

Cognitive Emotion Regulation in Early Adolescents with ADHD: Sex Differences in Adaptive Strategies

Annah R. Cash

annah.cash@cchmc.org

Cincinnati Children's Hospital Medical Center

Olivia Baron

Cincinnati Children's Hospital Medical Center

Melissa C. Miller

Cincinnati Children's Hospital Medical Center

Rosanna Breaux

Virginia Polytechnic Institute and State University

Stephen P. Becker

Cincinnati Children's Hospital Medical Center

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Abstract

Emotion regulation (ER) difficulties are common among youth with attention-deficit/hyperactivity disorder (ADHD), yet little is known about the cognitive strategies they use to regulate emotions or whether these associations differ by sex. We examined adaptive and maladaptive cognitive ER in 341 early adolescents (ages 10–12; $M = 10.90$; $SD = 0.80$), 47.8% of whom met diagnostic criteria for ADHD and 52.2% of whom were female. ADHD diagnosis was established using a semi-structured diagnostic interview administered to caregivers, and adolescents completed self-report measures of cognitive ER and internalizing symptoms. Regression models controlled for internalizing symptoms, age, family income, and medication use. Sex did not moderate the association between ADHD status and maladaptive cognitive ER. In contrast, sex moderated the association between ADHD and adaptive cognitive ER ($b = -0.32$, $p = .045$). Simple slopes analysis indicated ADHD status was associated with less frequent use of adaptive strategies among females ($b = -0.304$, $p = .011$) but was unrelated for males ($b = 0.02$, $p = .882$). Exploratory analyses of specific adaptive strategies indicated a significant ADHD $\times$ sex interaction for acceptance (i.e., acknowledging/coming to terms with what has occurred; $p = .032$), with the same pattern of simple slopes as observed for adaptive strategies. Findings suggest that ADHD-related differences in adaptive cognitive ER may be particularly relevant for females during early adolescence and highlight the importance of considering sex when examining ER in ADHD. Acceptance may warrant further investigation as a specific cognitive ER strategy relevant to females with ADHD.

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disorder characterized by developmentally inappropriate levels of inattention and/or hyperactivity-impulsivity [1]. Beyond core ADHD symptoms and associated impairments, difficulties with emotion regulation (ER) are increasingly recognized as a clinically important feature of ADHD, affecting an estimated 25–45% of youth with ADHD [2, 3]. ER difficulties may also contribute to the broader functional and psychiatric impairments experienced by youth with ADHD [4–6]. However, much of the ADHD literature has focused on emotional reactivity and broader manifestations of emotion dysregulation, such as emotional lability, irritability, and temper outbursts, with considerably less attention to the specific cognitive ER strategies youth use to regulate their emotional experiences [4, 7, 8].

Cognitive ER refers to the conscious cognitive strategies individuals use to manage their emotional responses to negative or unpleasant experiences [9, 10]. Cognitive ER strategies are commonly organized into broad adaptive and maladaptive domains [9]. Adaptive strategies include acceptance (acknowledging and coming to terms with what has occurred), positive refocusing (shifting attention toward positive or pleasant thoughts), refocusing on planning (thinking about steps that can be taken to manage the situation), positive reappraisal (identifying positive meaning or opportunities for growth), and putting into perspective (placing an experience in a broader context or considering its relative significance). Maladaptive strategies include self-blame (attributing responsibility for an experience to oneself), rumination or focus on thought (repetitively dwelling on thoughts and feelings associated with an experience), catastrophizing (magnifying the negative significance of an experience), and other-blame (attributing responsibility to others). Although these strategies are commonly categorized as adaptive or maladaptive based on their typical associations with adjustment, the effectiveness of a given strategy can also depend on situational context [11].

Understanding cognitive ER strategies may be particularly important during the transition to adolescence, a developmental period characterized by increasing emotional, social, and cognitive demands as well as greater expectations for independent ER [12]. Recent longitudinal work demonstrates that ER strategy use continues to change substantially across adolescence. For example, in two community-based longitudinal samples, Galarneau et al. [13] followed adolescents who were ages 11–12 and 13–15 at baseline, respectively, and found developmental changes in the use of individual ER strategies as well as increasing movement toward more diverse strategy selection across adolescence. Cognitive ER strategies are also associated with adolescent mental health and functioning. A meta-analysis of 35 studies using non-clinical samples found greater use of adaptive strategies to be associated with fewer depressive and anxiety symptoms and greater use of maladaptive strategies with more symptoms [14]. For instance, in a prospective school-based sample of 547 adolescents, greater use of maladaptive cognitive strategies was associated with higher anxiety and depressive symptoms, whereas greater use of adaptive strategies was associated with fewer internalizing symptoms [9]. Similarly, in a school-based prospective sample of 1,371 adolescents, greater use of maladaptive strategies and less use of adaptive strategies predicted higher depressive symptoms approximately six months later, even after accounting for baseline depressive symptoms [15]. Above and beyond dimensionally assessed ADHD symptoms and cognitive factors, greater use of maladaptive cognitive ER strategies was associated with greater overall functional impairment, including difficulties in family and social functioning and self-concept, in a community sample of 161 adolescents [5].

