Emotion dysregulation and emotional impulsivity among adults with attention-deficit/hyperactivity disorder: Results of a preliminary study.

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Abstract:

Recent reviews argue that emotion dysregulation is an important feature of attention-deficit/hyperactivity disorder (ADHD) and involves a failure to inhibit negative emotions that leads to negative affectively-driven impulsive behavior (i.e., emotional impulsivity). The goal of the current study was to assess (a) whether emotion dysregulation and emotional impulsivity was higher in a group of adults diagnosed with ADHD and (b) if the relationship between core ADHD symptoms (i.e., inattention and hyperactivity-impulsivity) and emotional impulsivity is mediated by emotion dysregulation symptoms. A group of adults with (n = 18) and without (n = 23) ADHD completed measures of core ADHD symptoms, emotion dysregulation, and emotional impulsivity. A series of one-way analyses of covariance indicated significant between-group differences in emotion dysregulation and emotional impulsivity when current depression and oppositional defiant disorder ratings were covaried. In addition, the relationship between ADHD symptoms and emotional impulsivity was mediated by emotion dysregulation symptoms. These findings suggest that emotion dysregulation and emotional impulsivity are higher in adults diagnosed with ADHD and that emotion dysregulation symptoms have predictive value beyond core ADHD symptoms.

Keywords: ADHD | emotion dysregulation | emotional impulsivity | clinical psychology | Attention-Deficit/Hyperactivity Disorder | behavioral assessment

Article:

Attention-deficit/hyperactivity disorder (ADHD) is a developmental disorder that persists into adulthood for the majority of cases (Barkley et al. 2008; Mannuzza et al. 1993; G. Weiss and Hechtman 1993) and occurs among approximately 4 % of adults (Kessler et al. 2006). Though developmentally inappropriate symptoms of inattention and hyperactivity-impulsivity are the two core symptom sets of the disorder (American Psychiatric Association 2000), recent reviews argue that emotion dysregulation is an additional feature of ADHD that should be incorporated into theoretical conceptualizations and diagnostic criteria (Barkley 2010; Martel 2009; Skirrow et al. 2009).

Even though there is no consistently agreed upon definition of emotion dysregulation (Putnam and Silk 2005), most accounts describe it as a multidimensional construct (Gratz and Roemer 2004) that includes (a) the lack of inhibition of behavior associated with strong negative or positive emotion and (b) subsequent failure to engage in self-regulatory actions, including self-soothing, refocusing attention, moderating the initial emotion, and organizing for coordinated action in the service of goal-directed behavior (Barkley 2010; Gottman and Katz 1989; Hinshaw 2003; Martel 2009; Melnick and Hinshaw 2000). According to one account of emotion dysregulation in ADHD (Barkley 2010), those with the disorder are less likely to inhibit their emotions, particularly those pertaining to frustration, impatience, and anger, as a result of deficient cognitive control. The outcome of this poor inhibitory process is emotional impulsivity, which “refers to the quickness or speed with which and the greater likelihood that an individual with ADHD will react with negative emotions in response to events relative to others of the same developmental level or age without ADHD” (p. 5, Barkley 2010). In other words, deficient emotion regulation involves a failure to inhibit negative emotions that leads to negative affectively-driven impulsive behavior in ADHD. Thus, emotions are less moderated by top-down, effortful executive control (Barkley 2010).

Empirical support for the inclusion of emotion dysregulation as a core feature of the disorder comes from several sources. First, neuroanatomical networks associated with ADHD also underlie emotional functioning (see Barkley 2010, for a review). For example, the anterior cingulate cortex and the lateral prefrontal cortex are identified in studies of ADHD (Bush et al. 2005; Paloyelis et al. 2007; Valera et al. 2007) and emotion regulation (Ochsner and Gross 2005). Emotion dysregulation may emerge in ADHD because of structural and functional deficits in top-down emotion regulation in these regions that support goal-directed behavior (Bush et al. 2000).

