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Examining Maternal Emotion Regulation in Children with and without ADHD: A Multimodal Approach

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EXAMINING MATERNAL EMOTION REGULATION AMONG CHILDREN WITH AND WITHOUT ADHD: A MULTIMODAL APPROACH

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Alexis M. Garcia

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To: Dean Michael R. Heithaus
College of Arts, Sciences and Education

This dissertation, written by Alexis M. Garcia, and entitled Examining Maternal Emotion Regulation Among Children with and without ADHD: A Multimodal Approach, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Date of Defense: June 22, 2020

The dissertation of Alexis M. Garcia is approved.

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Dean Michael R. Heithaus
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Vice President for Research and Economic Development
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Florida International University, 2020

DEDICATION

To my beautiful family: Tony, Patty, Anthony, Jazlyn, Jayden, and Christy. Thank you for believing in me.

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ABSTRACT OF THE DISSERTATION

EXAMINING MATERNAL EMOTION REGULATION AMONG CHILDREN WITH AND WITHOUT ADHD: A MULTIMODAL APPROACH

by

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Professor Paulo A. Graziano, Major Professor

Objectives: This study utilized a multimodal approach to explore profiles of emotion regulation (ER) in mothers of young children with and without attention-deficit/hyperactivity disorder (ADHD). We also sought to understand how parent factors (i.e., skills, stress, ADHD symptoms) as well as child factors were associated with membership to these profiles. Methods: The final sample consisted of 182 parent-child dyads. Sixty-six children were in the typically developing group (Mean age = 5.47, SD = .90, 74.2% males), and there were 116 children in the ADHD group (Mean child age = 5.41, SD = .75, 80.2% males). Dyads completed a stress-inducing task (clean up) during which mothers' heart rate variability (HRV), specifically, respiratory sinus arrhythmia and pre-ejection period, was collected. Maternal ER strategies and parenting behaviors (proportion of DO and DON'T skills) were coded during the same clean up task. Mothers also completed self-reports of their ER strategies, parenting stress, parenting behaviors, and ADHD symptoms. Mothers and teachers completed questionnaires on child ER and ADHD symptoms. Children completed two frustration tasks to assess domains of emotion dysregulation. Results:

Latent profile analysis included maternal ER as indicators (HRV, self report, coding) and yielded 4 distinct profiles: mixed (n = 64), moderate (n = 49), low (n = 12), and high (n = 57) ER. Mothers in the low ER profile demonstrated the highest levels of observed ER difficulties. The moderate ER profile demonstrated some co-activation of the autonomic nervous system (ANS), yet were more behaviorally regulated than mothers in the low ER group. There were no differences between mixed and high ER profile on behavioral measures of ER but there was evidence of co-activation of the ANS for the mixed ER profile. Lastly, proportion of DON'T skills were associated with the probability of membership to each profile. Parenting stress and child hyperactivity/impulsivity symptoms was predictive of membership to high ER profile. There was a significant difference between diagnostic groups and membership to profiles, Pearson $\chi^2(3) = 8.39$, $p < .05$, such that there were more children with ADHD in the low ER profile. Conclusions: Four distinct profiles of maternal ER emerged, highlighting the heterogeneity in maternal ER. Negative parenting behaviors, parenting stress, and child symptomology may also play a significant role in the development and maintenance of these maternal ER strategies. Future clinical trials should examine maternal ER as a potential therapeutic target.

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ABBREVIATIONS AND ACRONYMS

ADHD	Attention deficit/hyperactivity disorder
ANS	Autonomic nervous system
BL	Baseline
DERS-SF	Difficulties in Emotion Regulation Scale – Short form
DPICS	Dyadic Parent-Child Interaction Coding System
ER	Emotion regulation
HRV	Heart rate variability
LPA	Latent profile analysis
ODD	Oppositional defiant disorder
PEP	Pre-ejection period
PEP-R	Pre-ejection period reactivity
PNS	Parasympathetic nervous system
RSA	Respiratory sinus arrhythmia
RSA-W	Respiratory sinus arrhythmia withdrawal
SNS	Sympathetic nervous system
TD	Typically developing

I. INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by a triad of symptoms; inattention, hyperactivity, and impulsivity (Barkley, 2014). Impairments associated with ADHD affect 10 to 25% of young children (DuPaul & Kerns, 2011; Willcut, 2012; Voeller, 2004) and are the most common reason for child mental health referrals (Cormier, 2008). Impairments associated with the symptoms of ADHD affect social, academic, and familial functioning (Barkley & Mash, 2003). For example, behaviors associated with ADHD symptoms affect a parent's employment status (Harvey, 1998) and create added expenses for families due to additional health care services such as psychosocial and pharmacological treatments (Foster et al., 2007; Matza, Paramore, & Prasad, 2005; Pelham et al., 2007). Cognitive theories of ADHD have shown that deficits in self-regulation, primarily in executive functioning (EF) are one of the cornerstone features of ADHD (Barkley, 1997; Sjöwall, Roth, Lindqvist, & Thorell, 2013). However, recent work by Graziano and Garcia (2016) has demonstrated that emotion regulation (ER) dysfunction is also a hallmark of ADHD and independent from other impairing conduct problems. Considering the high heritability of ADHD (~.8) (Larsson, Chang, D'Onofrio, & Lichtenstein, 2014) and persistent nature of ADHD symptoms (Guelzow, Loya, & Hinshaw, 2016), it is important to consider the impact of parent ADHD on the development and maintenance of these dysfunctional ER skills in both parents and their children (Han et al., 2016).

Parenting

Decades worth of research have shown the effects of positive versus negative parenting on child outcomes (Kaiser, McBurnett, & Pfiffner, 2011; Yap, Schwartz, Byrne, Simmons, & Allen, 2010). Positive parenting includes factors such as warmth, consistent parenting, and praise (Kaminski, Valle, Filene, & Boyle, 2008). Negative parenting is generally described as being ineffective, punitive, inconsistent, and power assertive (Blair, 2002; Hoffman, 2001). From a cultural context, parents from ethnically diverse groups tend to engage in higher rates of negative parenting, and have children who are rated by teachers as being more disruptive (Fontes, 2002; Ryser, 2011). Being a parent to a child with ADHD amplifies these parenting difficulties when compared to parents of typically developing children (Wymbs, Wymbs, & Dawson, 2015). Not surprisingly, behavioral parent training (BPT) is the first line of treatment for young children with ADHD (Attention-Deficit, 2011) which focuses on increasing positive parenting/interactions (Bagner, Fernandez, & Eyberg, 2004; Kaminski et al., 2008), and implementing effective behavior management skills (Pelham & Fabiano, 2008; Webster-Stratton, Reid, & Beauchaine, 2011). One important factor that is crucial to examine in the context of parenting and as a target of BPT is stress related to parenting.

Parenting Stress

More than 30 years of research has suggested that the stress of being a parent is greater than other domains, such as work-related stress (Crnic & Greenberg, 1990; Deater-Deckard, 2008; Quittner, Glueckauf, Jackson, & psychology, 1990). There is an abundance of literature stating that chronic stress has serious negative implications

across biological (Ansell, Rando, Tuit, Guarnaccia, & Sinha, 2012; Jackson, Knight, & Rafferty, 2010; Miller & Blackwell, 2006) and mental health outcomes (Jackson et al., 2010; Staufenbiel, Penninx, Spijker, Elzinga, & van Rossum, 2013). Although parenting stress typically declines as a child gets older (Neece, Green, Baker, & disabilities, 2012), this association is maintained when parents have higher levels of psychopathology (Eiden, Colder, Edwards, & Leonard, 2009; Knappe et al., 2009) and/or their children have chronic conditions (Barroso, Mendez, Graziano, & Bagner, 2018; Craig et al., 2016; Golfenshtein, Srulovici, Medoff-Cooper, & nursing, 2016; Pai et al., 2007).

Parents with elevated levels of psychopathology have been shown to engage in poorer parenting behaviors (Berg-Nielsen, Vikan, Dahl, & psychiatry, 2002; Smith & Work, 2004). For example, in a large study ($N = 2838$) of mother-child dyads, greater levels of maternal depression was associated with higher rates of neglect, psychological aggression, physical assault, and poorer engagement (Turney, 2011). Similar findings exist for mothers with anxiety, such that mothers of newborns high in anxiety reported low levels of warmth, involvement, and parenting satisfaction (Seymour, Giallo, Cooklin, Dunning, 2015). Of interest to the current study, recent work has shown that parents with high levels of ADHD symptoms themselves experience less gains in BPT (Chronis-Tuscano et al., 2011; Sonuga-Barke, Daley, & Thompson, 2002). Taken together, it is not surprising that parents with elevated levels of psychopathology experience greater levels of stress. The constant need to manage their child's difficulties as well as their *own* cognitive and emotional impairments may be very overwhelming. Therefore, the variability in how parents manage their

emotions during these stressful situations is emerging as a promising mechanism to understanding the association between parenting stress and child outcomes (Chronis-Tuscano, Wang, Woods, Strickland, & Stein, 2017; Woods, Mazursky-Horowitz, Thomas, Dougherty, & Chronis-Tuscano, 2019).

Emotion Regulation

ER is defined as the extrinsic and intrinsic processes responsible for the monitoring, evaluation, and modification of emotional reactions to achieve one's goals (Gross, 2011). Children with ADHD demonstrate deficits in four crucial domains of emotion dysregulation (ED): emotion recognition/understanding (ERU), emotional reactivity/negativity/lability (ERNL), emotion regulation (EREG), and empathy/callous-unemotional traits (ECUT; Graziano & Garcia, 2016). For parents, a particularly important time to regulate one's emotions is in the context of managing their child's behavior, especially if children have difficulties regulating their own emotions. From an observational learning perspective, parents serve as models of emotional displays and these emotional behaviors are subsequently imitated by their children (Graziano, Keane, & Calkins, 2010). Inappropriate parental displays of ER in turn have shown to contribute to poor emotional development in children and increased risk of psychopathologies (Kim, Capaldi, Pears, Kerr, & Owen, 2009).

While factors such as stress play a large role in a parent's ability to modulate their emotions, parents with varying psychopathologies, specifically ADHD, tend to have greater levels of ER deficits (Mazursky-Horowitz et al., 2015). Additionally, mothers with greater ADHD symptoms tend to be less supportive in response to their child's negative emotions (Mokrova, O'Brien, Calkins, & Keane, 2010), and engage

in higher rates of negative parenting practices (Chronis-Tuscano et al., 2008). While most prior research examining parental ER strategies have relied heavily on self-reports or behavioral observations (Kim et al., 2009; Morelen, Shaffer, & Suveg, 2016; Morris, Silk, Steinberg, Myers, & Robinson, 2007), a growing body of research has focused on the study of biological markers of ER (Appelhans & Luecken, 2006; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012; S. R. Williams & Woodruff-Borden, 2015).

