

# Individual differences in personality traits and meta-traits are associated with features of intrinsic brain networks

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## Introduction

- Despite recent progress targeting specific personality traits and the function of particular brain regions, it remains unclear what features of individual differences might be associated with large-scale intrinsic networks observed in resting state functional connectivity.
- While much of the personality neuroscience research has focused on the structural and functional correlates of the Big Five traits, higher-order personality dimensions, or meta-traits, have received little attention.
- Although nascent research has investigated the functional organization of intrinsic connectivity networks (ICNs) underlying personality, research has yet to examine whether between-network properties are linked to traits.
- We sought to build upon existing research by examining whether the Big Two (i.e., Stability and Plasticity) and Big Five personality traits are associated with the mean participation coefficient (MPC) of ICN pairs.

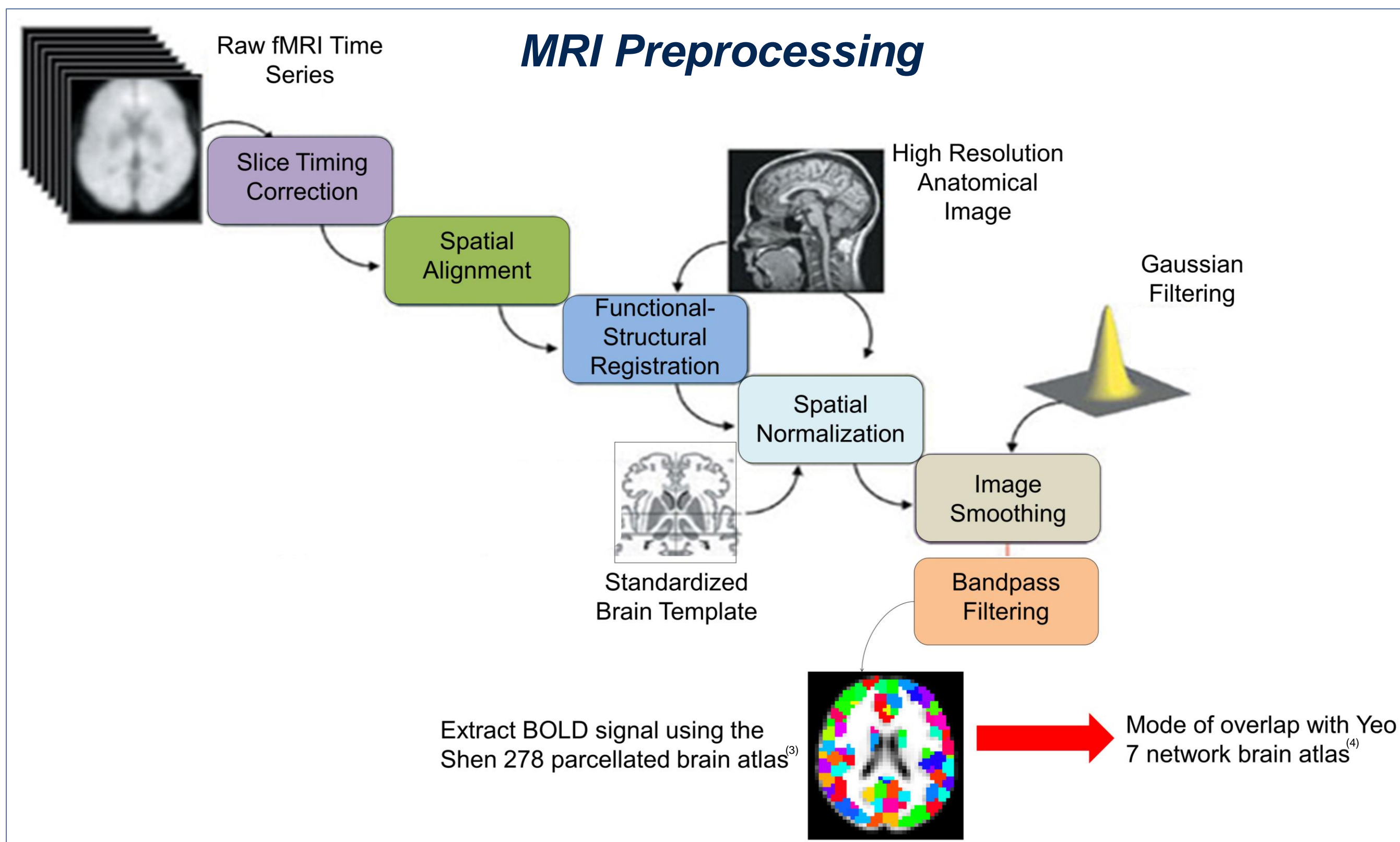
## Method

**Participants:** 289 healthy adults (18–43 years old, 148 females).

**Personality Measures:**

- 44-item Big Five Inventory<sup>(1)</sup>.
- Items were averaged for each personality domain (Extraversion, Agreeableness, Conscientiousness, Neuroticism, Openness).
- Two meta-traits (i.e., Plasticity and Stability) were obtained from the Big Five using confirmatory factor analysis<sup>(2)</sup>.