Second, several studies involving behavioral observations, rating scales, and clinician ratings have supported overlap between emotion dysregulation and ADHD among children and adults (Anastopoulos et al. 2011; Barkley and Fischer 2010; Barkley and Murphy 2010; Maedgen and Carlson 2000; Melnick and Hinshaw 2000; Reimherr et al. 2010; Reimherr et al. 2005; Walcott and Landau 2004). For instance, a recent study reported that emotion dysregulation is higher in

children with ADHD and that it plays an important role in determining functional impairment and comorbidity outcomes (Anastopoulos et al. 2011). Another study in adults with ADHD found that poor emotional self-control (a) was higher in a group of adults with ADHD than in clinical and community control groups and (b) added explanatory and predictive power to various forms of impairment (e.g., occupational, educational, criminal history, driving outcomes, marital satisfaction) above and beyond core inattentive and hyperactive-impulsive symptoms (Barkley and Murphy 2010). In a longitudinal sample of hyperactive children followed into adulthood, these findings were replicated in similar domains of impairment among those meeting ADHD criteria into adulthood (Barkley and Fischer 2010). In addition, clinician-rated emotion dysregulation symptoms of ADHD (i.e., items assessing emotional overreactivity, temper, and affective lability) were higher among adults with ADHD than non-diagnosed individuals (Reimherr et al. 2010; Reimherr et al. 2005). These emotion dysregulation symptoms were responsive to both stimulant and non-stimulant ADHD pharmacological treatments. Finally, evidence from studies indicating that ADHD is associated with other emotion-related abilities (Miller et al. 2011) and emotion-related constructs (Martel et al. 2009; Mitchell and Nelson-Gray 2006; Nigg et al. 2002) indirectly suggest a relationship between ADHD and emotion dysregulation. For example, in one study neuroticism, a construct that includes components of emotion dysregulation (Kokkonen and Pulkkinen 2001), was associated with ADHD symptoms (Mitchell and Nelson-Gray 2006).

To our knowledge, no studies to date have assessed how emotion dysregulation and emotional impulsivity (i.e., impulsive behavior accompanied by negative emotions) are related to one another in those with and without ADHD. Further, limited empirical work on emotion dysregulation and ADHD has been conducted, particularly among adults. The overall goal of this cross-sectional pilot study, therefore, was to assess how emotion dysregulation symptoms, emotional impulsivity, and ADHD are related. The first and central aim of this study was to assess whether emotion dysregulation and emotional impulsivity was higher in a group of adults diagnosed with ADHD than controls. The ADHD group was hypothesized to score higher than the control group on measures of both constructs. Given that co-occurring symptoms of other forms of psychopathology have overlapping emotion dysregulation features (Barkley 2010) and can also account for any relationship between ADHD and emotion dysregulation, current symptoms of depression and oppositional defiant disorder were assessed as covariates in the analyses to test our hypotheses.1 The second aim was to assess if the relationship between core ADHD symptoms (i.e., inattention and hyperactivity-impulsivity) and emotionally impulsive behavior is mediated by emotion dysregulation. Emotion dysregulation scores were predicted to mediate this relationship and therefore demonstrate explanatory value beyond core DSM-IV defined ADHD symptoms.

Method

Participants

Participants included a group of adults meeting criteria for ADHD, Combined Type (ADHD, n = 18) and a group of psychiatrically healthy adults who did not meet criteria for ADHD or other disorders (n = 23). ADHD participants were recruited from an ADHD specialty clinic (n = 11) and from an undergraduate participant pool within a large public university (n = 7). All control group participants were recruited from an undergraduate participant pool at the same university. See Table 1 for a summary of the demographic and clinical characteristics of both groups. Groups did not differ in age, sex, ethnicity, or education.

