# Intrinsic functional connectivity in emotion regulation network is altered in emotional laborers

Seokyoung Min[1], Suhnyoung Jun[1], Jeesung Ahn[2], Jonghyun Lee[2], Soohyun Park[1], Seung-Koo Lee[3], Sanghoon Han[1,2]

[1]Department of Psychology; [2]Graduate Program in Cognitive Science, Yonsei University, Seoul, Korea; [3]Department of Radiology, Yonsei University College of Medicine, Seoul, Korea

## BACKGROUND

### Emotional Labor
- Emotional labor is considered as a kind of emotion regulation process, which includes managing one's emotion and emotional expressions to fulfill other people's expectations.
- Although several studies have described the psychological characteristics of emotional laborers, little is known about the neurobiological consequences of emotional labor.

### Resting-State Functional Connectivity & Multivariate Pattern Analysis
- Several studies have examined the occupational effects on the structures of resting-state functional connectivity, in terms of expertise, work-related stress and burnout.
- More recently, researchers have begun to apply multivariate pattern analysis (MVPA) to resting-state fMRI data to detect any information in the whole-brain connectivity pattern.

### RESEARCH QUESTION

Can we classify emotional labors (EL) and controls (CTRL) with resting-state functional connectivity patterns?

If possible, which regions or networks are the most critical to classify these two groups?

## METHODS



Preprocessing | Node Selection | BOLD Time-series | Connectivity Matrix | Classification
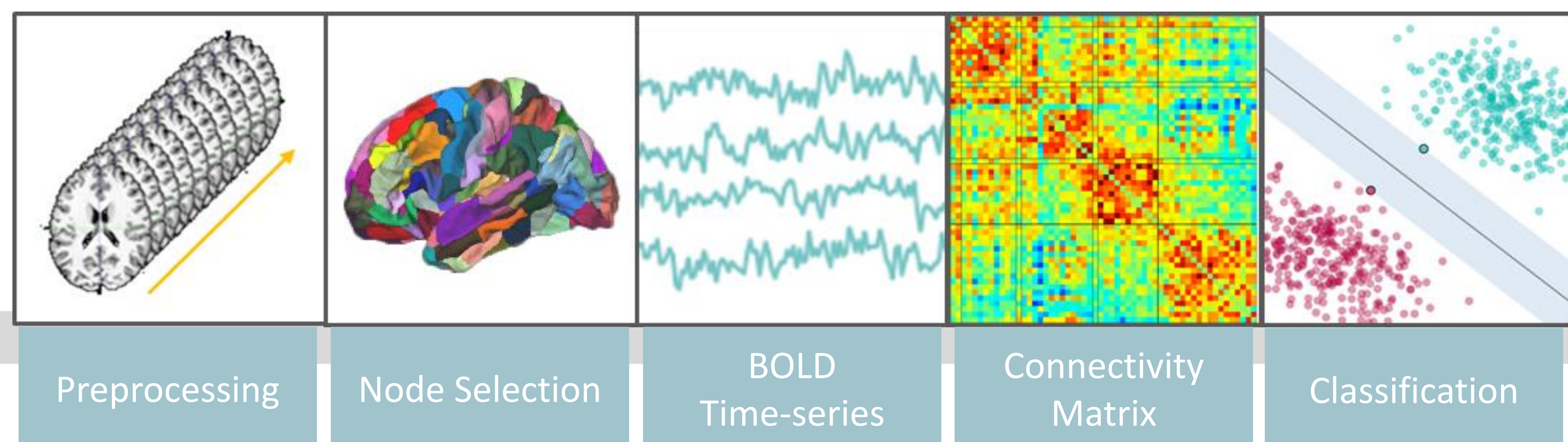
### fcMVPA (functional connectivity-based MVPA)
- **Node Selection:** Brainnetome Atlas; 246 nodes including both cortical & subcortical regions
- **Classification:** support vector machine (SVM) & leave-one-out cross-validation (LOOCV)
- **Motion Control:** ICA-AROMA; ICA-based automated tool for removing motion artifact
- **Age Control:** Before performing the actual pattern classification analysis, we first computed the Pearson correlation between every edge and age and then excluded any edge that was significantly correlated with age $(p < 0.05)$.
- **Permutation Testing:** we calculated the null distributions by performing 1000 iterations of non-parametric permutation testing.

