Reward Learning Bias and Risky Decision-Making Moderate ADHD Symptom Associations with Emotion Dysregulation

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Introduction

- Inattention, hyperactivity, and impulsivity are defining Attention Hyperactive Deficit Disorder (ADHD) characteristics (Corbisiero et al., 2013).
- The propensity to prioritize immediate gains above potential future losses of a greater magnitude (risky decision-making) and a heightened sensitivity to rewards are linked to impulsivity (Dekkers et al., 2022). These tendencies reflect transdiagnostic individual differences that heterogeneously cluster within the ADHD population and may be drivers of ADHD symptoms (Grimm et al., 2021).
- Emotion Dysregulation (ED), reflecting individuals whose emotional responses fall out of normal range, has also gained increasing traction as a transdiagnostic process associated with ADHD symptoms (Llewellyn, 2008), and with links to risky decision-making and reward sensitivity.
- Indeed, growing evidence closely associates ED with impulsivity, goal-undirected behaviors and ineffective distress management, as well as with functional impairment experienced by those with ADHD (Shaw et al., 2014). Deficits in emotion regulation have been identified as a mediator on the relationship betw7cheen ADHD and depression symptoms in adults. Additionally, research indicates that emotion regulation mediates the relationship between ADHD symptoms and relationship quality (Bodalski et. al, 2019). Thus, demonstrating the extensive impact of ED deficits affects among functional outcomes.
- Though linked with ADHD and ED, risky decision-making and reward sensitivity are independent constructs, and it is unknown whether their presence differentially connects ADHD symptoms with ED.
- This study tested the moderating roles of risky decision making and reward sensitivity effects between reported ADHD symptoms and tendencies to engage in impulsive, goals-undirected behaviors when in distress, and difficulty managing distress within a university student sample.

Hypotheses

H1: ADHD symptoms, risky decision-making, and reward sensitivity will positively correlate with ED impulsivity, goal-undirected behavior, and poor distress management facets.

H2: Risky decision-making and reward sensitivity will potentiate the association between ADHD and ED facets.

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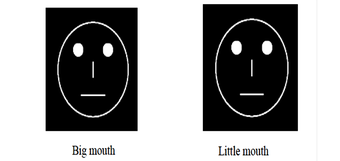
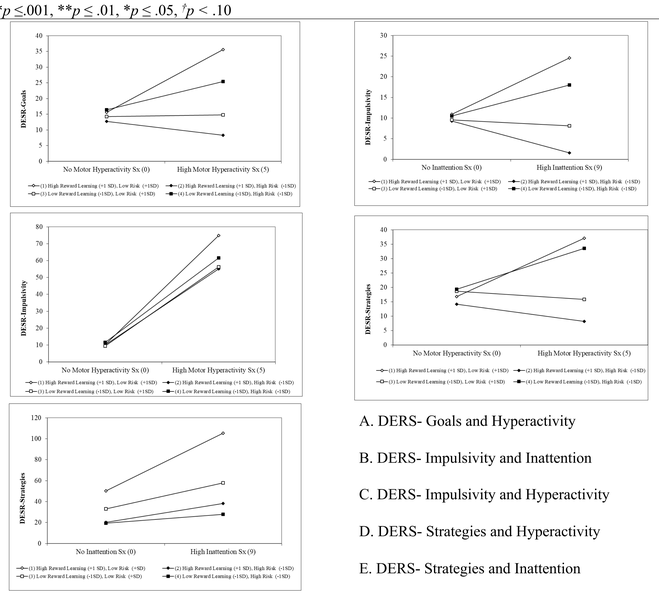


Figure 1. Iowa Gambling Task (above) and Probalistic Reward Learning Task stimuli (below).

Table 1. Descriptive statistics and bivariate correlation of study variables.