Table 1

Sample demographic and clinical characteristics

	ADHD Group (*n* = 18)			**Control Group (*n* = 23)**			
	n	***M***	***SD***	***n***	***M***	***SD***	***p***
Sex							0.99
Male	7			9			
Female	11			14			
Ethnicity							0.73
Caucasian	15			16			
African American	2			4			
Hispanic	0			1			
Other	1			1			
Age		24.83	4.93		22.61	5.60	0.19

	ADHD Group (*n* = 18)			**Control Group (*n* = 23)**			
	n	***M***	***SD***	***n***	***M***	***SD***	***p***
Education level		13.88	1.75		13.17	0.83	0.10
CAARS HI Symptoms (raw scores)		16.72	5.49		5.87	3.02	<0.001
CAARS IA Symptoms (raw scores)		19.67	4.55		5.00	3.53	<0.001
CAARS Total Symptoms (raw scores)		36.39	7.91		10.87	5.51	<0.001
CAARS ADHD Index (raw scores)		23.11	6.64		8.04	5.33	<0.001
No. of Current HI Symptoms		5.67	2.03		1.22	1.24	<0.001
No. of Current IA Symptoms		6.44	1.89		0.43	0.99	<0.001
No. of Childhood HI Symptoms		6.83	2.48		2.43	2.11	<0.001
No. of Childhood IA Symptoms		7.59	1.94		2.26	2.75	<0.001
Functional Impairment from Current ADHD Symptoms		17.28	4.27		5.87	6.08	<0.001
Oppositional Defiant Disorder Symptom Severity		7.83	5.01		3.74	3.57	0.004

	ADHD Group (*n* = 18)			Control Group (*n* = 23)			
	n	***M***	***SD***	***n***	***M***	***SD***	***p***
(current)							
Beck Depression Inventory		14.56	9.23		8.57	7.46	0.027

Ethnicity was not reported for one control group participant, *IA* inattentive, *HI* hyperactive-impulsive, the number of current and previous ADHD symptom counts are based on ADHD-RS scores.

Diagnostic criteria for the ADHD group included clinician-rated endorsement of six or more clinician-rated inattentive symptoms and four or more hyperactive-impulsive symptoms (see Murphy and Barkley 1996, regarding the age-appropriateness of this cut-off to capture developmental deviance for adults) on a modified version of the ADHD module in the Diagnostic Interview Schedule for Children (DISC-IV) (NIMH 1997) administered by a doctoral student working under the supervision of a senior project psychologist. Aside from the modified symptom count criteria for hyperactive-impulsive symptoms, full DSM diagnostic criteria were assessed via the DISC-IV. In addition, evidence of functional impairment related to reported symptoms on a functional impairment scale (see below), a T score greater than 60 on either the DSM-IV Inattentive, DSM-IV Hyperactive-Impulsive, or ADHD Index subscales of the Conners Adult ADHD Rating Scale (CAARS) (Conners et al. 1999), and a T score greater than 55 on the DSM-IV Total ADHD Symptoms subscale was required. Current and childhood ADHD symptoms were also assessed on a modified ADHD Rating Scale (ADHD-RS; DuPaul et al. 1998). All but one of the ADHD group participants reported a previous diagnosis of ADHD by a mental health care professional.

Control group participants were excluded if they were previously diagnosed with ADHD, met symptom count criteria based on the ADHD-RS, or yielded a T score greater than 55 on the Total Symptoms CAARS scale. Participants from both groups were excluded if they had a history of psychosis, neurological disability, traumatic brain injury, mental retardation, major sensory or motor impairment, or a pervasive developmental disorder. Forty-four percent of the ADHD group (n = 8) reported currently taking medication for ADHD.2 None of the participants in the control group were taking medication for ADHD.

Procedure

Participants (adults age 18 and above) were recruited from an ADHD specialty clinic and from a local public university. Consent was obtained in accordance with local institutional review board guidelines. Following completion of a consent form, the measures listed above were administered in randomized order along with other measures not included in this study. Sessions ranged from 60 to 90 min.