CONTACT: Seokyoung Min (seokyoungmind@gmail.com)

## RESULTS 1: Pattern Classification

### Classification Accuracy
- For pattern classification, we found that two groups (EL vs. CTRL) could be successfully classified based on their resting-state functional connectivity patterns.
- The peak classification accuracy reached 91.7% when the top 326 edges were included $(p = 0.002$; permutation test).
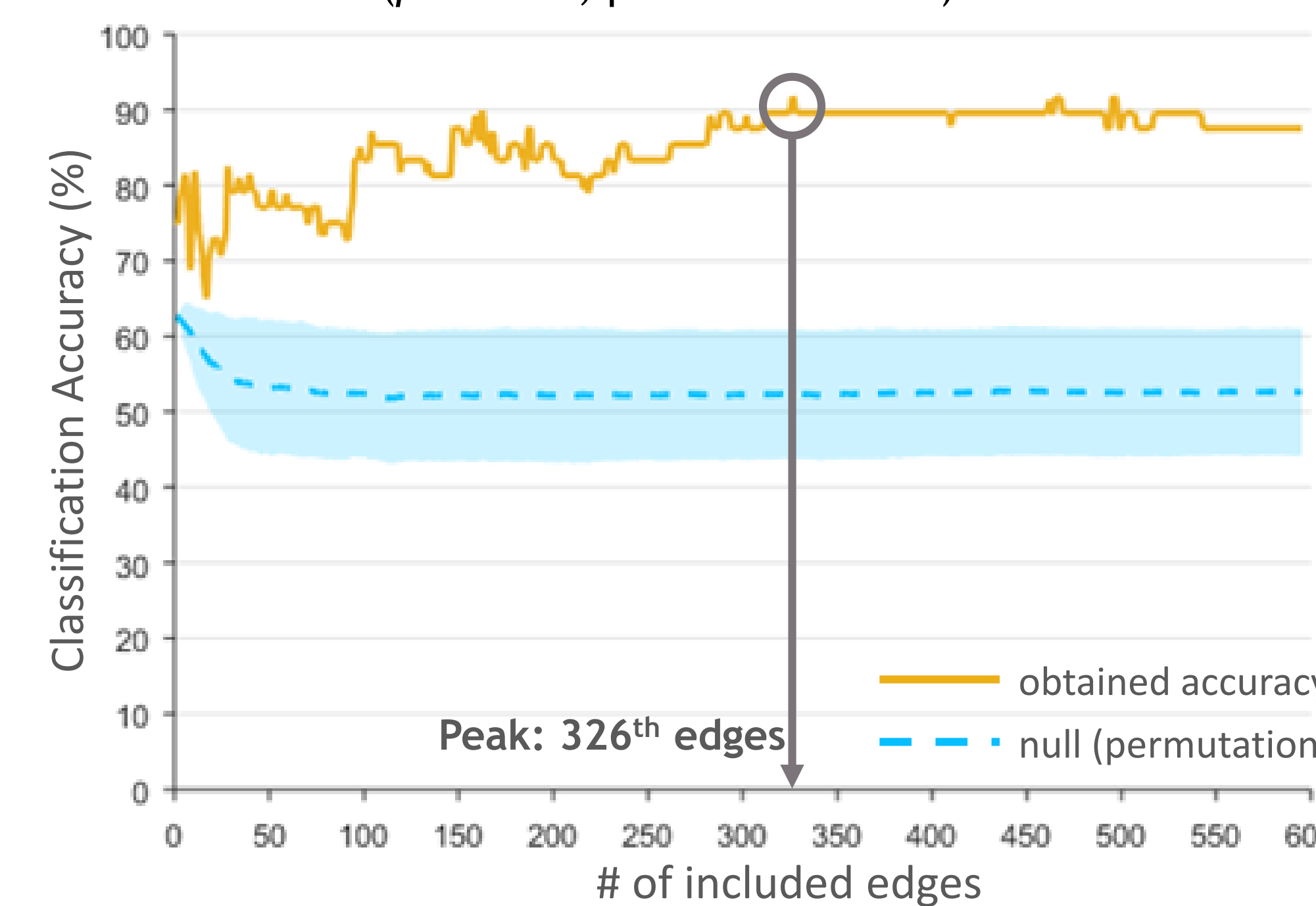


### Potential Confounds
- **Head motion:** When we compared each six head motion parameters separately, any of these parameters was not significantly different between two groups (Tx, $t(46) = 0.06$, $p = 0.96$; Ty, $t(46) = 1.10$, $p = 0.28$; Tz, $t(46) = 0.50$, $p = 0.62$; Rx, $t(46) = 1.70$, $p = 0.10$; Ry, $t(46) = 0.03$, $p = 0.98$; Rz, $t(46) = 0.02$, $p = 0.99$).
- **Gender:** When we tested whether our final classification model with the peak accuracy could predict gender regardless of the original group label, the accuracy of gender classification was 64.58%, which did not significantly exceed chance $(p = 0.22$; permutation test).

