

INTRODUCTION

- Motion

Animation is widely used in modern data visualizations. For example, wind maps communicate the speed and direction of wind in engaging and informative ways. At a lower level, the animation uses **motion** (such as **movement**, **rotation**, and **vibration**) to encode data values. This poster presents a study examining how well people can retrieve data values from animations.

- Measurements

1. Graphical Perception Experiment

- Quantitative judgment of the effectiveness of motion encodings

2. JND(Just Noticeable Difference) Experiment

- Model the minimum difference of data values can be communicated with motion.

- Objectives

We selected two visualization to study two types of motion respectively.

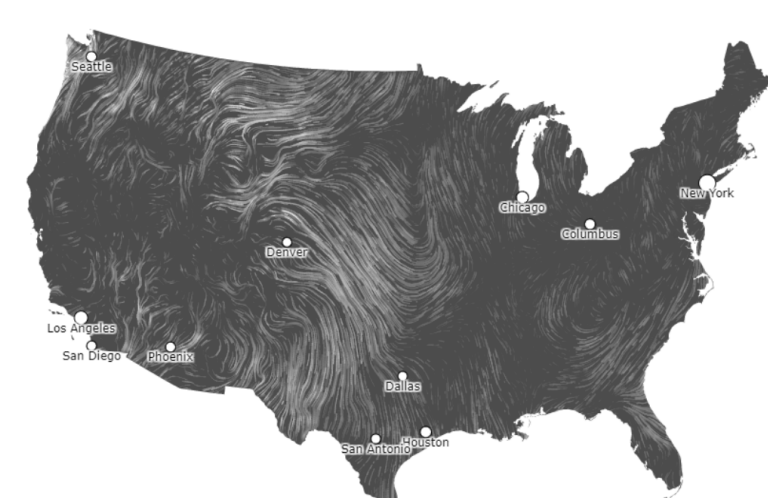
- Movement : **Particle Flow charts**

- Rotation: **Windmill charts**

METHODOLOGY

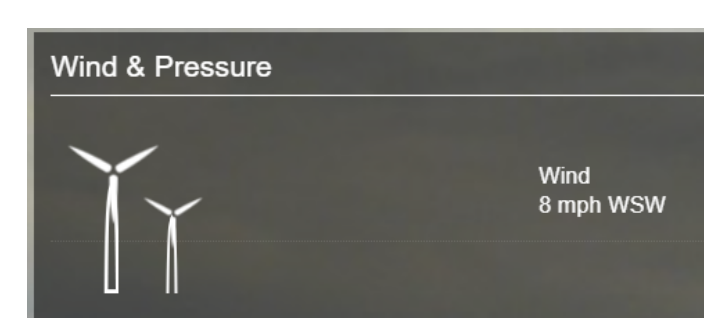
- Online Crowd sourced Experiment

Live Wind Map



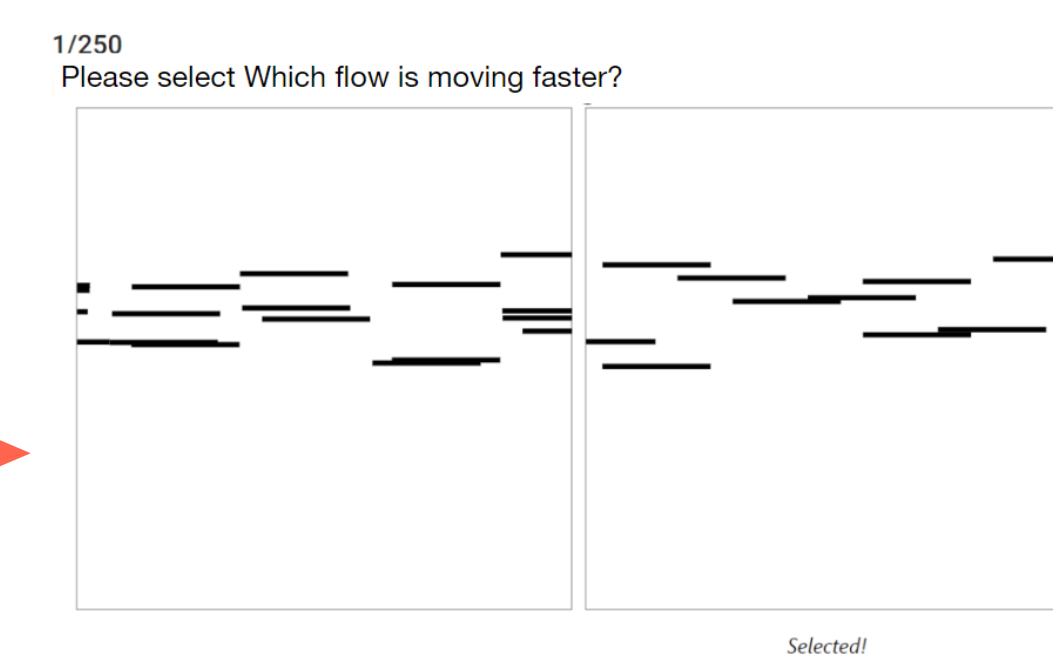
*Wind map from HINT.FM
<http://hint.fm/wind/>