Given the importance of these ER strategies for adolescent functioning, examining specific strategies in addition to broader adaptive and maladaptive domains may be particularly informative in ADHD, as ADHD-related differences may be concentrated within certain strategies and obscured when only broad composite scores are considered. A small but growing literature has examined ER strategy use among individuals with ADHD. Among 116 adolescents ages 11–18, Lange and Tröster [16] found that adolescents with ADHD reported using fewer adaptive ER strategies than adolescents without ADHD, although the groups did not differ in maladaptive strategy use. Among 413 youth ages 9–16 (148 with ADHD and 265 controls), Liu et al. [17] found that youth with ADHD reported less frequent use of cognitive reappraisal than youth without ADHD. In older samples, Alacha et al. [18] found that, among 4,183 college students, those with elevated ADHD symptoms reported greater use of maladaptive cognitive ER strategies than students without elevated ADHD symptoms, although the groups did not differ in adaptive strategy use. Similarly, Mayer et al. [19] compared 40 adolescents and young adults diagnosed with ADHD with 40 demographically matched individuals without ADHD (ages 14–34) and found that participants with ADHD reported greater use of maladaptive strategies, including self-blame, catastrophizing, and rumination, as well as less use of positive reappraisal. Importantly, these differences were more closely related to depressive symptoms than to ADHD symptom severity [19]. Most recently, Astensvald et al. [7] examined cognitive ER among adolescents with and without ADHD ($N = 176$; ages 10–17). ADHD was initially associated with less frequent use of adaptive strategies and greater use of maladaptive strategies; however, these broad associations did not remain after accounting for co-occurring psychiatric symptoms and multiple comparisons. In strategy-specific analyses, ADHD remained associated with less frequent use of acceptance [7]. Taken together, findings suggest that ADHD may be associated with differences in

cognitive ER, but the pattern is not uniform across adaptive and maladaptive domains and may be influenced by co-occurring psychopathology. Moreover, much of the existing self-report literature has focused on older adolescents, young adults, or college students, leaving cognitive ER during early adolescence comparatively understudied.

An additional limitation of the existing literature is the limited consideration of sex differences. This is particularly important in ADHD research, in which females have historically been underrepresented [20, 21], and emerging longitudinal evidence suggests that emotional functioning may follow different developmental patterns for females and males with ADHD. De Ronda et al. [22] examined 417 youth ages 8–18 with and without ADHD, including a subsample of 121 youth with repeated assessments. Although both females and males with ADHD displayed elevated emotion dysregulation relative to their same-sex peers, males with ADHD showed greater reductions in emotion dysregulation, irritability, and anxiety across development, whereas these difficulties remained elevated among females with ADHD. Depressive symptoms also remained persistently elevated among females with ADHD, whereas symptoms among males with ADHD decreased with age relative to same-sex peers [22]. More recent longitudinal findings similarly suggest that the transition to adolescence may be especially important for females with ADHD. Using population-based data assessing emotional symptoms at ages 7, 11, and 14, Wang et al. [23] found that girls with ADHD showed increasing emotional symptoms across development, whereas symptoms among boys with ADHD remained relatively stable. Sex differences have also been observed in other dimensions of ER. Among 902 young adults with and without ADHD, Welkie and colleagues [24] found that sex moderated associations between ADHD and difficulties with emotional awareness, engaging in goal-directed behavior while distressed, and perceived access to ER strategies, with several associations being stronger among women with ADHD.

Emerging evidence suggests that sex differences may extend specifically to cognitive ER strategies, although findings remain limited and somewhat mixed. In a community sample of adolescents, females reported greater use of maladaptive cognitive ER strategies than males [5]. Similarly, in the Astenvald et al. [7] study reviewed earlier, the authors found that adolescent females reported less frequent use of adaptive strategies and greater use of maladaptive strategies than males, although the latter difference appeared to be accounted for by co-occurring depressive symptoms. Although Astenvald et al. [7] found no evidence that sex moderated associations between ADHD and either adaptive or maladaptive cognitive ER, it is important to note that these analyses were based on 94 adolescents (53 with ADHD), including 58 females (38 with ADHD), limiting statistical power for detecting potential moderation by sex. Thus, additional work using larger samples with strong representation of both females and males is needed to clarify whether sex assigned at birth moderates associations between ADHD and cognitive ER.