Materials

ADHD Symptoms

The CAARS (Conners et al. 1999) is a 66-item self-report measure of current ADHD behaviors that has considerable normative data. Response options are on a four-point Likert scale. The CAARS yields the following DSM-based subscale symptom severity scores: Hyperactivity-Impulsivity symptoms, Inattentive symptoms, and Total DSM symptoms. A derived ADHD Index subscale score can also be calculated which provides an estimate of the likelihood that the respondent would meet full criteria for the disorder. Internal consistency for these subscales in the current study was very good (α's ranged from 0.91 to 0.96 for the scales listed above). The CAARS has demonstrated adequate reliability and validity (Erhardt et al. 1999). The ADHD-RS (DuPaul et al. 1998) lists DSM-IV inattentive and hyperactive-impulsive symptoms. Participants rate the frequency of each behavior on a four-point Likert scale. A modified adult self-report version of this scale was administered similar to that used by Barkley and Murphy (2006) to establish current and retrospective symptom counts. Internal consistency for the ADHD-RS items in this sample was very good (α's ranged from 0.90 to 0.95 for the current and retrospective scales). In general, self-reported ADHD symptoms on questionnaires are correlated with collateral reports and diagnostic interviews (Belendiuk et al. 2007; Van Voorhees et al. 2011). Finally, a modified version of the DISC-IV ADHD module (NIMH 1997) was administered to the clinical group. This ADHD module assesses DSM-IV symptoms of inattention and hyperactivity-impulsivity, as well as onset, course, and functional impairment. Modification of this interview involved revised wording of some items to match developmental appropriateness of ADHD symptoms more commonly seen in adults and noted in the DSM-IV (e.g., subjective restlessness), and is similar to other interviews that assess ADHD in adulthood (Epstein et al. 2000).

Functional Impairment

Functional impairment resulting from ADHD symptoms in ten different domains was assessed from a subset of items from the Current Symptom Scale (Barkley and Murphy 2006). Participants were asked to indicate the extent to which problems indicated on the ADHD-RS for current ADHD symptoms interfered with their ability to function in several areas of life (e.g., relational functioning) on a four-point Likert scale. Internal consistency was very good for this scale ($\alpha = .92$).

Emotion Dysregulation

Emotion dysregulation was assessed by the Impulsivity/Emotional Lability scale from the CAARS (Conners et al. 1999). This 12-item subscale, which is administered in an identical format to the other CAARS scales described above, assesses temper, irritability, stress intolerance, and labile mood. High scorers on this scale are more likely to engage in impulsive acts, moods change more quickly and more frequently, and are more easily angered and irritable. Items includes, "Many things set me off easily" and "My moods are unpredictable." Previous studies have administered the child version (Anastopoulos et al. 2011) and adult version (Mitchell et al. 2012) of this subscale to assess self-regulation of emotion. Internal consistency for this scale was very good ($\alpha = .94$). Although psychometric studies of the CAARS supports that the impulsivity and emotional functioning items from this scale (i.e., items separate from DSM symptoms) load onto one common factor (Conners et al. 1999), a potential confound in the current study was that the impulsivity items included in this subscale would artificially inflate the relationship between (a) ADHD and emotion dysregulation, (b) and emotional impulsivity and emotion dysregulation. Therefore, we also calculated a total score from the six emotion dysregulation items (e.g., "I am easily frustrated" and "Many things set me off easily") on this subscale by summing them consistent with other applications of this scale (Mitchell et al. 2012). Internal consistency for the six items in this revised subscale that only included emotion dysregulation items and excluded any impulsivity items was good ($\alpha = .88$). For the analyses, raw scores are reported for the full Impulsivity/Emotional Lability subscale and the modified subscale assessing only emotion dysregulation items. Descriptively, this scale measures the failure to engage in self-regulatory actions component of emotion dysregulation.

Emotional Impulsivity

The UPPS (Urgency, Premeditation, Perseverance, and Sensation Seeking) Impulsive Behavior scale (Whiteside and Lynam 2001) is a 45-item self-report measure that proposes a conceptual framework of four different types of impulsive behavior. Response options are on a four-point Likert scale. One of these subscales, Urgency, is composed of 12-items and was used for this study. Items were summed to yield a raw score. Urgency refers to a tendency to engage in rash, impulsive behavior in the context of experiencing negative emotions. Items include "Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse" and "When I am upset I often act without thinking." Urgency is associated with the impulsiveness facet of neuroticism within the five factor model of personality and can be accompanied by negative emotions such as anger, anxiety, or depression. Psychometric studies support the reliability and validity of this measure (Miller et al. 2003; Whiteside and Lynam 2001; Whiteside et al. 2005). Internal consistency for this scale in the current sample was good ($\alpha = .88$).

