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Cognitive emotion regulation as a statistical mediator of the association between autistic traits and academic performance in university students

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This study examined whether adaptive and maladaptive cognitive emotion regulation strategies showed indirect effects in the association between autistic traits and academic performance in university students. A sample of 279 undergraduates (54.1% female; M age=23.92 years, SD = 1.44) completed the Autism-Spectrum Quotient (AQ-10), scored continuously on a 1–4 response scale to preserve individual differences in this non-clinical sample, and the Cognitive Emotion Regulation Questionnaire (CERQ). Academic performance was measured approximately four months later using end-of-semester examination scores. A parallel mediation model was tested using the PROCESS macro (Model 4) with age as a covariate and bias-corrected bootstrap confidence intervals based on 5,000 resamples. Autistic traits were negatively associated with academic performance. Both adaptive and maladaptive cognitive emotion regulation showed significant indirect effects in this association, with the maladaptive pathway showing a substantially larger indirect effect. The direct effect of autistic traits on academic performance remained significant after accounting for both emotion regulation variables, consistent with partial statistical mediation. These findings suggest that maladaptive cognitive emotion regulation represents a potentially modifiable pathway linking autistic traits to academic difficulties, with implications for developing targeted intervention programs in higher education.

KEYWORDS
academic performance, adaptive emotion regulation, autistic traits, maladaptive emotion regulation, parallel mediation

Introduction

Autism is now widely understood as a dimensional trait distribution rather than a categorical diagnosis, with autistic traits—including difficulties with social reciprocity, preference for sameness, sensory sensitivities, and focused interests—existing in varying degrees across the general population (Baron-Cohen et al., 2001; Constantino and Todd, 2003). The Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001) captures this continuum and permits investigation of how trait variation relates to functional outcomes in non-clinical populations. University students with elevated autistic traits

may experience academic difficulties that are associated not only with academic demands themselves but also with differences in emotional and cognitive self-regulation (White et al., 2011; Hillier et al., 2018). Dijkhuis et al. (2020) found that autism symptom severity accounted for 12% of variance in higher education performance, rising to 36% when executive functioning was included. Shmulsky et al. (2017) similarly demonstrated that impaired behavioral regulation predicted lower grades among postsecondary students with autism. Comorbid anxiety and depression may further complicate this relationship by being associated with disrupted emotional and self-regulatory functioning and poorer academic outcomes (Gurbuz et al., 2019; Zukerman et al., 2023).

Cognitive emotion regulation—the conscious, thought-based strategies a person uses to manage emotional responses to negative events (Garnefski et al., 2001; Thompson, 1991)—is a plausible factor linking autistic traits to academic outcomes. The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001) distinguishes nine strategies. Five are classified as adaptive: positive reappraisal, refocus on planning, positive refocusing, putting into perspective, and acceptance. Four are classified as maladaptive: rumination, catastrophizing, self-blame, and other-blame. This adaptive–maladaptive classification is empirically supported by confirmatory factor analyses demonstrating that the two higher-order composites show differential associations with psychological outcomes: maladaptive strategies are consistently associated with greater psychopathology, whereas adaptive strategies are associated with reduced symptomatology (Garnefski and Kraaij, 2007; Jermann et al., 2006). Critically, meta-analytic evidence demonstrates an asymmetry in these associations: maladaptive strategies show stronger links to negative outcomes than adaptive strategies show to positive ones (Aldao et al., 2010; Martin and Dahlen, 2005).

Individuals with elevated autistic traits tend to underutilize adaptive strategies, particularly cognitive reappraisal, and overrely on maladaptive strategies such as rumination and catastrophizing (Mazefsky and White, 2014; Conner et al., 2020; Lu et al., 2025; Nagase, 2025). One theoretical account for this pattern is provided by Burrows et al. (2017) model of repetitive negative thinking (RNT) in autism, which proposes that aberrant connectivity in default mode and salience networks underlies the tendency toward perseverative, negatively valenced cognition. Zappullo et al. (2023) provided empirical support for this framework, demonstrating that individuals with higher autistic-like traits exhibited greater RNT, which in turn was associated with elevated anxiety and depression. At the neuropsychological level, executive dysfunction—particularly reduced cognitive flexibility (Hill, 2004; Demetriou et al., 2018)—mediates the relationship between autistic traits and cognitive reappraisal capacity. Together, these findings suggest that both neural-level predispositions toward RNT and executive-level constraints on cognitive flexibility contribute to the emotion regulation profile associated with elevated autistic traits.