Present Study

The present study examined cognitive ER strategies in a large, well-characterized sample of early adolescents with and without ADHD. Specifically, we examined whether ADHD status was associated with broad adaptive and maladaptive cognitive ER strategy use and whether sex moderated these associations. Building on recent adolescent work, the present study examined these associations in a substantially larger self-report sample with approximately equal representation of females and males overall and with a focus on early adolescence specifically. Based on prior evidence linking ADHD with greater use of maladaptive cognitive ER strategies and, less consistently, lower use of adaptive strategies, we hypothesized that adolescents with ADHD would report greater use of maladaptive and less frequent use of adaptive cognitive ER strategies than adolescents without ADHD. Given evidence that females with ADHD may experience more persistent emotional difficulties across the transition to adolescence, we further hypothesized that ADHD-related differences in cognitive ER would be more pronounced among females than males, characterized by greater maladaptive and less frequent adaptive strategy use. Finally, to better characterize potential differences underlying the broader adaptive and maladaptive domains, we conducted exploratory analyses examining each cognitive ER strategy.

Methods

Participants

Participants were 341 early adolescents aged 10–12 years ($M = 10.90$; $SD = 0.80$). Participant and caregiver/family characteristics are presented in Table 1. The sample included approximately equal numbers of females ($n = 178$; 52.2%) and males ($n = 163$; 47.8%). Approximately half of participants (48.7%; $n = 166$) met diagnostic criteria for ADHD based on a semi-structured diagnostic interview administered to the adolescent's caregiver.

Table 1
Sample Characteristics (N = 341)

Adolescent Characteristics		Caregiver/Family Characteristics	
	<i>M ± SD</i>		<i>n (%)</i>
Age	10.90 ± 0.80	Relationship to Child	
		Biological Mother	293 (85.9)
	<i>n (%)</i>	Biological Father	26 (7.6)
Sex		Stepmother	2 (0.6)
Female	178 (52.2)	Adoptive Mother	14 (4.1)
Male	163 (47.8)	Adoptive Father	1 (0.3)
		Foster Mother	1 (0.3)
Race		Grandmother	3 (0.9)
American Indian/Alaskan	1 (0.3)	Grandfather	1 (0.3)
Asian	8 (2.3)		
Black	72 (21.1)	Household Income ^b	
Multiracial	48 (14.1)	Under \$20,000	15 (4.5)
White	212 (62.2)	20,001–40,000	37 (11.1)
		40,001–60,000	34 (10.2)
Hispanic/Latinx	32 (9.4)	60,001–80,000	38 (11.4)
		80,001-100,000	34 (10.2)
Psychiatric diagnoses ^a		100,001-120,000	45 (13.5)
ADHD - CR	166 (48.7)	Over \$120,000	130 (39.0)
Any externalizing (ODD) ^a - CR	24 (7.0)		
Any anxiety - CR	52 (15.2)	Highest Primary Caregiver Education ^c	
Any anxiety - SR	39 (11.4)	High school degree or less	25 (7.4)
Any depression - CR	5 (1.5)	Partial college/vocational	51 (15.1)
Any depression - SR	8 (2.3)	College graduate	141 (41.7)
		Graduate/professional degree	121 (35.8)
Medication Use			
ADHD	83 (24.3)		
Other psychiatric	24 (7.0)		
<i>Note.</i> ADHD = attention-deficit/hyperactivity disorder. ODD = oppositional defiant disorder. Anxiety disorders = presence of generalized anxiety disorder, social phobia, panic disorder, and/or posttraumatic stress disorder (PTSD). Any depression = presence of major depression or dysthymia. CR = parent-report. SR = adolescent self-report.			
^a Current psychiatric diagnoses were assessed using the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS). Only caregivers were administered the ODD and PTSD modules. No participants met criteria for conduct disorder.			
^b Eight caregivers did not provide family income.			
^c Three caregivers did not provide education.			

Procedures

All study procedures were approved by the [MASKED FOR REVIEW] Institutional Review Board. Participants were recruited from a variety of sources, including media advertisements, community flyers, e-mail distribution within a children's hospital, and outreach to school and pediatrician partners. To facilitate recruitment of adolescents across a range of attentional functioning, advertisements were developed both with and without descriptions of attentional difficulties.

Interested caregivers first completed a brief REDCap screening survey assessing initial eligibility criteria, including adolescent age. Families meeting initial eligibility criteria were scheduled for an in-person research visit. At the visit, caregivers provided informed consent and adolescents provided assent prior to completing study procedures. Eligibility criteria included being 10–12 years of age, obtaining a standard score ≥ 80 on the Peabody Picture Vocabulary Test–Fifth Edition (PPVT-5; [25]), sufficient English-language proficiency to complete study measures, and willingness to withhold stimulant medication on the day of the research visit. Adolescents were excluded if caregivers reported a previous diagnosis of autism spectrum disorder, bipolar disorder, or psychosis, or a significant visual, hearing, or speech impairment that would preclude completion of study procedures. For additional details, see MASKED FOR REVIEW.

Measures

Caregivers completed a demographic questionnaire assessing participant and family characteristics summarized in Table 1. Current medication use and psychosocial treatment were assessed using an adaptation of the Services for Children and Adolescents–Parent Interview (SCA-PI; [26]).

Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS)

ADHD diagnostic status was determined using the KSADS–Present and Lifetime Version [27], a semi-structured diagnostic interview based on DSM-5 criteria. The K-SADS has demonstrated good reliability and validity for assessing psychiatric disorders among children and adolescents [28]. The ADHD module was administered to caregivers. Participants were classified in the ADHD group when caregivers endorsed (a) six or more clinically significant symptoms of inattention and/or hyperactivity/impulsivity, (b) symptom onset prior to age 12 years, (c) symptoms occurring across two or more settings, (d) clinically significant impairment associated with symptoms, and (e) symptoms that were not better explained by another disorder. Participants who did not meet full diagnostic criteria were classified in the non-ADHD comparison group. Additional K-SADS modules assessing conduct disorder, generalized anxiety disorder, social anxiety disorder/social phobia, panic disorder, posttraumatic stress disorder, major depressive disorder, and persistent depressive disorder were administered separately to caregivers and adolescents. The oppositional defiant disorder module was administered to caregivers only.

Cognitive Emotion Regulation Questionnaire (CERQ) - Short Form

Adolescents completed the CERQ – Short Form [29], an 18-item self-report measure assessing cognitive ER strategies used in response to negative or unpleasant experiences. A recent systematic review and meta-analysis provides robust support for the psychometric properties of the CERQ for assessing cognitive ER strategies in children and adolescents [30]. The measure includes nine two-item strategy subscales. Five strategies are typically categorized as adaptive: acceptance, positive refocusing, refocusing on planning, positive reappraisal, and putting into perspective. Four strategies are categorized as maladaptive: self-blame, rumination/focus on thought, catastrophizing, and other-blame. Items are rated on a 5-point scale ranging from 1 (*almost never*) to 5 (*almost always*), with higher scores reflecting more frequent use of the corresponding strategy. For the primary analyses, items were combined to create mean adaptive and maladaptive cognitive ER composite scores, with higher scores indicating more frequent use of adaptive and maladaptive strategies, respectively. Individual strategy scores were examined in exploratory analyses. In the current sample, $\alpha = .79$ and $.73$ for adaptive and maladaptive cognitive ER composites, respectively. For the individual strategy subscales, α s ranged from $.57$ to $.73$ for maladaptive strategies and from $.53$ to $.72$ for adaptive strategies.

Behavioral Assessment System for Children, Third Edition (BASC-3)

Internalizing symptoms were assessed using the Self-Report of Personality form of the BASC-3 [31]. The BASC-3 is a widely used multidimensional measure of emotional and behavioral functioning in youth. Items are rated using either true/false responses or a 4-point frequency scale ranging from 1 (*Never*) to 4 (*Almost Always*), depending on the item. The Internalizing Problems composite *T*-score was used in analyses in the present study, with higher scores indicating greater internalizing symptoms.

Analytic Approach

Analyses were conducted using IBM SPSS Statistics Version 29 (2023). Preliminary zero-order correlations were conducted to examine associations among study variables. Primary moderation analyses were calculated using Model 1 of the PROCESS macro for SPSS [32]. Separate models were estimated for adaptive and maladaptive cognitive ER. Each model included the main effects of ADHD status and sex and the ADHD status $\times$ sex interaction. Significant interactions were probed by estimating the conditional association between ADHD status and cognitive ER separately for females and males. Age, family income, current psychiatric medication status, and internalizing symptoms were included as covariates in the primary models. Medication status was coded 0 = not currently taking a prescribed psychiatric medication and 1 = currently taking a prescribed psychiatric medication. Family income was treated as an ordinal variable ranging from 1 (less than \$20,000 annually) to 7 (greater than \$120,000 annually). Eight participants were missing family-income data and were therefore excluded from regression analyses, resulting in an analytic sample of $N = 333$ (71 females with ADHD, 93 males with ADHD, 105 females without ADHD, 64 males without ADHD). PROCESS models used 5,000 bootstrap samples to estimate 95% confidence intervals. Primary analyses examined the broad adaptive and maladaptive cognitive ER composites. Exploratory follow-up models separately examined each of the nine individual CERQ-Short strategies to characterize whether any observed effects were concentrated within specific cognitive ER strategies.

Results

Bivariate Correlations

Table 2 provides the intercorrelations and descriptive statistics of the study variables. In considering our primary variables, there was a small but statistically significant association between having ADHD and higher maladaptive ER strategy use ($r = .14, p = .013$), whereas ADHD was not significantly associated with adaptive ER strategies ($r = -.10, p = .073$). Male sex was associated with both ADHD status ($r = -.18, p < .001$) and higher scores in adaptive ER strategies ($r = -.11, p = .040$). Sex was not significantly associated with maladaptive ER strategies ($r = -.06, p = .240$). Internalizing symptoms were strongly associated with higher maladaptive ER strategies ($r = .56, p < .001$), but were not significantly associated with adaptive ER strategies ($r = -.08, p = .166$). Finally, maladaptive and adaptive ER strategies were significantly, moderately positively correlated ($r = .27, p < .001$).

