is performing.

Results:

- Lower MAD in cued means more consistency which showed focused attention, stable performance across participants. Which gives the hint that the attention was consistently directed towards the correct location where cue was present. More uniform because all participants know where to look.

- Higher MAD in uncued means less consistency indicates uncertainty, attention misallocation. In this the RT will vary because some participants look on some other side for finding the target and some will look another side looking for target which is high variability which means less consistency.

Conclusions:

- Valid leads to both faster and consistent responses, which showed that attentional guidance improves perceptual efficiency.
- Emotions like Happy faces have higher RT and consistency because of their positiveness. Because people tend to be happy so they can recognise happy faces easily.
- In uncued conditions the response time was slower and less consistent, due misdirected attention.

References:

- https://www.w3schools.com/datascience/default.asp
- https://link.springer.com/article/10.3758/s13414-020-02017-y?utm_source=chatgpt.com