**MRI Acquisition:** A T1-weighted structural image was acquired for each participant (0.9 mm isotropic, TR = 1900 ms, TI = 900 ms, TE = 2.32 ms, with GRAPPA and an acceleration factor of 2). The fMRI data were acquired using EPI sequence images (1.9 x 1.9 x 2.0 mm<sup>3</sup> voxel size, 56 slices with 10% slice gap, TR = 2000 ms, TE = 30 ms, FOV = 240 mm, 90° flip angle, 10 min acquisition, or 300 volumes).



**Network Analysis:** The Big Two and Big Five were examined in relation to the MPC<sup>(5)</sup>; which measures how well distributed the links of a node are among modules.

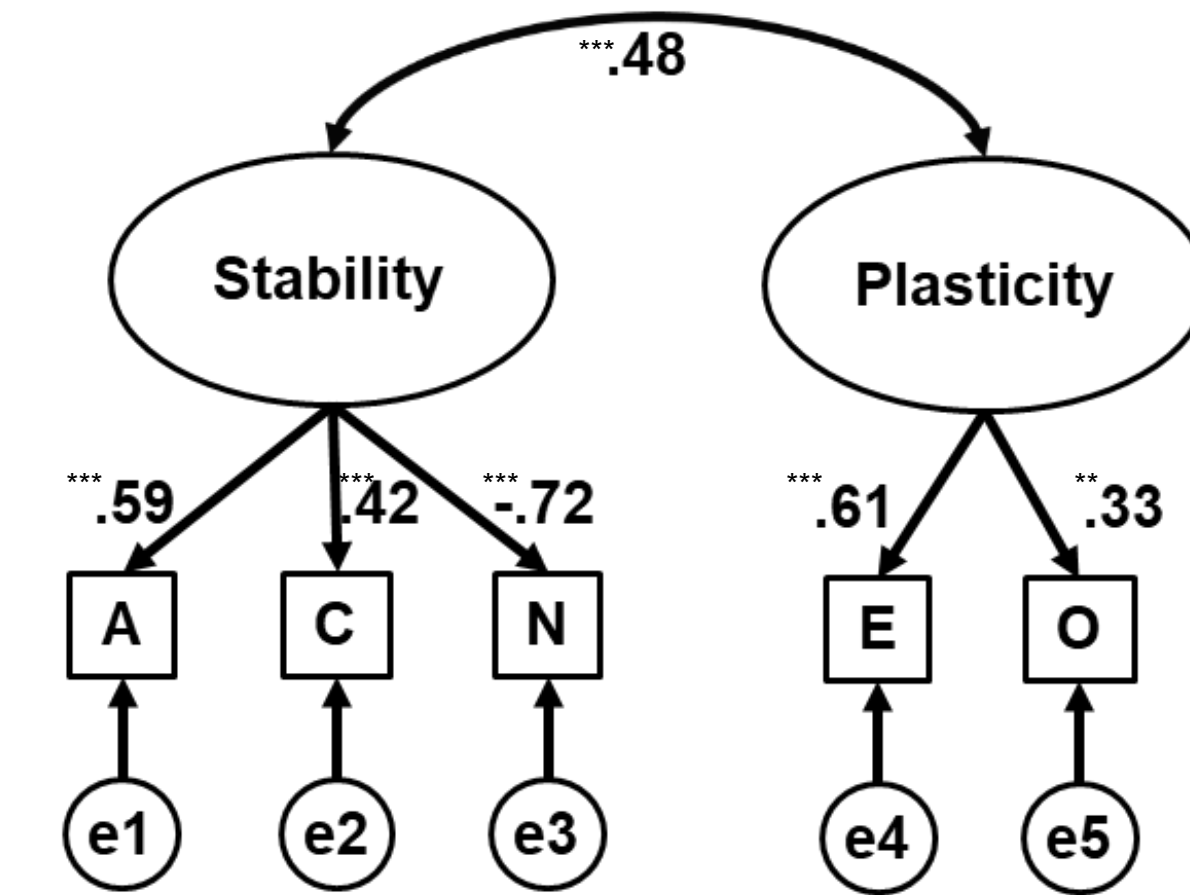
$$P_i = 1 - \sum_{s=1}^M \left( \frac{K_{is}}{K_i} \right)^2$$

Participation coefficient  $P_i$  of node  $i$ , where  $K_{is}$  is the number of links of node  $i$  to nodes in module  $s$ , and  $K_i$  is the total degree of node  $i$ . The participation coefficient of a node is close to 1 if its links are uniformly distributed among all the modules and 0 if all its links are within its own module.

**Local and Global Connectivity:** Local and global connectivity measures were also computed at the level of regions of interest (ROIs). Based on the between-network results, we further examined the ROIs within the relevant networks to clarify which regions may contribute to the observed associations.