Wind Speedometer



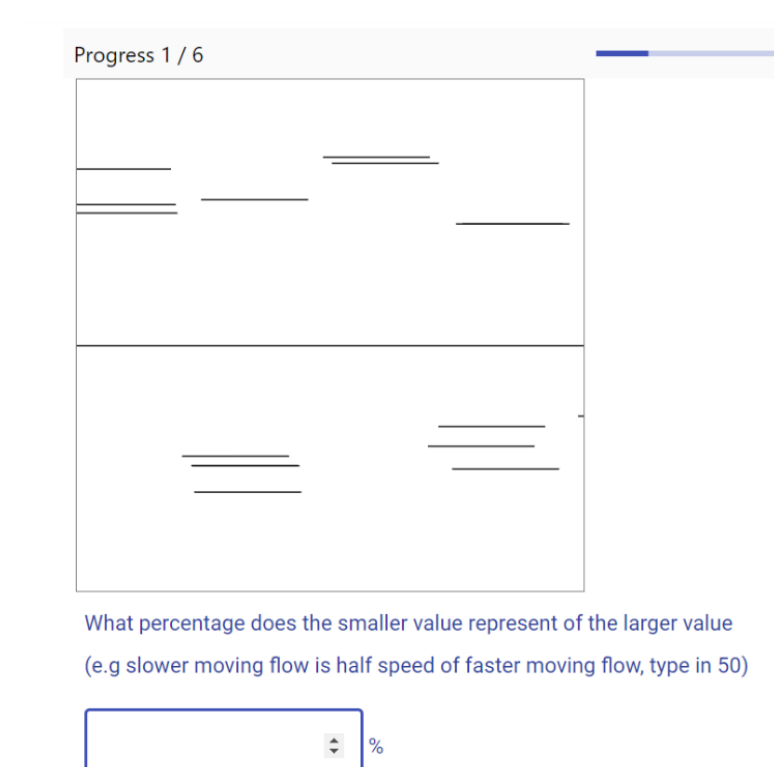
*Wind speedometer from Yahoo
<https://www.yahoo.com/news/>

Particle Flow Chart Stimuli for JND Exp



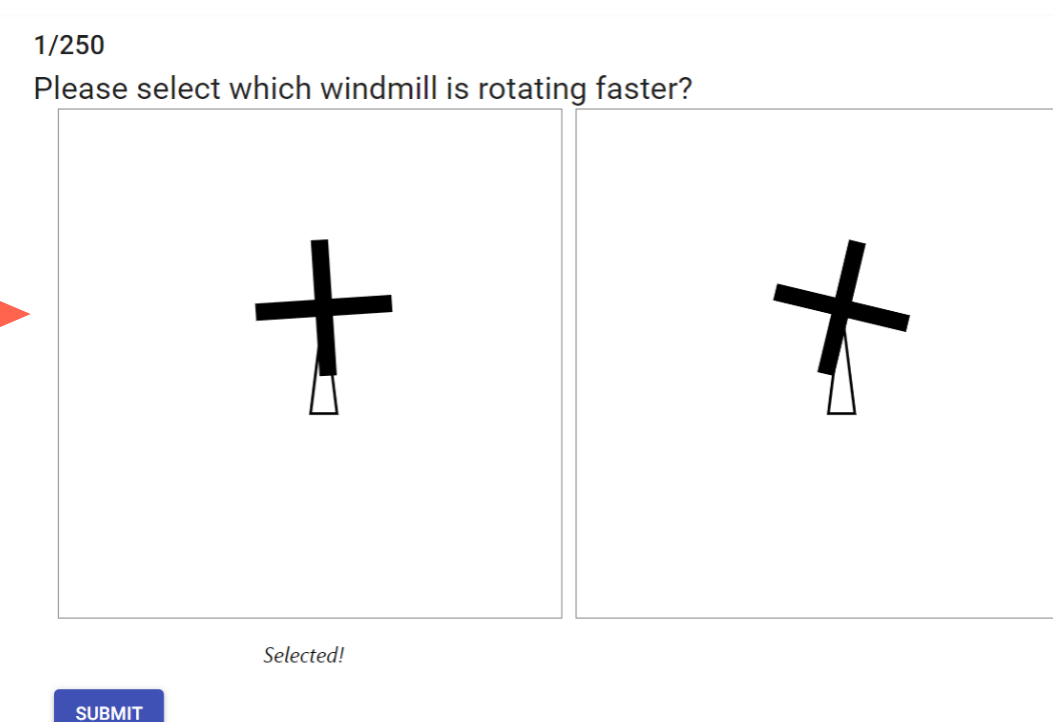
Participants were asked to select which flow was moving faster. If the answer is correct, they will be shown two charts have closer speed and vice versa.

