Beyond Kinematics: Predictors of Performance in Heider-Simmel Style Animations

Bianca Schuster[1], Dagmar Fraser[1], Sophie Sowden[1], Jasper Van den Bosch[1], Andrew Gordon[2], Jennifer Cook[1]

[1]University of Birmingham, UK [2]University of Southern California, USA

INTRODUCTION

- Humans readily attribute animacy to and infer mental states from movements of 2D geometric shapes (1)
- Previous studies have found interindividual differences in performance in these Heider-Simmel style tasks: Individuals with ASD perform worse than neurotypicals when making mental state inferences from animations (2)
- These differences have in part been linked to movement kinematics: Neurotypicals show poorer performance when interpreting the higher jerk animations created by individuals with ASD (3)
- At present it is unclear which other factors contribute to performance in interpreting Heider-Simmel style animations
- We were interested whether the shape trajectories of the triangles' movements played a role in their interpretation
- For quantifying the presence of different types of trajectories in animations, we used a well-established method developed by Huh & Sejnowski (4)

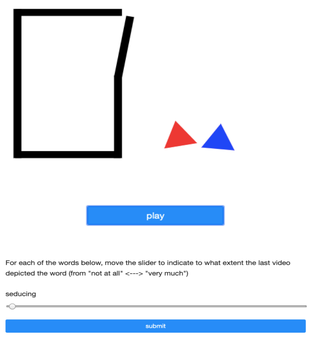
METHODS

Stimuli

- 52 healthy participants created 45 sec. long Heider-Simmel style animations of 5 target words by moving 2 triangles on a touch-screen device
- Target words: **mocking, seducing, surprising, following and fighting**
- The final stimulus set contained 203 animations with an average of 41 videos of each word

Procedure

- 36 naïve observers viewed 8 animations of each target word that were pseudo-randomly selected from the stimulus-set
- After viewing each animation, participants rated the extent to which it depicted the target word

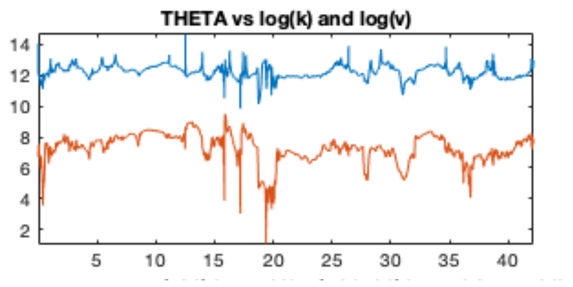


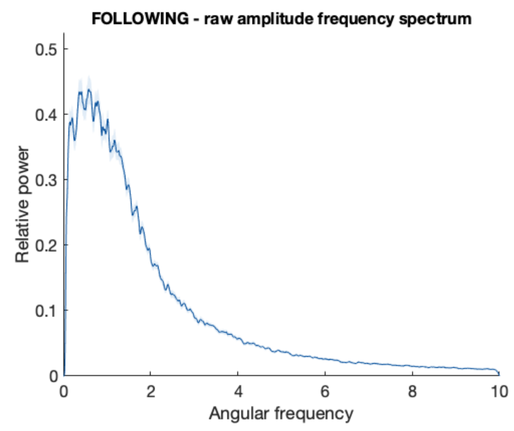
Analyses

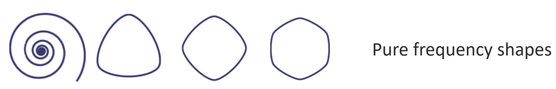
- Accuracy was calculated as: **rating target word – mean(ratings non-target words)**
- For each word, videos were grouped in high- and low accuracy by median split
- **Power in angular frequency bands** (see following box) was compared using permutation testing and cluster threshold multiple comparison correction
- Using stepwise entry, significant clusters of power were entered into a regression model together with other predictors in the following order:
  1. Significant power cluster
  2. Velocity, acceleration, jerk
  3. % of both triangles moving, distance between triangles, rotation

Angular frequency of curved movements

- Hand movements while drawing curved trajectories exhibit regularities that can mathematically be described by the 1/3rd power law, inversely relating speed and curvature
- The gradient of this relationship between speed and curvature is a function of the shape (= angular frequency band) of the movement trajectory (4)
- Spatial fast fourier transform (FFT) of log speed was performed to decompose the animations' curved trajectories into their constituent angular frequency bands

