A Connectome-based Predictive Model of Affective Experience during Naturalistic Viewing

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Background

Our thoughts and actions are guided by our ongoing affective experience.

How can we continuously measure people's affective experience during naturalistic viewing?

How are fluctuations of affective experience captured in the brain?

Two goals of the current study:

1. To compute a continuous, non-intrusive measure of affective experience derived from time-varying functional connectivity

2. To characterize the interaction between brain regions that contribute to ongoing affective experience

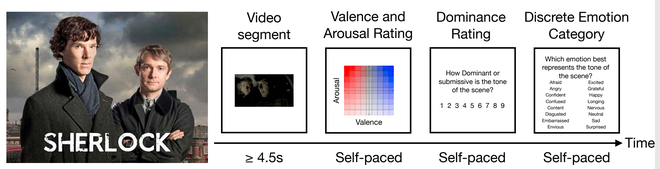
Dataset

fMRI data: openly available fMRI data from the *Sherlock* dataset[1]

Participants (n = 17) watched 50-minute BBC's Sherlock (episode 1) insider a scanner

Behavioral data: behavioral ratings acquired from [2]

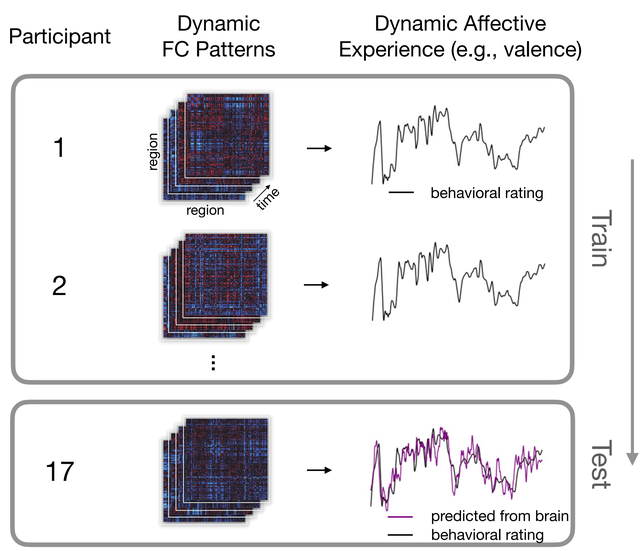
Participants (n = 125) watched the same 50-minute Sherlock episode. The video was paused every ~4.5s when participant rate valence, arousal, and dominance of the preceding segment.



Preprocessing: 1) interpolated to 1 rating each TR, 2) convolved with hemodynamic response function (HRF), 3) applied a sliding window size of 30 TRs

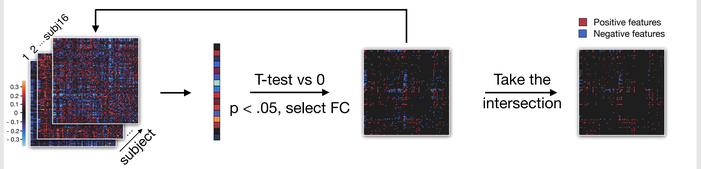
Computational Modeling

Leave-one-out Cross Validation



adapted from Song et al. 2021[3]

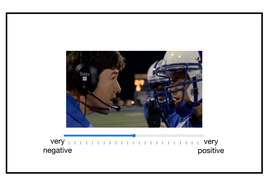
FC Feature Selection (in training set only)



Only selected FCs in the training set are used to train the support vector regression (SVR) model to predict affective experience from brain