Separately, the educational psychology literature has documented robust links between emotion regulation and academic outcomes. Cognitive reappraisal is positively associated with academic achievement (Mega et al., 2014), while maladaptive strategies such as rumination and catastrophizing are linked to poorer performance and increased psychological distress (Romo et al., 2025). Pekrun's (2006) Control-Value Theory of Achievement Emotions provides a conceptual framework for understanding these associations: students' cognitive appraisals of academic situations influence the emotions they experience, which in turn affect motivation, cognitive resource allocation, and learning strategy deployment. A student who catastrophizes about an examination may deplete working memory resources through worry and adopt avoidance-oriented study strategies, whereas a student who employs positive reappraisal preserves cognitive resources and maintains approach motivation.

Despite these converging literatures, few studies have examined cognitive emotion regulation strategies as specific mediators of the association between autistic traits and academic outcomes in higher education. The present study addresses this gap by testing a parallel mediation model in which adaptive and maladaptive cognitive emotion regulation strategies are examined as concurrent statistical mediators of the association between autistic traits and academic performance. Based on the theoretical and empirical literature, we hypothesized:

H1: Autistic traits will show a direct negative association with academic performance, independent of the indirect pathways through emotion regulation strategies.

H2: Adaptive cognitive emotion regulation will show a significant indirect effect in the association between autistic traits and academic performance.

H3: Maladaptive cognitive emotion regulation will show a significant indirect effect in the association between autistic traits and academic performance.

H4: The indirect effect via maladaptive strategies will be larger than the indirect effect via adaptive strategies, consistent with meta-analytic evidence that maladaptive strategies show stronger associations with negative outcomes (Aldao et al., 2010).

Method

Participants

An *a priori* power analysis was conducted using Fritz and MacKinnon's (2007) simulation-based approach for mediation models. Based on the assumption of small-to-medium path coefficients (a = .26, b = .26), achieving .80 power for detecting indirect effects using bias-corrected bootstrap methods required a minimum of 148 participants. The final sample of 279 psychology students therefore exceeded the minimum requirement, providing adequate power to detect the hypothesized indirect effects. Participants (151 female, 54.1%; 128 male, 45.9%) ranged in age from 21 to 27 years (M = 23.92, SD = 1.44) and participated voluntarily.

Measures

Autistic traits

Autistic traits were assessed using the 10-item Autism-Spectrum Quotient (AQ-10; Allison et al., 2012), a brief screening instrument derived from the original 50-item AQ

(Baron-Cohen et al., 2001). Each item was rated on a 4-point scale (1 = Definitely Disagree to 4 = Definitely Agree), with all items recoded so that higher scores uniformly reflect greater endorsement of autistic traits. Responses were retained on the continuous 1–4 scale rather than applying the conventional dichotomous scoring (Allison et al., 2012). This decision was motivated by the characteristics of the present non-clinical university sample, where scores are typically low and dichotomous scoring risks floor effects and loss of statistical power (see also MacCallum et al., 2002, on the costs of dichotomizing continuous variables). A sensitivity analysis using standard dichotomous scoring is reported to confirm the robustness of findings. Internal consistency in the present sample was acceptable (Cronbach's alpha = .85).

Cognitive emotion regulation

The short form of the Cognitive Emotion Regulation Questionnaire (CERQ-short; Garnefski and Kraaij, 2006) assessed participants' cognitive coping strategies following negative life events. This 18-item measure captures nine strategies, each comprising two items rated on a 5-point Likert scale (1 = almost never to 5 = almost always). Consistent with prior research (Garnefski et al., 2001; Garnefski and Kraaij, 2007), subscales were combined into two higher-order composites: an adaptive composite (positive reappraisal, refocus on planning, positive refocusing, putting into perspective, acceptance) and a maladaptive composite (rumination, catastrophizing, self-blame, other-blame). Cronbach's alpha coefficients were .83 (adaptive) and .84 (maladaptive).

Academic performance

Academic performance was operationalized as the mean score from two end-of-semester examinations in core undergraduate courses (Research Methods and Personality Psychology), each graded on a 0–100 scale. This domain-specific measure was chosen over cumulative GPA to reduce contamination from courses unrelated to the regulatory demands under investigation and to provide a consistent assessment context across participants.