Physiological Measurement of ER

The parasympathetic nervous system (PNS) is a branch of the autonomic nervous system (ANS) which plays a critical role in the regulation of emotional responses (Kreibig, 2010; Thayer, Åhs, Fredrikson, Sollers, et al., 2012). From a top-down feedback or brain-behavior perspective, there is evidence to suggest that cortical areas such as the ventro-medial prefrontal cortex (vmPFC) and subcortical areas like the amygdala are associated with heart rate variability (HRV) during emotionally arousing tasks (Lane et al., 2009; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). A measure of HRV, cardiac vagal tone, is an index of the PNS control of the heart via the vagus nerve (Grossman, Stemmler, & Meinhardt, 1990). HRV can be non-invasively measured by respiratory sinus arrhythmia (RSA; Porges, 2007). Polyvagal Theory differentiates the role of the vagus nerve during a resting state versus a more challenging state. Resting or baseline measures of vagal tone represent an organism's ability to maintain homeostasis and the potential responsiveness of that organism.

During such restful periods, the vagus nerve exerts an inhibitory influence on the heart acting as a "brake" by increasing vagal output to the sino-atrial (SA) node of the heart and limiting sympathetic influences, which contributes to a steady slow heart rate (HR). Indeed low baseline levels of RSA have been associated with numerous negative outcomes such as social impairments (Bornstein & Suess, 2000) increased levels of internalizing and externalizing problems during childhood (Calkins, Graziano, & Keane, 2007) and greater risk for depression into adulthood (Hamilton & Alloy, 2016). During stressful periods, the vagal "brake" is disengaged resulting in a decrease in vagal output to the SA node of the heart as well as increased activity in the vmPFC (Thayer & Lane, 2009; Thayer & Sternberg, 2006a), and thus contributing to an increase in HR (S. W. Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996). Indeed, a greater change in RSA, or vagal withdrawal (RSA-W), has shown to aid an individual's capacity to cope with stressful events (Porges, 2003). For example, children with higher RSA withdrawal during challenging tasks exhibit better ER (Beauchaine, Gatzke-Kopp, & Mead, 2007) and are less likely to exhibit externalizing and internalizing behavior problems (Graziano & Derefinko, 2013).

Within the sympathetic nervous system (SNS), cardiac pre-ejection period (PEP) functions similarly to RSA as an index of sympathetic cardiac control on the heart via the beta-adrenal system (Berntson, Cacioppo, Binkley, et al., 1994). PEP is the time between the left ventricular depolarization to the onset of blood ejected into the aorta. Similarly to the measurement of RSA, PEP is examined during emotion-induction conditions in order to understand the SNS response via shortened PEP. Exposure to repeated stressors increases the allostatic load on physiological systems,

such as PEP, that may contribute to increased sensitivity or dysfunction over time (Clark et al., 2014). PEP has been identified as an empirically supported measure of emotional reactivity (Kreibig, 2010; Kreibig, Wilhelm, Roth, & Gross, 2007; Stifter, Dollar, & Cipriano, 2011). Shortened PEP, or PEP reactivity (PEP-R), which is marked by greater reactivity and increased arousal to emotional stressors, has been associated with poorer social competence (Kalvin, Bierman, & Gatzke-Kopp, 2016), increased levels of aggression (Beauchaine et al., 2013), and predictive of alcohol and other substance use (Brenner, Beauchaine, & Sylvers, 2005).

Classic models of ANS functioning suggest reciprocal activation between the SNS and PNS branch as it relates to HR changes (Cannon, 1932). For example, as PNS activity increases, SNS activity decreases or vice versa. However, the "doctrine of autonomic space" (Berntson, Cacioppo, & Quigley, 1991; Berntson, Cacioppo, Quigley, & Fabro, 1994; Lenneman & Backs, 2009) states the two branches of the ANS function in a multidimensional matter, rather than just reciprocally. Hence, under certain conditions an individual's PNS and SNS activity can both have excitatory or inhibitory influences on HR simultaneously (i.e., co-activation and co-inhibition, respectively). Thus, it may be the case that synchronization between RSA-W and PEP-R may be a proxy of a "core integration" system, in which individuals attempt to attend to their external environment and their physiological/homeostatic state (Thayer & Lane, 2009). If this system is unbalanced or dysregulated, one's behavior will be disinhibited (Thayer & Sternberg, 2006a). Despite this potential interaction between PNS and SNS activity, most studies have only examined these

biological markers in isolation (Williams & Woodruff-Borden, 2015) with no study to our knowledge examining these coupled systems in the context of parenting.

Current Study

Despite the emergence of ER as being a key self-regulatory process across the lifespan (Diamond & Aspinwall, 2003), the majority of the literature on ER has focused on the infant and early childhood period. Given the important role parents play in the development of children's ER skills via modeling of appropriate ER skills, it is imperative to examine underlying mechanisms associated with parent ER. Currently, the field relies heavily on traditional measures of ER such as self-reports and behavioral observations. Although studies with children have started to incorporate biomarkers of ER such as RSA and PEP, examination of the same constructs for parents is scant.

On the other hand, there is a very large body of research on stress. Individuals exposed to stress for extended periods have been shown to have poorer outcomes (Dube et al., 2009; Felitti & Anda, 2010). From poor biological processes (i.e., cardiac problems; Dimsdale, 2008) to higher susceptibility for a mental health disorder (Felitti & Anda, 2010; Kiecolt-Glaser et al., 2011), it is not surprising that most evidence-based interventions for children with behavior problems aim to reduce parenting stress. While various constructs such as parental psychopathology and parenting behaviors have been shown to play a role in treatment outcomes following interventions, little to no work has examined if ER skills differ between parents of TD developing children and children with ADHD.

This is the first study to overcome these limitations by examining parent ER by integrating self-reports, behavioral observations, and psychophysiology to further understand maternal ER (Crandall, Deater-Deckard, & Riley, 2015). The goal was to capture the heterogeneity of maternal ER by utilizing a latent profile approach. We hypothesized that distinct profiles of maternal ER would emerge, categorized as low, moderate, and high levels of ER across indicators. Using the profiles that emerged from the analyses, we then sought to examine how these distinct profiles were associated with various parental factors. For example, we hypothesized distinct measures of maternal ER would be uniquely associated with parent factors such as parental ADHD, parenting stress, and parenting behaviors. Furthermore, we hypothesized that mothers in the low maternal ER profile would have greater ADHD symptoms, more negative parenting, higher levels of stress, and lower levels of positive parenting compared to mothers in the moderate and high ER profiles.

Lastly, given the novelty of these maternal ER profiles, we sought to take an exploratory approach to understanding how domains of child ER and child symptomology were uniquely associated with each profile of maternal ER. We hypothesized mothers in the low ER profile would also have children with the greater ER deficits and highest levels of ADHD symptoms, relative to mothers in the high ER profile.

II. METHOD

Participants and Recruitment

The study was conducted at a large urban university in the southeastern region of the United States with a predominately Hispanic/Latino population. Families were recruited from local preschool and elementary schools, as well as mental health agencies through brochures, open houses/parent workshops. For the ADHD sample, if the mother (1) endorsed clinically significant levels of ADHD symptoms (six or more symptoms of either Inattention or Hyperactivity/Impulsivity according to the DSM-5 (Association, 2013) OR a previous diagnosis of ADHD), (2) indicated that the child was currently displaying clinically significant academic, behavioral, or social impairments as measured by a score of 3 or higher on a seven-point impairment rating scale (Fabiano et al., 2006), and (3) were not taking any psychotropic medication, the mother and child were invited to participate in an assessment to determine study eligibility. For the TD sample, if the parent (1) endorsed less than four ADHD symptoms (across either Inattention or Hyperactivity/Impulsivity according to the DSM-5), (2) less than four Oppositional Defiant Disorder (ODD) symptoms, and (3) indicated no clinically significant impairment (score below 3 on the impairment rating scale), the mother and child were invited to participate in an assessment to determine study eligibility. Exclusionary criteria included (1) a confirmed history of an Autism Spectrum Disorder and/or Intellectual Disability, (2) not currently enrolled in school, (3) and inability to attend an 8-week summer treatment program (STP-PreK; Graziano et al., 2014) prior to the start of the next school year (ADHD groups only).

The final sample consisted of 182 parent-child dyads. Sixty-six children were in the TD group (Mean child age = 5.47, SD = .90, 74.2% males; Mean mother age = 36.47, SD = 5.70;), and there were 116 children diagnosed with ADHD (Mean child age = 5.41, SD = .75, 80.2% males; Mean mother age = 36.14, SD = 6.21). As seen in table 2, there were no demographic differences between the ADHD and TD group. Within the ADHD group, 87 children met criteria for ADHD and ODD while 29 children met criteria for ADHD only. At intake, mothers provided informed consent to participate in the research study. Questionnaires were completed by the maternal caregiver in their preferred language (34 mothers completed questionnaires in Spanish).

Data Collection Procedures

All families participated in a one-time assessment prior to the start of the STP-PreK (ADHD group only), which included completion of the ADHD, ODD, and CD modules on the C-DISC (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) and various questionnaires regarding their children's behavioral, academic, and emotional functioning. Mothers completed a set of questionnaires based on their self-reported parenting strategies, ADHD symptomology, and ER strategies. Mother-child dyads also completed a series of tasks in the laboratory.

Mothers and child wore a total of seven electrodes that were attached to an ambulatory MindWare Mobile. For the baseline condition, children watched a 5-minute neutral movie clip ("spot", a short story about a dog exploring a neighborhood). While this episode was not a true resting baseline given children's attention to the external stimulus, it was necessary to keep children sitting quietly as

done in prior work (Calkins, Graziano, & Keane, 2007). A research assistant remained in the room with the child to ensure the child was not touching the electrodes nor talking during the movie. Similarly, mothers completed a baseline task by sitting in a quiet room by themselves. They were instructed to avoid using their phones and falling asleep. A research assistant remained in the room to ensure these conditions were met.

Next, families were brought to a separate room with a two-way mirror. Mothers were informed that the research staff was on the other side of the mirror recording the interaction. Mothers were given a bug in the ear device through which the procedures would be communicated to her. Mothers and children were allowed to ambulate around the room as they pleased during the observation. At the end of the parent-child interaction, the mother was escorted back to her separate room to complete questionnaires while the child completed various tasks. Children were provided snack and coloring breaks between tasks. At the end of the clinic visit, children were allowed to select a toy from the treasure chest. All families received a $100 gift card for completing the assessment.

