



ADHD Symptoms and Procrastination in College Students: The Roles of Emotion Dysregulation and Self-Esteem

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Abstract

Previous work suggests that symptoms of attention-deficit/hyperactivity disorder (ADHD) are associated with procrastination in college students, but relatively little is known about markers that account for this relation. In the present study, we examined the relation between ADHD symptoms and procrastination and whether indirect effects through emotion regulation and self-esteem independently and/or serially account for this relation. Five hundred ninety-five college students (79.5% female; 84.7% white; 94.3% between 18 and 22 years of age) completed a variety of online self-report measures assessing ADHD symptoms, emotion dysregulation, self-esteem, and procrastination. Difficulties in emotion regulation and self-esteem partially accounted for the relation between ADHD symptoms and procrastination individually in simple mediation models as well as together in a serial mediation model. These results are consistent with previous literature linking ADHD symptoms to greater difficulties in emotion regulation, lower self-esteem, and more frequent procrastination. This work suggests that improving emotion regulation skills and self-esteem in college students with symptoms of ADHD should be an important goal of treatment, but future work using longitudinal data is needed to gain a better understanding of the temporal relations among these variables.

Keywords ADHD · College · Emotion dysregulation · Self-esteem · Procrastination

Preliminary evidence supports a link between symptoms of attention-deficit/hyperactivity disorder (ADHD) and procrastination in the college student population, but relatively little is known about what could account for this putative association. Emotion dysregulation and low self-esteem are commonly seen among those with ADHD, both likely connected to underlying deficits in executive functioning (Barkley, 2015; Bolden & Fillauer, 2019; Kolubinski et al., 2019). Given that procrastination is a form of emotion-based avoidance, it seems that both emotion dysregulation and low self-esteem could help to account for the relation between ADHD symptoms and procrastination. If one is not equipped with skills to regulate distressing emotions that come up

when completing an undesirable task, this might lead them to avoid the task altogether. Further, since avoidance of a task prevents or delays the experience of failure, procrastination may be a self-protective strategy employed in response to low self-esteem (Rebetz et al., 2015). Since recent literature suggests that emotion dysregulation contributes substantially to low levels of self-esteem in the college student population (Fasciano et al., 2021; Yalçinkaya-Alkar, 2020), there could also be a serial pathway in which ADHD symptoms would predict emotion dysregulation, which in turn would predict lower self-esteem, which in turn would predict more frequent procrastination.

In the present study, we examined indirect effects of ADHD on procrastination both through emotion regulation and through self-esteem to see if either independently accounted for the relation between ADHD symptoms and procrastination. Given those initial results, we then tested a serial model to investigate a pathway through both emotion dysregulation and self-esteem. Emotion dysregulation was selected to be first in the serial pathway in light of recent literature suggesting that it contributes substantially to low levels of self-esteem in the college student population

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(Fasciano et al., 2021; Yalçinkaya-Alkar, 2020). Investigating indirect effects through these variables independently as well as serially can shed light on whether interventions for procrastination should focus on emotion dysregulation and/or self-esteem. If a serial pathway is found, then targeting just emotion dysregulation could be expected to have downstream effects on self-esteem and procrastination.

ADHD Symptoms and Procrastination in College Students

Symptoms of ADHD, a neurodevelopmental disorder characterized by impairing levels of inattention, hyperactivity, and impulsivity, affect approximately 2% to 8% of the college student population (DuPaul et al., 2009). College students with ADHD experience impairment in many domains of functioning (Weyandt et al., 2013), including the academic domain. Students with ADHD take longer to finish their degrees, have lower GPAs, and have a higher likelihood of dropping out when compared to students without ADHD (Advokat et al., 2011; Barkley et al., 2008; Faraone & Biederman, 2005; Weyandt et al., 2013). One reason for these academic difficulties could be that college students with ADHD are more likely to procrastinate than their typically developing peers (Miller, 2007). Difficulties with procrastination are likely tied to underlying deficits in executive functioning, which have been shown to partially account for the relation between procrastination and ADHD symptoms in college students (Bolden & Fillauer, 2019).

