



Pubertal Maturation Influences Mesocorticolimbic Development in Youth: Implications for Sensitivity to Rewards and Punishment

Amar Ojha^{1,2}; Neil P. Jones³; Elizabeth A. Shirtcliff⁴; Cecile D. Ladouceur^{1,2,3,5}

1. Center for Neuroscience; 2. Center for Neural Basis of Cognition; 3. Department of Psychiatry, University of Pittsburgh;
4. Human Development & Family Studies, Iowa State University; 5. Department of Psychology, University of Pittsburgh



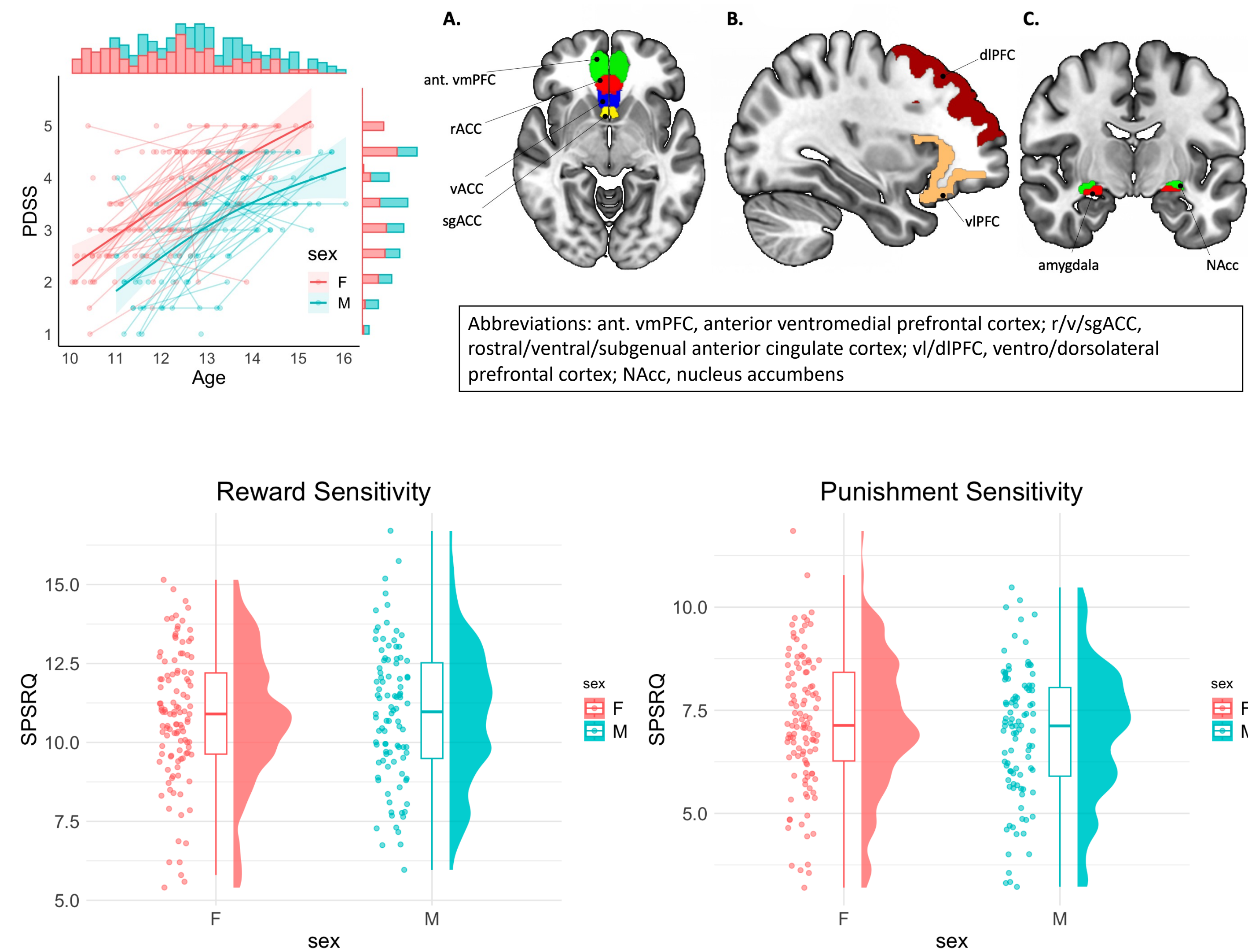
BACKGROUND

- Puberty initiates neuroendocrinological changes in adolescent socio-affective processing and behavior¹.
- Puberty-related shifts in sensitivity to reward or punishment might underlie heightened risk for psychopathology².
- It remains unknown how various aspects of puberty influence the maturation of neural circuitry underlying reward/punishment sensitivity.

Hypothesis: We predict that fronto-striatal connectivity will support reward sensitivity³ whereas fronto-amygdala connectivity will support punishment sensitivity⁴. Pubertal maturation will moderate the association.

METHODS

- Sample: 126 adolescents studied longitudinally (216 scans; approx. 2-year interval).
- Acquired resting-state fMRI scan (two 6-min sessions).
- Indexed resting-state functional connectivity (RSFC) by taking the PCA across all ROI voxels; Pearson correlation coefficients were computed between ROIs and normalized using Fisher's Z transformation.
- Puberty was assessed via the Puberty Development Scale (PDS)⁵, which was transformed to 5-scale Tanner ratings.
- Parent-report SPSRQ (max subscore = 24) was used to assess sensitivity to rewards/punishments⁶.
- Statistical tests were FDR-corrected to account for multiple comparisons and control for age effects.