### Classifier Evidences & Behavioral Measures
- To further investigate the nature of our classification results, we computed the distance from hyperplane for each participant.
- The distance from hyperplane showed a significant correlation with depression score $(r = 0.41$, $p = 0.004)$ and social anxiety score $(r = 0.35$, $p = 0.016)$.
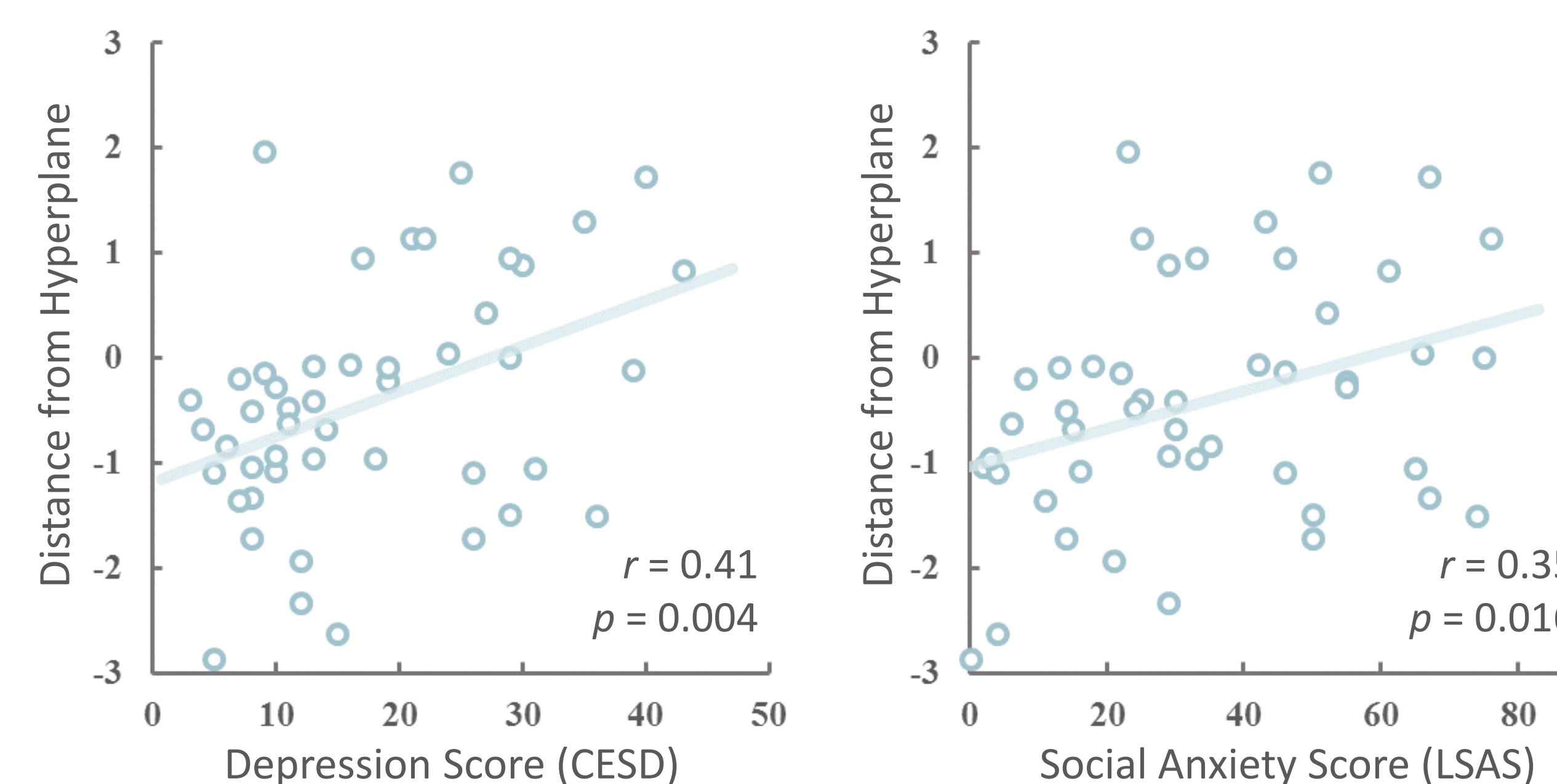