Particle Flow Chart Stimuli for Graphical Perception Exp

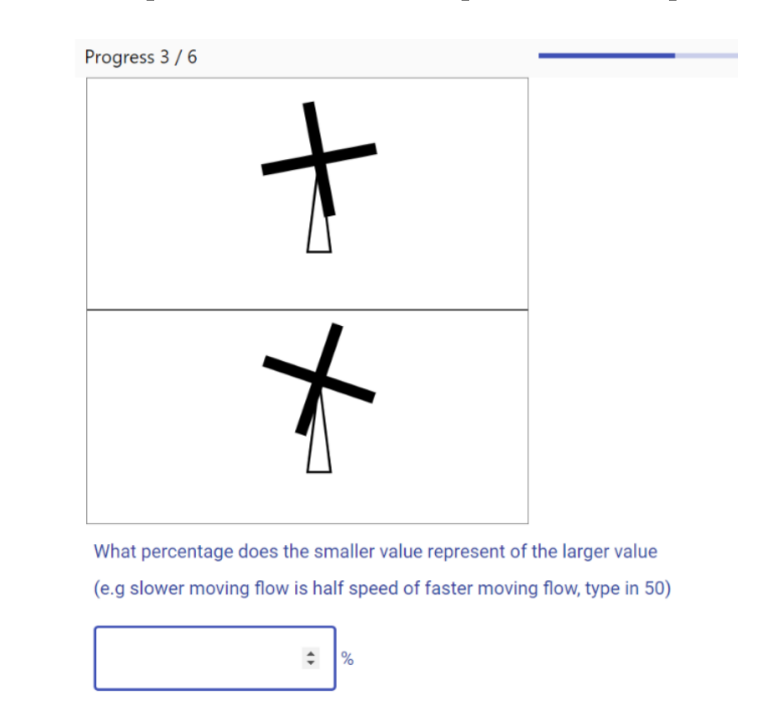


Participants were asked to estimate the percentage of smaller value represent of the larger value

Windmill Chart Stimuli for JND Exp



Windmill Chart Stimuli for Graphical Perception Exp



Participants were asked to estimate the percentage of smaller value represent of the larger value

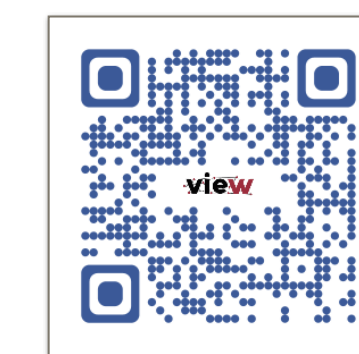
CURRENT RESULT

-Graphical Perception Experiment

How to measure perception accuracy?

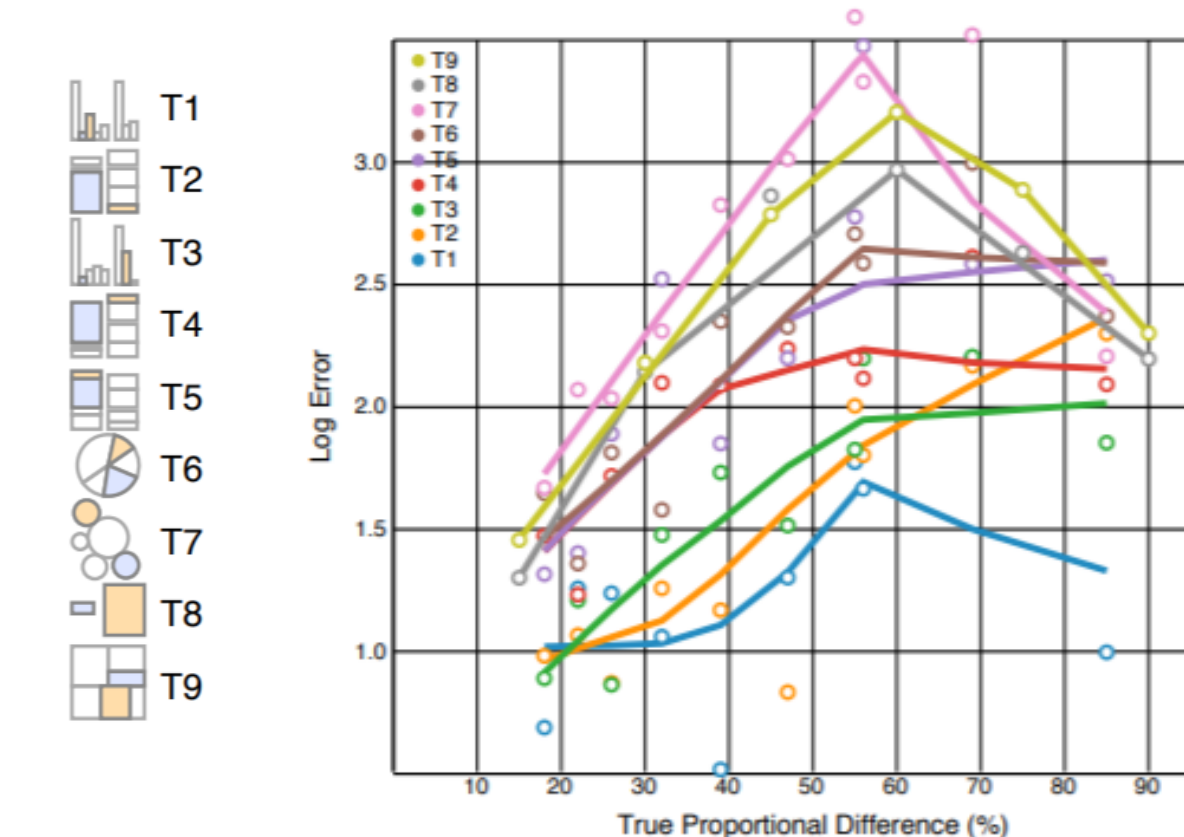
Log absolute error:
 $\log_2(|\text{judged percent} - \text{true percent}| + 1/8)$