Procrastination, defined by Küchler and colleagues as “the irrational and voluntary delaying of necessary tasks” (Küchler et al., 2019, p. 1), is a behavior that is seen frequently among students and young people (Beutel et al., 2016; Kachgal et al., 2001) and is tied to a number of negative outcomes such as depression, anxiety, fatigue, stress, and poorer academic performance in college (Beutel et al., 2016; Kim & Seo, 2015; Tice & Baumeister, 1997; You, 2015). Given that college students with ADHD are already at risk for many of these negative outcomes, it is especially important to understand the role that symptoms of ADHD play in predicting this behavior.

Several studies provide preliminary evidence that ADHD may be associated with procrastination in college students. For example, a 2018 study found that adults with ADHD scored significantly higher than non-diagnosed adults on the Tuckman Procrastination Scale (Altgassen et al., 2019). In another study, college students with ADHD scored significantly higher than their non-ADHD counterparts on both the Mann’s Decisional Procrastination Scale and the Lay’s General Procrastination Scale (Miller, 2007). The association between ADHD and procrastination also appears to exist when looking at ADHD as a dimensional rather than

categorical construct. In a sample of 114 undergraduate students, ADHD symptom dimensions (inattention and hyperactivity) were positively associated with procrastination (Bolden & Fillauer, 2019). Despite these preliminary findings linking ADHD to procrastination in college students, this body of literature is limited, and more work is necessary to replicate these findings and better understand factors accounting for the relation between ADHD and procrastination. As noted above, one variable that may help to account for the relation between ADHD symptoms and procrastination is difficulties with emotion dysregulation, a component of executive dysfunction frequently experienced by adults with ADHD. An indirect effect through emotion dysregulation would also be supported by current conceptualizations of procrastination as a maladaptive emotion regulation strategy that provides short-term mood repair (Pychyl & Sirois, 2016).

Indirect Effects Through Emotion Dysregulation

Emotion regulation is a process that involves not just the modulation of emotional arousal, but also the awareness, understanding, and acceptance of emotions, as well as the ability to act in desired ways regardless of emotional state (Gratz & Roemer, 2004). Shaw et al. (2014) found that about 30% to 70% of adults with ADHD have significant difficulties with emotion dysregulation (Shaw et al., 2014), and prior work supports that ADHD is associated with emotion dysregulation difficulties in emerging adulthood (Weyandt et al., 2013). The literature also indicates that problematic emotion dysregulation helps account for the relation between ADHD and negative outcomes such as maladaptive anger while driving (Oliver et al., 2015), social impairment (Flannery et al., 2016), and suicidal ideation (Van Eck et al., 2015) in college students.

Less is known about whether emotion dysregulation plays a role in accounting for the association between ADHD and procrastination, but a role for it seems likely given (a) the link between ADHD and emotion dysregulation and (b) growing evidence of an association between emotion dysregulation and procrastination (Wypych et al., 2018). For instance, a 2019 study found evidence that low emotional intelligence, a construct that is closely related to emotion dysregulation (Mikolajczak et al., 2008), is associated with procrastination among nursing students (Guo et al., 2019). Evidence also indicates that training in emotion regulation skills can help to decrease procrastination (Eckert et al., 2016), which further supports that these two constructs are closely linked.

Existing literature looking at indirect effects of ADHD on procrastination through emotion dysregulation is quite limited. A 2019 study by Bolden and Fillauer found that

procrastination had an indirect effect on ADHD symptoms through executive functions, and one of several subscales of the executive functions measure used in this study was a self-regulation of emotion subscale. However, follow up analyses suggested that self-management of time and organization/problem solving, and not self-regulation of emotion, were the subscales driving the indirect association between procrastination and ADHD symptoms. One important limitation of the model examined in the Bolden and Fillauer (2019) study was that ADHD symptoms were treated as the outcome variable while procrastination was the predictor variable. Given that ADHD is a neurodevelopmental disorder that typically manifests early in childhood, it is important to examine a model in which ADHD symptoms predict difficulties with procrastination. Additionally, some evidence suggests a common type of emotion regulation strategy, suppression (defined by Gross in 1998 as “the conscious inhibition of emotion-expressive behavior”, p. 226), accounts for a link between impulsivity and procrastination (Wypych et al., 2018). Given that this literature is still sparse, more work is needed to investigate indirect effects of ADHD symptoms on procrastination through emotion dysregulation.