## Results

### BFI Confirmatory Factor Analysis

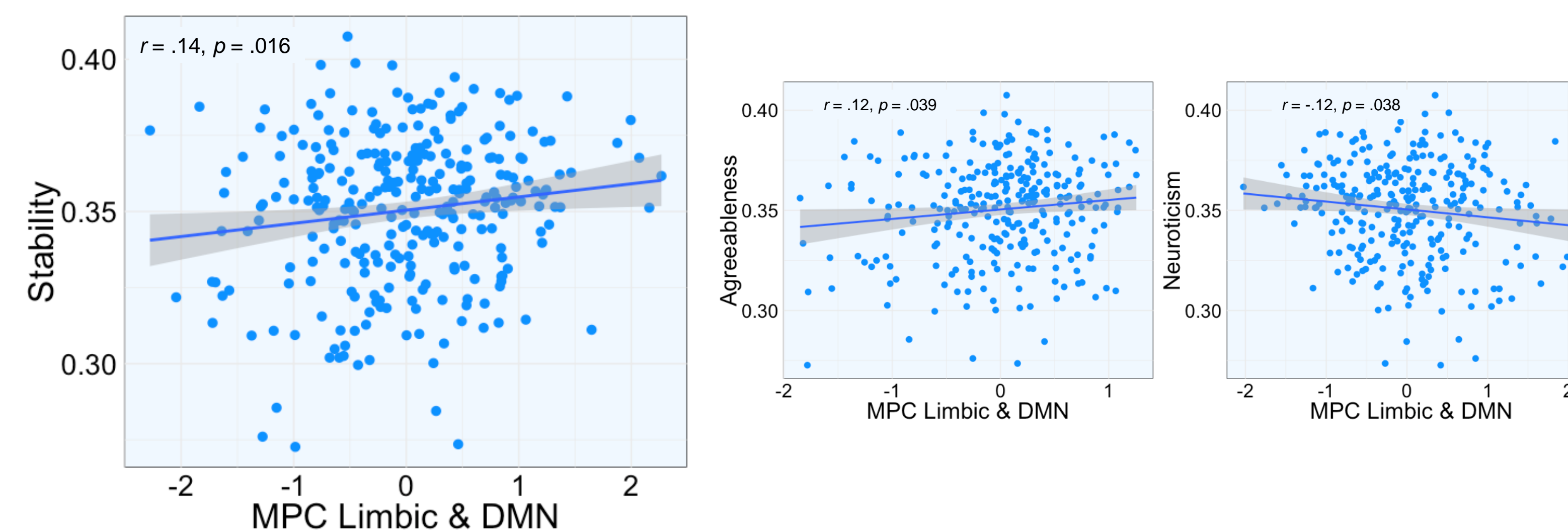


The model had sufficient fit to the data:  $\chi^2(4) = 3.36, p = .50, CFI = 1.00, RMSEA < .001$ ; A = Agreeableness, C = Conscientiousness, N = Neuroticism, E = Extraversion, O = Openness; \*\* $p < .01$ , all others \*\*\* $p < .001$ .

Individuals high in **Stability** tend to have high levels of **Agreeableness** and **Conscientiousness**, and low levels of **Neuroticism**. Individuals high in **Plasticity** tend to have high levels of **Extraversion** and **Openness**<sup>(2)</sup>.

### Stability & MPC of Limbic-DMN

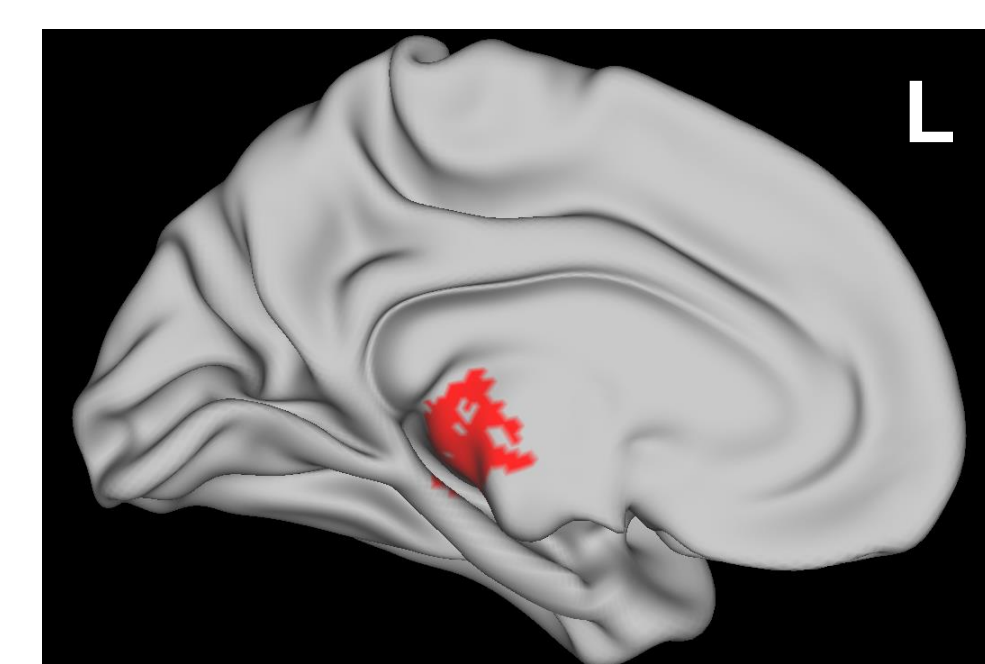
**Stability** was **positively** associated with the **limbic-DMN MPC**, and **Agreeableness** and **Neuroticism** showed **opposing** patterns of association with MPC between these networks.



