Individual Differences in Emotion Regulation Strategies and Neural Discrimination Patterns Among Basic Emotions

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Background

- Emotion regulation (ER) strategies are associated with basic emotion cognition and emotion discrimination skills[1,2].
- Lower perceptual and linguistic emotion discrimination has been associated with increased symptoms in adolescence[3,4].
- Eye-tracking study[5] have shown that different ER strategies are associated with differences in visual-attentional preference of emotions, however little is known about how ER strategies relate to the neural emotion discrimination.
- **The current study aim to investigate how positive reconstruction and repression relate to neural emotion discrimination patterns**

Measures

All data were from the Healthy Brain Network Biobank[6]:
Prelim: N=361; age= 11.5 ± 2.25 years; 61.2% male

Emotion Regulation Strategies

Children's Coping Strategies Checklist (CCSC)[7]

- CCSC is a 54 item self-report inventory in which children describe their coping efforts in 11 dimensions
- The current study focused on **positive cognitive reconstruction (PCR)** and **repression (REP)**

Example questions:

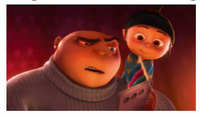
When you have problems or upset feelings...

"You told yourself things would get better." [PCR]

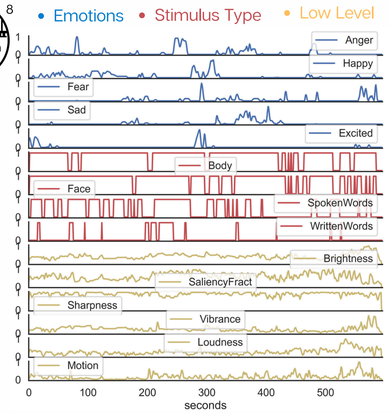
"You tried to ignore it." [REP]

Quantifying Neural Emotion Discrimination

1.fMRI during movie watching ~10mins



2.Video features

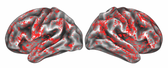


3. Estimating Activation of Emotion Discrimination

1. Elastic Net Regression with 5-fold cross validation at the subject level (video features predicting BOLD)
2. Weights from the model denote selective coding for that video feature at the subject level
3. Neural discrimination between emotion pairs (e.g., 'Anger_Happy', 'Sad_Excited') is quantified by calculating absolute differences in cortical selectivity patterns, covarying age, sex, and motion.

Main Analysis

Emotion Reguation and Neural Emotions Discrimination



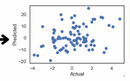
Cortical selectivity differences map between emotion pairs

Step 1: Support Vector Regression

Computing mean SVR weights with 5-fold cross-validation

Training: 75% of sample | Testing: 25% of sample

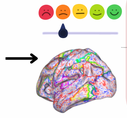
Motion, Sex, Age regressed out



Step 2: Test Model Fit

If rho>0.1, p<0.051.

Test the final model with held-out 25%



Step 3: Model Interpretation

a. Whole brain vertex-wise correlation

Calculating vertex-wise correlations between brain activation and ER strategy scores

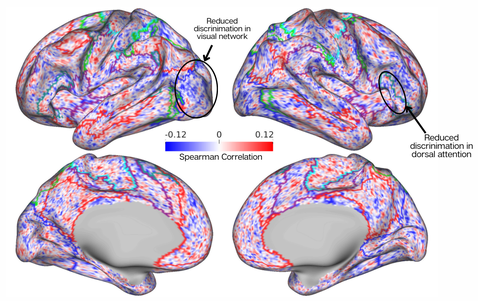
b. Permutation-based important test

Use Powers network atlas to identify significant network contributions. [n.perm=1000]

Emotion Repression predicts differences in neural discrimination between negative emotions-excitement in default mode, attention, visual networks

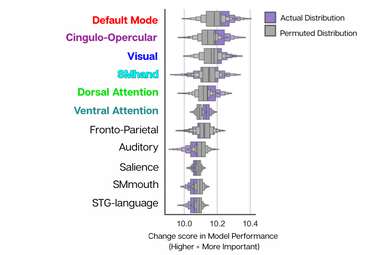
Anger-Excited

SVR Model Performance: rho=0.26, p=0.012



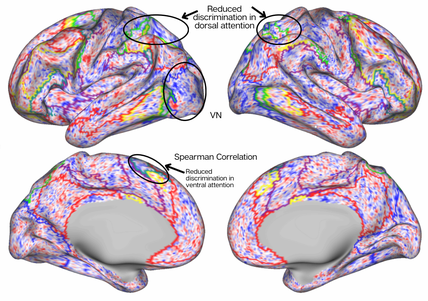
Repression ↓ Neural discrimination between anger and excited in VN, DAN, VAN, CON

Network Contribution to Emotion Discrimination (Permutation Score)



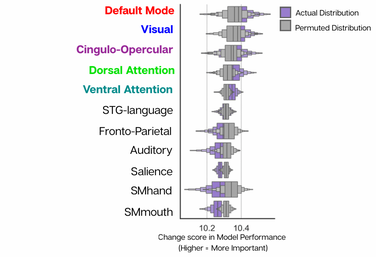
Fear-Excited

SVR Model Performance: rho=0.36, p<0.001



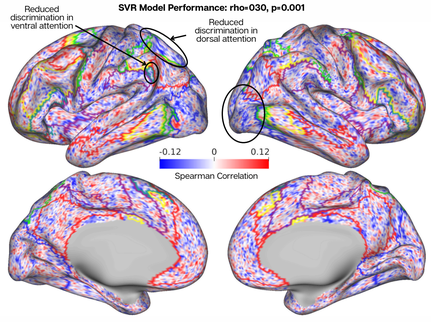
Repression ↓ Neural discrimination between fear and excited in VN, DAN, VAN