Measures

Pathophysiology Acquisition

*Respiratory Sinus Arrhythmia***.** RSA was indexed by extracting the high frequency component (>0.15 Hz) of R-R peak time series. R-R waves were examined for artifacts and outliers using MindWare® Heart Rate Variability software V.3.1. RSA was derived by using spectral analysis in 30 s epochs. Time series were detrended and submitted to a Fourier transform. The high frequency band (in ms^2)

were set over the respiratory frequency band of .15 to .40 Hz, which is the recommended range for adults. Respiratory rates were derived from the impedance cardiogram (ICG; Z0) ensuring that the signals remained within analytical bandwidth.

Cardiac Pre-ejection Period. PEP was derived from ECG and ICG in 30s epochs, using MindWare Impedance Cardiography V.3.1. PEP was indexed as the time interval in milliseconds from the onset of the Q-wave to the B point of the dZ/dt wave, using the methods delineated by Bernston and colleagues (2004). Artifacts were examined and removed using the MindWare Impedance Software. Less than 10% of parent data was not used due to hardware malfunction or excessive artifacts (more than 50% of segment was not useable).

Maternal Emotion Regulation (ER)

Psychophysiological ER. Mothers were asked to complete three tasks: a 5-minute baseline task in which they sat quietly in a room by themselves (baseline physiological functioning), followed by a child lead play interaction, parent lead interaction, and a clean up task with their child (each task last for 5-minutes). Mothers and their children participated in a clean up situation using the *Dyadic Parent-Child Interaction Coding System, 4th edition* (DPICS-4; Eyberg, Nelson, Ginn, Bhuiyan, & Boggs, 2013). Mothers instructed their child to put away three sets of toys (i.e., Mr. Potato Head, Legos, Play Food) without their help. The clean up task has been used in similar samples of young children with externalizing behavior problems (Bagner et al., 2009; Rodriguez et al., 2013) as an externally valid means of eliciting emotional reactions from the child. By creating a challenging situation for the child, we were able to examine mothers' reactions to their child. RSA and PEP

were calculated by averaging the 30 s epochs together for a mean RSA and PEP score. RSA-W was calculated by subtracting the task score from the baseline (Baseline RSA – Clean up RSA). Greater RSA-W scores suggest a decrease in PNS influence on the heart. PEP-R was calculated by subtracting baseline PEP from task PEP (Clean up PEP – Baseline PEP). Lower PEP-R scores indicate shorting of PEP during the task, thus greater SNS reactivity.

Behavioral observation of ER. Mothers' participation in the clean up task was videotaped and coded for maternal duration of distress (total time in seconds mother was emotionally reactive) and emotion regulation (range from 0 = dysregulated to 4 = well-regulated), all of which have reported high reliability (Graziano, Slavec, Hart, Garcia, & Pelham Jr, 2014). Twenty percent of the sample were coded by a second rater for reliability. Duration of distress during the task was highly correlated (r = .86) and weighted kappa for the global code was in the almost perfect agreement range (.83).

Self-reported ER. Mothers completed the Difficulties in Emotion Regulation Scale-Short Form (DERS-SF; Kaufman et al., 2016). The DERS-SF is a validated 18-item measure of emotional problems in adults (Victor & Klonsky, 2016). The DERS-SF yields 6 subscales (Awareness, Clarity, Goals, Impulse, Non-acceptance, Strategies) and an overall score. The overall score from the DERS-SF was used, α = .80.

Parental Factors

Parenting behaviors. Mother and child behaviors were coded during a 5-minute clean-up situation using the *Dyadic Parent-Child Interaction Coding System,*

4th edition (DPICS-4; Eyberg et al., 2013). Interactions were coded and categorized as "DO skills" (i.e., labeled/unlabeled praises, behavior descriptions, and reflections) and "DON'T skills" (i.e., commands, criticisms, and questions), and "Neutral Talk". Total "DO" and "DON'T" scores during the clean up task were computed, as well as a "Total Interactions" composite which was a sum of the "DO", "DON'T" and "Neutral Talk" behaviors. Finally, two proportion scores were computed 1) proportion of DO skills to Total Interactions and 2) proportion of DON'T skills to Total Interactions. An independent coder (blind to child diagnostic status) was assigned to code 20% of the observations a second time for reliability (*r*s = .80-.90).

Parenting Practices. Mothers also completed the *Alabama Parenting Questionnaire* (APQ; Shelton, Frick, & Wooton, 1996), which is a 42-item measure of parenting practices across 5 domains: parental involvement, positive parenting, poor monitoring/supervision, inconsistent discipline, and corporal punishment. Consistent with prior work, two factors, Positive Parenting Composite (α = .82) and Inconsistent Discipline (α = .70) were examined in the current study (Hawes & Dadds, 2006; Hinshaw et al., 2000). The APQ has been validated with young children (Clerkin, Halperin, Marks, & Policaro, 2007).

ADHD Symptomology. The Adult ADHD Self-Report Scale (ASRS; Adler et al., 2006) in an 18-item measure used as a tool to identify impairing ADHD symptoms in adults (Van de Gild et al., 2013). Responses on the Adult ASRS vary from 0 – (never) to 4 (very often) when endorsing symptoms associated with ADHD within the past 6 months. A mean ADHD score was used, α = .94.

Parental Stress. The Parenting Stress Index- Short Form (PSI-SF) is a 36-item questionnaire that consists of 3 subscales (parental distress, parent-child dysfunctional interactions, and difficulty of the child), along with a total score. The total PSI-SF score was used in the current study, $\alpha = .94$.

Child Factors

ADHD and ODD Symptomology. Mothers and teachers completed the Disruptive Behavior Disorders (DBD) Rating Scale (Pelham, Gnagy, Greenslade, & Milich, 1992), adapted for DSM-5 terminology. The DBD rating scale asks the respondent to rate on a 4-point scale ranging from 0 (not at all) to 3 (very much), the degree to which children display symptoms of ADHD, ODD, and CD. The DBD Rating Scale's responses range from 0 (not at all) to 3 (very much). Consistent with prior work (Hartman, Rhee, Willcutt, & Pennington, 2007; Sibley et al., 2010), parent and teacher ratings were combined by taking the higher of the two ratings for each item to create composites: hyperactivity/impulsivity, inattention, and impulsivity. The mean score for each inattention, ($\alpha = .88$), hyperactivity/impulsivity, ($\alpha = .92$), and ODD symptoms were examined ($\alpha = .85$).

Emotion recognition/understanding (ERU). Children completed a standardized emotion knowledge task (Denham, 1986) that required children to both expressively and receptively identify 8 different emotions (sad, happy, angry, afraid, surprised, disgusted, embarrassed, guilty) as presented visually via cartoon faces. Children scored 1 point for each correct expressive and subsequent receptive answer. A total of 16 points was possible with higher scores indicative of better emotional awareness/knowledge.

Emotional regulation (EREG). Children completed two frustration tasks adapted from the Lab-TAB (Goldsmith & Rothbart, 1996): I'm Not Sharing and Impossibly Perfect Circles. In the I'm Not Sharing task, an assistant brings a container of candy and tells the experimenter to share it equally with the child. The experimenter initially divides the candy equally. Eventually, the examiner takes more candy, eats a piece of the child's candy, then proceeds to take more candy, until they take all of the child's candy.

In the Impossibly Perfect Circles task, children were asked to draw circles repeatedly and were criticized (e.g., too large, too small) after each attempt. The tasks were discontinued if the child was highly distressed or cried for more than 30s. If the child was not highly distressed, the tasks was terminated after 3 minutes and 30 seconds in which the child was praised for their effort and provided a small prize from a treasure chest (e.g., stickers, pencils, candy). The total amount of time the child was distressed was recorded and a proportion score (time distress/time in task) was used. Twenty percent of the sample was coded by a second rater for reliability. Duration of distress during the tasks was highly correlated (r = .80). For data reduction purposes, the most severe rating of dysregulation between the two tasks was used for the current study.

Emotional reactivity/negativity/lability (ERNL). Mothers and teachers also completed the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). The ERC is a 24-item questionnaire that uses a 4-point Likert scale (1=almost always to 4=never). The ERC and yields two subscales: Negativity/Lability scale (15 items), which represents negative affect/mood lability, and the Emotion Regulation scale

(eight items), which assesses processes central to adaptive regulation. For the present study, the highest Negativity/Lability score between parent/teachers was used, with higher scores indicating greater levels of negativity/lability ($\alpha = .93$).

Callous-unemotional behaviors (CU). Mothers and teachers completed an abbreviated version of the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004) consisting of 12 items identified by Hawes and colleagues (2014) as showing psychometric properties similar to those of the full ICU. The items were rated on a four-point Likert scale ranging from 0 (not at all) to 3 (very much), and a CU composite was created by averaging these 12 items ($\alpha = .72$). Once again, the highest score among parent and teacher reports was used.

Data Analysis Plan

All analyses were conducted using the Statistical Package for the Social Sciences version 20.0 (SPSS 20) and Mplus Version 7 (Muthen & Muthen, 2012). For the maternal emotion regulation profiles, 80% of participants had complete psychophysiological data, 98% behavioral data, and 100% self-reported ER. During the psychophysiological data acquisition, excessive artifacts due to movement or hardware malfunction resulted in unusable data. Four maternal ER observations were lost due to camera malfunctioning. Little's Missing Completely at Random Test suggested there was no evidence that the missing data were not missing at random, $\chi^2 (48) = 56.60$, $p = .19$. There was less than 5% missing data for maternal self-reports. According to Little's Missing Completely at Random Test, there was no evidence to suggest that the maternal questionnaires were not missing at random, $\chi^2 (7) = 10.93$, $p = .14$.

Latent profile analysis (LPA) was completed in Mplus using maximum likelihood estimation. Profiles of maternal emotion regulation comprised of self-reported (DERS) and observed (RSA/PEP and behavioral codes) measures of maternal emotion regulation as indicators. Multiple fit statistics were examined to evaluate each model. These indices included Akaike information criterion (AIC), Bayesian information criteria (BIC), Adjusted BIC, bootstrap likelihood ratio test (BLRT), and entropy. Following guidelines from Nylund, Asparouhov, and Muthen (2007), we began specifying two latent profiles and increased the number of latent profiles until the increase in model fit was no longer parsimonious. The best fit model consisted of the lowest BLRT, AIC, BIC, and highest entropy, compared to other models in conjunction with theory-based decisions and interpretability. The probability of profile membership was saved for each participant.