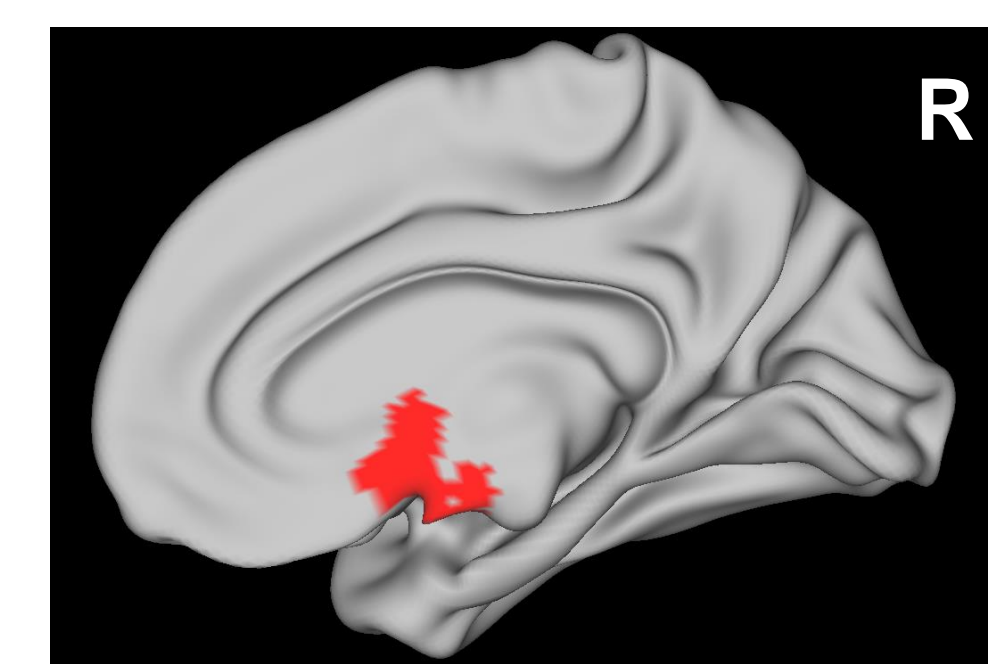
### ROI level: Global Connectivity

Global connectivity of ROIs within the **limbic** and **DMN** points to regional specificity linked to **Conscientiousness**.