Procedure

After providing informed consent, participants completed the AQ-10 and CERQ in person during a supervised session at the beginning of the academic semester. Academic performance data, consisting of end-of-semester examination scores, were obtained approximately four months later at the conclusion of the semester. All procedures were approved by the institutional review board and conducted in accordance with relevant ethical standards.

Analytic strategy

Bivariate Pearson correlations were computed among all study variables. Parallel indirect-effect analyses were conducted using Hayes's (2022) PROCESS macro for SPSS (Model 4) with 5,000 bootstrap resamples and 95% bias-corrected confidence intervals. Autistic traits served as the independent variable (X), adaptive and maladaptive cognitive emotion regulation as parallel mediators (M1 and M2), and academic performance as the dependent variable (Y). Age was included as a covariate given its significant correlations with maladaptive emotion regulation ($r = .15$, $p < .05$) and academic performance ($r = .23$, $p < .01$). A sensitivity analysis excluding age and a second replicating the model under dichotomous AQ-10 scoring were conducted to evaluate robustness.

Results

Preliminary analyses

Descriptive statistics and bivariate correlations are presented in Table 1. All correlations were in the hypothesized directions: autistic traits were negatively associated with adaptive emotion regulation and academic performance, and positively associated with maladaptive emotion regulation. The two mediators were moderately negatively intercorrelated.

Parallel mediation model

Autistic traits significantly predicted both mediators after controlling for age: higher autistic trait scores were associated with lower adaptive emotion regulation and higher maladaptive emotion regulation (see Table 2 for all regression coefficients). Age was not significantly associated with adaptive emotion regulation but was a significant positive predictor of maladaptive emotion regulation.

In the outcome model, both mediators, autistic traits, and age were entered simultaneously as predictors of academic performance, $R^2 = .268$, $F(4, 274) = 25.03$, $p < .001$. Adaptive emotion regulation was a significant positive predictor and maladaptive emotion regulation was a significant negative predictor. The direct effect of autistic traits remained significant after accounting for both mediators and age, consistent with partial statistical mediation.

The total indirect effect was significant, as were specific indirect effects through both pathways, though the adaptive pathway was at the boundary of significance with its upper

TABLE 1 Descriptive statistics and bivariate correlations ($N = 279$).

Variable	M	SD	1	2	3	4
1. AQ-10	2.52	0.55	—			
2. Adaptive ER	2.99	0.50	−.26**	—		
3. Maladaptive ER	3.06	0.51	.38**	−.37**	—	
4. Academic Perf.	71.19	13.30	−.33**	.29**	−.38**	—
5. Age	23.92	1.44	−.06	.01	.15*	.23**

*$p < .05$; **$p < .01$. ER, emotion regulation; AQ-10, autism-spectrum quotient (continuous 1–4 scoring). Columns 4, 5, and 6 report correlations with variables 1, 2, and 3 respectively. Age (M = 23.92, SD = 1.44) correlated with maladaptive ER ($r = .15$, $p < .05$) and academic performance ($r = .23$, $p < .01$).

TABLE 2 Unstandardized regression coefficients for parallel indirect-effect model.

Predictor	b	SE	t	*p*	LLCI	ULCI
Outcome: Adaptive ER R2 = .071, F(2, 276) = 10.48, $p < .001$						
Autistic traits	−0.24	0.05	−4.58	<.001	−0.35	−0.14
Age	−0.004	0.020	−0.19	.847	−0.04	0.04
Outcome: Maladaptive ER R2 = .178, F(2, 276) = 29.77, $p < .001$						
Autistic traits	0.37	0.05	7.21	<.001	0.27	0.47
Age	0.06	0.02	3.16	.002	0.02	0.10
Outcome: Academic Performance R2 = .268, F(4, 274) = 25.03, $p < .001$						
Adaptive ER	3.65	1.50	2.44	.015	0.70	6.59
Maladaptive ER	−8.03	1.57	−5.13	<.001	−11.12	−4.95
Autistic traits (c')	−3.89	1.39	−2.79	.006	−6.63	−1.14
Age	2.45	0.49	4.97	<.001	1.48	3.42

ER, emotion regulation; b, unstandardized coefficient. $N = 279$.

confidence limit reaching zero (Table 3). A pairwise contrast of the two specific indirect effects confirmed that the maladaptive indirect effect was significantly larger in absolute magnitude, supporting H4. Full path coefficients are presented in Table 2, indirect effects in Table 3, and the mediation model in Figure 1.