Oppositional Defiant Disorder and Depressive Symptoms

Current DSM-IV oppositional defiant disorder symptoms were assessed with the Current Symptoms Scale (Barkley and Murphy 2006); depressive symptoms were assessed with the Beck Depression Inventory (Beck and Steer 1984). Respondents rated symptom severity on a four-point Likert scale for both measures. Internal consistency for both depressive and oppositional defiant disorder scales in the current sample was good (α's = .88 and .85, respectively).

Data Analysis

All analyses were conducted using SPSS version 19.0. The sample was dichotomized into two groups, ADHD and non-ADHD, to assess the first hypothesis that emotion dysregulation and emotional impulsivity would be higher in the ADHD group. A series of one-way analyses of covariance (ANCOVA) were conducted. Current oppositional defiant disorder and depressive symptoms were covaried in these analyses. Eta-square was used as an effect size estimate and was interpreted in accordance with standard guidelines in which small effect sizes are $\geq$0.0099, medium effect sizes are $\geq$0.0588, and large effect sizes are $\geq$0.1379 (Cohen 1988).

To test the second hypothesis that emotion dysregulation scores would mediate the relationship between core ADHD symptoms and emotional impulsivity, a series of hierarchical regressions was conducted following traditional mediational analysis guidelines (Baron and Kenny 1986). As a more rigorous test of the mediational model, we utilized a bootstrapping (resampling) strategy to test the significance of the indirect path from core ADHD symptoms → emotion dysregulation → emotional impulsivity based on recommendations by Preacher and Hayes (2008). Bootstrapping is a nonparametric statistic using repeated sampling with replacement of the available data to generate an approximation of the sampling distribution. Bootstrapping provides relatively more accurate type I error rates and greater statistical power in detecting indirect effects than traditional mediational analysis. Moreover, it is a better estimate for samples that are small in size or not normally distributed (Preacher and Hayes 2008). An SPSS macro for bootstrapping using 10,000 samples was applied to conduct this analysis (Preacher and Hayes 2008). The significance and magnitude of indirect effects estimated through the bootstrap technique was evaluated with 95 % confidence intervals (CIs). Similar to previous studies assessing the relationship between ADHD and emotional functioning (e.g., Barkley and Fischer 2010; Barkley and Murphy 2010), both groups were collapsed together for the dimensional analysis.

Results

Table 1 indicates that the ADHD and control groups did not differ on demographic or clinical characteristics (non-significant ts < 1.69 and χ2s < 1.32), other than ratings of ADHD symptoms

(current and past), ADHD functional impairment, and depression and oppositional defiant disorder symptoms (significant ts ranged from 2.30 to 13.16).

Consistent with the hypothesis that the ADHD group would score higher on a measure of emotion dysregulation than the control group, a one-way ANCOVA indicated significant between-group differences while statistically controlling for current oppositional defiant disorder and depressive symptoms (ADHD group: $M = 19.44$, adjusted $M = 16.80$, $SD = 7.06$, Control group: $M = 7.22$, adjusted $M = 9.29$, $SD = 5.21$), $F(1, 37) = 25.14$, $\eta 2 = .41$, $p < .001$. This group difference remained when the modified, six-item emotion dysregulation scale was considered (ADHD group: $M = 8.67$, adjusted $M = 7.12$, $SD = 3.85$, Control group: $M = 3.74$, adjusted $M = 4.95$, $SD = 3.11$), $F(1, 37) = 7.37$, $\eta 2 = .17$, $p = .01$. Consistent with the hypothesis that the ADHD group would report higher emotional impulsivity than the control group, a one-way ANCOVA indicated significant between-group differences while statistically controlling for current oppositional defiant disorder and depressive symptoms (ADHD group: $M = 34.11$, adjusted $M = 31.76$, $SD = 7.03$, Control group: $M = 25.17$, adjusted $M = 27.01$, $SD = 6.31$), $F(1, 37) = 6.02$, $\eta 2 = .14$, $p = .019$.