**Conscientiousness & DMN (+)**



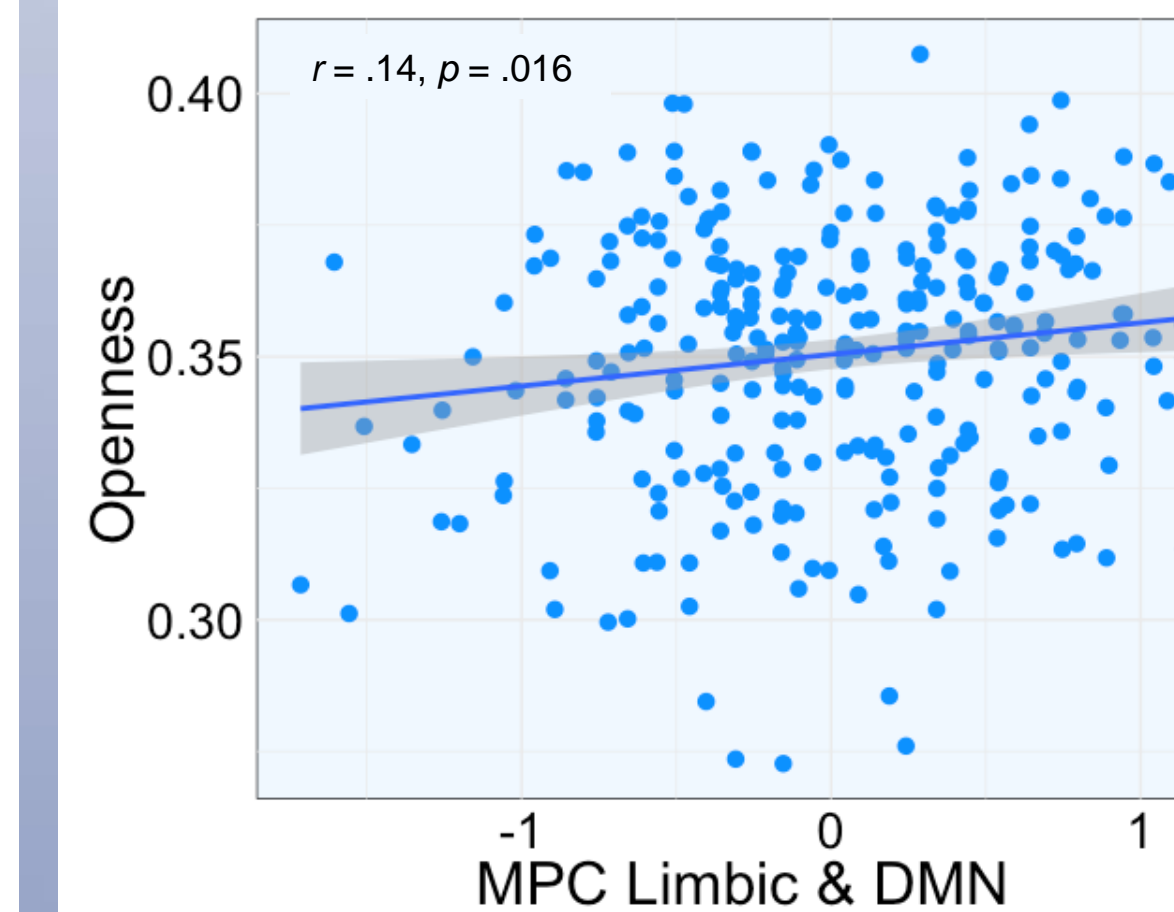
**Conscientiousness & Limbic (+)**



## Results (continued)

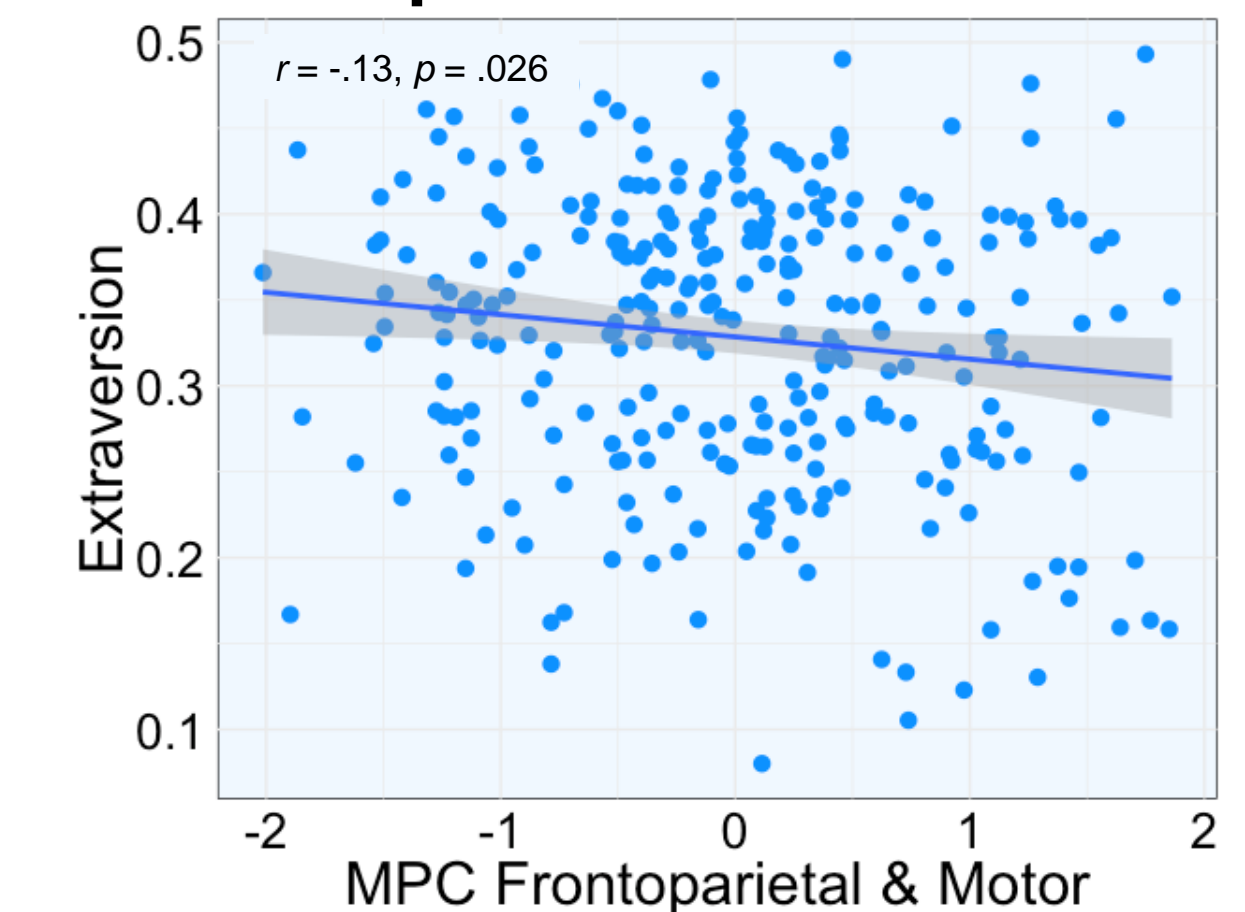
### Openness & MPC of Limbic-DMN

**Openness** was **positively** associated with the **limbic-DMN MPC**.



### Extraversion & MPC of Frontoparietal-Motor

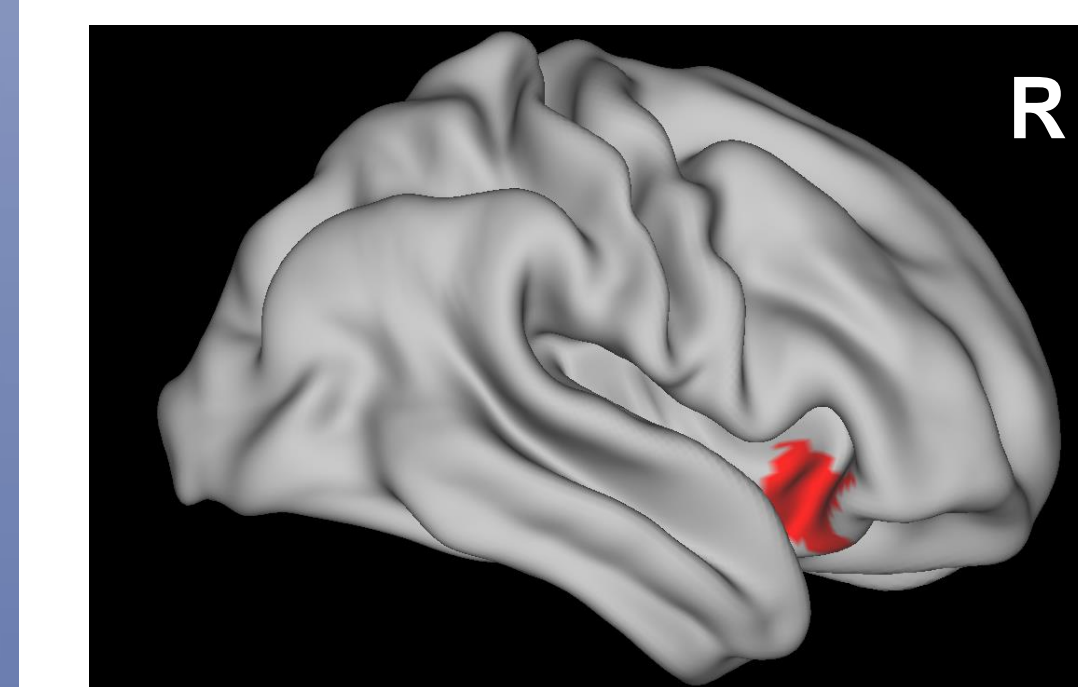