A series of univariate analysis of variance (ANOVA) tests were conducted to test the hypothesis that there were differences between profiles on measures of maternal ER (i.e., self-report, physiological, observed), parenting factors (i.e., behaviors, stress, ADHD symptoms) and child factors (i.e., ADHD and ODD symptoms, ER deficits). Lastly, linear regressions were conducted to examine the extent to which maternal and child factors were associated with the probability of membership to each maternal ER profile.

III. RESULTS

Preliminary analyses

Prior to examining maternal emotion regulation profile, we examined if there were any differences between the ADHD and TD groups on various measures of maternal demographics. As seen in Table 1, there were no differences between maternal age, marital status, race, ethnicity, or maternal education.

Maternal Emotion Regulation Latent Profile Analyses

LPAs were conducted in Mplus. Seven variables were used as indicators to create profiles of maternal emotion regulation. Observational measures included behavioral (proportion of distress and global emotion regulation) and psychophysiological (baseline RSA, baseline PEP, RSA-W, PEP-R) indices of maternal emotion regulation. Mothers self-reported emotion dysregulation (DERS) was also used an indicator. See Table 4 for intercorrelations on maternal ER indicators and maternal factors. As seen in Table 3, post-hoc analyses revealed there were no differences between maternal demographic variables and ER profiles.

Fit indices for one-profile to five-profile solutions are presented in Table 2. Following Nylund and colleagues (2007) suggestions, profiles with less than 5% of the total sample size should be interpreted with caution due to their low convergent probabilities, suggesting less than 50% of participants are correctly classified. Therefore, the five-profile solution was deemed uninterpretable since one profile only accounted for four participants (2.2% of the sample). The bootstrapped likelihood ratio test revealed the four-profile model was significantly better than the three-profile model $\chi^2(8) = 38.20$, $p < .001$, with a lower adjusted BIC value of 3458.96 and

AIC value of 3457.56. Although the two and three-profile solutions produced better entropy (.91 and .86, respectively), the four-profile solution indicated a .74 entropy that appropriately estimated about three-fourths of the participants into appropriate profiles. Thus a four-profile solution was selected.

The profiles were conceptualized as a (a) behaviorally regulated yet physiologically distressed profile (Mixed ER; $n = 64$), (b) moderate distress profile (Moderate ER; $n = 49$), (c) high behavioral distress and average physiological regulation profile (Low ER; $n = 12$), and (d) behaviorally regulated and physiologically regulated profile (High ER; $n = 57$). As seen in Table 3, there was a significant difference between diagnostic groups and membership to profiles, Pearson $\chi^2(3) = 8.39$, $p < .05$, such that there were more children with ADHD in the high behavioral distress and average physiological regulation profile. Figure 1 depicts the pattern of means across the four profiles. Scores were standardized so that positive values are above the mean while negative scores are below the mean.

Profile 1, or the Mixed ER, consisted of 35% of the sample, 24 of which were in the ADHD group and 40 belonging in the TD group. As seen in Table 4, individuals in this group displayed low levels of distress during a 5-minute clean up task with their child (i.e., only spent 3% of the task time, 9 seconds, in distress). Additionally, individuals in this group engaged in effective emotion regulation strategies during the clean-up task with their child. However, parasympathetic influence, as measured by RSA-W, indicated an augmented response, suggesting individuals needed to increase their allostasis in order to attend to the task. This in

part may also be due to the fact that individuals in this profile also had lower baseline RSA, which is associated with less parasympathetic control on cardiac output.

Profile 2, or Moderate ER, consisted of 27% of the sample, 35 of which were in the ADHD group and 14 belonging in the TD group. Table 4 demonstrates how individuals in this profile were distressed for 13% of the clean-up task (39 seconds) and were "somewhat" regulated during the task (mean = 2.80, *SD* = .46). Similarly to Mixed ER, membership to this group was associated with a lower baseline RSA and an augmented parasympathetic response (Mean RSA-W = -.02, *SD* = .70)

Profile 3, or Low ER, consisted of 7% of the sample, 11 of which were in the ADHD group and 1 in the TD group. As demonstrated in Table 4, individuals in the profile were distressed for 33% (108 seconds) of the clean-up task as well as engaged in "somewhat" effective emotion regulation strategies. Compared to Mixed ER, individuals in this profile had significantly higher baseline RSA and RSA-W, suggesting a typical trend of parasympathetic withdrawal on the heart during a stressful situation.

Profile 4, or High ER, consisted of 31% of the sample, 30 of which were in the ADHD group and 27 in the TD group. Across behavioral and psychophysiological measures of maternal emotion regulation, individuals in this profile had low levels of distress (approximately 3% of the clean-up task), mostly regulated levels of ER skills (mean global ER code = 3.69, *SD* = .47), and the highest RSA-W. See Table 4 for all other mean comparisons.

Comparison of Parenting Outcomes between Maternal ER Profiles

A series of ANOVAs were conducted to test the hypothesis that there would be one or more mean differences between maternal emotion regulation profiles and parenting outcomes, even after accounting for child symptomology (i.e., ADHD and ODD symptoms). Pairwise comparisons revealed differences between profiles of maternal ER and DON'T[1] skills. Mothers in the Low ER profile displayed a significantly greater proportion of DON'T skills (Mean = .70, *se* = .04) compared to mothers in the Mixed ER (Mean = .52, *se* = .02), Moderate ER (Mean = .61, *se* = .02), and High ER profiles (Mean = .52, *se* = .02) *p*s < .001. Mothers in the Moderate ER profile (Mean = .61, se = .02) displayed a significantly greater amount of DON'T skills compared to mothers in the High ER profile, $p < .001$. There were no mean differences between mothers in Mixed ER and High ER profile on DON'T skills, $p > .05$. Means for each parent outcome are reported in Table 5. There were no significant differences between profile membership and maternal ADHD symptoms, parenting stress, or positive and negative parenting practices, *p*s > .05.

Comparison of Child Outcomes between Maternal ER Profiles

A second series of ANOVAs were conducted to examine if there were differences in child factors between maternal ER profiles. We found no statistical differences across any child factors, Wilks lambda = .88 F (21, 471.47) = 1.07, p = .38. Means for each child outcome are reported in Table 6.

[1] In order to increase the generalizability and external validity of our findings, we utilized the proportion of DO and DON'T skills from the clean up task. It is important to note that all analyses were tested with total as well as CDI specific behaviors and there were no differences in our findings.

Linear Regressions Examining Maternal and Child Factors Predicting Probability of Membership to Maternal ER Profiles

Maternal Factors. Linear regressions were conducted to examine the association between parenting and child outcomes and probability of membership to each profile. First, we examined the extent to which maternal factors were associated with the probability of membership to each profile (Table 7). In terms of the Mixed ER profile, no significant predictors emerged, F (9, 166) = 1.72, R^2 = .09, p > .05; however, it is important to note a marginally significant association between the probability of membership to the Mixed ER profile and parenting stress, β = -.18, p = .051.

Proportion of DON'T skills was the only significant predictor of the probability of belonging in this Moderate ER profile, F (9,166) = 2.70, R^2 = .13, p < .01. There was a small effect (β = .21, p < .05) of proportion of DON'T skills on membership to the Moderate ER profile, such that mothers tended to use more DON'T skills during the clean up task.

For the Low ER group, proportion of DON'T skills (β = .28, p < .01) were associated with membership to this profile, F (9,166) = 2.42, R^2 = .12, p < .05. Mothers in the Low ER group tended to use more DON'T skills during the clean up task.

Lastly, in terms of membership to the High ER profile, proportion of DON'T skills was the only significant predictor of the probability of belonging in this profile, F (9,166) = 2.62, R^2 = .12, p < .01. There was a small to moderate effect (β = -.27, p < .01) of the proportion of DON'T skills on membership to the High ER profile, such

that mothers tended to use less DON'T skills during the clean up task. Thus, proportion of DON'T skills and parenting stress were used in Table 14.

Child Factors. As seen in Table 13, child ER and symptomology were entered as predictors of the probability of membership to each maternal ER profile. Consistently across profiles, the inclusion of all the child factors yielded non-significant models. However, significant individual effects are presented. Parent/teacher reports of child hyperactivity/impulsivity symptoms ($\beta = .44$, $p < .01$) was significantly associated with membership to the Mixed ER profile, such that children in this group had greater levels of hyperactivity/impulsivity symptoms. There were no significant child predictors for the Low, Moderate, of High ER profiles. Subsequently, hyperactivity/impulsivity symptoms was the only child factor used in Table 13.

Maternal and Child Factors. Table 14 included the significant maternal and child factors presented above. Three significant variables emerged when predicting probability of belonging to the Mixed ER profile, F (7, 168) = 4.95, $R^2 = .17$, $p < .001$. DON'T skills ($\beta = -.34$, $p < .001$), parenting stress ($\beta = -.20$, $p < .01$), and hyperactivity/impulsivity symptoms ($\beta = .19$, $p < .05$), were significantly associated with the Mixed ER group. Mothers in the Mixed ER profile engaged in less DON'T skills during the clean up task, reported less parenting stress, yet their children tended to be more hyper/impulsive.

Next, we examined how maternal and child factors were associated with membership to the Moderate ER profile. DON'T skills ($\beta = .32$, $p < .001$), was the only significant predictor of membership to the Moderate ER group, F (7, 168) =

3.91, R^2 = .14, p < .001. Mothers in the Moderate ER profile tended to engage in more DON'T skills during the clean up task.

When examining possible predictors of membership to the Low ER profile, only one maternal factor emerged, F (7, 168) = 10.87, R^2 = .31, p < .001. Greater DON'T skills (β = .55, p < .001) was significantly associated with a greater possibility of being in the Low ER profile. Of note, there was a trending association between DO skills and membership to the Low ER profile, (β = -.13, p = .06).

Lastly, two significant predictors emerged for the High ER profile, F (7, 168) = 4.44, R^2 = .16, p < .001. DON'T skills (β = -.32, p < .001) and child hyperactivity/impulsivity symptoms (β = -.16, p < .05) were predictive of membership to the High ER profile. Mothers in this profile used less DON'T skills during the clean up task and their children have lower levels of hyperactivity/impulsivity.