Indirect Effects Through Self-Esteem

Another important marker accounting for the relation between ADHD symptoms and procrastination could be self-esteem. A number of studies have found a negative relation between ADHD and self-esteem (Canu & Carlson, 2007; Dan & Raz, 2015; Dooling-Litfin & Rosen, 1997; Foley-Nicpon et al., 2012; Harpin et al., 2016; Newark et al., 2016), and this could be rooted in underlying deficits in executive functioning (Molavi et al., 2020). In Dooling-Litfin & Rosen’s, 1997 study, college students with ADHD reported lower levels of self-esteem than peers without ADHD, even after controlling for the effects of socioeconomic status, gender, and aptitude test scores. More recent literature is also consistent with the idea that ADHD might be linked to lower self-esteem. For example, Dan and Raz (2015) found a medium effect size of ADHD status on self-esteem in a sample of 55 undergraduate women, and other evidence indicates that this effect of ADHD on self-esteem is not seen in women alone. In a sample that was comprised of 36 women and 50 men, Newark et al. (2016) found that adults with ADHD had significantly lower self-esteem and self-efficacy when compared with adults without ADHD, and that this relation was not moderated by biological sex.

Ample literature also suggests that low self-esteem is associated with higher levels of procrastination (Athulya et al., 2016; Batool et al., 2017; Ferrari, 1994; Hajloo, 2014). Ferrari and Sanders (2006) mention that one type of procrastination that adults with ADHD engage in is avoidance

procrastination, which they define as “behavior delays motivated to protect one’s self-esteem and social image” (p. 2). Therefore, it seems likely that lower self-esteem might lead to more frequent attempts to protect one’s self-image by avoiding tasks that might reveal flaws of some kind, thus accounting for the relation between ADHD and procrastination.

Serial Indirect Effects Through Emotion Dysregulation and Self-Esteem

If indirect effects through both emotion dysregulation and self-esteem independently help to account for the relation between ADHD symptoms and procrastination, it is possible that a serial pathway also exists in which both of these constructs together drive the indirect relation between ADHD symptoms and procrastination. Past work indicates that emotional intelligence, a construct that is closely linked to emotion self-regulation, plays a pivotal role in shaping self-esteem among young adults (Cheung et al., 2015). Another study found evidence indicating that deficient awareness (i.e., lack of awareness of emotional responses) and strategies (i.e., difficulty accessing effective emotion regulation strategies) are the specific aspects of emotion dysregulation that impact self-esteem in young adults (Fasciano et al., 2021). This is also consistent with previous work supporting the idea that positive emotion regulation strategies, such as emotional reappraisal, are linked to higher self-esteem, whereas negative strategies, such as suppression, are linked to lower self-esteem (Nezlek et al., 2008). Some evidence suggests that the relation between emotion dysregulation and self-esteem also exists in the ADHD population. Specifically, a 2018 study found that in a sample of newly-diagnosed adults with ADHD, emotion dysregulation was closely related to difficulties with self-concept (Hirsch et al., 2018). The authors speculate that low self-concept in the ADHD population is the result of cognitive and interpersonal difficulties which might be at least partially driven by ineffective long-term regulation of emotions. Thus, research is needed to understand whether a serial pathway through emotion dysregulation and self-esteem might account for the relation between ADHD symptoms and procrastination in the college student population.

The Current Study

In summary, the current study examines three questions:

1. Do ADHD symptoms have an indirect effect on procrastination via emotion dysregulation?

2. Do ADHD symptoms have an indirect effect on procrastination via self-esteem?
3. Is the relation between ADHD symptoms and procrastination accounted for indirectly through serial effects of emotion dysregulation and self-esteem?

