

Shared and Distinct Alterations of Brain Functional Connectivity Across Attention Deficit Hyperactivity Disorder, Bipolar Disorder, and Major Depressive Disorder in Adolescence

Wan-Chen Chang^{1,2,3}, Mu-Hong Chen^{3,5,*}, Zih-Kai Kao², Pei-Chi Tu^{2,3,4}, Hui-Ju Wu³, Ju-Wei Hsu^{3,5},
Ya-Mei Bai^{3,5,6}, Tung-Ping Su^{5,6,7}, You-Yin Chen^{1,8,*}

¹Department of Biomedical Engineering, National Yang Ming Chiao Tung University, Taipei, Taiwan

²Department of Medical Research, Taipei Veterans General Hospital, Taipei, Taiwan

³Department of Psychiatry, Taipei Veterans General Hospital, Taipei, Taiwan

⁴Institute of Philosophy of Mind and Cognition, National Yang Ming Chiao Tung University, Taipei, Taiwan

⁵Department of Psychiatry, Faculty of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan

⁶Institute of Brain Science, National Yang Ming Chiao Tung, Taipei, Taiwan

⁷Department of Psychiatry, Cheng Hsin General Hospital, Taipei, Taiwan

⁸The Ph.D. Program for Neural Regenerative Medicine, College of Medical Science and Technology, Taipei Medical University, Taipei, Taiwan.

*Corresponding author

Background Previous functional connectivity (FC) studies of attention deficit hyperactivity disorder (ADHD) were compared cases with typically developing (TD) individuals. The co-occurrence of ADHD and bipolar disorder (BD) also has received much recent attention in the literature. These have led to many associations, but uncertainties about their specificity to ADHD in contrast with the other childhood psychopathologies including BD, major depressive disorder (MDD) and did not provided comprehensive FC dysconnectivity alterations for the neurodevelopmental disorders.

Aims & Objectives This study aimed to examine FC within disrupted default mode network which reduced in the core cortices seed and to identify the common connectivity abnormalities based on the whole-brain connectivity pattern across three major childhood psychopathologies.

Methods This study recruited twenty-five patients in each group with ADHD, BD, and MDD and thirty TD controls. Each participant underwent resting functional magnetic resonance imaging. The six impulsivity or inattention related seeds were used to derive FC maps, and group comparisons were made between each patient group and TD controls using independent-sample t test. A conjunction analysis was performed to identify common neural regions with FC abnormalities across these groups of psychopathologies. An ANOVA was computed to identify specific alterations among three psychiatric disorders.

Results The conjunction of the FC maps revealed that the three groups of patients shared pattern of fronto-cortical cortex dysconnectivity characterized by an increase in FC with the paracingulate gyrus, precentral gyrus, and a decrease in middle prefrontal gyrus, frontal pole and supplementary motor area. ANOVA analysis demonstrated that distinct alterations in bilateral occipital cortex, left lingual gyrus, angular gyrus, supramarginal gyrus and hippocampus. Smaller clusters in frontoparietal cortices were identified and most of them belonged to the salience and dorsal attention network.

Discussion & Conclusion The findings indicate that these regions are modulated the switch between the internally directed cognition of the default mode network and the externally directed cognition of the central executive network with cognition, motivation, and movement rather than emotional processing. Given the functional heterogeneity and the homogeneity within the frontoparietal network which compelling evidence of cardinal dysfunction with common neural substrates for trait impulsivity or inattention of psychopathology are present across neurodevelopmental disorders during adolescence.