Table 2
Intercorrelations and Descriptive Statistics of Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Medication Status	--															
2. Age	.03	--														
3. Family Income	.07	.05	--													
4. Internalizing Symptoms	.32***	.01	-.02	--												
5. Sex	-.15**	.06	-.07	-.04	--											
6. ADHD Status	.49***	-.01	-.06	.33***	-.18***	--										
7. Maladaptive ER	.17**	.02	.04	.56***	-.06	.14*	--									
8. Adaptive ER	-.03	.12*	.03	-.08	-.11*	-.10	.27***	--								
9. Self-Blame	.11	.08	.08	.49***	-.002	.04	.68***	.16***	--							
10. Focus On Thought	.05	.08	.05	.29***	-.01	.07	.70***	.42***	.32***	--						
11. Catastrophize	.22***	-.08	-.01	.48***	-.06	.17**	.76***	.04	.36***	.30***	--					
12. Other-Blame	.08	-.04	-.03	.26***	-.12*	.10	.59***	.11*	.16**	.23***	.35***	--				
13. Acceptance	-.09	.07	.02	.004	-.13*	-.07	.25***	.66***	.17**	.40***	.06	.02	--			
14. Positive Refocusing	.06	.03	-.09	-.09	-.03	.05	.08	.62***	.02	.14*	-.01	.08	.21***	--		
15. Refocus On Planning	-.03	.05	.04	-.09	-.11*	-.10	.24***	.77***	.17**	.32***	.03	.12*	.33***	.37***	--	
16. Positive Appraisal	-.13*	.10	.11*	-.17**	-.06	-.16**	.09	.74***	.04	.26***	-.10	.06	.38***	.29***	.54***	--
17. Put Into Perspective	.09	.15**	-.003	.09	-.07	-.04	.28***	.68***	.16**	.34***	.15**	.10	.37***	.27***	.42***	.30***
Mean	--	10.90	5.08	52.57	--	--	2.13	2.87	2.11	2.54	1.99	1.87	2.99	2.63	2.91	3.00
SD	--	0.80	1.99	10.82	--	--	0.63	0.72	0.91	0.99	1.01	0.76	1.03	1.02	1.06	1.01
Skewness	--	0.18	-0.59	0.98	--	--	0.66	0.10	1.02	0.46	1.08	1.08	0.13	0.49	0.12	-0.01
Kurtosis	--	-1.40	-1.06	1.16	--	--	0.41	-0.05	0.83	-0.29	0.68	1.65	-0.69	-0.28	-0.75	-0.01

Note. $N = 341$. For medication status, 0 = not currently taking any prescribed psychiatric medication, 1 = currently taking prescribed psychiatric medication. For family income, 1 = annual income under \$20,000 to 7 = over \$120,000. (see Table 1 for categories). For sex, 0 = male, 1 = female. For ADHD status, 0 = non-ADHD, 1 = ADHD. ER = emotion regulation.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Primary Moderation Analyses Examining Maladaptive and Adaptive Cognitive ER Strategies

Results of the regression analyses examining ADHD group status, sex assigned at birth, and their interaction in relation to maladaptive and adaptive cognitive ER strategies are summarized in Table 3. In analyses controlling for age, medication status, family income, and internalizing symptoms, the ADHD × sex interaction was not significant in predicting maladaptive ER strategies ($p = .121$). Internalizing symptoms was the only independent variable associated with higher maladaptive ER strategies, ($p < .001$), with findings unchanged when the regression model was re-run without the interaction term.

Table 3
Moderation Models Examining Sex as a Moderator of the Association between ADHD Status in Relation to Maladaptive and Adaptive Cognitive Emotion Regulation Strategies

Maladaptive ER Strategies	Coefficient (SE)	<i>t</i>	95% CI
<i>F</i> (7,325) = 22.25***, <i>R</i> ² = .32			
Age	0.01 (0.04)	0.29	-0.06, 0.08
Medication Use	0.01 (0.08)	0.17	-0.14, 0.16
Family Income	0.01 (0.01)	0.75	-0.02, 0.04
Internalizing Symptoms	0.03 (0.003)	11.62***	0.03, 0.04
ADHD Status	0.03 (0.09)	0.29	-0.16, 0.21
Sex	0.04 (0.08)	0.52	-0.12, 0.21
ADHD Status × Sex	-0.18 (0.12)	-1.56	-0.42, 0.05
Adaptive ER Strategies	<i>F</i> (7,325) = 2.52*, <i>R</i> ² = .05		
Age	0.11 (0.05)	2.25*	0.01, 0.21
Medication Use	0.01 (0.10)	0.13	-0.19, 0.21
Family Income	-0.003 (0.02)	-0.16	-0.04, 0.04
Internalizing Symptoms	-0.003 (0.004)	-0.74	-0.01, 0.005
ADHD Status	0.02 (0.13)	0.15	-0.23, 0.27
Sex	-0.02 (0.11)	-0.21	-0.25, 0.20
ADHD Status × Sex	-0.32 (0.16)	-2.01*	-0.64, -0.01
Note. Bootstrap samples = 5,000. For medication status, 0 = not currently taking any prescribed psychiatric medication, 1 = currently taking a prescribed psychiatric medication. For sex, 0 = male, 1 = female. ADHD = attention-deficit/hyperactivity disorder. ER = emotion regulation.			
* $p < .05$. *** $p < .001$.			
Supplemental Table S1			
<i>Exploratory Moderation Models Examining Sex as a Moderator of the Association Between ADHD Status and Specific Maladaptive Cognitive Emotion Regulation Strategies</i>			