Scan to test your accuracy!

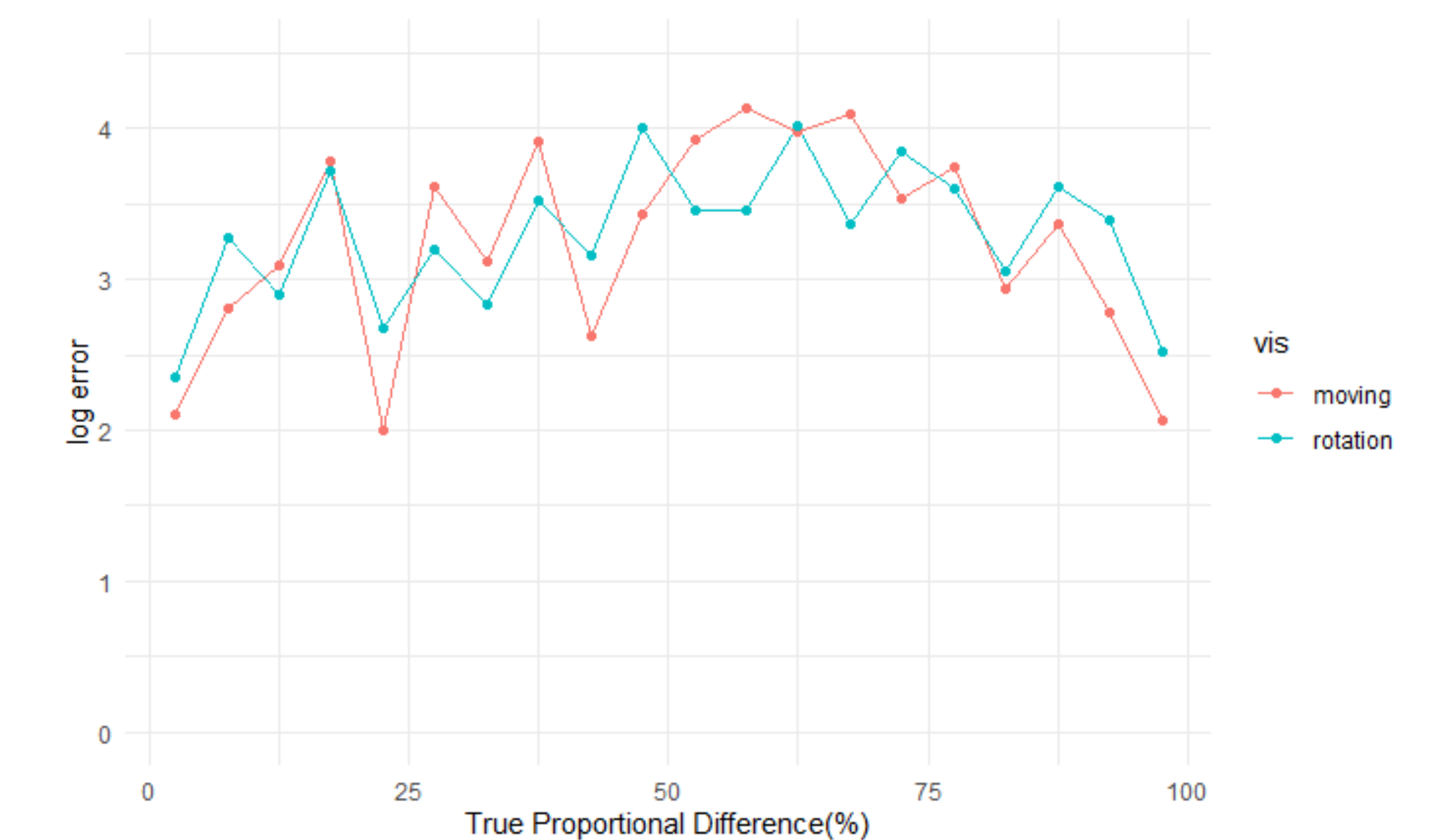


How flow chart and windmill chart performed