

Functional Connectivity Accounts for Variability in Temporal Discounting Across Diagnostic Groups

Jacob DeRosa¹, Yu Tong², Aki Nikolaidis², Michael Milham^{1,2,3}

¹Healthy Brain Network, Child Mind Institute, NY, USA, ²Center for the Developing Brain, Child Mind Institute, NY, USA,

³Center for Biomedical Imaging and Neuromodulation, Nathan Kline Institute, NY, USA

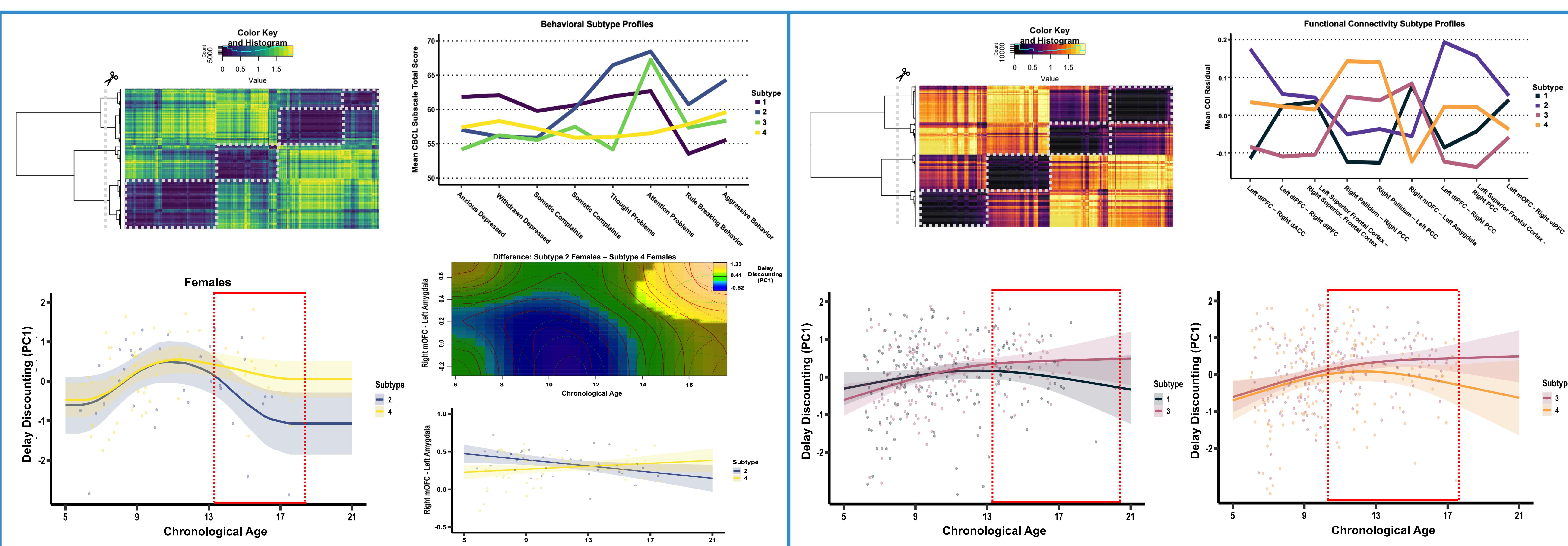
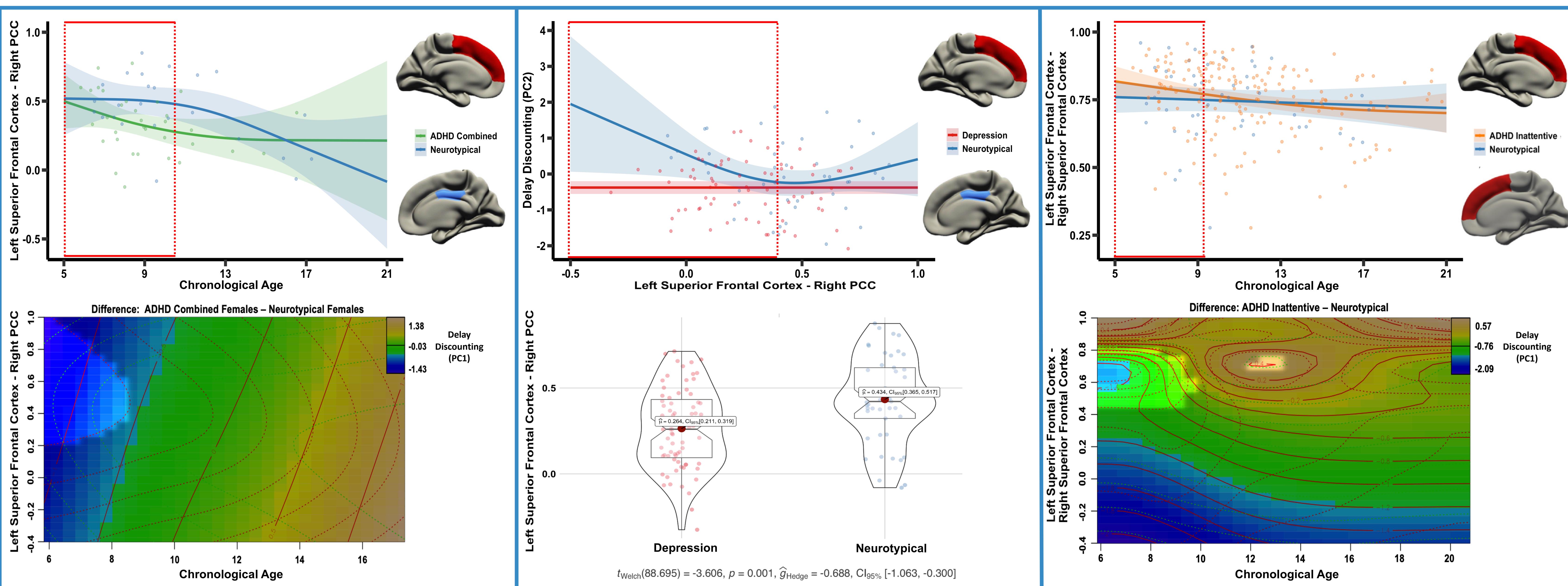
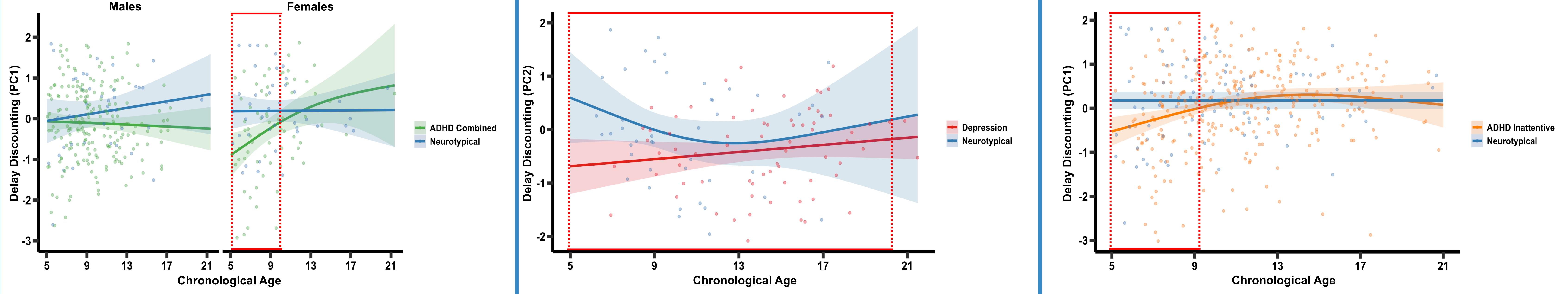


