Altered Emotional Attention and Brain Functional Connectivity Networks of Emotional Laborers

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

[1] Graduate Program in Cognitive Science, [2] Department of Psychology, Yonsei University, Seoul, South Korea
[3] Integrated Neurocognitive Functional Imaging Center (INFIC) , Yonsei University Severance Hospital, Seoul, South Korea

RESEARCH BACKGROUND

- For cordial communication with clients under any circumstances, emotional laborers are demanded to regulate and suppress their emotion at everyday workplaces.
- It has been proposed that a high level of emotional demands in work induces chronic stress and instigates various physical and psychological health problems such as musculoskeletal disorders, depressive symptom, burnout, and self-alienation (Kim & Choo, 2017; Tuten & Neidermeyer, 2004).
- Although an increasing number of workers suffer from negative effects of emotional labor, only a few studies have investigated how emotional labor can affect behavioral and neural processing of emotional stimuli, such as threatening faces.
- The present study aims to identify differential behavioral and neural mechanisms in emotional attention processing of emotional labor and control groups.

EXPERIMENTAL DESIGN : Emotional Attention Task

| 0.5s (A) | 0.5s (B) | 1s (C) |
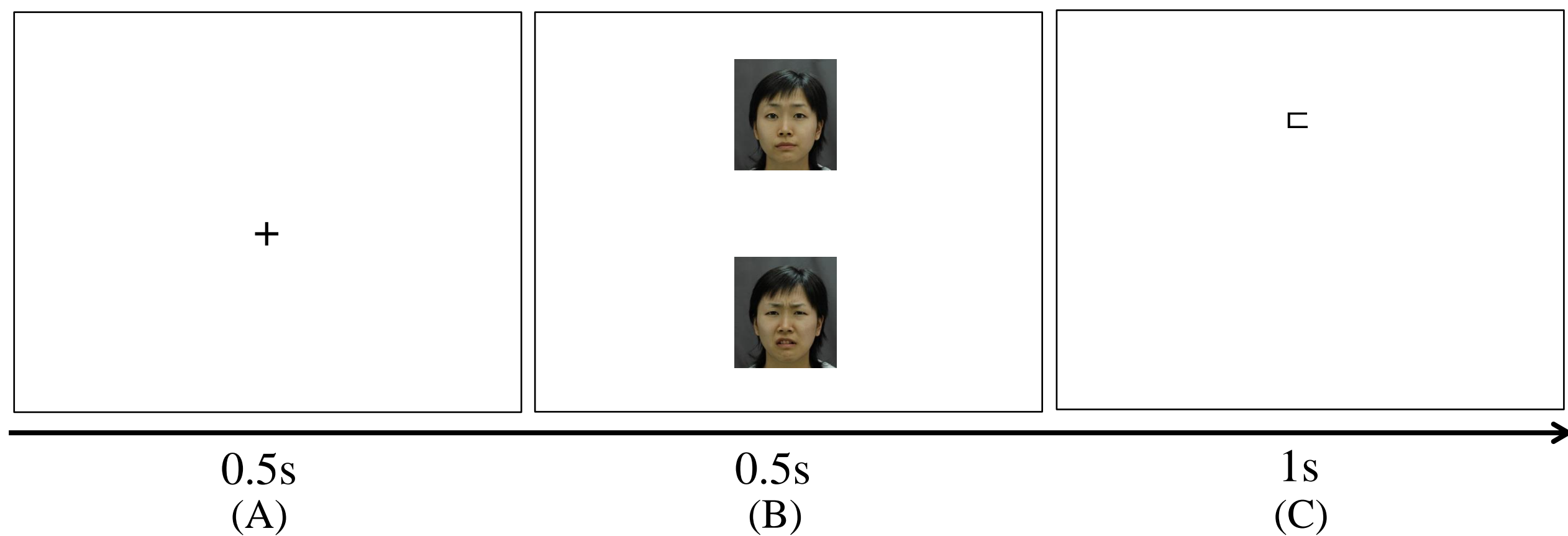
(A) A black central fixation cross was initially presented for 500ms
(B) A threat-neutral face pair (emotional incongruence condition) or neutral-neutral face pair (emotional congruence condition) was presented for 500 sec.
(C) The probes were either a Korean alphabet 'ㄷ' or 'ㅌ' corresponding to English letter 'D' or 'T'. The probe always appeared in the location occupied by the neutral stimulus, and never the location occupied by threat.