compare to regular charts

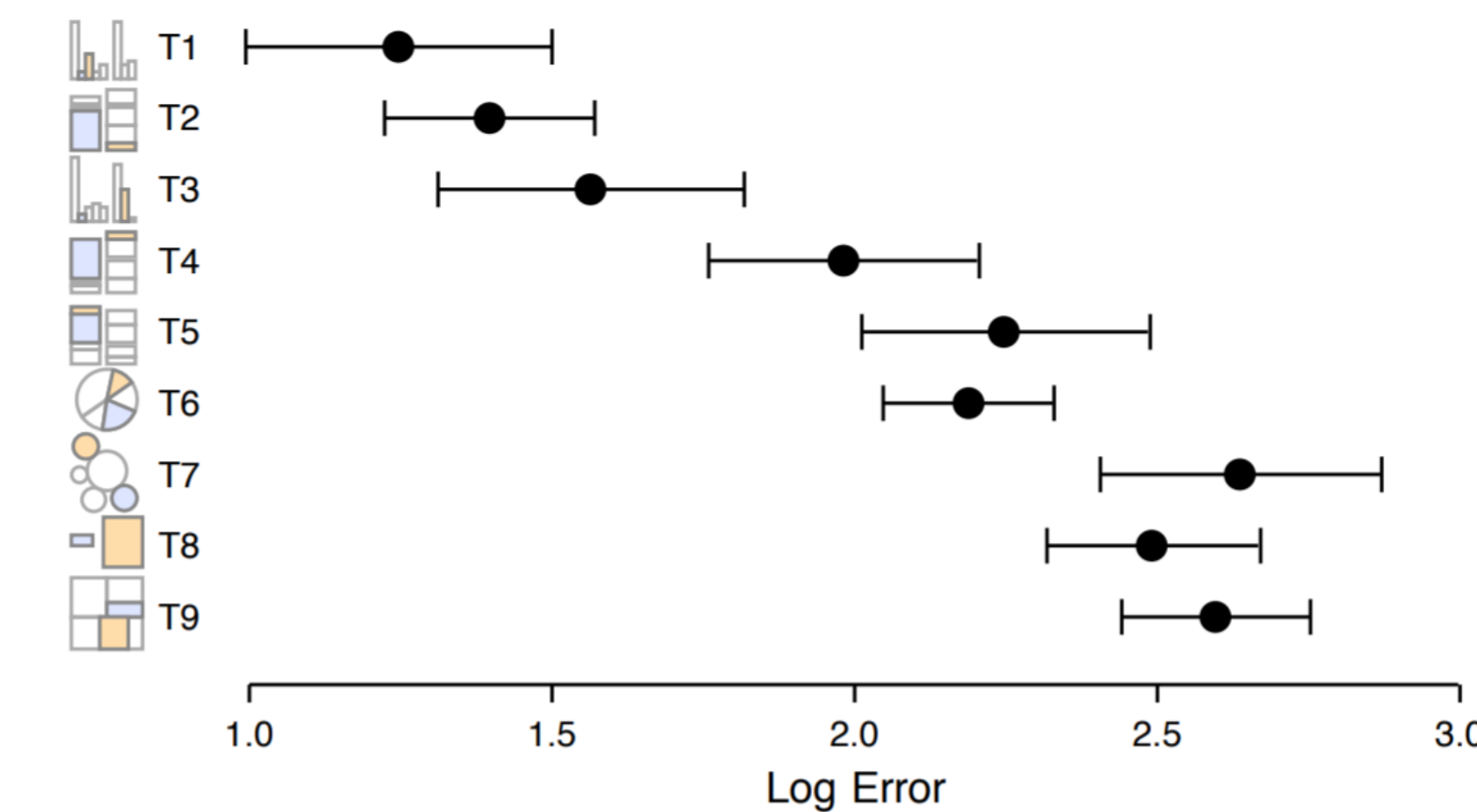
Mean of log absolute error for regular charts