## RESULTS 2: Network Characteristics

### Edge & Node Characteristics
- To summarize the distributed edges used for our classification model, we calculated degree centrality, which drawn from the graph theory.
- Degree centrality is defined as the number of edges connected to that node.
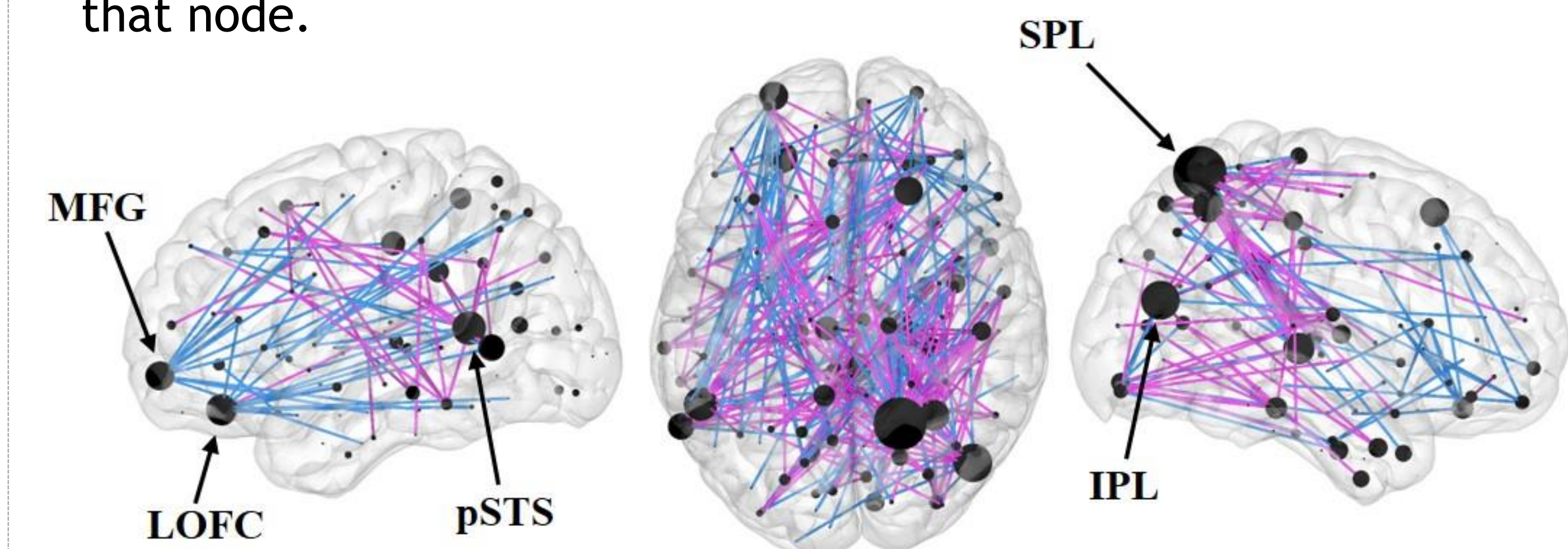