To test the hypothesis that the relationship between ADHD symptoms and emotional impulsivity was mediated by emotion dysregulation, a series of regression analyses were conducted first. Values for skewness (ranging from 0.03 to 0.71) and kurtosis (ranging from −0.22 to −1.18) indicated that the variables were normally distributed when the groups were collapsed together (Kline 2005). Table 2 summarizes the correlational relationship between these variables. Tolerance (ranging from 0.28 to 0.46) and variance inflation factor (ranging from 2.17 to 3.53) were considered and minimized concerns about multicollinearity following standard guidelines (Menard 1995).

Table 2

Correlational relationship among emotional impulsivity, emotion dysregulation, and ADHD symptoms

	Emotional Impulsivity	**Emotion Dysregulation (12 item)**	**Emotion Dysregulation (6 item)**	**ADHD Symptoms**
Emotional Impulsivity	–	0.75*	0.80*	0.60*
Emotion Dysregulation (12 item)		–	0.93*	0.85*
Emotion Dysregulation (6 item)			–	0.73*

	Emotional Impulsivity	Emotion Dysregulation (12 item)	Emotion Dysregulation (6 item)	ADHD Symptoms
ADHD Symptoms				–

Emotional Impulsivity = Urgency subscale; Emotion Dysregulation = CAARS Impulsivity Emotional Lability subscale (12 item version and 6 item version including only emotion dysregulation items, respectively); ADHD Symptoms = CAARS DSM-IV Inattentive and Hyperactive-Impulsive subscales.

* $p < .001$

A series of separate regression analyses indicated that both ADHD symptoms ($\beta = .60$, $p < .001$) and emotion dysregulation ($\beta = .75$, $p < .001$) predicted emotional impulsivity, and that ADHD symptoms predicted emotion dysregulation ($\beta = .85$, $p < .001$). These findings indicated that a test of a mediated model was appropriate. Once emotion dysregulation scores were first entered in a regression model, ADHD symptoms were no longer predictive of emotional impulsivity ($\beta = -.11$, $p > .05$). See Table 3 for a summary of these regressions. An analysis was then conducted using 10,000 bootstrap samples following recommendations by Preacher and Hayes (2008) to assess the indirect path from ADHD symptoms → emotion dysregulation → emotional impulsivity. Using bias corrected confidence intervals, the results were significant (indirect effect =1.21, 95 % CI [0.89, 1.67], $z = 6.19$, $SE = .20$, $p < .001$) and indicated that emotion dysregulation symptoms mediate the relationship between ADHD symptoms and emotional impulsivity.

Table 3

Summary of hierarchical regression analyses testing mediation between symptoms of ADHD and emotional impulsivity

	Emotional Impulsivity	
	ΔR^2	β
Step1		
ADHD Symptoms	0.36	0.60*
Step 1		

	Emotional Impulsivity	
	ΔR^2	β
Emotion Dysregulation (12 item)	0.56	0.75*
Step2		
ADHD Symptoms	<0.01	−0.11

Emotional Impulsivity = Urgency subscale; Emotion Dysregulation = CAARS Impulsivity Emotional Lability subscale (12 item version); ADHD Symptoms = CAARS DSM-IV Inattentive and Hyperactive-Impulsive subscales.

*p < .001

The mediation analysis was repeated with the modified, six-item emotion dysregulation scale that only included emotion regulation items. Both ADHD symptoms (β = .60, p < .001) and modified emotion dysregulation (β = .80, p < .001) predicted emotional impulsivity in separate regression models. In addition, ADHD symptoms predicted the modified emotion dysregulation scale (β = .73, p < .001) in a separate regression model. Again, once modified emotion dysregulation scores were considered in the regression model, ADHD symptoms were no longer predictive of emotional impulsivity (β = .04, p > .05). The indirect path from ADHD symptoms → emotion dysregulation (six-item scale version) → emotional impulsivity following bootstrapping methods resulted in similar findings (indirect effect =0.99, 95 % CI [0.43, 1.53], z = 3.52, SE = .28, p < .001).