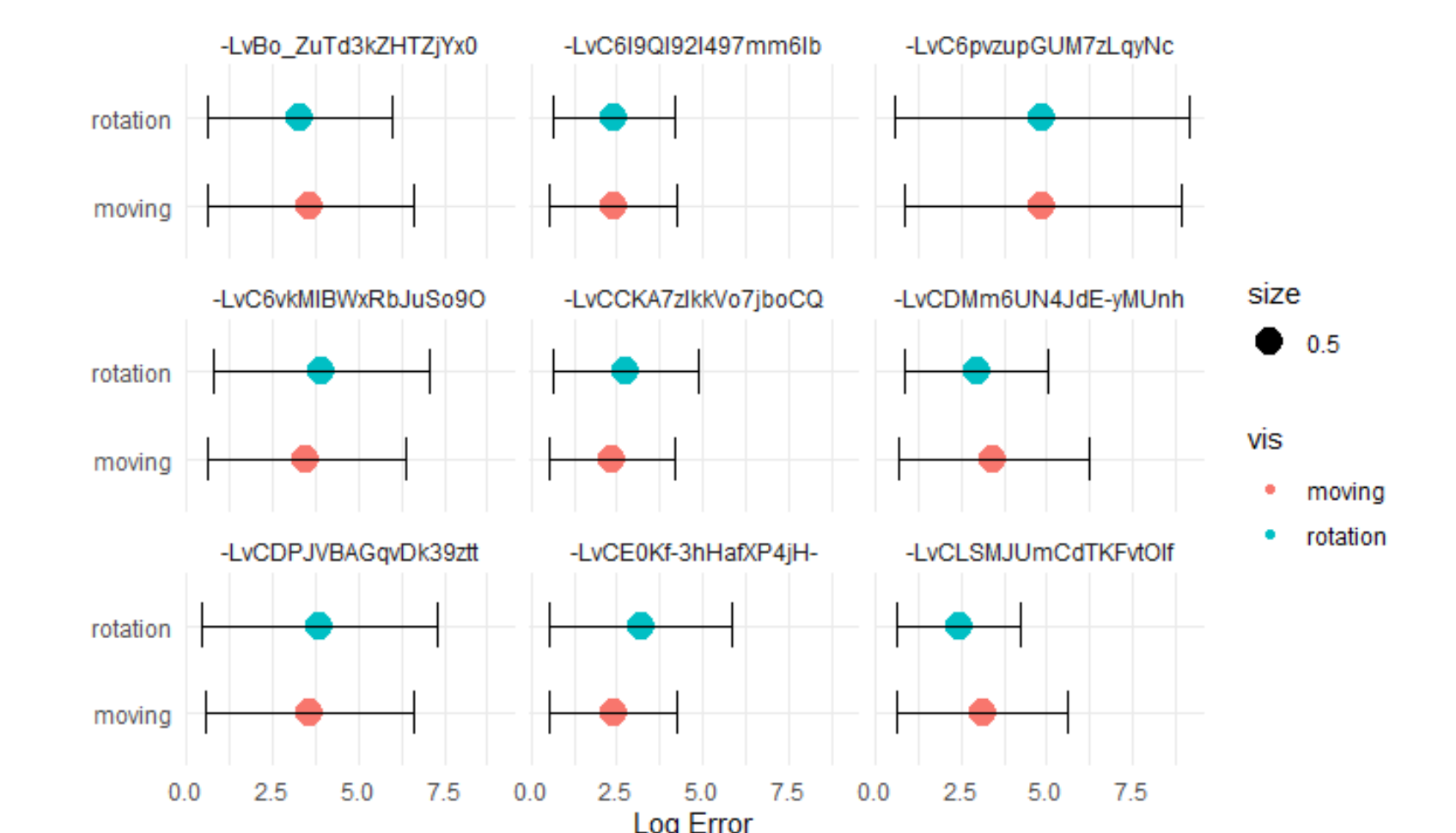
Mean of log absolute error for moving/rotation charts



CI of mean error for regular charts



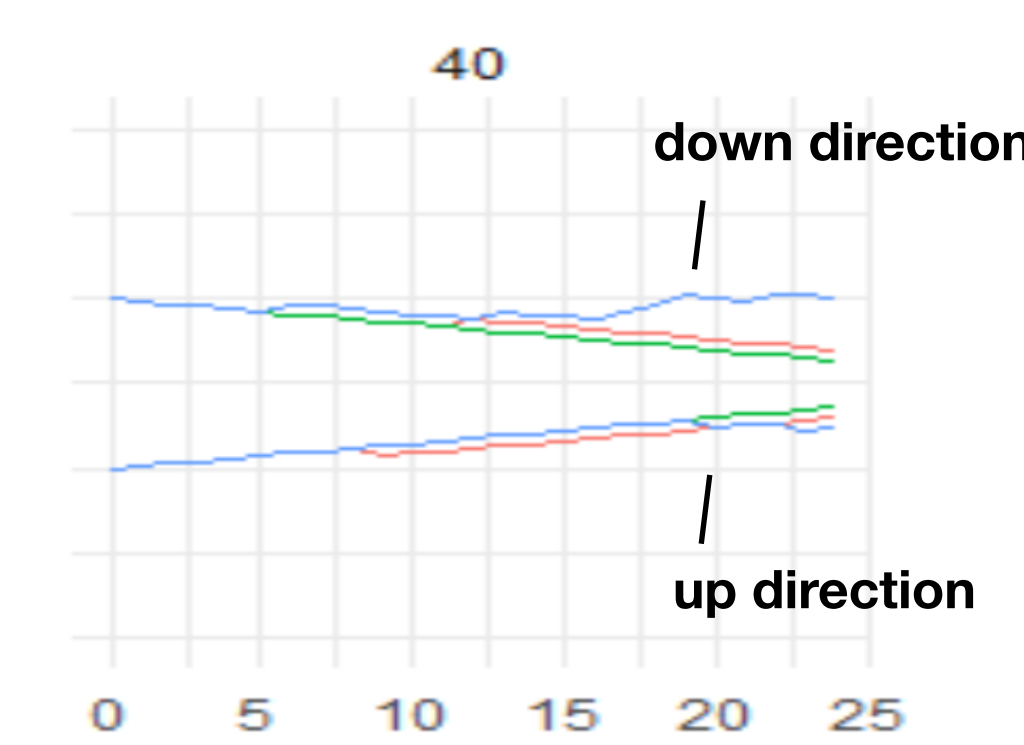
CI of mean error for flow/windmill charts