### Network Characteristics
- To further explore the distributed edges in terms of large-scale brain networks, we calculated the fraction of edges for each network pair.
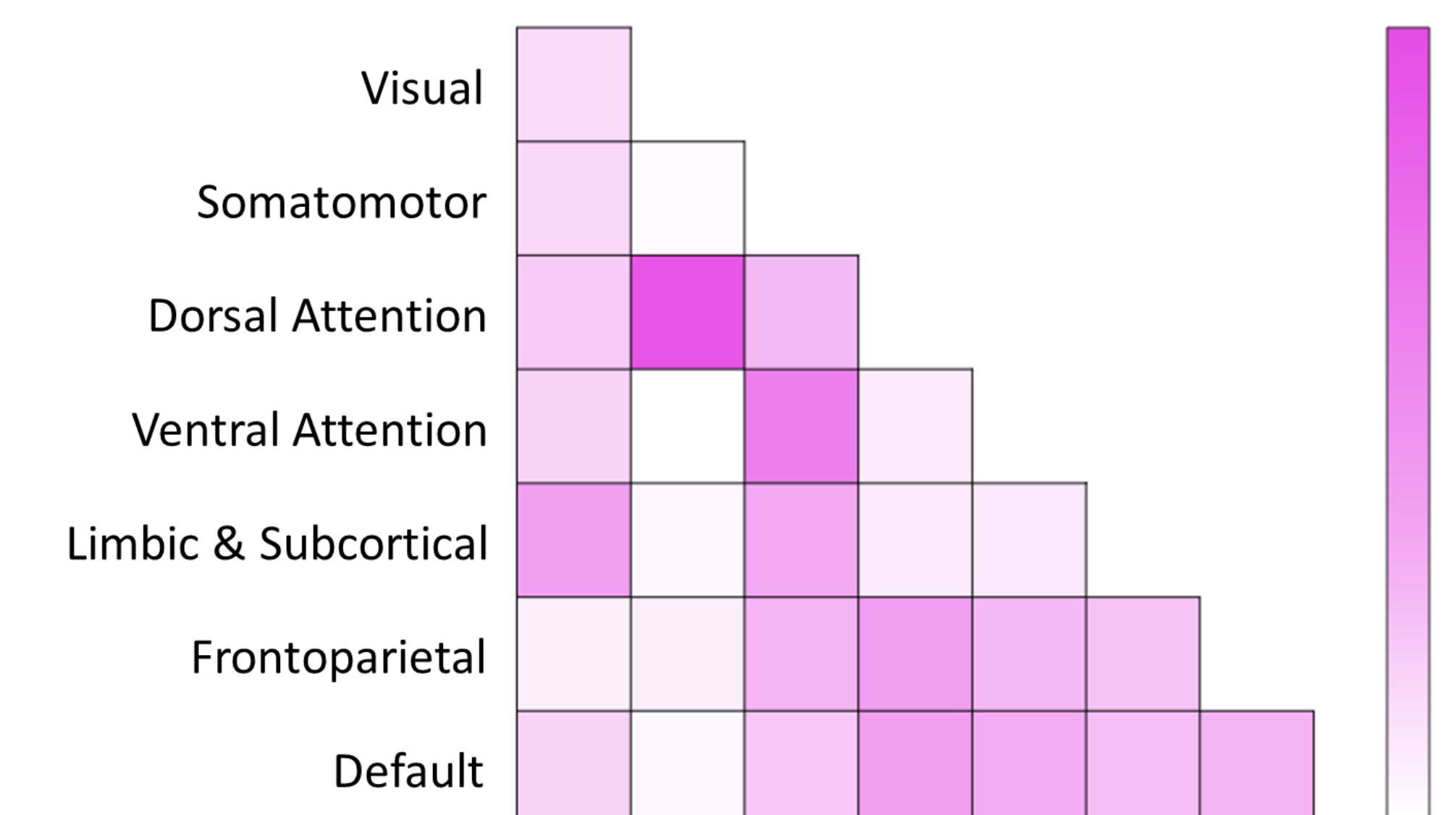


## CONCLUSIONS

- Classification between EL and CTRL based on resting-state functional connectivity was successful.
- Functional connectivity-based MVPA is an especially useful technique to explore the occupational effects on the brain.

### Reference
- Dosenbach, N. U., Nardos, B., Cohen, A. L., Fair, D. A., Power, J. D., Church, J. A., ... & Barnes, K. A. (2010). Prediction of individual brain maturity using fMRI. Science, 329(5997), 1358-1361.
- Fan, L., Li, H., Zhuo, J., Zhang, Y., Wang, J., Chen, L., ... & Fox, P. T. (2016). The human brainnetome atlas: a new brain atlas based on connectional architecture. Cerebral cortex, 26(8), 3508-3526.
- Finn, E. S., Shen, X., Scheinost, D., Rosenberg, M. D., Huang, J., Chun, M. M., ... & Constable, R. T. (2015). Functional connectome fingerprinting: identifying individuals using patterns of brain connectivity. Nature neuroscience, 18(11), 1664.