**Extraversion** was **negatively** associated with the **frontoparietal-motor MPC**.



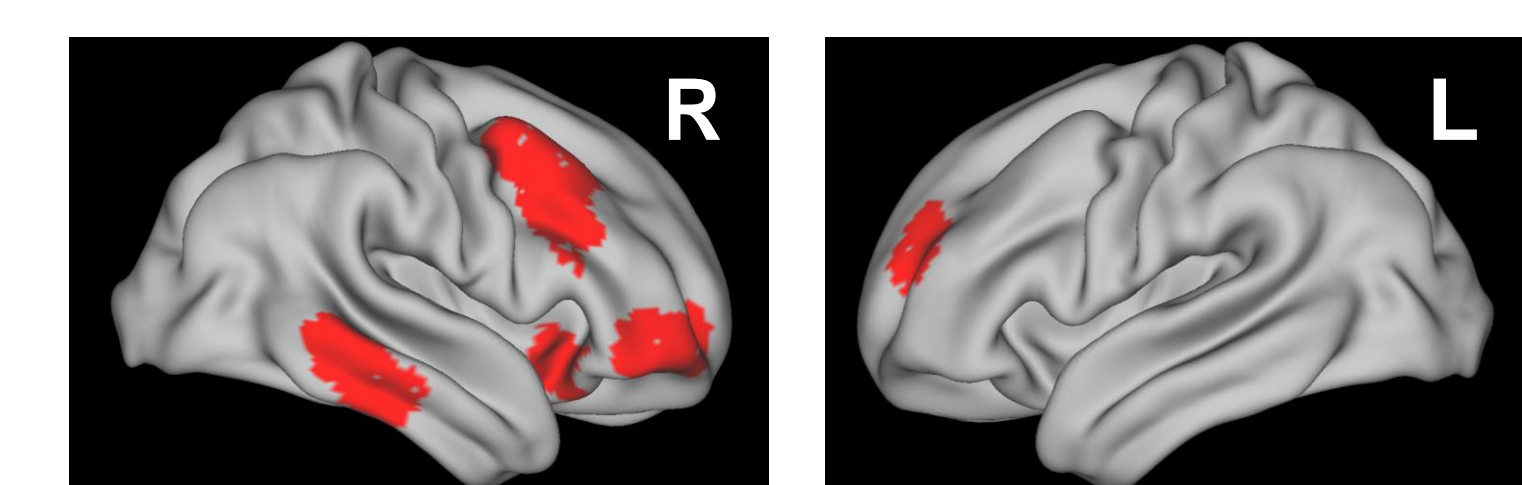
Global and local connectivity of ROIs within the **frontoparietal** and **motor** networks highlights regional specificity linked to **Plasticity** and **Extraversion**.