TABLE 3 Bias-Corrected bootstrap indirect effects of autistic traits on academic performance.

Path	Effect	Boot SE	LLCI	ULCI
Total indirect effect	−3.85	0.84	−5.55	−2.25
Via adaptive ER	−0.89	0.51	−1.99	0.00
Via maladaptive ER	−2.96	0.76	−4.53	−1.56
Contrast: adaptive−maladaptive	2.07	0.98	0.14	4.02

Bootstrap CIs based on 5,000 bias-corrected resamples. CIs excluding zero are statistically significant. Positive contrast values indicate that the maladaptive indirect effect is larger in absolute magnitude. LLCI, lower-limit CI; ULCI, upper-limit CI.

Sensitivity analysis

The mediation model was re-estimated using standard dichotomous AQ-10 scoring (0–10; Allison et al., 2012). The pattern of findings was fully replicated: autistic traits remained a significant predictor of both mediators and academic performance, both specific indirect effects were significant, and the maladaptive pathway accounted for the larger share of the indirect effect ($R^2 = .193$). A sensitivity analysis excluding age as a covariate also confirmed that the overall pattern was consistent across specifications.

Discussion

The present study examined whether cognitive emotion regulation strategies show significant indirect effects in the association between autistic traits and academic performance among university students. Consistent with hypotheses, autistic traits were negatively associated with academic performance, and parallel mediation analyses revealed significant indirect effects through both adaptive and maladaptive cognitive emotion regulation, with the maladaptive pathway showing a substantially larger effect. Because the direct effect remained significant after accounting for both mediators, these results are consistent with partial statistical mediation, suggesting that emotion regulation accounts for only a portion of the overall association.

The negative association between autistic traits and academic performance is consistent with prior research documenting academic challenges among students with elevated autistic traits within a dimensional framework (Baron-Cohen et al., 2001; Constantino and Todd, 2003). The present findings align with Dijkhuis et al. (2020), who reported that autism symptom severity predicted academic performance in higher education, and with Shmulsky et al. (2017), who found that behavioral regulation difficulties contributed to poorer outcomes among students on the autism spectrum. The present study extends this work by demonstrating that cognitive emotion regulation strategies statistically account for part of this association, consistent with the broader proposal that self-regulatory processes are relevant to academic functioning in this population (White et al., 2011; Hillier et al., 2018).

The pattern of reduced adaptive strategy use and elevated maladaptive strategy use among students with higher autistic traits is consistent with existing literature (Mazefsky and White, 2014; Conner et al., 2020; Nagase, 2025). Burrows et al.'s (2017) model of repetitive negative thinking in autism provides a theoretical account for the maladaptive finding: neural predispositions toward perseverative, negatively valenced cognition may channel regulatory efforts toward rumination and catastrophizing rather than reappraisal. This interpretation is further supported Zappullo et al.'s (2023) demonstration that repetitive negative thinking mediates the link between autistic-like traits and internalizing symptoms.

The larger indirect effect observed through the maladaptive pathway is consistent with meta-analytic evidence that