Network Contribution to Emotion Discrimination (Permutation Score)



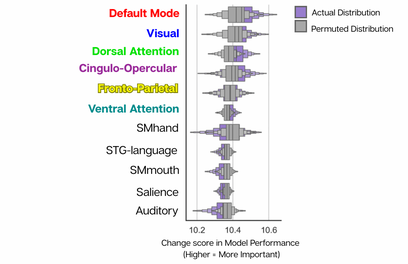
Sad-Excited

SVR Model Performance: rho=030, p=0.001



Repression ↓ Neural discrimination between sad and excited in VN, DAN, VAN

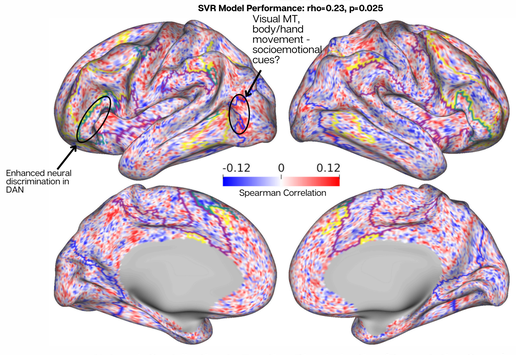
Network Contribution to Emotion Discrimination (Permutation Score)



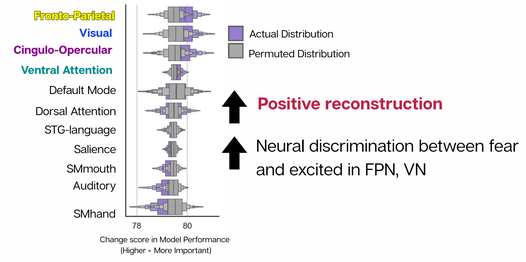
Positive cognitive reconstruction predicts enhanced neural discrimination between negative emotions-excitement in FPN and VN

Fear-Excited

SVR Model Performance: rho=0.23, p=0.025



Network Contribution to Emotion Discrimination (Permutation Score)

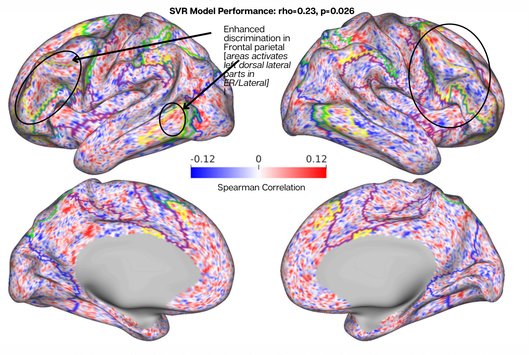


Positive reconstruction

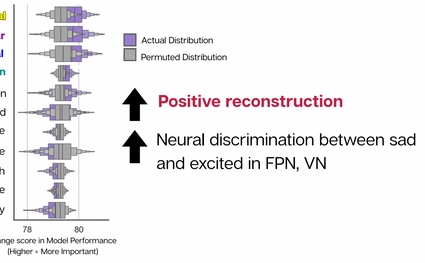
Neural discrimination between fear and excited in FPN, VN

Sad-Excited

SVR Model Performance: rho=0.23, p=0.026



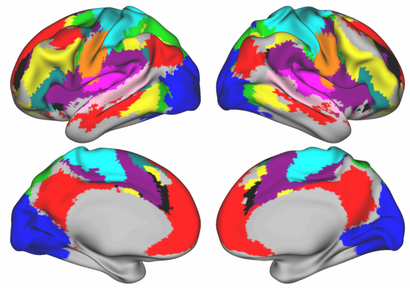
Network Contribution to Emotion Discrimination (Permutation Score)



Positive reconstruction

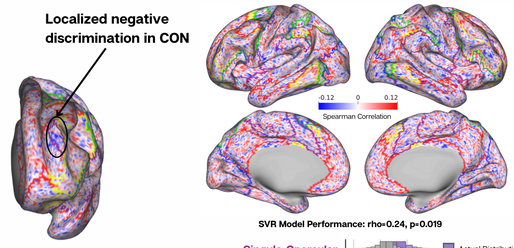
Neural discrimination between sad and excited in FPN, VN

Power et. al Network Labels

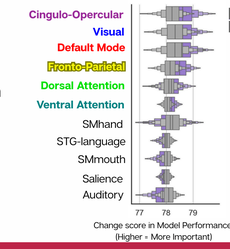


Auditory	Frontal-parietal	Salience
Cingulo-opercular	somatomotor-hand	Ventral Attention
Default mode	STG-Language	Visual
Dorsal Attention	somatomotor-mouth	

Positive Cognitive Reconstruction and reduced discrimination between Happy and Excited in CON



SVR Model Performance: rho=0.24, p=0.019



Positive reconstruction

Neural discrimination between happy and excited in CON

Discussion

1. Reduced neural discrimination in visual and attentional networks, associated with emotion repression, suggests a tendency to avoid attending to emotional stimuli. This results in less differentiated perceptual and attentional processing and less distinct neural signals, even for conceptually different emotions.
2. Positive coping may support clearer, more distinct representations of emotional states, which facilitating more unique emotion regulation pattern tailored for conceptually different emotions—reflected in enhanced FPN discrimination

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Acknowledgements

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