Discussion

The current study assessed the relationship among ADHD, emotion dysregulation, and emotional impulsivity (i.e., negative affectively-driven impulsive behavior). Scores of emotion dysregulation and emotional impulsivity were higher in the ADHD group after covarying depressive and oppositional defiant disorder symptoms. In addition, a series of regression analyses indicated that emotion dysregulation scores mediated the relationship between core ADHD symptoms and emotional impulsivity. These findings are consistent with recent reviews and empirical findings that argue that emotion dysregulation is an important component of

ADHD, adds predictive value beyond traditional ADHD symptoms, and should be considered in diagnostic conceptualizations of ADHD in DSM-V (Barkley 2010; Martel 2009; Skirrow et al. 2009). To our knowledge, this is the first study to assess how both emotion dysregulation symptoms and emotional impulsivity, constructs emphasized in ADHD-emotion dysregulation research (Barkley 2010), are related to ADHD symptoms. Further, this pilot study adds to the small, but growing literature assessing the role of emotion dysregulation among adults diagnosed with ADHD.

These findings are consistent with neuropsychological accounts of ADHD. For instance, according to an executive functioning theory of ADHD (Barkley 1997), response inhibition allows for separable executive functions that serve to guide behavior across time delays toward future goals that serve to maximize delayed rather than immediate consequences. Emotional inhibition is among these major executive functions and is argued to be disrupted in ADHD, therefore leading to emotion dysregulation (see Barkley 2010, for a summary). As another example, the delay aversion account of ADHD (Sonuga-Barke 2002, 2003) proposes that those with ADHD have a deficit in signaling for future rewards and therefore are characterized by a preference for smaller, immediate rewards over larger, delayed rewards. Accordingly, those who are delay averse learn to associate delay cues with failure due to the problematic functional outcomes of delay aversion behavioral patterns. Escape from or avoidance of situations associated with delay regulates negative affect (Sonuga-Barke et al. 2008). Thus, this pathway predicts that negative affect should be higher in ADHD, and that maladaptive ways of regulating negative emotions are likely to emerge as the result of negative reinforcement of escape or avoidant behaviors. Although these accounts predict how emotion dysregulation is related to these different phenotypes, these relationships have yet to be examined.

Emotion dysregulation deficits have implications for ADHD diagnosis and prognosis. Regarding diagnosis, some have argued that emotion dysregulation may comprise a separate subset of adults with ADHD with possibly more severe levels of functional impairment and comorbidities (Reimherr et al. 2010). In addition to diagnostic implications involving subtyping and differing developmental trajectories, future research should consider if emotion dysregulation is a mechanism that mediates higher rates of functional impairment and comorbidity in ADHD. Although some studies have reported that poor emotional self-control predicts functional impairment in multiple domains for adults diagnosed with ADHD (Barkley and Fischer 2010; Barkley and Murphy 2010), additional domains such as substance use have yet to be considered. In particular, one particular promising avenue of future research involves cigarette smoking. Adults with ADHD smoke at significantly higher rates, initiate smoking earlier, exhibit a higher level of nicotine dependence, and have greater difficulty quitting than non-ADHD smokers (McClernon and Kollins 2008). In addition, ADHD is an independent risk factor for smoking, even after accounting for comorbidity (Milberger et al. 1997; Molina and Pelham 2003). Smoking to regulate negative emotions is one proposed mechanism maintaining smoking behavior (Gehricke et al. 2007). Consistent with such proposals, smokers with ADHD endorse

higher rates of negative affect associated with withdrawal (McClernon et al. 2010). However, to date, no studies have explicitly addressed the role of emotion dysregulation in smoking and ADHD.

Another implication of the current findings involves ADHD treatment. Given that emotion dysregulation appears to be higher in ADHD samples, future pharmacological research should consider targeting these symptoms in addition to core ADHD symptoms. Indeed, clinician-rated emotion dysregulation symptoms are responsive to methylphenidate and atomoxetine (Reimherr et al. 2010; Reimherr et al. 2005). Also, cognitive-behavioral therapy has been demonstrated to be an efficacious treatment in recent randomized controlled trials (Safren et al. 2010; Solanto et al. 2010). Given the role of emotion dysregulation in ADHD, perhaps treatments should also target emotion dysregulation symptoms as well. Supplementary cognitive-behavioral treatments emphasizing mood regulation or treatments that can be incorporated within a cognitive-behavioral approach may be beneficial. For example, a feasibility study provides promising support for a mindfulness-based treatments in ADHD (Zylowska et al. 2008). Given that mindfulness has been incorporated into cognitive-behaviorally-based treatments for other forms of psychopathology (Segal et al. 2002) and emotion regulation is a proposed mechanism of change in mindfulness-based interventions (Gratz and Tull 2010), integrating mindfulness training with existing cognitive-behavioral interventions may be a promising avenue for future research. As an example, a modified group-based dialectical behavior therapy adapted by Philipsen and colleagues for adults with ADHD includes mindfulness and cognitive-behavioral skills training while also including a module that specifically targets emotion regulation (Philipsen et al. 2007).