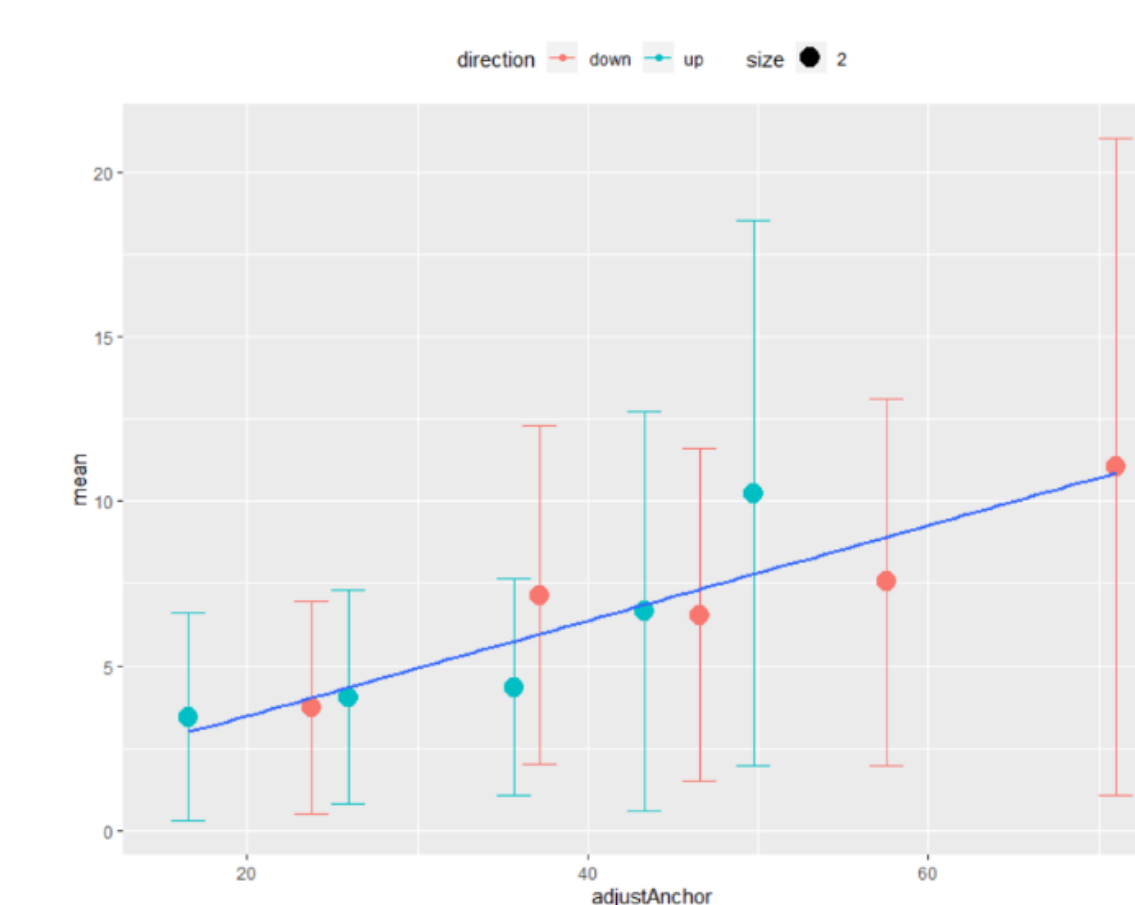
-JND Experiment

Example of JND Exp data

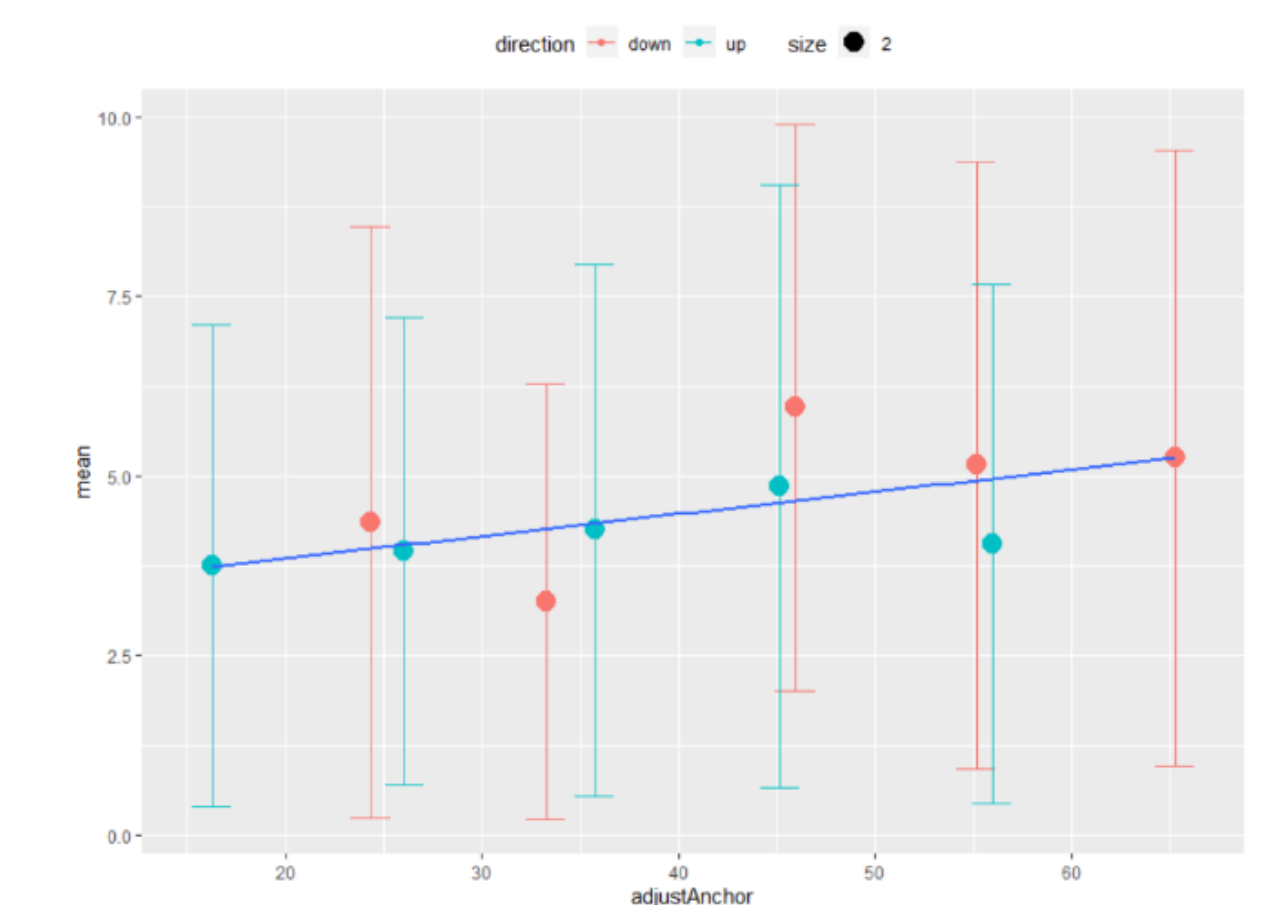
This data come from windmill chart trial at speed 40. The value reach convergence at the end of 25 trials. We pick the mean of last 5 trials as JND.



Linear model for flow chart



Linear model for windmill chart



Conclusion & Future Work

- Participants' perception on flow chart and rotation windmill chart is very similar.

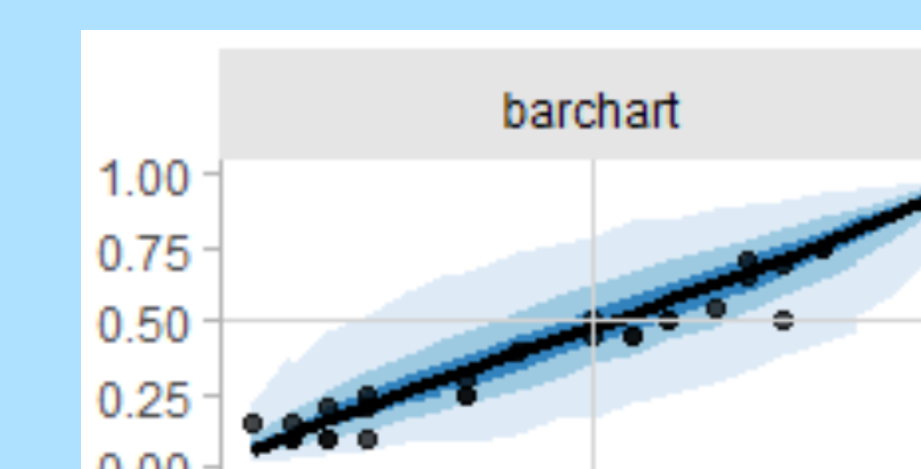
- The performance of charts leverage movement/rotation to communicate information are close to tree map & bubble charts, which is lower than

- The value of JND for both charts were calculated. Rotation has smaller JND than movement

- Participants' performance varies.

Next Step:

Bayesian modeling can be used to fit models that represent individual performance. Instead of giving confidence interval, we can predict the possibility of participants' future selection.



*An example of Bayesian model fitting for bar chart in graphical perception trials

Model Fit

We adjusted anchor value by:
 $V(\text{adjusted}) = V \pm 0.5 \cdot \text{jnd}(v)$
for up direction and down direction data respectively. Then linear models were fit to the data

Reference
-J.Heer and M. Bostock. Crowdsourcing graphical perception: using mechanical turk to assessing visualization design. (2010)
- L.Harrison,etc. Ranking Visualizations of Correlation Using Weber's Law.(2014)