- Emotional Labor group (EL) : 18 participants (3 males), mean age =38.2
- Healthy Control group (HC) : 24 participants (15 males), mean age= 25
- Total 200 trials, delivered inside the MRI scanner.
- Participants were instructed to discriminate which probe was presented by pressing a left or right fMRI-compatible button pad as fast as they could.

## BEHAVIORAL RESULTS: Reaction Time
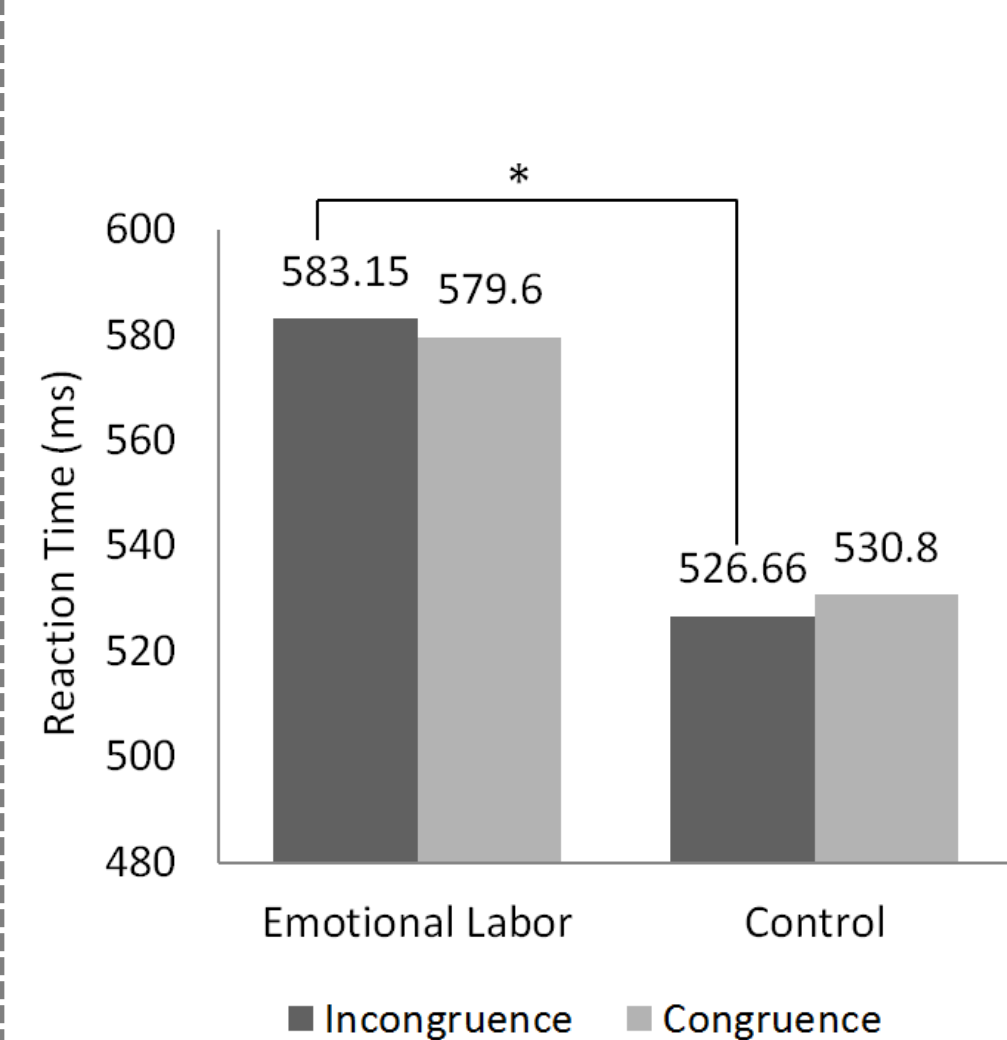
- 2 (group) ×2 (condition) ANOVA yielded a main effect of GROUP on reaction time, $F (1, 78) = 9.31, p < 0.005$
- Average reaction time: emotional laborers were significantly slower than healthy controls ($p < 0.05$; EL, M =581.37ms, SD=56.99; HC, M =528.73ms, SD=86.91)
- Delay of reaction time in emotional laborers: significant only in incongruence condition ($p < 0.05$; EL, M= 583.15, SD=53.28; HC, M= 526.66, SD=87.35)
- The results might indicate that emotional laborers took longer to disengage from negative stimuli to find probes presented behind neutral stimuli.