Ongoing Data Collection

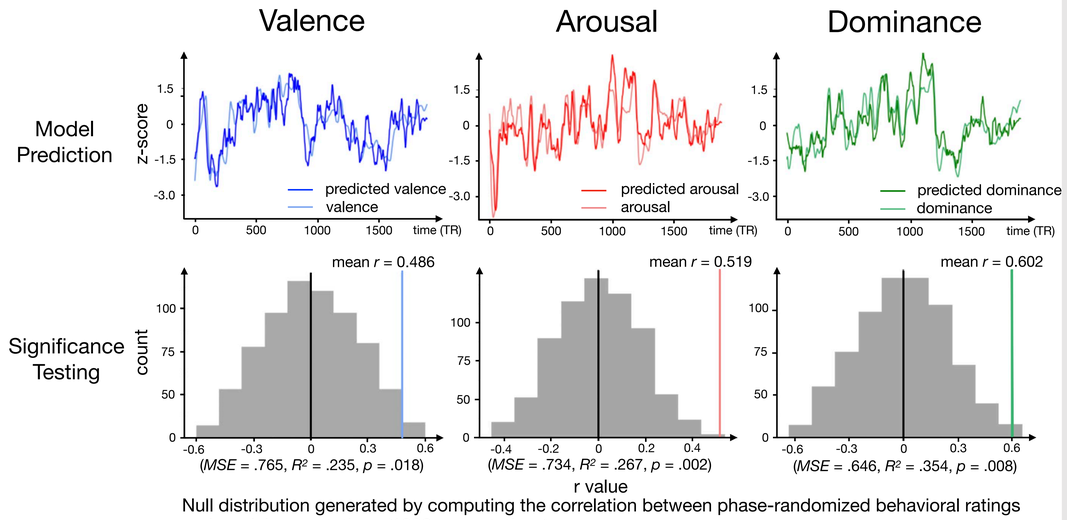
Continuous Rating Task (Valence/Arousal)



Participants (expected n = 80) watch the same *Sherlock* episode, and the first episode (45 minutes) of the series drama *Friday Night Lights*[4].

Each participant rates either valence or arousal on a continuous scale.

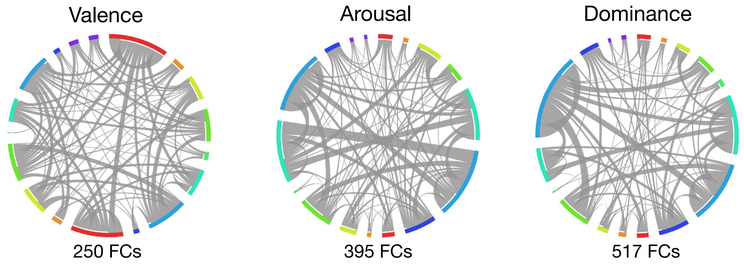
Model Predictions Track Self-Reported Affective Experience



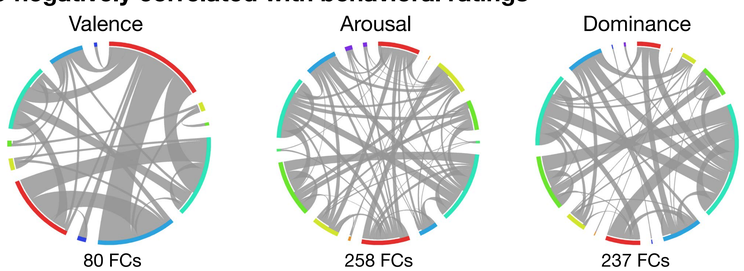
Null distribution generated by computing the correlation between phase-randomized behavioral ratings and model permutations (1000 permutations).

Functional Connectivity Networks for Affective Experience

FC positively correlated with behavioral ratings



FC negatively correlated with behavioral ratings



1) Affective states are encoded by more than the subcortical and limbic networks, which are commonly associated with emotional experience[4].
2) The default and control networks are also substantially involved via connection with other networks.

Conclusions

We trained connectome-based predictive models to predict subjective ratings of affective experience from fMRI data of people watching a TV episode. All three models achieved reasonable accuracy (valence: r = .486, p = .018; arousal: r = .519, p = .002; dominance: r = .602, p = .008).

Functional connections within and between large-scale functional brain networks reliably contributed to model prediction, suggesting that affective states are encoded in the interactions between brain regions.

References

[1] Chen et al. (2017). *Nature Neuroscience*
[2] Kim et al. (2020). *Neuropsychologia*
[3] Song et al. (2021). *PNAS*
https://github.com/hyssong/NarrativeEngagement
[4] Chang et al. (2021). *Science Advances*
[5] Kober et al. (2008). *Neuroimage*