IV. DISCUSSION

The purpose of the current study was to examine maternal ER from a multimodal perspective within a sample of mothers of children with and without ADHD. Given the emergence of emotion dysregulation as a core deficit in individuals with ADHD, our primary goal was to understand how various measurements of ER characterize the heterogeneity in maternal ER. Our secondary goal was to examine how differences in maternal ER were associated with parental factors such as ADHD symptomology, parenting stress, and parenting behaviors. Lastly, we were interested in examining how child factors, specifically ADHD symptomology and ER were associated with these maternal ER profiles. Results of the study revealed that maternal ER was characterized by four distinct profiles: mixed ER, low ER, moderate ER, and high ER. Additionally, we found that membership to the low and moderate ER profile was associated with greater levels of observable negative parenting behaviors while membership to the mixed ER profile was associated with self-reported levels of parenting stress. Lastly, we found that child hyperactivity/impulsivity symptoms were associated to the mixed and high maternal ER profiles, respectively. We elaborate on these findings below.

Partially consistent with our hypothesis, we found three profiles of maternal ER marked by low, moderate, and high levels of behavioral and physiological distress. Unexpectedly, a fourth profile emerged with high behavioral regulation but poor physiological reactivity. It is also important to note that self-reports of ER did not differentiate any profiles. While previous studies have found an association between self-reports on the DERS and HRV, it is important to note that the

populations used in these studies were primarily college students (Visted et al., 2017; Williams et al., 2015). Additionally, the aforementioned studies were only able to examine state-levels of ER following an emotion-inducing task. On the contrary, our study employed a trait-level examination of maternal ER and did not pair the administration of the measure following the clean-up task. Therefore, the difference in sample demographics and study design may explain the mixed findings.

Both behavioral measures, proportion of distress and global regulation, were significantly associated with profile membership. For example, the low ER profile had a significantly higher proportion of distress and poorer global regulation during the clean-up task compared to mothers in the moderate, high, and mixed ER profiles. Mothers in the high and mixer ER profiles exhibited the least amount of distress and could be classified as "mostly regulated" to "well regulated" according to their scores on the global regulation code.

Within the physiological domain, greater baseline RSA as well as greater RSA-W was observed in high and low ER profiles relative to the moderate and mixed ER profiles. It is important to note that the difference in RSA-W between the low ER and high ER profiles was approaching significance, $p = .06$. Although it may be difficult to explain these null findings, we can cautiously speculate that there may be quantifiable differences in their parasympathetic response during the clean-up task. For example, previous work suggests that higher levels of RSA BL are associated with optimal physiological functioning in conjunction with RSA-W when dealing with stressful events (Hinnant & El-Sheikh, 2009; Vasilev, Crowell, Beauchaine, Mead, & Gatzke-Kopp, 2009; Cribbet, Williams, Gunn, & Rau, 2011). Thus, it may

be the case that mothers in the low ER profile demonstrate suboptimal parasympathetic withdrawal compared to mothers in the high ER profile.

There were also differences in sympathetic indices of maternal ER (i.e., PEP BL and PEP-R) between the mixed, moderate, and high ER groups. Our findings align with a review by Kreibig (2010) that found that PEP typically shortens when individuals experience anger, anxiety, and fear. While there no significant differences in PEP-R between the mothers in the low ER group compared to the other three groups, the directionality of this score is what we expected. Lastly, it is important to note the PEP-R standard error for the moderate ER group was twice as large compared to the other groups.

It is important to acknowledge the mixed ER profile. Mothers in this profile had the lowest RSA measures (i.e., RSA BL and RSA-W), significant PEP-R, yet had comparable levels of distress and global regulation relative to the high ER profile. While RSA and behavioral observations tend to be highly associated during the infancy period (Calkins et al., 2001), this association tends to taper off during the adolescent and adult periods (Beauchaine, 2001). It may be the case that mothers in the mixed ER profile have an imbalanced or co-activated autonomic response, causing them to be chronically hyper-aroused, especially during periods of rest (Thayer & Sternberg, 2006b). Given this imbalance, mothers in the mixed ER profile seem to increase their allostatic load, as indexed by an augmented RSA response, or negative RSA-W score, during the clean-up task. As explained by Porges vagal brake theory (1996), vagal tone will *decrease* when the "brake" is removed, allowing the individual to *respond* or "fight" in order to respond to a situation. However, if an

individual *increases* the vagal brake, this can *prevent* an individual from appropriately responding to their environment. Since the vagus nerve also innervates striated muscles in the face and neck area (Porges, 2001), it is not surprising that mothers in the mixed ER, who maintained high levels of RSA through tasks, demonstrated the least amount of changes in negative expressions and verbalizations. Similar to individuals with anxiety, it may be the case that mothers in this profile are in a constant state of "engagement" with their environment as indexed by their heightened PNS scores.

As it relates to our second goal, and after accounting for child ADHD and co-occurring ODD symptoms, the only significant difference across maternal ER profiles and maternal factors was on an observable measure of parenting, DON'T skills. Mothers in the high and mixed ER profiles were observed using approximately 6-7 DON'T skills per minute during the clean-up task. Next mothers in the moderate ER profile used approximately 10 DON'T skills per minute. Lastly, mothers in the low ER profile used nearly 17 DON'T skills per minute. When examining membership to each profile continuously, DON'T skills significantly predicted probability of membership to each of the profiles (see Table 12). Not surprisingly, mothers in the mixed and high ER profiles tended to have the least DON'T skills where as the low and moderate ER profiles tended to have mothers who engaged in more DON'T skills. It is important to note that our dimensional analysis, as reported in Table 4, also support these findings such that mothers with poor ER (self-reported and observed) also report less positive parenting (rs = -.37 to -.17, ps < .05). These findings were further supported by the finding that mothers in the low ER profile used

less DO skills. Consistent with previous work, mothers who engage in greater rates of negative parenting behaviors also have poorer ER (Crandall et al., 2015; Mazursky-Horowitz et al., 2015; Woods et al., 2019). Considering the salient findings associated with DON'T skills and maternal ER, future studies would benefit from incorporating a dyadic observational task to further elucidate the role of parent ER on maladaptive parenting skills.

Similar to other studies of maternal ADHD symptomology (Park, Hudec, & Johnston, 2017) we found a large association between maternal ADHD symptomology and the DERS ($r = .60$, $p < .001$). However, as seen in Table 10, there were no differences across maternal ER profiles on self-reported ADHD symptoms. Thus, when examined dimensionally, it may be the case that maternal ER may partially explain the association between parental ADHD and negative parenting behaviors (Chronis-Tuscano et al., 2011; Mazursky-Horowitz et al., 2015). The underlying ER deficits in ADHD (Barkley, Fischer, & Psychiatry, 2010) may better explain the difficulties parents with ADHD experience over and above the actual symptoms of ADHD. Thus, future work should examine if parent ER mediates the association between ADHD symptomology and parenting outcomes.

In regards to child factors, we found there was a significantly greater amount of children with ADHD in the low ER profile. It is important to note that approximately 83% (n = 10) of the children in the low ER maternal profile had ADHD and co-occurring ODD. Given children with ADHD and co-occurring conduct problems tend to have more behavioral and emotional deficits (Caspi et al., 2008; Graziano & Garcia, 2016), it is not surprising that mothers in this profile had the

lowest ER skills given the co-occurring presentation may elicit more dysfunctional parenting behaviors. Next, we hypothesized that mothers in the low ER profile would also have children with greater ER deficits. While there were no differences across the four measures of ER, ADHD, or ODD symptoms (Table 6), only child hyperactivity/impulsivity symptoms were significantly predictive of membership to the mixed and high ER profile. Although cross-sectional in nature, our findings replicate previous work demonstrating parents of children with less behavioral and emotional problems have lower rates of parent psychopathology (Bagner et al., 2013; Han & Shaffer, 2014). Interestingly, mothers in the mixed ER profile engaged in less DON'T skills, reported lower levels of parenting stress, yet their children tended to have higher levels of hyperactivity/impulsivity skills. Consistent with models suggesting continuous exposure to stressors increase an individuals' allostatic load (Goldstein & McEwen, 2002; Sturge et al., 2011), the continuous "wear and tear" associated with managing a child's hyperactive/impulsive symptoms may be indexed by augmented RSA, or negative RSA-W scores. Considering the negative mental and physical sequelae associated with chronic exposure to stress, it is imperative to understand the bidirectional nature of ER problems between children and their parents over time.

Although we did not find significant differences across maternal profiles on measures of child ER, post-hoc analyses revealed that hyperactivity/impulsivity were strongly related to parent/teacher reported negativity ($r = .76$, $p < .001$) and CU-behaviors ($r = .57$, $p < .001$). Considering children with ADHD also have significant emotional impulsivity problems (Farone et al., 2019), it may be the case that

hyperactive/impulsive symptoms may partially explain the link between ADHD and ED in young children.

The current study has several strengths. While previous studies of maternal ER have only examined self-reports (Woods et al., 2019), this is the first study to our knowledge, to use a multimodal approach to examine maternal ER. Aligned with RDoC (Insel et al., 2010), we examined maternal ER by using concurrent measurements of ER (i.e., behavioral and physiological) during a well-known and widely used parent-child paradigm (clean-up task; Eyberg, Nelson, Duke, & Boggs, 2005) and included self-reported ER strategies. While some studies have examined the differences in young children's RSA during various tasks with their parent (Cooper-Vince et al., 2017; Richardson, Bocknek, McGoron, & Trentacosta, 2019), findings from the current study elucidate the underlying processes that occur for parents during challenging parent-child interactions. We found that there were no differences across profiles on the self-report of ER (DERS), however there were significant differences on behavioral and physiological indices of maternal ER. Thus, future studies interested in examining the heterogeneity of maternal ER would benefit from observational and physiological data.

There were some limitations to the current study that need to be acknowledged. First, our measurement of self-reported ER (DERS) was not collected immediately after the clean-up task. The unique moment-to-moment nuances of the parenting "experience" may not of been captured in the same light as the observational (i.e., physiological and behavior coding) measures. Nonetheless, there is evidence to suggest that individuals will consistently use certain regulation

strategies and can be conceptualized as a "trait-level" difference when conceptualizing ER (Gross & John, 2003). Secondly, due to the design of the the current study, only mothers' reports and ER strategies were examined. While there is a growing literature on the influence of fathers on children's development (Jeynes, 2016), we were unable to examine any associations between mother and father emotion regulation. Future studies would benefit from understanding if differences exist between mother and fathers' reports of ER in the context of parenting. Lastly, approximately 6% of mothers reported having an ADHD diagnosis. Therefore, these results may not generalize to clinical samples of mothers who have an ADHD diagnosis.