Method

Participants and Procedure

The sample consisted of 595 students who participated in an online study conducted at three universities located in the Southeastern, Midwestern, and Rocky Mountain regions of the U.S. Undergraduates at least 18 years of age attending one of the three universities were eligible to participate in this research study. There were no other inclusion or exclusion criteria. Of the total sample, 471 were female (79.2%), 123 were male (20.7%), and 1 person selected “prefer not to answer.” Five hundred and four participants identified as White (84.7%), 43 identified as Black (7.2%), 38 identified as Asian (6.4%), 27 identified as Latinx/Hispanic (4.5%), 12 identified as multiracial (2.0%), 8 identified as Pacific Islander (1.3%), 8 identified as Native American (1.3%), 4 chose “not listed” (0.7%), 2 identified as Middle Eastern (0.3%), and 1 chose “prefer not to answer” (0.2%). Almost all of the participants (94.3%) were between 18 and 22 years of age. The demographics of the study sample were relatively consistent with the demographics of the university populations, which are composed of mostly white students. A full overview of the sample demographics can be found in Table 1.

Recruitment procedures included announcements in psychology and other classes, psychology research pools (i.e., SONA system), posted flyers, advertisements via listservs of students on campus, emails to campus organizations, and posts on social media platforms that serve students. Participants who were enrolled in lower-to-mid-level psychology classes were quite often eligible for course credit through the research pools. All participants were also entered into a drawing for a \$100 Visa gift card. The survey was administered online through Qualtrics. Upon indicating their informed consent, participants completed measures that took approximately one hour. Participants responded to several survey items that were designed as attention checks (e.g., “Please select strongly disagree” followed by response options including “Strongly Disagree”). Forty-five participants in total were eliminated from the sample after failing attention check questions. All study procedures were approved by the IRBs at each participating university site.

Table 1 Demographics

	N	%
Biological Sex		
Male	123	20.7
Female	471	79.2
Prefer not to answer	1	<.01
Race		
Native American/American Indian/Alaska Native/Indigenous	8	1.3
Asian	38	6.4
Black	43	7.2
Latinx/Hispanic (Non-White)	27	4.5
Middle Eastern/North African (Non-White)	2	.3
Pacific Islander/Native Hawaiian	8	1.3
White	504	84.7
Multiracial	12	2.0
Not listed	4	.7
Prefer not to answer	1	.2
Age		
18	101	17
19	193	32.4
20	120	20.2
21	105	17.6
22	42	7.1
23	10	1.7
24	3	.5
25	7	1.2
26 or older	14	2.4

Measures

Demographics Participants completed a demographics measure that asked them about age, gender identity, and race/ethnicity.

ADHD Symptoms Participants completed an 18-item measure that asks about the symptoms of ADHD that are included in the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013). Participants were asked to indicate how frequently they experience symptoms such as “difficulty sustaining attention in tasks” or “losing things necessary for tasks or activities.” Participants responded using a 4-point Likert scale ranging from “Never or Rarely” to “Very Often.” This measure is frequently used in samples of individuals with ADHD, and in this sample, this scale had excellent internal consistency (Cronbach’s $\alpha=0.93$). Item responses were averaged to create mean scores for total ADHD symptoms.

Self-Esteem The 10-item Rosenberg Self-esteem Scale (Rosenberg, 1965) assesses how participants generally view

themselves. Items include statements such as “I feel I do not have much to be proud of” and “All in all, I am inclined to feel like a failure.” Participants responded using a 4-point Likert scale ranging from “Strongly Agree” to “Strongly Disagree.” Items on the Rosenberg Self-Esteem Scale have been shown to have good convergent validity, discriminant validity, and reliability (Sinclair et al., 2010). In this sample, this scale had excellent internal consistency ($\alpha=0.91$). Items were averaged to create a mean score to be used in analyses.