### ROI level: Global Connectivity

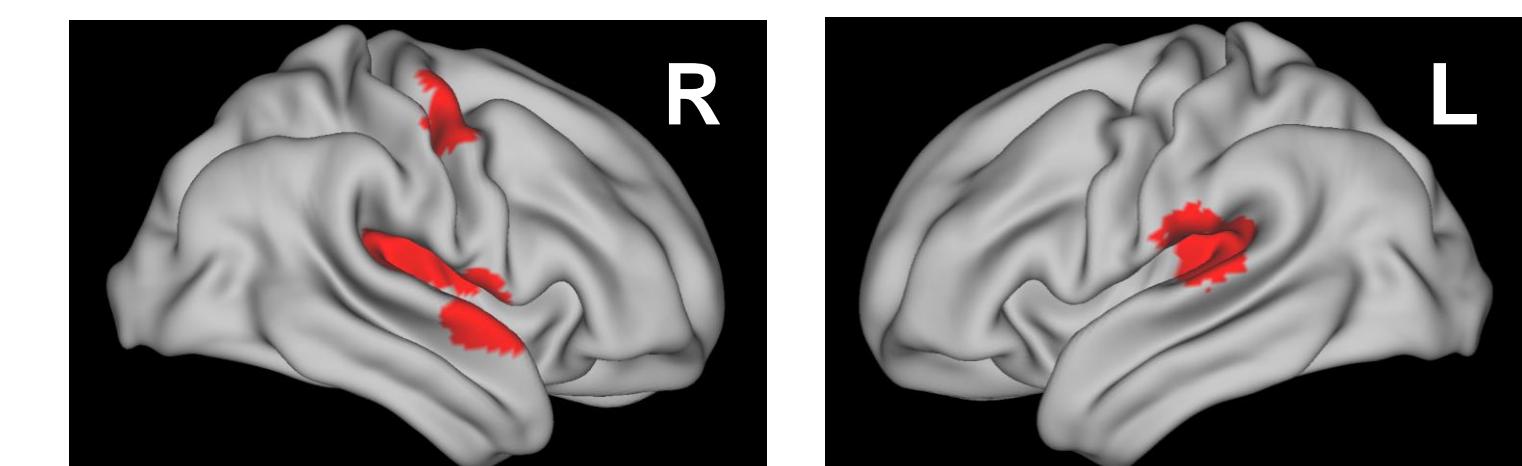
**Plasticity & FPN (+)**



**Extraversion & FPN (+)**

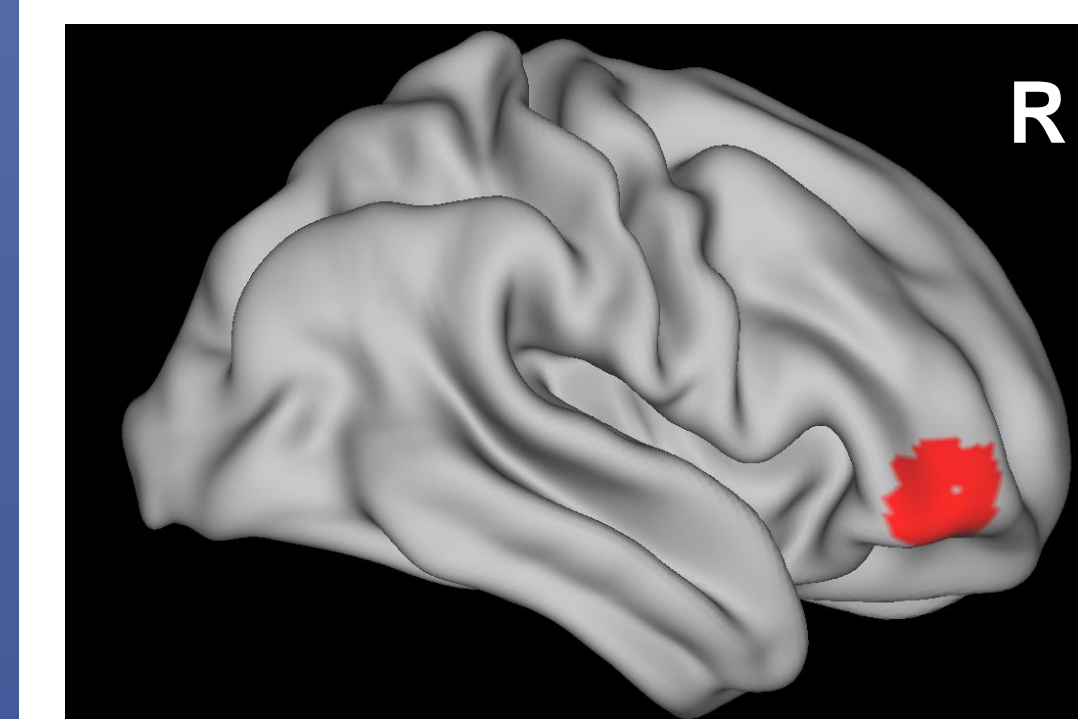


**Extraversion & Motor (+)**

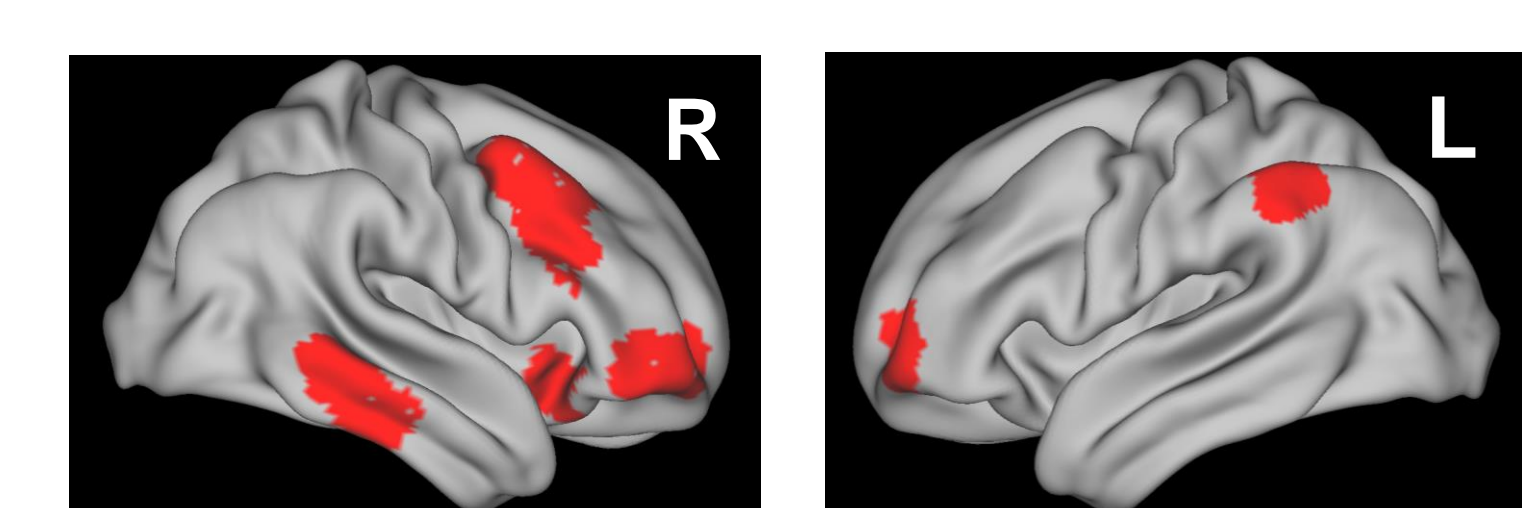


### ROI level: Local Connectivity

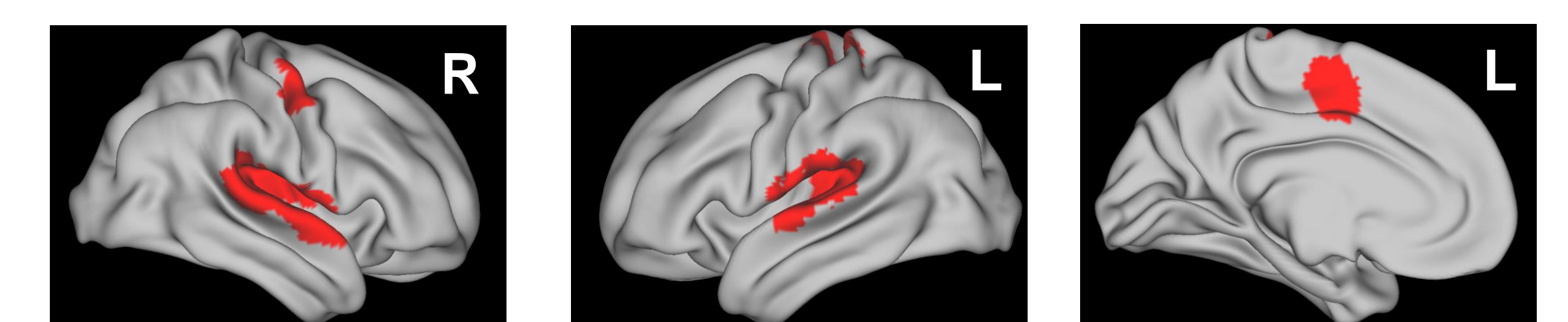
**Plasticity & FPN (+)**



**Extraversion & FPN (+)**



**Extraversion & Motor (+)**



## Discussion & Future Directions

•The positive association between **Stability** and **limbic-DMN MPC** suggests that participants high in **Stability** had more between-module connections. The opposing patterns of **Agreeableness** and **Neuroticism** are in line with the **Stability** pattern, and the association with **Openness** also highlights the importance of these networks in relation to traits contributing to **Plasticity**. These results point to relative integration of these networks, consistent with the idea that individuals high in **Stability** might have greater coordination among networks involved in emotional and self-referential processing<sup>(6)</sup>.

•The negative association between **Extraversion** and **frontoparietal-motor MPC** suggests that participants high in **Extraversion** had more within-module connections. This result is consistent with the idea that these networks are engaged during coordinating behavior in a rapid, accurate, and flexible goal-driven manner<sup>(7)</sup>, which might be facilitated by relative segregation of modules in these networks.

•The ROI-level results highlight regional specificity within the networks that might contribute to the MPC results, as well as effects that were not apparent at the level of between-network effects. For example, **Conscientiousness** was associated with global connectivity of ROIs within the **limbic** and **DMN**, and **Plasticity** was associated with global and local connectivity of ROIs within the **FPN**. These results point to the importance of specific regions within the networks and their connections across the brain.

•Overall, these results support the idea that there are distinct associations between personality and features of ICNs and may provide novel insights with valuable implications for understanding the interaction of these factors in healthy and clinical groups.

•Future research will examine the network-personality associations with specific cognitive abilities.

## References & Acknowledgments

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