Mapping Vulnerable Brain:

Neural Mechanisms of Sensitivity to Criticism across Adolescence and Major Depressive Disorders

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Curriculum Vitae

Qinyuan Chen obtained her Bachelor’s degree in Psychology in 2017 and Master’s degree in Cognitive Neuroscience in 2020 from South China Normal University. From 2020 to 2025, she worked as a PhD researcher for the Ghent Experimental Psychiatry Lab at Ghent University.

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Summary

Social evaluation, especially negative feedback such as criticism, is a potent source of psychosocial stress. Repeated exposure to criticism has been linked to emotional dysregulation and increased vulnerability to mental disorders. Understanding how the brain processes social evaluation, particularly criticism, may therefore help clarify the neural mechanisms that underlie this vulnerability. Previous studies have highlighted three large-scale brain networks involved in this process: the salience network (SN); the central executive network (CEN); and the default mode network (DMN).

This dissertation investigates how brain regions within these networks interact during social evaluation, how these interactions differ across development and depression, and whether they can be modified through intervention. Across studies, participants were exposed to a series of self-referential auditory clips containing critical, praising, and neutral comments to mimic an experience of social evaluation, while undergoing fMRI scanning.

Chapter 2 focuses on healthy adolescents, a population often described as highly sensitive to social evaluation due to ongoing socio-emotional and regulatory development. Results showed that being criticized inhibited the DMN-to-CEN coupling, suggesting that adolescents' can disengage from self-referential when confronted with criticism. However, adolescents who reported perceived more criticism showed less of this inhibition during criticism, suggesting weaker disengagement from self-focused thoughts.

Chapter 3 compares adolescents with young adults to examine developmental differences. Adolescents showed weaker top-down influence from CEN to SN during criticism, suggesting less cognitive control over affective salience. During praise, adolescents showed more persistent signaling from SN to CEN, implying that positive social feedback remains salient and continues to demand regulatory resources.

Chapter 4 turns to a clinical population: patients with Major Depressive Disorder (MDD). Compared with healthy volunteers, MDD patients showed weaker excitation from SN to CEN during criticism, suggesting impaired facilitation of cognitive control in response to criticism. This supports the view that MDD involves difficulty recruiting regulatory systems when confronted with negative information.

Chapter 5 tests whether these neural patterns can be altered using intervention. Here, MDD patients received either active or sham aiTBS over the left DLPFC (a core CEN node). Compared with sham, active aiTBS treatment strengthened excitatory coupling from CEN-to-SN during social evaluation in general, which may suggest a partial restoration of regulatory from cognitive control regions to affective regions.

Taken together, this dissertation provide insights into how the SN, CEN, and DMN interact during social evaluation. Their interactions differ across adolescence, adulthood, and MDD, and can be modulated with targeted neuromodulation. These findings suggest that altered interactions among these networks may underlie why some individuals – such as adolescents and individuals with MDD – are more vulnerable to criticism. More broadly, they may inform the development of neural targets for early identification and intervention in at-risk populations.

Manuscripts included in the thesis

Chen, Q., Bonduelle, S. L. B., Wu, G. R., Vanderhasselt, M. A., De Raedt, R., & Baeken, C. (2024). Unraveling how the adolescent brain deals with criticism using dynamic causal modeling. *NeuroImage*, 286, 120510. https://doi.org/10.1016/j.neuroimage.2024.120510

Chen, Q., Bonduelle, S., Wu, G. R., De Raedt, R., & Baeken, C. Being praised and criticized in adolescents and adults: Neural developmental changes in response to social evaluations. (in Revision)

Chen, Q., Wu, G. R., De Witte, S., De Raedt, R., & Baeken, C. Aberrant fronto-cingulate effective coupling underlies criticism sensitivity in major depression. (Under Review)

Chen, Q., Wu, G. R., De Witte, S., De Raedt, R., & Baeken, C. The Effects of Accelerated Intermittent Theta Burst Stimulation (aiTBS) on Emotion-Related Neural Processes in Major Depression. (in Preparation)