fMRI ANALYSIS 1. Whole-Brain General Linear Model (GLM)

Emotional Laborers vs. Healthy Controls

Gathered contrast volumes of each participant *(Incongruence > Congruence)* were used to compare two groups using independent two-sample t-tests ($p < 005 /25$)
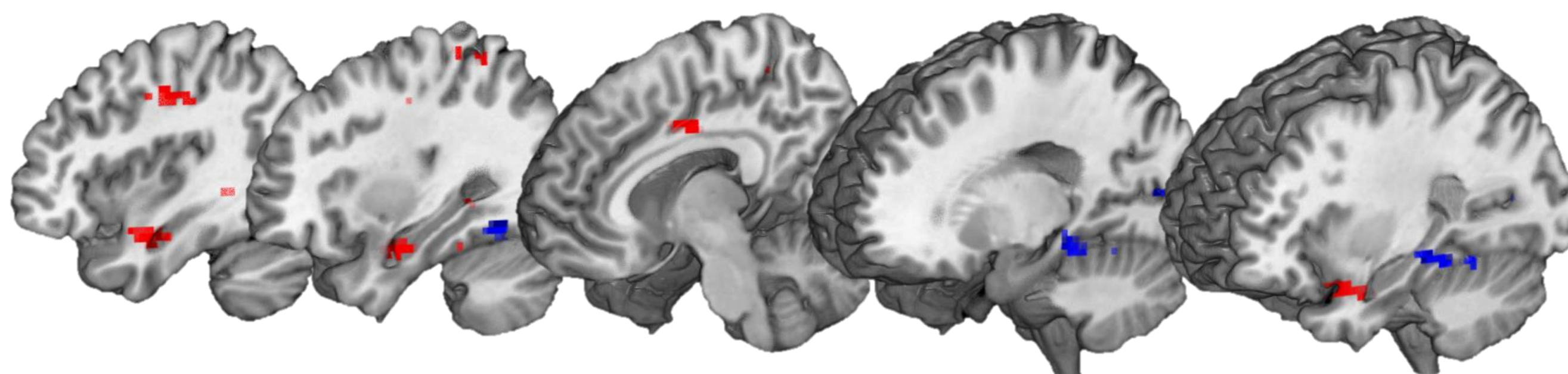

Emotional Laborers > Healthy Controls

More Activated in EL,
left parahippocampal gyrus,
left middle temporal gyrus, left middle occipital gyrus, and bilateral fusiform gyrus

Healthy Controls > Emotional Laborers

Less Activated in EL
bilateral amygdala, hippocampus, left insula, right superior parietal lobule, right postcentral gyrus, and right supramarginal gyrus
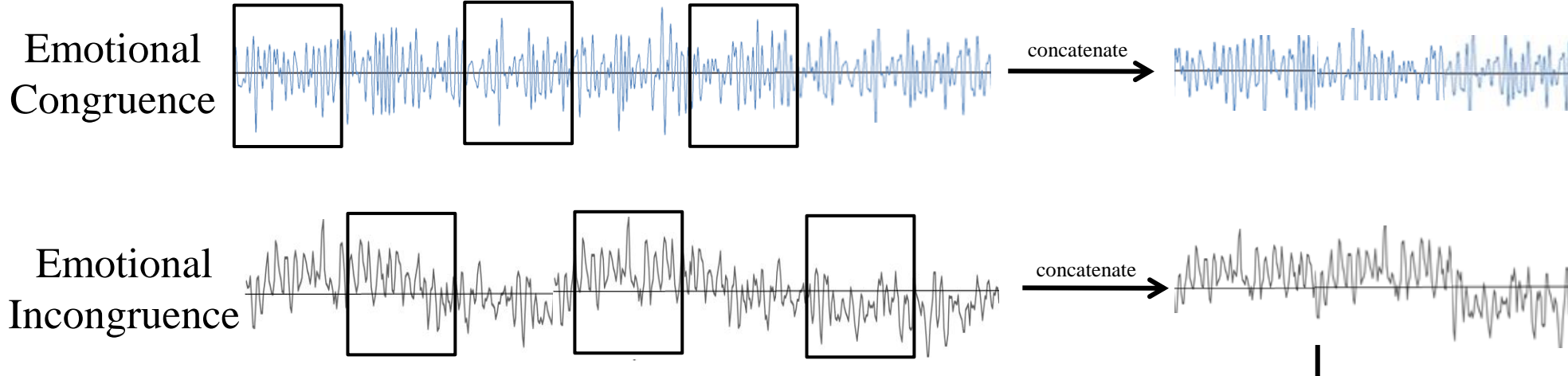
## fMRI ANALYSIS 2. Connectivity Pattern Analysis (fcMVPA)