Emotion Dysregulation The 36-item Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) measures how frequently participants experience difficulties related to emotion dysregulation. Items include statements such as “I am confused about how I feel” and “When I’m upset, I lose control over my behavior.” Participants responded using a 5-point Likert scale ranging from “Almost Never” to “Almost Always.” The DERS has six subscales including Nonacceptance of Emotional Responses, Difficulties Engaging in Goal-Directed Behavior, Impulse Control Difficulties, Lack of Emotional Awareness, Limited Access to Emotional Regulation Strategies, and Lack of Emotional Clarity. This measure has demonstrated good test–retest reliability over a period ranging from four to eight weeks (Gratz & Roemer, 2004). Items were averaged to create mean scores for the total scale as well as each of the subscales. In this sample, this scale had excellent internal consistency ($\alpha=0.95$) and the internal consistencies of the subscales ranged from good ($\alpha=0.82$) to excellent ($\alpha=0.92$).

Procrastination The 12-item Pure Procrastination Scale (PPS; Steel, 2010) provides an assessment of general procrastination behaviors. Participants are asked how much they agree with statements such as “I delay making decisions until it’s too late” and “I am continually saying ‘I’ll do it tomorrow.’” Participants respond using a 5-point Likert scale ranging from “Agree” to “Disagree.” Items were averaged to create a mean score. The PPS shows good convergent validity in that it has moderate to strong correlations with the Irrational Procrastination Scale, Satisfaction with Life Scale, and Susceptibility to Temptation Scale (Steel, 2010). In this sample, this scale had excellent internal consistency ($\alpha=0.93$).

Table 2 Descriptive Statistics

	<i>M</i>	<i>SD</i>	<i>Min.—Max</i>
ADHD Symptoms			
Inattentive	16.78	6.24	9—36
Hyperactive	15.17	5.20	9—35
Combined	31.96	10.46	18—70
Self-Esteem	20.72	6.62	10—40
General Procrastination	36.19	12.42	12—60
Difficulties in Emotion Regulation	88.88	25.81	36—164
Nonacceptance	14.66	6.51	6—30
Goals	14.91	5.14	5—25
Impulse	12.74	5.34	6—30
Awareness	15.73	5.28	6—30
Strategies	18.64	7.76	8—39
Clarity	12.20	4.25	5—25

Analytic Plan

All analyses were conducted using version 28 of SPSS. After computing descriptive statistics and initial bivariate correlations, we ran a simple mediation model using Hayes PROCESS model 4 (Hayes, 2013) to test indirect effects of ADHD symptoms on procrastination through emotion dysregulation. PROCESS model 4 is a logistic regression path analysis modeling tool that can be used through SPSS to estimate direct and indirect effects in mediator models. Next, in models where the indirect effects were significant, follow up analyses were conducted to determine whether results differed when examining the indirect effects of ADHD on procrastination via specific facets of emotion dysregulation (e.g., nonacceptance of emotional responses, limited access to emotion regulation strategies). This resulted in six more models. Next, we ran a simple mediation model to test indirect effects of ADHD symptoms on procrastination through self-esteem. We then tested serial effects of emotion dysregulation and self-esteem. Follow up exploratory analyses examined this serial model using specific facets of emotion dysregulation in place of the total score. In total, this analytic plan included 15 total mediation models.

Table 3 Zero order correlations

	Inattentive Symptoms	Hyperactive Symptoms	Combined Symptoms	General Procrastination	Self-Esteem
Hyperactive Symptoms	.669*				
Combined Symptoms	.929*	.896*			
General Procrastination	.488*	.265*	.423*		
Self-Esteem	.353*	.164*	.293*	.406*	
Emotion Regulation	.469*	.349*	.454*	.428*	.548*

* $p < .001$ (two-tailed)