Despite these limitations, the current study highlights the heterogeneity in maternal ER. The emergence of four profiles suggest that maternal ER is multidimensional and may be best conceptualized with various concurrent measures. The utility of using an ecological valid task, such as the clean-up scenario, allows these findings to generalize to parent-child interactions outside of a laboratory setting. Additionally, interventions for young children with behavior problems, such as behavioral parent training, focus on increasing positive parenting and decreasing negative parenting. Thus, focusing on negative parenting behaviors, such as the use of DON'T skills, is a key factor to consider when understanding the extent to which ER strategies impact a parents ability to engage effectively with their child.

Although this is the first study to examine maternal ER from a multi-modal perspective, there are various clinical implications. First, this study highlights the importance of examining parenting factors (i.e., ER, parenting stress, and parenting

behaviors) when considering interventions for children with behavior problems, specifically ADHD. For example, as seen in Table 6, there were no significant differences in continuous measures of child symptomology (ADHD or ODD) or ED. However, from a diagnostic standpoint, we found children with ADHD and co-occurring ODD were more likely to have mothers with suboptimal ER strategies. Therefore, identifying if a child has "pure" ADHD or a co-occurring presentation will be helpful in identifying appropriate interventions considering mothers of children with the co-occurring presentation are at risk of having greater ER deficits themselves. Thus, interventions, which focus on improving parents' ER strategies, may be promising in attenuating mothers' ER problems.

While behavioral parent training programs such as Positive Parenting Program (Triple P; Sanders et al., 2000) and Parent-Child Interaction Therapy (PCIT; Eyberg et al., 2001) are effective in improving parenting and child behaviors, mothers with greater ADHD related impairments, such as poor ER, might benefit from alternative treatments. For example, mothers with ADHD may benefit from a combined treatment that is sequenced (Schoenfelder et al., 2019) to address their most impairing behaviors, such as poor ER strategies. We found there were no differences on self-reported ER (DERS); however, there were significant differences across physiological and behavioral indices of ER. While equipment for physiological acquisition may be limited to university-based settings, examining parents interacting with their children during challenging tasks can still yield helpful information on the parent-child dynamic and any dysfunctional behaviors.

While there were no behavioral differences between mothers in the mixed and high ER groups, there were significant differences in their physiological reactions. One theory to support these differences in physiological functioning is the role cognitive reappraisal, which involves changing the meaning or thoughts about a stimulus/situation as a means to alter its change the emotional impact. Individuals who engage in cognitive reappraisal tend to demonstrate greater levels of emotion regulation (Gross 1998, 2015) as well as decreased likelihood of having psychopathology (Aldao, Nolen-Hoeskema, & Schweizer, 2010). Deater-Decker and colleagues (2016) found that greater levels of ER and cognitive appraisal strategies during a challenging situation with their young child was associated with greater levels of positive affect and less negative affect. Thus, it may be the case that the largest difference between mothers in the mixed ER and high ER group is the physiologically taxing effect of cognitive reappraisal during the clean up task. It is also important to note that mothers in the mixed ER group were more likely to also have children with higher levels of hyperactivity/impulsivity symptoms, therefore requiring them to constantly upregulate their ER strategies (i.e.. physiological regulation [augmented RSA-W] and cognitive appraisal skills) in order to effective manage their own emotions as well as their child's behavior.

In summary, our multimodal assessment of maternal ER, which included physiological, behavioral, and self-reported ER strategies, yielded four distinct profiles: mixed, moderate, low, and high ER. By examining various indices of ER, we were able to further explain the heterogeneity in how mothers interact with their children during stressful situations. At a biological level, we found that mothers in the

mixed ER group experience a unique ANS response in which there is a co-activation of the PNS and SNS branch. Most interestingly, mothers in the mixed ER profile were physiologically over aroused yet appeared behaviorally regulated. Behaviorally, mothers in the low ER profile experienced the most distress and were the least regulated during the clean up task. In regards to the moderate profile, mothers exhibited some co-activation of ANS, as indexed by a small augmented RSA score and a high PEP shortening (or PEP-R score), as well as some difficulties controlling their behavioral response. Lastly, the high ER profile was characterized as behaviorally regulated and predominantly PNS-controlled, as indexed by a greater RSA-W score and almost minimal shortening of PEP.

When examined continuously, the probability of pertaining to each of these maternal ER profiles was highly associated with DON'T skills. Not surprisingly, the probability of being in the high and mixed ER profile was greater for mothers with low DON'T skills and the inverse is was true for mothers in the low and moderate profiles. Interestingly, mothers in the mixed ER profile were less likely to have high levels of stress and mothers in the high ER profile reported having children with lower levels of hyperactivity/impulsivity symptoms.

While interventions may not be able to target a parent's physiological function directly, behavioral changes (i.e., improved ER during a challenging situation) may be associated with favorable outcomes for both parents and their children. Understanding ER functioning (Maliken & Katz, 2013) prior to the start of treatment may be necessary in order to provide "precision medicine" (Insel, 2014) to parents whom may not benefit from the current traditional parent training programs. For

example, the use of a dyad task, such as the clean-up task, could be a useful tool in identifying specific targets of treatment for parents. Additionally, future research studies can employ longitudinal approaches to understand the temporal precedence of ER problems in mothers and their children. Given the bidirectional nature of mental health problems in children and their parents (Bagner et al., 2013), future work should identify *how* and *when* these problematic ER strategies emerge. In doing so, treatments can be tailored to fit the developmental period (i.e., toddler, school age, adolescence) during which children and their parents are experiencing significant impairments due to their ER strategies. Theoretically speaking, addressing these significant parent ER problems may decrease stress levels associated with parenting and also decrease the probability on engaging in negative parenting behaviors.

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Table 1. Maternal Demographics by Child Diagnostic Group

	ADHD	TD	Full Sample
Maternal Age M (*SD*)	35.92 (6.05)	36.08 (5.43)	35.98 (5.79)
Marital Status (Married)[a]	71.6%	81.8%	75.7%
Race/Ethnicity			
White	88.8%	87.9%	88.5%
Black	10.3%	9.1%	9.9%
Other[b]	.8%	4.5%	.5%
Hispanic	81.0%	80.3%	81.2%
Education			
Some high school	1.7%	4.5%	2.8%
High school diploma	7.8%	6.1%	7.2%
Some college	19.0%	7.6%	14.9%
Associate degree	7.8%	15.2%	10.5%
College graduate	31.0%	31.8%	31.5%
Advanced degree	31.9%	34.8%	33.1%

Note. There were no demographic differences across 1) maternal profiles or 2) diagnostic groups, ER = emotion regulation, ADHD = Attention-deficit/hyperactivity disorder, TD = Typically developing; a = marital status as defined by living with partner/married or single; b = "Other" race defined as Asian or Indian American/Native Alaskan.

Table 2. Maternal ER by Child Diagnostic Group

	Full Sample	ADHD	TD	F
Variable				
PEP BL (O)	99.77 (13.71)	100.74 (14.87)	98.22 (11.55)	1.29
RSA BL (O)	6.03 (1.04)	6.02 (1.00)	6.04 (1.11)	.01
PEP-R (O)	-4.73 (13.32)	-5.26 (14.54)	-3.88 (11.18)	.35
RSA-W (O)	-.04 (.83)	-.05 (.85)	-.01 (.81)	.07
DERS (S)	1.78 (.55)	1.85 (.60)	1.65 (.41)	**6.10***
Pro Distress (O)	.08 (.10)	.10 (.10)	.05 (.06)	**12.41*****
Global Reg (O)	3.32 (.66)	3.20 (.65)	3.53 (.61)	**10.83*****
Parent ADHD (S)	1.23 (.64)	1.41 (.62)	.93 (.53)	**27. 64*****
(+) Parenting (S)	69.16 (6.74)	67.81 (7.19)	71.55 (5.09)	**13.92*****
(-) Parenting (S)	29.35 (6.55)	30.59 (6.83)	27.15 (5.41)	**12.25*****
Parent Stress (S)	71.34 (22.62)	80. 36 (22.06)	55.25 (12.44)	**71.43*****
DO Skills (O)	.07 (.08)	.07 (.09)	.07 (.06)	.44
DON'T Skills (O)	.56 (.14)	.58 (.14)	.52 (.12)	**7.91****

Note. Note. BL = Baseline; PEP = Pre-ejection period; PEP R = PEP reactivity; RSA = respiratory sinus arrhythmia; RSA W = RSA withdrawal; DERS = Difficulties in Emotion Regulation Scale; O = Observation; S = Self-report; + = Positive parenting; - = Negative parenting

Table 3. Child Symptomology and ER differences by Diagnostic Group

	Full Sample	**ADHD**	**TD**	X^2 / F
Age	5.43 (.80)	5.41 (.75)	5.47 (.90)	.27
Sex (male)	78%	80.2%	74.2%	.86
IQ	96.70 (13.28)	93.53 (13.26)	102.21 (11.46)	19.79***
Race/Ethnicity				
White	89.0%	88.8%	89.4%	.02
Black	11.0%	12.1%	9.1%	.38
Other	2.7%	.9	4.5%	1.77
Hispanic	85.2%	85.3%	84.8%	.05
Symptomology/ ER Domains				
INATT symptoms (C)	1.54 (.99)	2.17 (.58)	.44 (.43)	452.51***
HI symptoms (C)	1.70 (.97)	2.30 (.57)	.64 (.48)	397.21***
ODD symptoms (C)	1.16 (.88)	1.62 (.72)	.34 (.41)	180.98***
Emotion Knowledge (O)	10.03 (2.13)	9.97 (2.11)	10.16 (2.18)	.33
Proportion of time in distress (O)	.52 (.29)	.35 (.21)	.79 (.16)	206.80***
Negativity (C)	2.27 (.63)	2.62 (.46)	1.67 (.40)	196.96***
CU-behaviors (C)	1.08 (.54)	1.31 (.52)	.68 (.27)	81.33***

Note. O = Observation; C = Combined report, ER = Emotion regulation

Table 4. Correlation Among Emotion Regulation Measures and Maternal Factors

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. PEP BL (O)	-												
2. RSA BL (O)	.17*	-											
3. PEP-R (O)	-.45***	-.04	-										
4. RSA-W (O)	-.17*	.48***	.13	-									
5. DERS (S)	-.02	-.02	-.05	.06	-								
6. Pro Distress (O)	.10	.21**	.-.07	.04	.09	-							
7. Global Reg (O)	-.09	-.10	.15	.01	-.09	-.69***	-						
8. Parent ADHD (S)	.08	.08	-.08	.01	.60***	.07	-.01	-					
9. (+) Parenting (S)	-.11	-.10	.16	-.001	-.37***	-.17*	.13	-.34***	-				
10. (-) Parenting (S)	.13	-.04	.07	-.07	.41***	.09	-.08	.28***	-.30***	-			
11. Parent Stress (S)	-.10	.07	.01	.06	.43***	.16*	-.12	.42***	-.31***	.23**	-		
12. DO Skills (O)	-.04	-.07	-.05	-.04	.03	-.22**	.17*	.04	-.003	-.15*	.04	-	
13. DON'T Skills (O)	-.01	.09	.01	.004	.03	.40***	-.37***	.07	-.10	.07	.07	-.47***	-