1. Node Selection
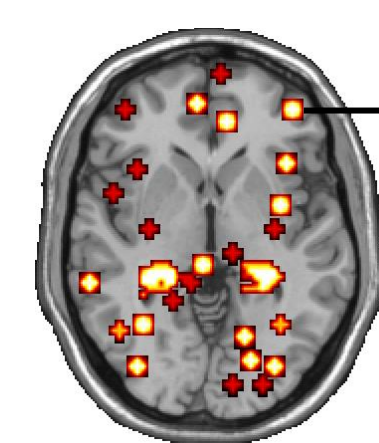
- **166 Regions of Interest (ROI)**
Dosenbach 160 (*Dosenbach et al., 2010*),
Bilateral Amygdala, Hippocampus,
Parahippocampal Gyrus (*AAL, Tzourio-Mazoyer et al., 2002*)

2. Time-Series Extraction

VOXEL-WISE

Emotional Congruence

Emotional Incongruence

Principal Component Analysis

3. Functional Connectivity Multivariate Pattern Analysis (fcMVPA)

$ROI_X \times ROI_Y$ Pearson correlation coefficient = MVPA Feature

Subj #1 EL
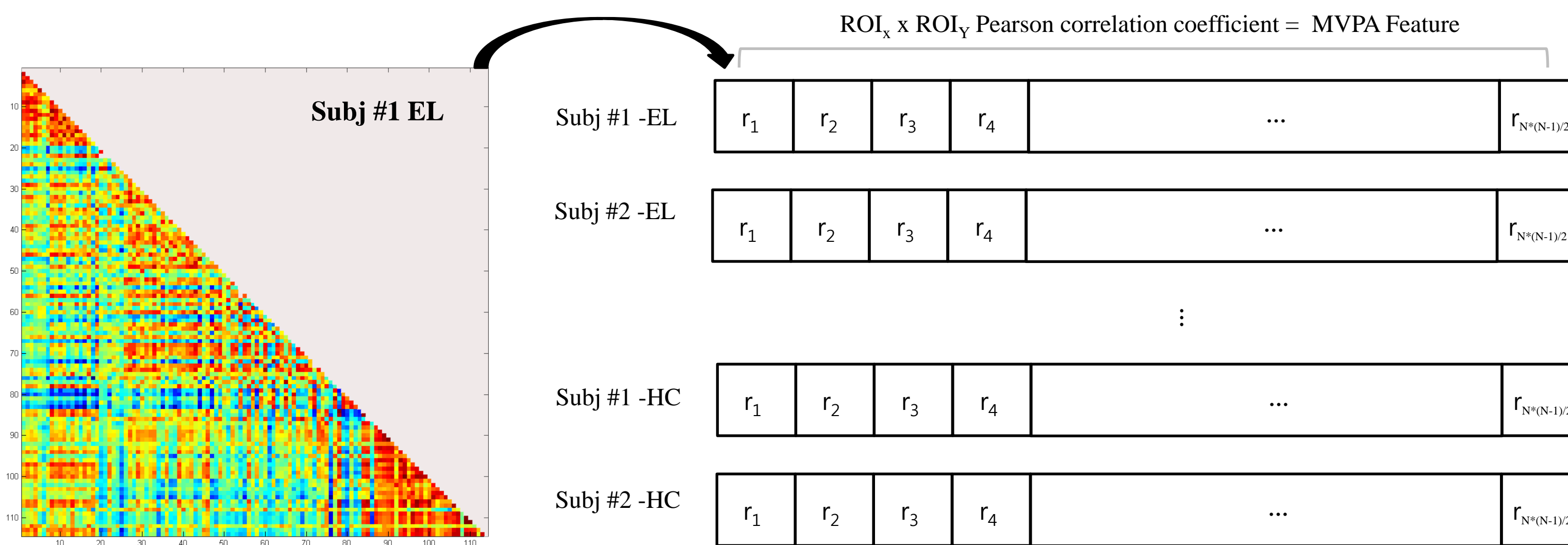
- **Feature (link) Selection**
Pair-wise cross-correlation coefficients between 166 ROIs were calculated

- Features were ranked based on absolute *t*-value from the independent two-sample t-test.
- Leave-one-out cross validation was applied in the feature ranking process.