RESULTS

Reward sensitivity is supported by fronto-striatal connectivity.

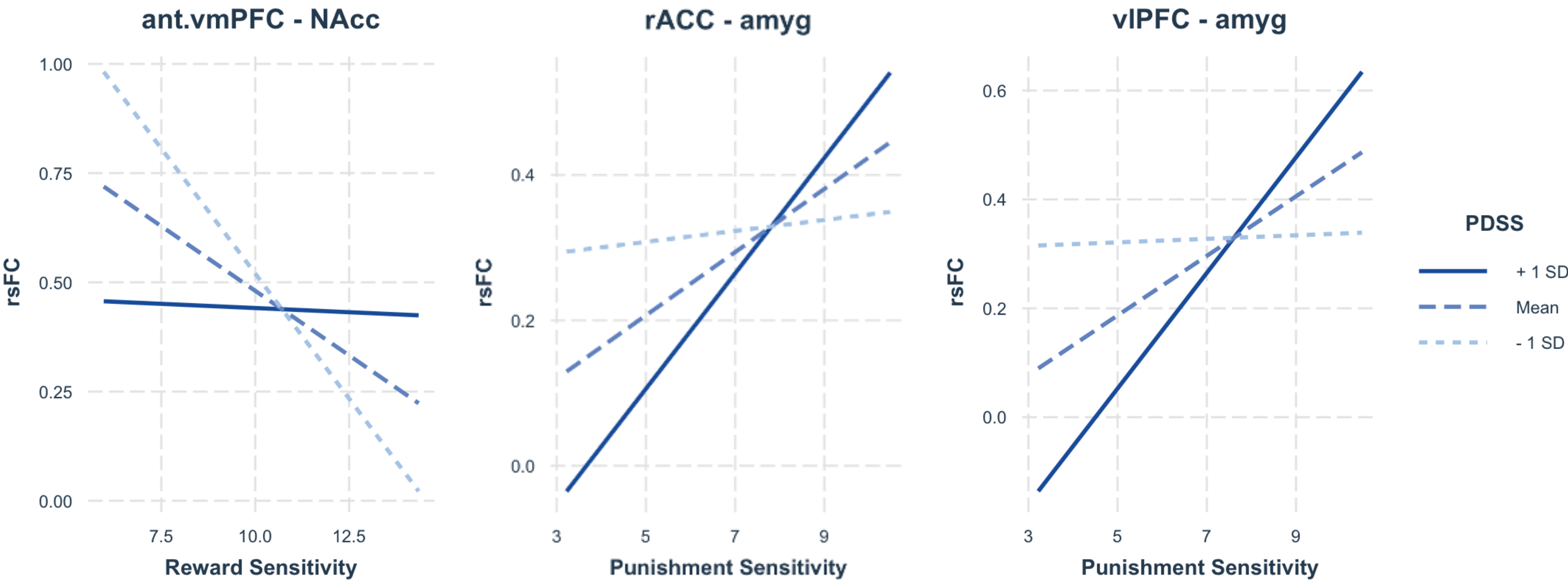
Weaker ant.vmpFC-NAcc rsFC is associated with greater reward sensitivity ($\beta = -0.03$, $p_{FDR} = .007$).

Punishment sensitivity is supported by both fronto-striatal and fronto-amygdala connectivity.

Stronger fronto-striatal/amygdala rsFC is associated with punishment sensitivity (ant.vmpFC-NAcc: $\beta = 0.03$, $p_{FDR} = .003$; ant.vmpFC-amyg: $\beta = 0.03$, $p_{FDR} = .015$; dlPFC-NAcc: $\beta = 0.05$, $p_{FDR} = .0002$; dlPFC-amyg: $\beta = 0.03$, $p_{FDR} = .007$; rACC-NAcc: $\beta = 0.03$, $p_{FDR} = .003$; rACC-amyg: $\beta = 0.02$, $p_{FDR} = .046$; vACC-NAcc: $\beta = 0.02$, $p_{FDR} = .045$; viPFC-NAcc: $\beta = 0.03$, $p_{FDR} = .003$; viPFC-amyg: $\beta = 0.03$, $p_{FDR} = .003$).

Puberty significantly moderates the relationship between reward/punishment sensitivity and rsFC in boys but not girls.

Pubertal maturation is associated with a weakening of the relationship between ant.vmpFC-NAcc RSFC and reward sensitivity in boys ($\beta = 0.06$, $p_{FDR} < .001$). In contrast, pubertal maturation is associated with a strengthening of the relationship between rACC/viPFC-amygdala RSFC and punishment sensitivity in boys (rACC: $\beta = 0.04$, $p_{FDR} = .006$; viPFC: $\beta = 0.05$, $p_{FDR} < .001$).



CONCLUSIONS

- Puberty significantly influences functional mesocorticolimbic circuitry underlying sensitivity to rewards/punishments, particularly in boys, which has been relatively understudied in the literature.
- Such pubertal influences on mesocorticolimbic circuitry may underscore a neurobiological process by which puberty confers risk for affective disorders differently in boys and girls.
- Future work should investigate hormonal changes as they relate to sensitivity to reward/punishment and increasing risk of anxiety/depression.

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