Note. BL = Baseline; PEP = Pre-ejection period; PEP-R = PEP reactivity; RSA = respiratory sinus arrhythmia; RSA-W = RSA withdrawal; DERS = Difficulties in Emotion Regulation Scale; O = Observation; S = Self-report; + = Positive parenting; - = Negative parenting

Table 5. Maternal Demographics by ER profile

	Mixed ER	Moderate ER	Low ER	High ER	Full Sample
Maternal Age M (*SD*)	37.75 (5.48)	34.98 (5.75)	35.72 (5.62)	34.98 (5.85)	35.98 (5.79)
Marital Status (Married)[a]	76.2%	66.3%	66.6%	84.2%	75.7%
Race/Ethnicity					
White	81.3%	91.8%	100%	91.2%	88.5%
Black	15.6%	6.1%	0%	8.8%	9.9%
Other[b]	3.1%	2.0%	0%	1.8%	.5%
Hispanic	71.4%	85.7%	83.3%	87.7%	81.2%
Education					
Some high school	4.8%	2%	0%	1.8%	2.8%
High school diploma	6.3%	10.2%	0%	7.0%	7.2%
Some college	11.1 %	22.4%	16.7%	12.3%	14.9%
Associate degree	12.7%	6.1%	8.3%	12.3%	10.5%
College graduate	36.5%	22.4%	41.7%	31.6%	31.5%
Advanced degree	28.6%	36.7%	33.3%	35.1%	33.1%

Note. There were no demographic differences across 1) maternal profiles or 2) diagnostic groups, ER = emotion regulation, ADHD = Attention-deficit/hyperactivity disorder, TD = Typically developing; a = marital status as defined by living with partner/married or single; b = "Other" race defined as Asian or Indian American/Native Alaskan.

Table 6. Fit Indices for Profile Solutions

Fit statistic	Number of profiles				
	1	2	3	4	5
AIC	3667.35	3549.38	3479.76	3457.56	3415.36
BIC	3712.2	3619.87	3575.88	3579.31	3562.74
Adjusted BIC	3667.86	3550.2	3480.87	3458.96	3417.06
Bootstrapped LRT		133.96	85.62	38.2	62.63
Entropy		0.91	0.86	0.74	0.87
Smallest n	182	24	11	12	4

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; LRT = Likelihood ratio test

Table 7. Maternal Emotion Regulation Profile Membership by Diagnostic Group

		Mixed ER	Moderate ER	Low ER*	High ER
Control	Actual	24	14	1	27
	Expected	23.2	17.8	4.4	20.7
ADHD	Actual	40	35	11	30
	Expected	40.8	31.2	7.6	36.3
N		64	49	12	57

Note. *Pearson $\chi^2(3) = 8.39$, $p < .05$. ER = Emotion regulation.

Table 8. Maternal Demographics by ER profile

	Mixed ER	Moderate ER	Low ER	High ER	Full Sample
Maternal Age M (*SD*)	37.75 (5.48)	34.98 (5.75)	35.72 (5.62)	34.98 (5.85)	35.98 (5.79)
Marital Status (Married)[a]	76.2%	66.3%	66.6%	84.2%	75.7%
Race/Ethnicity					
White	81.3%	91.8%	100%	91.2%	88.5%
Black	15.6%	6.1%	0%	8.8%	9.9%
Other[b]	3.1%	2.0%	0%	1.8%	.5%
Hispanic	71.4%	85.7%	83.3%	87.7%	81.2%
Education					
Some high school	4.8%	2%	0%	1.8%	2.8%
High school diploma	6.3%	10.2%	0%	7.0%	7.2%
Some college	11.1 %	22.4%	16.7%	12.3%	14.9%
Associate degree	12.7%	6.1%	8.3%	12.3%	10.5%
College graduate	36.5%	22.4%	41.7%	31.6%	31.5%
Advanced degree	28.6%	36.7%	33.3%	35.1%	33.1%

Note. There were no demographic differences across 1) maternal profiles or 2) diagnostic groups, ER = emotion regulation, ADHD = Attention-deficit/hyperactivity disorder, TD = Typically developing; a = marital status as defined by living with partner/married or single; b = "Other" race defined as Asian or Indian American/Native Alaskan.

Table 9. Comparison of Maternal Emotion Regulation Latent Profiles on Indicator Variables

	Mixed ER [a]	Moderate ER [b]	Low ER [c]	High ER [d]		
Raw Scores	M (SD)	M (SD)	M (SD)	M (SD)	*F*	Cohen's *d*
PEP BL (O)	99.37 (12.71)	101.94 (14.16)	104.32 (11.38)	97.51 (14.67)	1.17	---
PEP Task (O)	91.62 (14.70)	94.84 (16.01)	96.25 (12.09)	95.07 (13.51)	.68	---
RSA BL (O)	5.15 (.76)	6.22 (.85)	6.66 (.64)	6.71 (.82)	40.17***	1.33^{ab}***, 2.15^{ac}***, 1.97^{ad}***, $.59^{bd}$*
RSA Task (O)	5.84 (1.08)	6.22 (.89)	6.42 (.91)	6.09 (.91)	.12	---
RSA W (O)	-.70 (.67)	-.02 (.70)	.07 (.62)	.61 (.55)	39.23***	$.99^{ab}$***, 1.19^{ac}***, 2.14^{ad}***, 1.00^{bd}***, $.92^{cd}$+
PEP R (O)	-6.18 (13.99)	-7.29 (14.71)	-7.60 (9.53)	-.01 (10.74)	2.67*	$.49^{ad}$*, $.57^{bd}$*
DERS (S)	1.79 (.52)	1.84 (.64)	1.95 (.53)	1.68 (.49)	1.29	---
Proportion of time in distress (O)	.03 (.02)	.13 (.04)	.36 (.08)	.03 (.03)	328.08***	3.16^{ab}***, 5.67^{ac}***, 3.64^{bc}***, 2.83^{bd}***, 5.46^{cd}***
Global regulation (O)	3.60 (.49)	2.80 (.46)	2.33 (.49)	3.69 (.47)	55.29***	1.68^{ab}***, 2.59^{ac}***, $.99^{bc}$*, 1.91^{bd}***, 2.83^{cd}***

Note. ER= Emotion regulation, BL = Baseline; PEP = Pre-ejection period; PEP R = PEP reactivity; RSA = respiratory sinus arrhythmia; RSA W = RSA withdrawal; DERS = Difficulties in Emotion Regulation Scale; O = Observation; S = Self-report

Table 10. Comparison of Maternal Factors and Profile Membership

	Mixed ER [a]	Moderate ER [b]	Low ER [c]	High ER [d]		
Raw Scores	M (*se*)	M (*se*)	M (*se*)	M (*se*)	*F*	Cohen's *d*
DO Skills: Proportion Score (O)	.09 (.01)	.05 (.01)	.02 (02)	.08 (.01)	3.70*	.58[ac]+
DON'T Skills: Proportion Score (O)	.52 (.02)	.61 (.02)	.70 (.04)	.52 (.02)	11.19***	.71[ab]**, 1.51[ac]*** , .96[bd]**, 1.67[cd]***
Positive Parenting (S)	69.33 (.85)	68.32 (.94)	66.69 (1.99)	69.63 (.89)	.82	-
Negative Parenting (S)	29.25 (.84)	29.60 (.93)	30.75 (1.95)	29.20 (.88)	.20	-
Mother ADHD Sx (S)	1.22(.07)	1.19 (.08)	1.37 (.17)	1.24 (.08)	.75	-
Parenting Stress (S)	68.79 (2.42)	73.97 (2.69)	76.84 (5.66)	70.91 (2.54)	1.00	-

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. All analyses controlled for parent/teacher reports of inattention, hyperactivity, and ODD symptoms. O = Observation; S = Self-report, Sx = symptoms

Table 11. Comparison of Child Factors and Profile Membership

	Mixed ER [a]	Moderate ER [b]	Low ER [c]	High ER [d]	
Raw Scores	M (*se*)	M (*se*)	M (*se*)	M (*se*)	*F*
INATT symptoms (C)	1.55 (.12)	1.71 (.14)	1.93 (.28)	1.31 (.13)	2.12
HI symptoms (C)	1.83 (.12)	1.76 (.14)	1.88 (.28)	1.46 (.13)	1.75
ODD symptoms (C)	1.14 (.11)	1.29 (.12)	1.26 (.26)	1.04 (.12)	.74
Emotion Knowledge (O)	10.04 (.24)	10.00 (.28)	10.11 (.56)	10.04 (.26)	.01
Proportion of time in distress (O)	.54 (.04)	.50 (.04)	.38 (.08)	.54 (.04)	.34
Negativity (C)	2.31 (.08)	2.36 (.09)	2.24 (.18)	2.17 (.08)	.87
CU-behaviors (C)	1.07 (.07)	1.16 (.08)	1.16 (.16)	1.01 (.07)	.77

Note. All analyses controlled for age, sex, and IQ. ER = Emotion regulation, INATT = Inattention, HI = Hyperactivity/impulsivity, ODD = Oppositional defiant disorder, CU = callous/unemotional, C = Combined report, O = Observation

Table 12. Regression Predicting Emotion Regulation Profile Membership from Maternal Factors

	β	*T*-value	Model R^2	*F*
Membership Probability in Mixed ER Profile				
Model 1. DO Skills (O)	.10	1.11	.09	1.72+
DON'T Skills (O)	-.12	-1.37		
Positive Parenting (S)	.05	.58		
Negative Parenting (S)	.07	.82		
Parenting Stress (S)	-.18+	-1.84		
Parent ADHD Sx (S)	.01	.10		
Membership Probability in Moderate ER Profile				
Model 1. DO Skills (O)	-.07	-.81	.13	2.70**
DON'T Skills (O)	.21*	2.42		
Positive Parenting (S)	-.10	-1.20		
Negative Parenting (S)	-.04	-.53		
Parenting Stress (S)	.12	1.24		
Parent ADHD Sx (S)	-.15	-1.71		
Membership Probability in Low ER Profile				
Model 1. DO Skills (O)	-.04	-.47	.12	2.42*
DON'T Skills (O)	.28**	3.21		
Positive Parenting (S)	-.06	-.73		
Negative Parenting (S)	-.01	-.15		
Parenting Stress (S)	.07	.70		
Parent ADHD Sx (S)	.09	1.08		
Membership Probability in High ER Profile				
Model 1. DO Skills (O)	-.004	-.05	.12	2.62**
DON'T Skills (O)	-.27**	-3.13		
Positive Parenting (S)	.09	1.10		
Negative Parenting (S)	-.02	-.23		
Parenting Stress (S)	.02	.24		
Parent ADHD Sx (S)	.09	1.02		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. All analyses controlled for child hyperactivity/impulsivity, inattention, and oppositional defiant disorder symptoms. O = Observation, C = Combined report, S = Self-report, HI = Hyperactive/impulsive, INATT = Inattention.

