Reward-Based Learning as a Function of Severity of Substance Abuse Risk in Drug-Naïve Youth with ADHD

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Abstract

Objective:
Attention-deficit/hyperactivity disorder (ADHD) is associated with elevated risk for later development of substance use disorders (SUD), specifically because youth with ADHD, similar to individuals with SUD, exhibit deficits in learning abilities and reward processing. Another known risk factor for SUD is familial history of substance dependence. Youth with familial SUD history show reward processing deficits, higher prevalence of externalizing disorders, and higher impulsivity scores. Thus, the main objective of this proof-of-concept study is to investigate whether risk loading (ADHD and parental substance use) for developing SUD in drug-naïve youth impacts reward-related learning.

Methods:
Forty-one drug-naïve youth, stratified into three groups: Healthy Controls (HC, n = 13; neither ADHD nor parental SUD), Low Risk (LR, n = 13; ADHD only), and High Risk (HR, n = 15; ADHD and parental SUD), performed a novel Anticipation, Conflict, and Reward (ACR) task. In addition to conventional reaction time (RT) and accuracy analyses, we analyzed computational variables including learning rates and assessed the influence of learned predictions of reward probability and stimulus congruency on RT.

Results:
The multivariate ANOVA on learning rate, congruence, and prediction revealed a significant main Group effect across these variables [F(3, 37) = 3.79, p = 0.018]. There were significant linear effects for learning rate (Contrast Estimate = 0.181, p = 0.038) and the influence of stimulus congruency on RTs (Contrast Estimate = 1.16, p = 0.017). Post hoc comparisons revealed that HR youth showed the most significant deficits in accuracy and learning rates, while stimulus congruency had a lower impact on RTs in this group. LR youth showed scores between those of the HC and HR youth.

Conclusion:
These preliminary results suggest that deficits in learning and in adjusting to task difficulty are a function of increasing risk loading for SUD in drug-naïve youth. These results also highlight the importance of developing and applying computational models to study intricate details in behavior that typical analytic methodology may not be sensitive to.