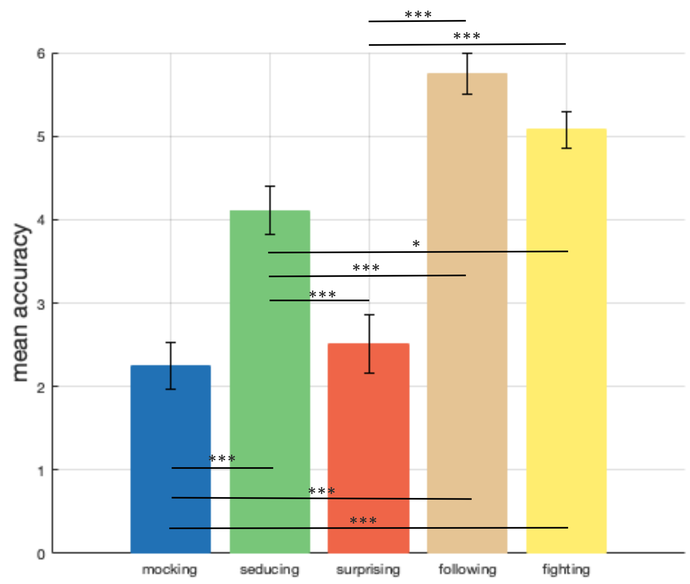






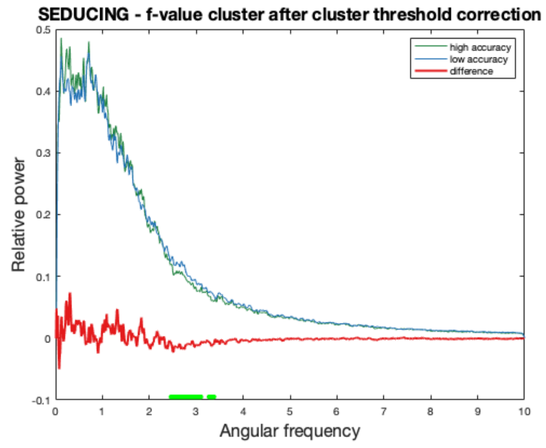
RESULTS

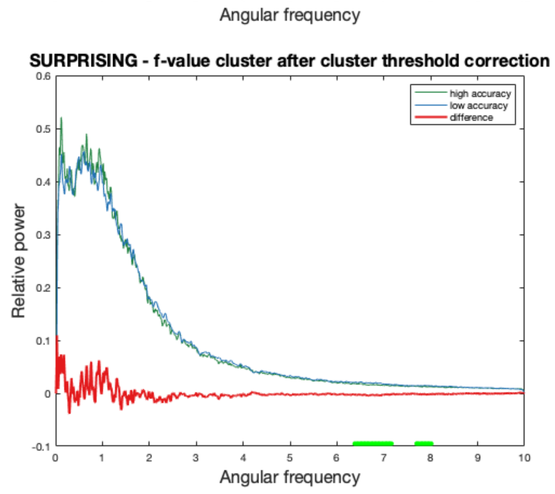
1) Mean accuracy was different across words:



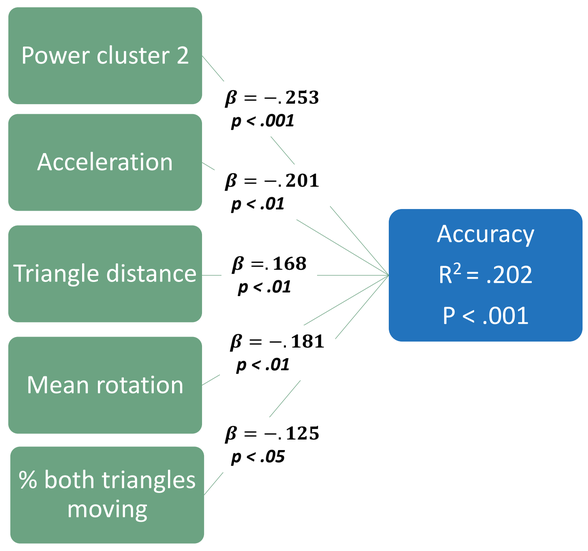
- A one-way ANOVA and bonferroni corrected post hoc tests revealed significant differences between words ($F(4,1420) = 47.03$, $p < .000$)

2) Cluster based permutation tests reveal significant clusters of differences in power between high and low accuracy videos for seducing and surprising





3) For surprising, power in cluster 2 stays significant predictor after kinematic and other predictor variables entered



SUMMARY

- Significant clusters of difference in angular frequency were observed for 2 words: **seducing and surprising**
- After entering kinematic variables and other spatial factors into the model, power in angular frequency remains significant predictor only for surprising
- Trajectory shape plays a significant role in accurate interpretation of some words and in one example explains variance beyond kinematic variables
- Future studies employing Heider-Simmel style animations should consider trajectory shape as an additional factor that discriminates performance

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