Above and beyond covariates, the ADHD × sex interaction was significant in predicting adaptive ER strategies ($p = .045$; see Table 3). Simple slope conditional effect analysis indicated that ADHD status was associated with lower adaptive cognitive ER strategies for females ($b = -0.30$, $SE = .12$, $t = -2.56$, $p = .011$), but not for males ($b = 0.02$, $SE = .13$, $t = 0.15$, $p = .882$).

Supplemental Analyses Examining Specific Cognitive ER Strategies

Exploratory analyses were conducted examining the ADHD × sex interaction in separate models with each of the maladaptive cognitive ER subdomains (i.e., self-blame, focus on thought/rumination, catastrophizing, other-blame) and adaptive ER subdomains (i.e., acceptance, positive appraisal, positive refocusing, refocusing on planning, putting into perspective). Results of these exploratory models are presented in Supplemental Tables S1 (maladaptive strategies) and S2 (adaptive strategies). Consistent with the primary model examining total maladaptive cognitive ER strategies, there were no significant ADHD × sex interaction for any of the maladaptive cognitive ER subdomains (all $ps > .05$).

In considering the adaptive cognitive ER subdomains, the ADHD × sex interactions were not significant for the positive appraisal, positive refocusing, refocusing on planning, or putting into perspective subdomains (all $ps > .05$). A significant ADHD × sex interaction was found for acceptance ($t = -2.16$, $p = .032$). Consistent with the primary model examining total adaptive cognitive emotion regulation strategies, simple slope conditional effect analyses indicated that ADHD was associated with lower acceptance among females ($b = -0.356$, $SE = .17$, $t = -2.095$, $p = .037$) but not among males ($b = 0.139$, $SE = .18$, $t = 0.763$, $p = .446$).

Discussion

The present study examined cognitive ER strategies in a well-characterized sample of early adolescents with and without ADHD, with particular attention to whether associations differed between females and males. In a sample with a larger number of females with ADHD than prior work in this area, we found that ADHD was associated with less frequent use of adaptive cognitive ER strategies among females but not males. This finding underscores the importance

of directly examining sex differences in ADHD, particularly in samples with sufficient representation of females. In contrast, although ADHD was initially associated with greater maladaptive strategy use in the full sample, this association did not remain after accounting for internalizing symptoms and other covariates and there was no indication of moderation by sex for maladaptive ER strategies. Together, findings suggest that associations between ADHD and cognitive ER may differ depending on both the type of strategy examined and adolescent sex assigned at birth.

Sex Differences in Adaptive Cognitive Emotion Regulation

Based on correlation analyses in the full sample, ADHD status was not associated with adaptive cognitive ER strategy use. However, this overall null association would have led to a premature conclusion, as moderation analyses indicated important sex differences. Specifically, ADHD status was associated with less frequent use of adaptive ER strategies among females but not males. This pattern highlights the value of examining sex as a potential moderator, as considering only the overall association between ADHD and adaptive strategy use would have masked an association specific to females in this sample. This finding is particularly important given the historical underrepresentation of females in ADHD research and underscores the importance of adequately representing females when examining potential sex differences in ADHD-related functioning [20, 21].

Our finding regarding adaptive cognitive ER strategies builds on a limited number of studies examining cognitive ER in youth with ADHD [7, 17, 19]. Although Astensvald et al. [7] found females reported less frequent use of adaptive ER strategies than males during adolescence, they did not find sex to moderate the link between ADHD and cognitive ER. It is possible that differences in findings between our study and the study by Astensvald and colleagues are attributable to sample size, or their larger age range (i.e., 10–17 years). Whereas the analyses involving adaptive ER strategies in Astensvald et al. [7] included 53 adolescents with ADHD, 38 of whom were female, primary analyses in the current study included 164 adolescents with ADHD, 71 of whom were female. The present study may have thus been better-powered to detect sex-specific moderation in the context of ADHD, though the differing findings across studies underscore the importance of replication before drawing firm conclusions. Similarly, there is some prior evidence of differential findings based on developmental period, and since the Astensvald et al. [7] study spanned both early and mid-to-late adolescence, it is possible that a three-way interaction may be present with age and sex both interacting with ADHD status.