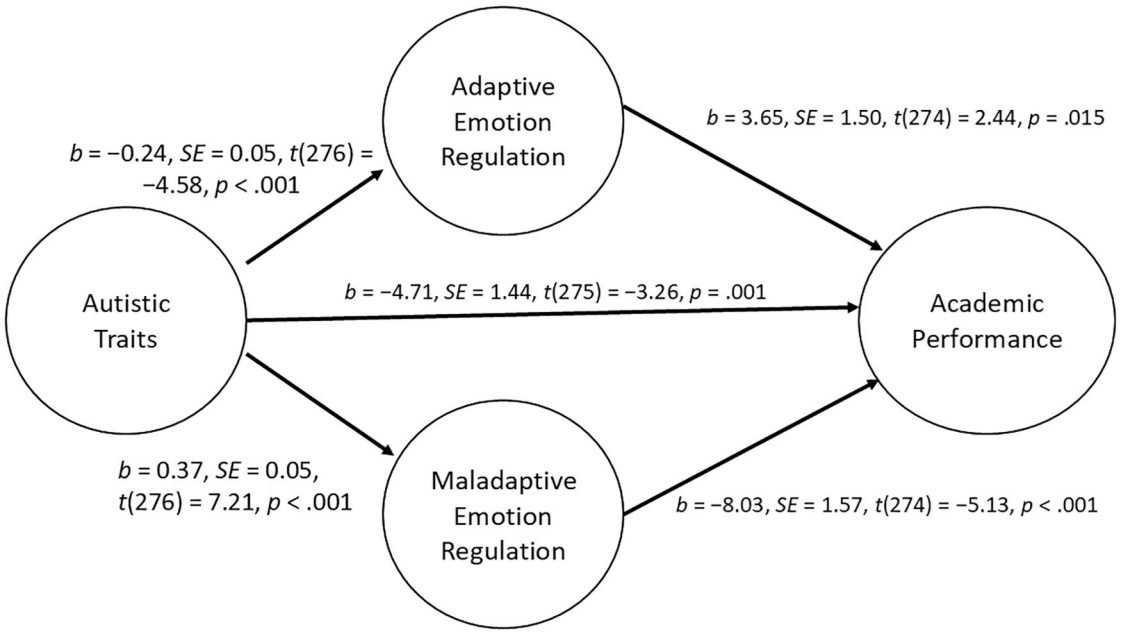

FIGURE 1
Parallel indirect-effect model of the association between autistic traits and academic performance via adaptive and maladaptive cognitive emotion regulation.

maladaptive regulatory strategies tend to show stronger associations with negative outcomes than adaptive strategies show with positive outcomes (Aldao et al., 2010). Interpreted through Pekrun, 2006 Control-Value Theory, maladaptive strategies such as catastrophizing and rumination may deplete cognitive resources, amplify stress responses, and interfere with concentration and task persistence in academic settings. The persistence of a significant direct effect suggests that additional factors not measured in this study—including executive functioning, sensory sensitivities, and social communication demands—likely also contribute to academic difficulties among students with elevated autistic traits (Gurbuz et al., 2019; Zukerman et al., 2023; Demetriou et al., 2018).

The findings suggest that academic difficulties associated with elevated autistic traits may partly reflect differences in cognitive emotion regulation, pointing toward potentially modifiable intervention targets. Cognitive-behavioral approaches targeting ruminative and catastrophizing thought patterns have shown promise in reducing emotion dysregulation among individuals with autism or elevated autistic traits (Mazefsky and White, 2014; Conner et al., 2020), and the present findings suggest that such approaches may also be relevant to academic outcomes. Programs targeting cognitive flexibility, such as the 'Unstuck and on Target' intervention (Kenworthy et al., 2014), provide models that could be adapted for higher education contexts, although direct intervention studies in university settings are needed before firm practical recommendations can be made.

More broadly, the findings support a process-oriented understanding of academic functioning among students with elevated autistic traits, in which academic success requires not only intellectual ability but also the capacity to regulate emotions in response to academic stressors. Structural accommodations addressing sensory, executive, and social communication demands remain important complements to any psychological intervention.

Limitations

Several limitations should be considered. Although the study employed a temporally separated design in which autistic traits and emotion regulation were assessed at the start of the semester and academic performance approximately four months later, the concurrent assessment of autistic traits and emotion regulation at baseline means that the temporal ordering of the mediating process cannot be definitively established. Accordingly, the indirect effects should be interpreted as statistical rather than causal; longitudinal research with repeated measurements would help clarify these relationships. The reliance on self-report measures may introduce shared method variance; future studies could incorporate behavioral assessments or informant reports. The sample consisted of psychology students from a single university, which may limit generalizability. The AQ-10 is a brief screening measure and may not capture the full complexity of autistic traits, and findings may not generalize to students with formal autism diagnoses. Executive functioning (Demetriou et al., 2018), comorbid anxiety and depression (Gurbuz et al., 2019; Zukerman et al., 2023), and additional contextual factors were not assessed and represent important directions for future research.

Conclusion

The present study provides evidence of significant indirect effects through cognitive emotion regulation in the association

between autistic traits and academic performance. Maladaptive cognitive emotion regulation accounted for a larger portion of the indirect effect, consistent with the theoretical proposal that dysregulating cognitive strategies may be particularly consequential for academic functioning. These findings highlight cognitive emotion regulation as a potentially important and modifiable factor to consider in future intervention research aimed at supporting students with elevated autistic traits in higher education.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Oakland University institutional review board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

TI: Writing – original draft, Writing – review & editing. RB: Writing – original draft, Writing – review & editing. HK: Writing – original draft, Writing – review & editing. MN: Writing – original draft, Writing – review & editing. CM: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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