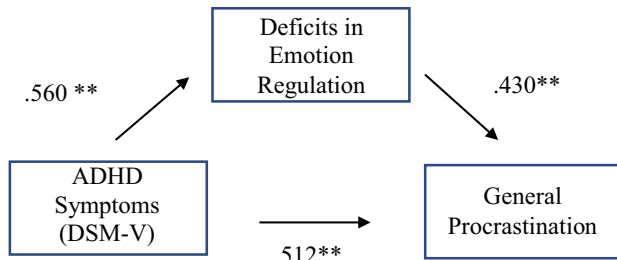


Fig. 1 A simple mediation model with deficits in emotion regulation mediating the relationship between ADHD symptoms and general procrastination. Indirect effect: .241, 95% *CI*: .171-.319. ** $p < .001$, * $p < .05$

Results

Means and standard deviations of all variables of interest are displayed in Table 2. Zero-order correlations among ADHD symptoms, emotion dysregulation, self-esteem, and general procrastination are displayed in Table 3. Significant correlations were observed in the expected directions for all variables. ADHD symptoms were associated with greater emotion regulation problems, lower self-esteem, and greater general procrastination. All of these associations were stronger for inattentive symptoms of ADHD than for hyperactive/impulsive symptoms.

Research Question 1: Indirect Effects Through Emotion Dysregulation

Results showed that emotion dysregulation partially mediated the relation between ADHD symptoms and procrastination (see Fig. 1). ADHD symptoms were associated with greater difficulties in emotion dysregulation ($a = 0.56$, $p < 0.001$) which in turn were associated with greater general procrastination ($b = 0.43$, $p < 0.001$)¹. Using bootstrap analysis with 10,000 samples, a significant indirect effect through emotion dysregulation was found when predicting procrastination ($ab = 0.24$, *CI* 0.17 to 0.32).

Follow up analyses examined simple mediation models using each of the six subscales of the deficits in emotion regulation measure as mediators. These analyses showed that the pattern remained consistent when looking at each of the different subscales of the deficits in emotion regulation scale as mediators in place of the total score.

Research Question 2: Indirect Effects Through Self-Esteem

Next, indirect effects through self-esteem were tested. Results showed that self-esteem partially accounted for the

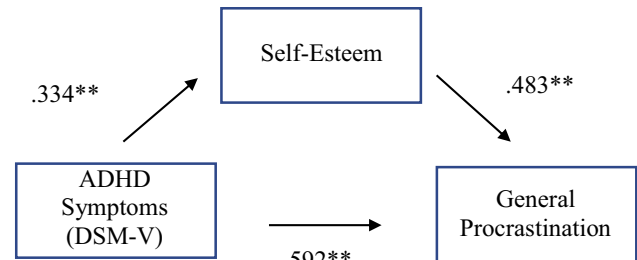


Fig. 2 A simple mediation model with self-esteem mediating the relationship between ADHD symptoms and general procrastination. Indirect effect: .161, 95% *CI*: .103-.229. ** $p < .001$, * $p < .05$

relation between ADHD symptoms and procrastination (see Fig. 2). ADHD symptoms were associated with lower self-esteem ($a = 0.33$, $p < 0.001$), which in turn was associated with greater procrastination ($b = 0.48$, $p < 0.001$). Using bootstrap analyses with 10,000 samples, a significant indirect effect through self-esteem was found when predicting procrastination ($ab = 0.16$, *CI* 0.102 to 0.230).

Research Question 3: Indirect Effects through Emotion Dysregulation and Self-Esteem

Finally, serial indirect effects through emotion dysregulation and self-esteem were tested using Hayes PROCESS model 6. Serial mediation analyses showed that ADHD symptoms indirectly influenced general procrastination through serial effects on deficits in emotion dysregulation and self-esteem (Fig. 3). ADHD symptoms were associated with more deficits in emotion dysregulation ($a1 = 0.56$, $p < 0.001$), which was associated with lower self-esteem ($a3 = 0.48$, $p < 0.001$), which in turn was associated with greater general procrastination ($b1 = 0.36$, $p < 0.001$). Using bootstrap analyses with 10,000 samples, a significant indirect effect through emotion dysregulation and self-esteem was found when predicting procrastination ($a1a3b2 = 0.10$, *CI* 0.05 to 0.15).