More broadly, the current findings are consistent with evidence that sex may be important to consider when examining emotional functioning in ADHD. Emotional difficulties have been found to persist or increase among females with ADHD across the transition to adolescence, whereas males with ADHD demonstrate comparatively stable or improving emotional functioning across development [22, 23]. Similarly, in a sample of young adults, Welkie and colleagues [24] found that ADHD was more strongly associated with several aspects of ER difficulty among females compared to males, including perceived limited access to ER strategies. Our findings add to this literature by raising the possibility that sex-related differences in adaptive cognitive ER among individuals with ADHD are already evident by early adolescence. Longitudinal research is needed to determine whether these differences emerge during this developmental period, precede adolescence, or become more pronounced as adolescents encounter increasing emotional and self-regulatory demands.

Exploratory analyses examining individual adaptive strategies provided additional insight into the broader adaptive ER strategy finding. Acceptance was the only adaptive strategy for which the ADHD $\times$ sex interaction was significant, with ADHD being associated with less frequent acceptance among females but not males. This finding is notable in light of recent work in which lower acceptance was also the cognitive ER strategy that remained associated with ADHD in final models accounting for co-occurring psychiatric symptoms [7]. Although findings differed slightly across studies, with Astensvald et al. [7] finding an overall ADHD-related difference and the present study finding a female sex-specific association, the pattern of results from these two independent studies point to acceptance as a likely important cognitive ER strategy among youth with ADHD, perhaps especially for females.

Acceptance may also be particularly relevant during adolescence, as Lennarz et al. [33] found that acceptance was the most frequently reported ER strategy in adolescents' daily lives and that its use was associated with reductions in negative affect. Strategy selection also appears to vary according to characteristics of the emotional experience; for example, adolescents may be more likely to use acceptance in response to lower-intensity negative emotions. One possibility warranting future investigation is therefore that differences in the frequency, intensity, or context of negative emotional experiences may influence when youth with ADHD are able or inclined to use acceptance relative to other ER strategies. Intensive longitudinal approaches such as ecological momentary assessment could help determine whether females with ADHD use acceptance less frequently across negative emotional experiences generally or whether group differences emerge under particular emotional conditions. Nevertheless, the present finding should be considered preliminary. The strategy-specific analyses were exploratory, and each strategy is represented by only two items on the CERQ-Short. Replication using more comprehensive measures of individual cognitive ER strategies is therefore important before drawing strong conclusions regarding acceptance specifically.

Maladaptive Cognitive Emotion Regulation and Internalizing Symptoms

Findings for maladaptive cognitive ER strategies showed a different pattern. Consistent with our hypothesis and previous studies [18, 19], ADHD was associated with greater maladaptive strategy use at the bivariate level, although the magnitude of this association was small. However, this association did not remain in the multivariable model after accounting for age, medication use, family income, and internalizing symptoms. Sex also did not moderate the association between ADHD status and maladaptive strategy use. Instead, internalizing symptoms were the only significant predictor of maladaptive cognitive ER in the adjusted model and accounted for a substantial portion of the variance in maladaptive strategy use. The prominent role of internalizing symptoms is consistent with previous cognitive ER research in ADHD. For example, Mayer and colleagues [19] found that differences in cognitive ER among youth with ADHD were more closely related to depressive symptoms than to ADHD symptom severity. Similarly, in another recent study, Astensvald et al. [7] initially found greater maladaptive strategy use among youth with ADHD, but these broad ADHD-related differences did not remain after accounting for co-occurring psychiatric symptoms, with depressive symptoms emerging as particularly relevant to maladaptive strategy use. The present findings therefore add to evidence suggesting that elevated use of strategies such as rumination, catastrophizing, and self-blame among adolescents with ADHD may not be uniquely associated with ADHD itself and may instead substantially overlap with co-occurring internalizing difficulties. This distinction may be especially important when interpreting previous studies that report greater maladaptive cognitive ER among individuals with ADHD without fully accounting for co-occurring

symptoms. At the same time, the cross-sectional design of the current study prevents conclusions regarding the direction of these associations. Greater reliance on maladaptive cognitive ER strategies may contribute to the emergence or maintenance of anxiety and depressive symptoms, internalizing symptoms may increase adolescents' tendency to engage in strategies such as rumination and catastrophizing, or these processes may reinforce one another over time. Prospective research is particularly important given evidence that greater maladaptive and less frequent adaptive strategy use prospectively predict depressive symptoms during adolescence [15]. Examining these processes longitudinally among youth with ADHD could help clarify whether maladaptive strategy use represents one potential pathway through which some youth with ADHD develop co-occurring internalizing difficulties, particularly depressive symptoms.

