

Jin Ke, Yuan Chang Leong

Department of Psychology, The University of Chicago

BACKGROUND

- Narrative engagement is the experience of being deeply immersed in a story and connecting to its plots and characters.
- Previous work suggests that people are more engaged during emotional moments of a narrative.
- However, it remains unclear under **which specific emotions** are people more engaged.
- A more fine-grained analysis of the relationship between affective experience and narrative engagement will shed light on how stories capture attention
- **Research question:** to quantify the association between subject affective experience of 16 types of emotions and narrative engagement during naturalistic viewing.

DATASETS

The *Friday Night Lights* dataset (FNL)

- A 45-min audio visual stimuli from the first episode of a character-driven television drama *Friday Night Lights*
- Behavioral data (n=188): the episode was paused at random intervals of 200 to 280s, participants rated the intensity of 16 emotions.
- fMRI data (n=35): structural and functional images collected when participants watching the FNL episode (TR = 2000ms).

The *Sherlock* dataset

- A 50-min audio visual stimuli from the first episode of the BBC television series *Sherlock*
- Behavioral data (n=17): Participants rated continuously how engaging they found the story by adjusting a scale bar from 1 to 9
- fMRI data (n=17): structural and functional images collected when participants watching the *Sherlock* episode (TR = 1500ms).

RESULTS

Neural synchrony across participants tracks narrative engagement

- Correlations were calculated between predicted engagement with the dynamic ISC which was averaged across participant pairs for each of the 122 ROIs.
- Brain regions showing significant correlations included dorsal attention network, ventral attention network, and default mode network (Figure 1), suggesting that these regions are synchronized when people are engaged.

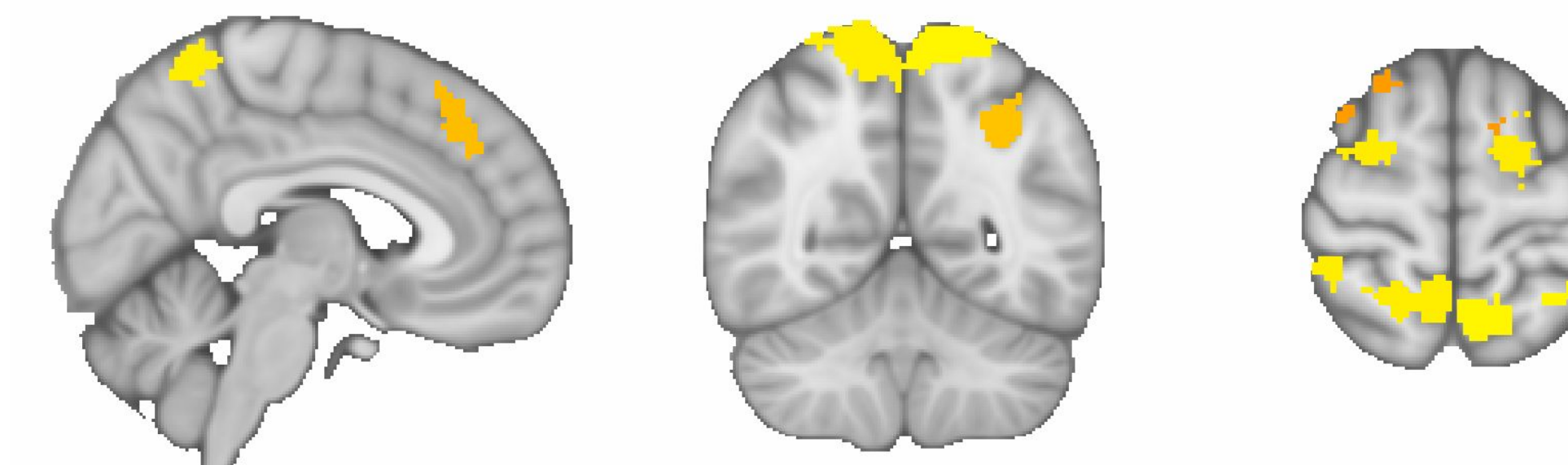


Fig. 1. Dynamic ISC scales with changes in engagement. Regions that show significant correlation between dynamic ISC and group-average engagement ($p < .05$)

Affective Ratings Predict Engagement

- High arousal emotions (e.g., anger and disgust) are positive predictors of engagement, while low arousal emotions (e.g., satisfaction and relief) are negative predictors. (Fig. 2)
- These results suggest that people are more engaged when experiencing high arousal negative emotions.



Fig. 2. Ridge Regression Modeling. (A) The relationship between engagement and 16 emotions. (B) Coefficient for 16 emotions in predicting engagement.

Exploratory Independent Component Analysis

- An independent component analysis (ICA) was conducted to separate dependent components in the 16-emotion ratings.
- A linear regression analysis was conducted to predict engagement from IC1 and IC2. The overall model was significant ($F(1,1332) = 280.71$, $p < .001$, $R^2 = .375$), with IC1 negatively predicting engagement ($\beta = -.303$, $p = .042$) and IC2 positively predicting engagement ($\beta = 3.481$, $p < .001$).
- IC1 corresponded to valence, but IC2 did not neatly correspond to arousal.

METHODS

Support vector regression (SVR) model

- A SVR model was trained in the *Sherlock* dataset, to predict engagement from dynamic functional connectivity (FC), and applied in the *FNL* dataset to compute its moment-to-moment engagement.
- Applied leave-one-subject-out (LOO) cross-validation, predictive accuracy (Pearson's r , MSE, R^2) were significantly higher than null models permutation, $p < .001$).

Dynamic Intersubject Correlation (ISC)

- A method of isolating shared, stimuli-driven brain activity which assumes participants perceive the same stimuli at the same time.
- Dynamic ISC calculated in the *Sherlock* dataset (sliding window = 30 TRs) for all participants pairs for each of the 122 ROIs across the time course.

Ridge regression model

- A ridge regression model was trained to use 16-emotion ratings to predict engagement.
- Predictive accuracy was 62%.

CONCLUSIONS

- In this study, we trained a support vector regression (SVR) model in the *Sherlock* dataset and applied it to the *Friday Night Lights* (FNL) dataset to predict engagement from dynamic functional connectivity.
- Correlation between dynamic Intersubject Correlation (ISC) and predicted engagement revealed that dorsal attention network, ventral attention network, and default mode network are synchronized when people are engaged.
- A ridge regression model was built to predict engagement from affective experience of 16 emotions. The results suggest that people are more engaged when they are subjectively experiencing high arousal negative emotions.