Introduction

Delay discounting (DD) is a measure of self regulation that measures an individual's tendency to prefer smaller, immediate rewards over larger, delayed rewards. DD is a core feature of choice impulsivity that has been implicated in a variety of maladaptive outcomes, such as substance and alcohol abuse, obesity, delinquent behavior, and poor treatment outcomes^{1,4}. The exploration of DD across psychiatric disorders may help inform transdiagnostic treatments by identifying target behavioral processes and providing markers of change in existing treatments. To this end, elucidating the clinically significant differences in DD has become a priority for psychiatric research. Recent work has identified DD as a key transdiagnostic marker of psychiatric illness across a range of disorders including ADHD, Anxiety, Schizophrenia and Autism¹. Brain network organization may serve as a biomarker of choice impulsivity³. Identifying connections that explain differences in choice impulsivity across psychiatric disorders may clarify the degree to which DD should be considered a transdiagnostic biomarker. Recent evidence shows that sex and diagnostic group differences in functional connectivity (FC) can be linked to differences in choice preferences⁵. Our aim is to identify network FC involved in choice impulsivity or reduced to better understand the underlying neurobiological systems that lead to developmental variations in delay discounting preference across neurotypical and psychiatric populations. We also seek to determine if variance in FC contributes to differences in DD between males and females in these populations.

Methods

- Our sample consists of 1283 (452 female) participants from the Healthy Brain Network Biobank between the ages of 5-21 (10.02 ± 3.57).
- The neuroimaging sample consists of 658 (235 female) participants.
- The 5-trial adjusting delay task³ (ADT-5) was used to obtain individual discount rates by directly measuring the Effective Delay 50% for a given hypothetical commodity.
- Principal components based on the six ADT-5 commodities were computed and the first two components were used (PC1 & PC2).
- The Desikan-Killiany Atlas was used to generate regions of interest determined a priori following procedures from Anandakumar et al., 2018 (Caudal middle frontal, Posterior cingulate, Superior frontal, Orbitalis, Medial orbitofrontal, Caudal anterior cingulate), and subcortical components (Right Pallidum, Left amygdala).
- Behavioral subtypes were generated by applying the Louvain community detection algorithm to the the Child Behavior Checklist Subscale Total Scores.
- Louvain was applied to age corrected FC COI correlation coefficients to obtain FC subtypes.
- Bootstrap aggregation was utilized on the subtyping methods to reduce variability in our sample composition and to enhance reproducibility.
- General Additive Models and ANOVA were used to compare DD and Functional Connectivity in our samples across diagnostic groups, subtypes, within sex, and across age.



Results and Discussion

- This study provides evidence that DD is a multifaceted transdiagnostic indicator of childhood and adolescent psychiatric illness.
- Regions within and between cognitive control and valuation networks influence reward-based decision-making preference in children with ADHD, Autism, Depression, Anxiety, and Learning Disorders.
- Notable differences were also found in DD and FC between males and females within certain diagnostic groups.
- Greater connectivity between cognitive control and valuation regions was related to decreased DD. The inverse was found in connectivity between valuation network regions. DD trends across our FC subtypes support these findings.
- Both Subtyping approaches identified significantly different developmental trajectories in DD.
- Within and across subtype sex differences were also found in DD and FC.
- Overall, these approaches highlight the importance of developing data driven methods to phenotypic and neurobiological categorization.

References

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