- **Group Classification using Support Vector Machine algorithm (SVM)**
Each feature was added cumulatively by iteration.
Leave-one-out cross validation was applied.
Permutation tests were performed (n=1000).

Emotional Laborers vs. Healthy Controls
1. Emotional Congruence
2. Emotional Incongruence

fMRI ANALYSIS 2. fcMVPA Results

90.5%, 64 features

88.1%, 1033 features
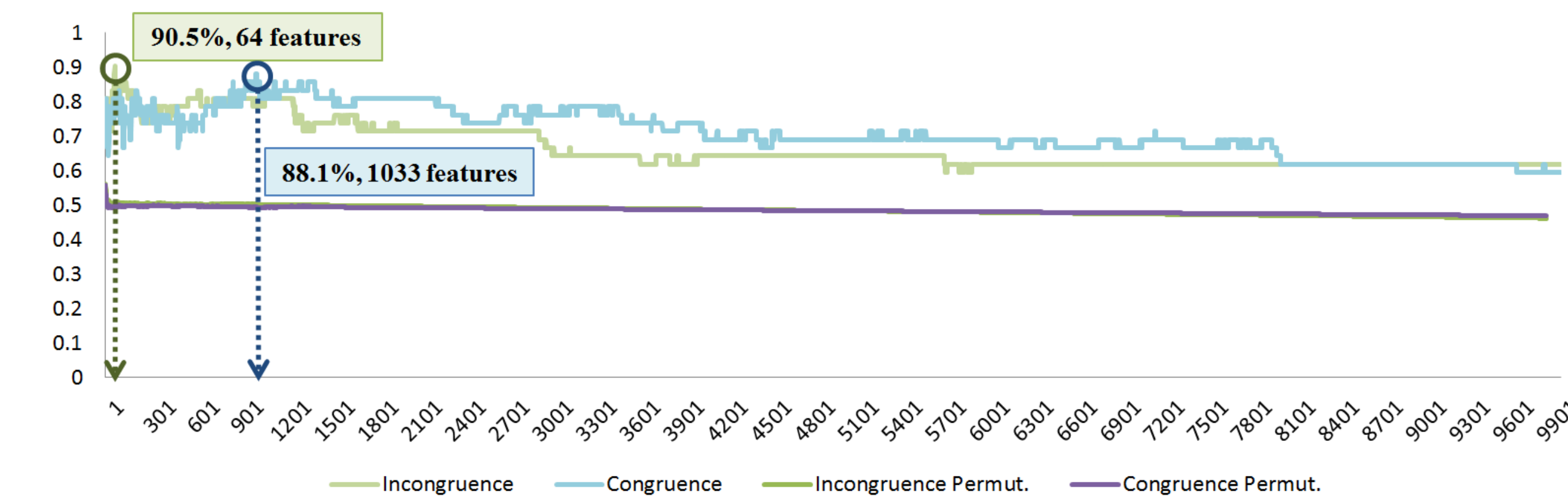
- **X axis :** Range of features included for SVM classification, **Y axis :** Mean classification accuracy (%)
- **Classification Accuracy**: how successfully the combination of included features discriminated two groups.
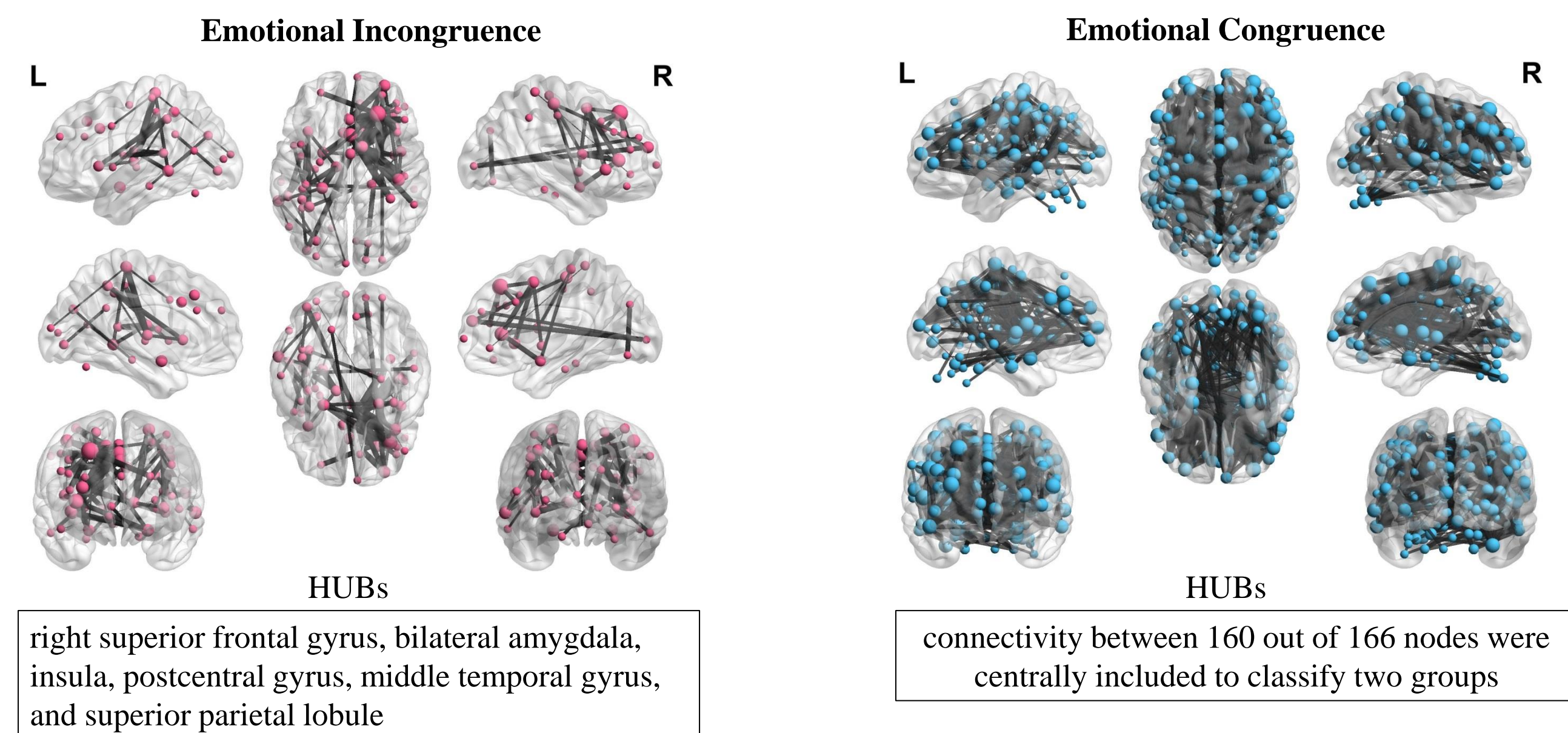
- **Peak Accuracies & Number of Features Included**
1. Emotional Incongruence: 90.5%, 64 features included,
2. Emotional Congruence: 88.1 %, 1033 features included
   Decreased Accuracy & Network Efficiency to distinguish two groups
- Permutation accuracies remained at chance level (50%).

Degree Centrality
Degree centrality analysis using features that elicited peak accuracies

Emotional Incongruence

HUBs

right superior frontal gyrus, bilateral amygdala, insula, postcentral gyrus, middle temporal gyrus, and superior parietal lobule

Emotional Congruence

HUBs

connectivity between 160 out of 166 nodes were centrally included to classify two groups

Conclusion

1. These findings suggest that attentive ability to disengage from negative emotion is impeded in emotional laborers, which might be the results of persistent exposure to stress and emotive dissonance.
2. This behavioral impediment can be attributed to the altered recruitment of large-scale functional connectivity patterns centering the prefrontal cortex, amygdala, and insula especially when there is a need for processing negative emotional stimuli.
3. Although many features such as functional connectivity between the amygdala and prefrontal cortex, and the amygdala and insula, were commonly utilized in classifying two group, the pattern of features worked as a more efficient and informative classifier when negative and neutral stimuli were presented together.
4. Overall functional connectivity between ROI is significantly decreased in emotional laborers.

References
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Contact Jeesung Ahn jeesungjessahn@gmail.com