Follow up analyses examined this serial mediation model using each of the subscales for emotion dysregulation in place of the total score. The pattern of results remained consistent when looking at each of the different subscales of the deficits in emotion regulation scale as mediators in place of the total score for difficulties in emotion regulation.²³

² When running all analyses with the ADHD symptom subscales instead of the total score, the pattern of results also remained the same.

³ When running all analyses separately by sex, most simple mediation models were not significant among males except the models examining indirect effects via self-esteem and lack of emotional clarity. Most of the serial mediation models were significant for males except for the serial pathway via nonacceptance of emotional responses. Note that these analyses are not included in the text due to lack of adequate power.

¹ All reported pathway parameters are unstandardized coefficients.

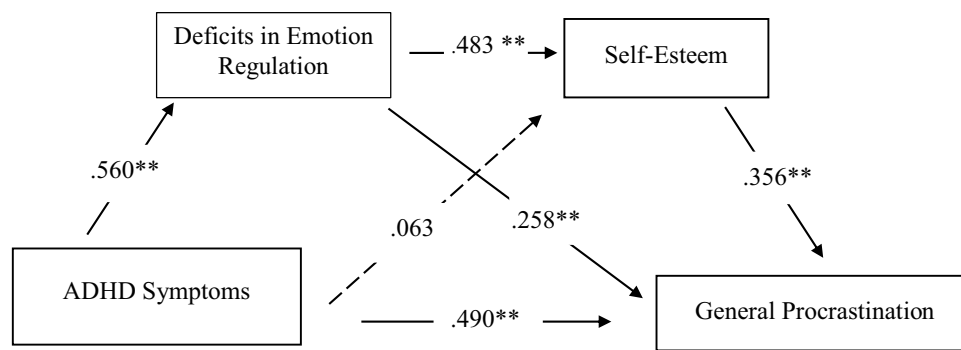


Fig. 3 A serial multiple mediation model with deficits in emotion regulation and self-esteem as serial mediators on the relationship between ADHD symptoms and general procrastination. Indirect Effects: ADHD → Deficits in Emotion Regulation → General Procrastination – Value:

.145 95% CI .066:.230 ADHD → Deficits in Emotion Regulation → Self-Esteem → General Procrastination – Value: .096 95% CI .051:.149 ADHD → Self-Esteem → General Procrastination – Value: .023 95% CI -.009:.058. ** $p < .001$, * $p < .05$

Discussion

The purpose of this study was to examine three primary hypotheses, that (a) emotion dysregulation mediates the relation between ADHD symptoms and procrastination, (b) self-esteem mediates the relation between ADHD symptoms and procrastination, and (c) emotion dysregulation and self-esteem are serial mediators of the relation between ADHD symptoms and procrastination in college students. The findings herein support all of these hypotheses. Deficits in emotion regulation partially accounted for the relation between ADHD symptoms and procrastination. Follow up analyses showed that all components of emotion dysregulation follow this pattern. Self-esteem also partially accounted for the relation between ADHD symptoms and procrastination. Lastly, results supported a serial pathway through emotion dysregulation and self-esteem in accounting for this relation.

These findings fit well into the existing literature on ADHD symptoms, emotion dysregulation, self-esteem, and procrastination. Given that previous work has shown that ADHD symptoms are associated with more emotion dysregulation (Shaw et al., 2014) and lower self-esteem (Dooling-Litfin & Rosen, 1997; Newark et al., 2016), and that emotion dysregulation and low self-esteem are both associated with more procrastination (Athulya et al., 2016; Batool et al., 2017; Ferrari, 1994; Guo et al., 2019; Hajloo, 2014), it is not surprising that emotion dysregulation and self-esteem partially mediated the relation between ADHD symptoms and procrastination in this sample. Although Bolden and Fillauer (2019) found that self-regulation of emotions did not account for the relation between procrastination (the predictor) and ADHD symptoms (the outcome), our study used a model in which ADHD symptoms preceded procrastination, which is more consistent with the conceptualization of ADHD as a developmental disorder that first manifests in childhood.