Broader Implications for ER in ADHD

The present findings also have implications for how ER difficulties are conceptualized and assessed in youth with ADHD. Much of the ADHD and ER literature has focused on emotional reactivity, irritability, emotional lability, and other broader manifestations of dysregulation. The current findings suggest that it may also be useful to assess the cognitive strategies youth use to navigate negative emotional experiences. In particular, adaptive ER strategy use may provide information not captured by assessments focusing primarily on maladaptive thinking or overt emotional dysregulation, especially among females with ADHD. However, the present findings should not yet be interpreted as evidence that females and males with ADHD require different treatments. Rather, they identify adaptive cognitive ER, and potentially acceptance specifically, as areas warranting further investigation in intervention research. Future studies could examine whether interventions that strengthen flexible selection and use of adaptive cognitive strategies improve emotional functioning among youth with ADHD and whether their effects differ by sex. Early adolescence may be a particularly useful period in which to examine such approaches because ER strategies and broader strategy selection continue to develop during this period.

Strengths, Limitations, and Future Directions

The present study has several strengths. We examined cognitive ER in a relatively large, well-characterized sample of early adolescents that included approximately equal numbers of females and males overall and of adolescents with and without ADHD. ADHD diagnostic status was established using a semi-structured diagnostic interview rather than relying solely on questionnaire-based symptom elevations. The narrow age range of 10–12 years also provided a focused examination of early adolescence, a developmental period during which ER strategies are continuing to change and sex-related differences in emotional functioning may be emerging, despite this developmental period being understudied in prior research.

Several limitations should also be considered. First, the cross-sectional design precludes conclusions regarding developmental or temporal processes. Although sex differences in the association between ADHD and adaptive cognitive ER were evident in this early adolescent sample, longitudinal research beginning in childhood and extending through adolescence is needed to determine when these differences emerge and how they change over time. Such studies would also help clarify the temporal relationships among ADHD, cognitive ER, and internalizing symptoms. Second, ADHD diagnostic status was determined based on caregiver report during a semi-structured interview and, although rigorous, future work would benefit from integrating adolescent self-report and additional informants (e.g., teachers), particularly given evidence that ADHD may manifest or be recognized differently among females and males. Examining ADHD symptom dimensions continuously may also provide additional information beyond categorical diagnostic status and allow future research to determine whether inattention and hyperactivity-impulsivity show distinct associations with cognitive ER. Third, cognitive ER was assessed exclusively through adolescent self-report. Although adolescents are best equipped to speak to their internal states, incorporating multiple methods, including ecological momentary assessment and experimental assessments of strategy selection and use, would provide a more context-sensitive understanding of how adolescents regulate emotions in everyday life. Such approaches could be particularly informative given evidence that strategy selection and effectiveness vary according to features of emotional experiences, including emotional intensity. Moreover, internalizing symptoms and cognitive ER were both assessed through adolescent self-report, meaning that the strong association between these constructs may be influenced in part by shared method variance. Future multimethod work will therefore be important for clarifying the extent to which internalizing symptoms independently account for maladaptive cognitive ER among youth with ADHD. Fourth, use of the 18-item CERQ-Short limited the assessment of each cognitive ER strategy to two items. Accordingly, the exploratory acceptance finding should be considered preliminary and replicated using the full CERQ or other measures that provide more comprehensive assessment of individual strategies. This caution is particularly important given the exploratory nature of the strategy-specific analyses. Finally, although the sample included adolescents from diverse racial backgrounds and was approximately balanced by sex, participants disproportionately came from families with higher caregiver education and household income. Replication in more socioeconomically representative samples is needed. In addition, the current study examined sex using binary female/male categories and did not assess gender-related processes. Future research should also consider whether observed differences are associated with biological sex-linked processes, pubertal development, gendered social experiences, or some combination of these factors, while also including intersex and gender-diverse youth.

Conclusion

The present study advances a small but growing literature examining cognitive ER among youth with ADHD and provides evidence that sex may be important to consider in associations between ADHD and adaptive cognitive ER during early adolescence. Although ADHD was not associated with overall adaptive cognitive ER across the full sample, ADHD was associated with less frequent use of adaptive strategies among females but not males. Exploratory analyses further identified acceptance as one potentially relevant strategy. In contrast, the small bivariate association between ADHD and maladaptive cognitive ER did not remain after accounting for internalizing symptoms, which emerged as the strongest correlate of maladaptive strategy use. Together, these findings underscore the importance of looking beyond broad emotion dysregulation in ADHD to consider specific cognitive ER strategies and potential sex differences in their use, while also highlighting the need for longitudinal and multimethod research to determine how these associations unfold across development.

Declarations

Conflict of interests:

The authors declare no potential conflicts of interest with respect to the research, authorship, or publication of this article.

Declaration of Interests:

The authors have declared that they have no competing or potential conflicts of interest.

Author Contribution

ARC: Conceptualization, Writing – Original Draft Preparation, Writing – Review & Editing, & prepared supplemental tables S1-S2. OB: Conceptualization, Writing – Original Draft Preparation, Writing – Review & Editing, & prepared tables 1-3. MCM: Conceptualization, Writing – Review & Editing. RB: Writing – Review & Editing. SPB: Conceptualization, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing, Funding Acquisition. All authors reviewed the manuscript.

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Data Availability

Data are available upon request through the corresponding author.

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