Variables	*M* (*SD*)	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	19.84 (3.15)	---								
2. Sex (male)	---	-.19	---							
3. R. Sens.	.11 (.40)	-.17	-.19	---						
4. Risk Dec.	-5.58 (32.26)	-.19	-.01	.05	---					
5. Attn.	3.26 (2.07)	-.05	.03	-.30*	-.15	---				
6. Imp. M.	1.05 (1.12)	-.12	.19	-.08	-.18	.29*	---			
7 Imp. V.	.91 (1.11)	.03	.17	-.10	-.19	.32*	.20	---		
8. Goals	14.65 (4.85)	-.39**	.21	-.14	-.05	.44**	.24†	.10	---	
9. Impulsivity	10.12 (3.94)	-.17	.26*	-.19	-.24†	.30*	.16	.20	.62***	---
10. Strategy	17.25 (6.85)	-.28*	.27*	-.27*	.00	.38*	.16	.11	.64***	.67***

Note. R. Sens.= Reward Sensitivity, Risk Dec.= Risky Decision-Making, Attn= Attention, Imp. M.= Motor Hyperactivity , Imp. V.= Verbal Hyperactivity, DERS Scales= Goals, Impulsivity and Strategy.
***$p \leq .001$, **$p \leq .01$, *$p \leq .05$, †$p < .10$



A. DERS- Goals and Hyperactivity

B. DERS- Impulsivity and Inattention

C. DERS- Impulsivity and Hyperactivity

D. DERS- Strategies and Hyperactivity

E. DERS- Strategies and Inattention

Figure 2. DERS Interaction Figure A-E (above).

Method

- Participants
  - N= 57 university students (74% female, M = 19.84 years old, SD = 3.15) who completed self-report measures and were told that task performance would influence their honorarium was contingent on risky-decision making (Iowa Gambling Task) and reward sensitivity (Probalistic Reward Learning Task) task performance (see Figure 1)
- Measures
  - Difficulties in Emotion Regulation Scale (DERS) – impulsivity, goals & management subscales
  - Adult ADHD self report scale – inattention & motoric and verbal hyper-activity subscales

Results

- H1: As expected, inattention symptoms positively correlated with the three DERS subscales, reduced reward sensitivity, as did risky-decision making with poor distress management (see Table 1). In contrast to expectation, neither reward sensitivity nor the motoric or verbal hyperactivity correlated with ED.
- H2: MANOVAs predicting the DERS subscale revealed significant three-way interactions between risky decision-making, reward sensitivity, and motoric hyperactivity $F(3,47) = 3.42$, $p = .025$) and inattention at a trend level $F(3,47) = 2.73$, $p = .055$) .
  - Follow-up ANOVAs ($Fs = 6.00 - 8.45$, $ps < .02$) and post-hoc probes revealed that patterns of high reward sensitivity and low risky decision making were consistently linked with greater ED as a function increasing motor hyperactivity and inattention symptoms, as was the pattern of low reward bias and high risky decision-making (see Figures A-E).
  - A high reward bias combined with low risky decision-making reduced the tie between ADHD symptoms (motor hyperactivity and inattention) and ED facets.
  - Conversely, a combination of risky decision making in the context of high reward sensitivity presaged the strongest link between ADHD and ED.

Conclusion

- Results suggest a nuanced interplay between decision-making, reward bias, and ADHD symptoms in relation to ED, which is consistent with others finding ADHD to be a heterogenous disorder (Luo et. al, 2019).
- The salubrious low risky decision-making—high reward learning pattern may point to intact decision-making processes that may protect against ED, despite ADHD symptom elevations, and low depression levels that co-occur with ADHD, but were not measured in this study. Conversely, the strong ADHD-ED associations with risky decision-making in conjunction with reward responsiveness mirrors findings within the extant literature.
- The notable link between ADHD and ED for those with low risky decision making-low reward sensitivity and converse effects of the risky-decision-making—low reward sensitivity are curious and warrant further investigations, as do the clinical implications of our findings.