Importantly, the current results agree with prior research that suggests emotion dysregulation is an important associated feature of ADHD in emerging adults (e.g., Barkley, 2015) and that lower self-esteem is also frequently seen in this population (e.g., Dan & Rax, 2015). It has already been well established that emotion dysregulation is important to understanding ADHD, and our findings further underscore its importance to understanding ADHD and ADHD-related impairment in the college student population. These findings are especially important for this population given that college students are highly impacted by procrastination and that their primary responsibility is schoolwork. The fact that emotion dysregulation and self-esteem were found to partially account for the relation between ADHD symptoms and procrastination, both independently and serially, helps to identify new targets for treatment and suggests that decreasing emotion dysregulation and increasing self-esteem may be more effective than targeting procrastination directly. The fact that findings did not differ when examining specific facets of emotion dysregulation suggests that emotion dysregulation as a whole is important to target, and there are not necessarily specific components of the construct that are more important than others in contributing to lower self-esteem or difficulties with procrastination. Thus, targeting any component of emotion dysregulation might be beneficial for college students with symptoms of ADHD.

Since our study was cross-sectional in nature and could not explore the temporal relations among these variables, future work should use a longitudinal design to investigate whether ADHD symptoms do, in fact, lead to later difficulties with emotion dysregulation, self-esteem, and procrastination. There are a few other important limitations to note. First, our sample was predominantly female and white, making it hard to assess the generalizability of our findings beyond whites and females. Future work with a more

diverse sample will also be necessary to examine the generalizability of findings from our serial mediation analyses. Second, this study was based solely on self-report measures, and it is possible that using reports from friends or partners would paint a clearer picture of each participant's symptoms and behaviors. However, previous work suggests that adults with ADHD are better reporters of their symptoms than their partners (Sandra Kooij et al., 2008). Lastly, the survey was relatively long, and it might have been challenging for participants to pay attention all the way until the end. However, the variables of interest were assessed towards the beginning of the survey, and attention check questions were used to ensure that we only included data from participants who were reading the survey items carefully and attending throughout the survey completion.

This study also had several relevant strengths. First, it included students from universities in three different parts of the United States, helping to ensure that the findings are generalizable beyond just one geographic region. This study also looked at specific components of emotion dysregulation to explore whether there are certain elements of this construct that drove the pattern of findings. Lastly, this study was novel in that no previous studies to our knowledge have investigated emotion dysregulation and self-esteem as serial mediators of the association between ADHD symptoms and procrastination. Understanding the serial effects these variables have is helpful for clinicians working with college students with symptoms of ADHD. Specifically, these findings suggest that treatments that encourage learning and practicing new emotion regulation skills, such as Dialectical Behavior Therapy (Linehan, 1993a, b) and the Unified Protocol (Barlow et al., 2018), might help to improve self-concept among college students with symptoms of ADHD and in turn decrease their avoidance of important tasks.

Some evidence already supports the effectiveness of third wave behavioral interventions such as DBT and mindfulness-based approaches in treating adult ADHD (Edel et al., 2017; Mitchell et al., 2017), but not much is known about the impact these interventions have on emotion regulation and self-esteem in the college student population. Mindfulness-based approaches may be particularly useful in improving the allocation of attentional resources, which in turn enhances later stages of processing information and emotions (Malinowski, 2013). Further, DBT teaches skills like recognizing emotions, observing emotions, and letting go of painful emotions, which could all be useful skills for college students with ADHD. Some work also suggests that interpersonal group therapy may be helpful for improving self-esteem and psychosocial competence in college students with ADHD (Shaikh, 2018). Although these preliminary findings are promising, there is still not enough work on this topic to draw conclusions about which therapies are most effective in improving emotion regulation and self-esteem in college students with symptoms of

ADHD. Future interventions research, including randomized controlled trials, should focus on tracking positive change in these variables to empirically substantiate how clinicians serving this population can potentially reduce procrastination in their clients.

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Declarations

Conflict of Interest The authors declare that they have no conflict of interest in publishing this work.

Experiment Participants All procedures were approved by the Institutional Review Boards at the participating sites, and informed consent was obtained from all participants.

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