Limitations & Future Directions

Although the current findings are novel and promising, they should be tempered by limitations. First, the sample size for this pilot study was small, which may have reduced statistical power. However, despite this limitation, the predicted relationships emerged and the estimated effect sizes were large. Future studies should also consider sample size to allow for an analysis of sex differences when considering emotion dysregulation among adults diagnosed with ADHD. A second limitation involved sample composition. For instance, the ADHD sample in the current study included some participants enrolled in college. Since fewer adults diagnosed with ADHD attempt or complete college (Biederman et al. 2006), the current study may have included a relatively higher functioning ADHD sample. Future studies should include a larger community sample to improve generalizability.

Third, the current study relied on self-report measures of emotion dysregulation as a unidimensional construct. Although unidimensional emotion dysregulation scores are not uncommon, self-report measures of emotion dysregulation also incorporate facets of emotion

dysregulation not assessed in the current study (Gratz and Roemer 2004). Future studies should consider the hypotheses of this study with laboratory tasks of emotion dysregulation (Gratz et al. 2006) or self-report measures specifically developed to operationalize emotion dysregulation, such as the Difficulties in Emotion Regulation Scale (Gratz and Roemer 2004). Fourth, the current study relied on self-report measures. This methodology leaves open the possibility of error caused by shared method variance. Future research should consider ADHD symptom severity and impairment from other reporters, in addition to laboratory tasks assessing emotion dysregulation.

Fifth, future research should explore the construct validity of emotional impulsivity and test additional features of the model proposed by Barkley (2010) involving core inhibitory control deficits in individuals with ADHD and emotionally dysregulated behavior. The current study represents only a preliminary test of features of a model in a small, but growing literature among adults diagnosed with ADHD. Although we administered an emotion dysregulation measure that has been administered in other studies assessing ADHD and ADHD symptoms (Anastopoulos et al. 2011; Mitchell et al. 2012), future studies should include other measures of emotion dysregulation (as noted above) to not just assess the role of emotion dysregulation in ADHD, but how it is associated with emotional impulsivity since these constructs are theoretically related but separable (Barkley 2010). These construct definitional issues require attention in future research to build upon existing models involving the role of emotion dysregulation in ADHD (e.g., Barkley 2010). Sixth, the current study did not fully assess different comorbidity patterns in ADHD. Those diagnosed with ADHD are heterogeneous in phenotypic expression, including comorbidity, and is indicative of possible variations in etiology which should be considered (Nigg, Goldsmith, & Sachek, 2004). Future research should more thoroughly evaluate the role of comorbidity in ADHD. Finally, a non-ADHD clinical comparison group was not included. This should be considered in future studies since it would allow for assessing how emotion dysregulation is specific to ADHD or perhaps is a transdiagnostic construct elevated in other psychiatric populations as well.

Conclusion

In conclusion, the role of emotion dysregulation in ADHD is an emerging field of research and the current findings add to previous studies supporting a relationship between ADHD and emotion dysregulation. In addition, the current study offers novel empirical insight into the role of emotional impulsivity and how emotion dysregulation symptoms mediate this relationship. Though replication with methodological and conceptual considerations listed above are warranted, the current study provides a foundation to generate hypotheses for future studies assessing the phenomenology of emotion regulation in this clinical population.

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Footnotes

1 We included a measure of oppositional defiant disorder in our adult sample given that emerging research suggests that this disorder can continue into adulthood for some and is functionally impairing (M. D. Weiss et al. 2011).

2 Of those taking medication for ADHD, 5 were from the student group.