Table 13. Regression Predicting Emotion Regulation Profile Membership from Child Factors

	β	*T*-value	Model R^2	*F*
Membership Probability in Mixed ER Profile				
Model 1. Emotion Knowledge (O)	-.05	-.54	.08	1.48
Distress (O)	.16	1.62		
Negativity (C)	-.002	-.02		
CU-behaviors (C)	-.09	-.84		
INATT Sxs (C)	-.19	-1.30		
HI Sxs (C)	.44**	2.60		
ODD Sxs (C)	-.12	-.75		
Membership Probability in Moderate ER Profile				
Model 1. Emotion Knowledge (O)	.02	.79	.07	1.20
Distress (O)	-.04	.72		
Negativity (C)	.13	.40		
CU-behaviors (C)	.06	.57		
INATT Sxs (C)	.19	.19		
HI Sxs (C)	-.26	.13		
ODD Sxs (C)	.07	.67		
Membership Probability in Low ER Profile				
Model 1. Emotion Knowledge (O)	.04	.42	.08	1.39
Distress (O)	-.13	-1.33		
Negativity (C)	-.17	-1.16		
CU-behaviors (C)	.01	.06		
INATT Sxs (C)	.23	1.56		
HI Sxs (C)	-.13	-.77		
ODD Sxs (C)	.04	.27		
Membership Probability in High ER Profile				
Model 1. Emotion Knowledge (O)	.001	.02	.07	1.25
Distress (O)	-.05	-.46		
Negativity (C)	-.02	-.12		
CU-behaviors (C)	.03	.24		
INATT Sxs (C)	-.15	-1.05		
HI Sxs (C)	-.11	-.63		
ODD Sxs (C)	.03	.16		

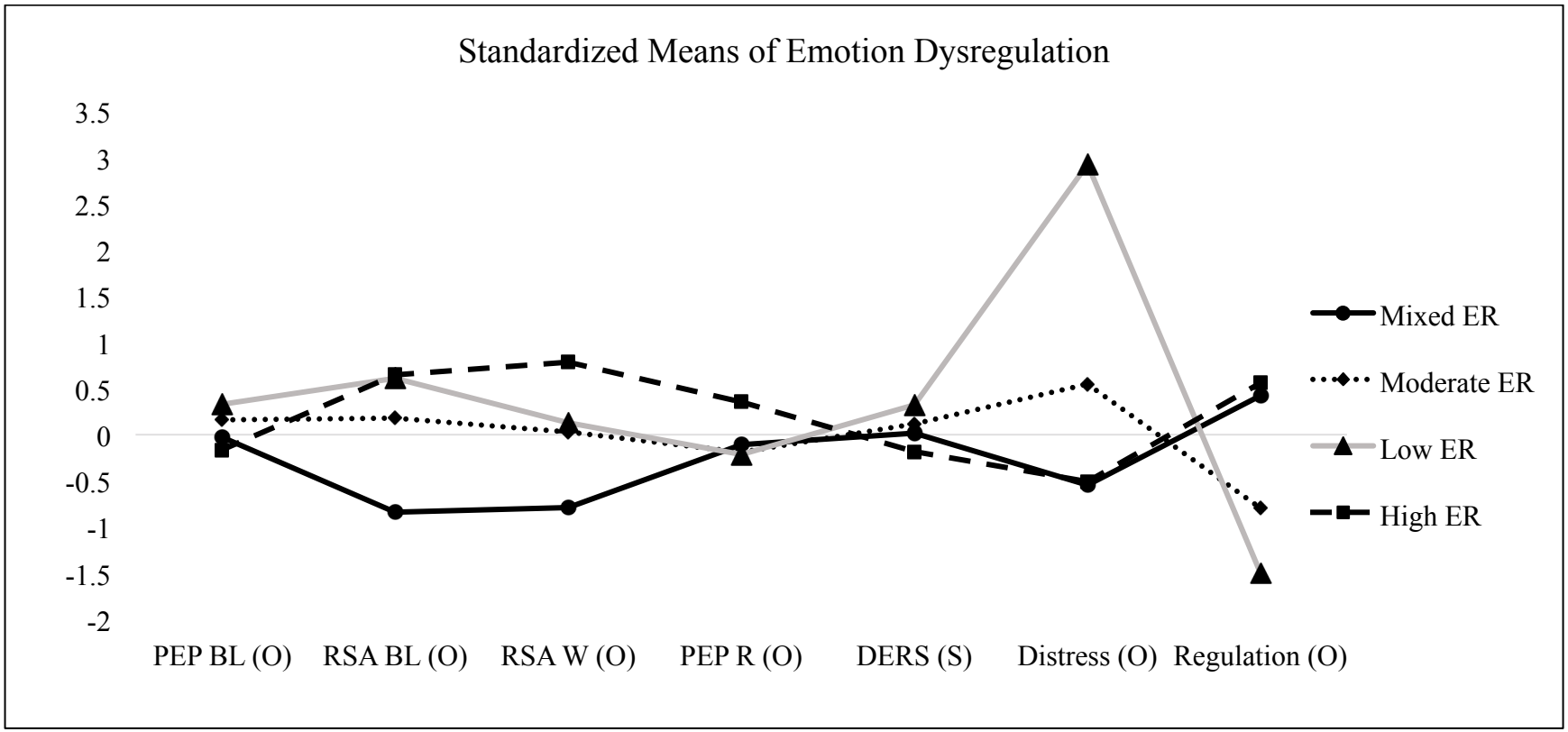
Note. * $p < .05$, ** $p < .01$, *** $p < .001$. All analyses controlled for child age, sex, and IQ. O = Observation, C = Combined report, CU = Callous-unemotional, HI = Hyperactive/impulsive, INATT = Inattention, ODD = Oppositional defiant disorder, Sxs = symptoms.

Table 14. Regression Predicting Emotion Regulation Profile Membership from Maternal and Child Factors

	β	*T*-value	Model R^2	*F*
Membership Probability in Mixed ER Profile				
Model 1. DON'T Skills	-.17*	-2.25	.09	2.87*
Parenting Stress (S)	-.21**	-2.62		
HI Sxs (C)	.18*	2.07		
Membership Probability in Moderate ER Profile				
Model 1. DON'T Skills	.24***	3.30	.12	3.79**
Parenting Stress (S)	.16	1.94+		
HI Sxs (C)	-.01	-.16		
Membership Probability in Low ER Profile				
Model 1. DON'T Skills	.28***	3.82	.13	4.12**
Parenting Stress (S)	.08	1.04		
HI Sxs (C)	-.03	-.38		
Membership Probability in High ER Profile				
Model 1. DON'T Skills	-.26***	-3.55	.14	4.49***
Parenting Stress (S)	.01	.10		
HI Sxs (C)	-.15+	-1.83		

Note. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. All analyses controlled for child age, sex, and IQ. O = Observation, S = Self report, C = Combined report, HI = Hyperactive/impulsive, Sxs = symptoms.

Figure 1. Maternal Emotion Regulation Profiles



Note. ER = Emotion regulation, BL = Baseline; PEP = Pre-ejection period; PEP R = PEP reactivity; RSA = respiratory sinus arrhythmia; RSA W = RSA withdrawal; DERS = Difficulties in Emotion Regulation Scale; O = Observation; S = Self-report

APPENDICES

A Multimodal Assessment of Emotion Dysregulation in Young Children with and without ADHD

This manuscript has been published in PsyrXiv Preprints and is under review in Journal of Child and Adolescent Clinical Psychology.

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Abstract

Objective: This study utilized a multimodal approach to examine emotion dysregulation (ED) in young children with attention-deficit/hyperactivity disorder (ADHD), ADHD + oppositional defiant disorder (ODD), and typically developing (TD) children. **Methods:** We sought to explore if specific domains of ED (emotion regulation [ER], negativity/lability [ERNL], emotion knowledge/understanding [ERU], and callous-unemotional [CU] behaviors) were uniquely associated with diagnostic classifications. The final sample consisted of 152 children (75% boys; mean age = 5.52, SD = .84, 83.4% Latinx) with the following group composition: ADHD- Only (*n* = 24), ADHD + ODD (*n* = 54), and TD (*n* = 74). **Results:** Higher levels of ADHD and ODD symptoms, measured continuously, were significantly associated with poorer EREG, greater ERNL, and higher levels of reported CU behaviors. There were no significant associations between ADHD or ODD symptoms on ERU. Using discriminant analyses, we found that parent/teacher reported EREG, ERNL, and CU were significant predictors of diagnostic classification. These ED domains correctly identified 84.7% of preschoolers. The model was most successful in classifying children with ADHD+ODD (92.3%) and TD (93.2%) children; however, the ADHD-Only group was correctly identified only 41.7% of the time. **Conclusions:** This is the first study to 1) examine multiple domains of ED in a clinical sample of preschool children with and without ADHD and 2) explore the clinical utility of considering ED when assessing for ADHD and ODD. Our findings suggest that measures of ED are particularly helpful for correctly diagnosing ADHD and co-occurring ODD but not necessarily children with ADHD-Only.

Keywords: emotion dysregulation; attention deficit/hyperactivity disorder; oppositional defiant disorder, preschoolers, discriminant analysis

A Multimodal Assessment of Emotion Dysregulation in Young Children With and Without ADHD

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder which is marked by a triad of symptoms: inattention, hyperactivity, and impulsivity (Barkley, 2014). Impairments associated with ADHD are seen across various functional domains. It is well documented that symptoms of ADHD impair social functioning (Ros & Graziano, 2018), academic performance (Loe & Feldman, 2007), and increase familial problems (Barkley & Mash, 2003). Aside from suboptimal outcomes at an individual level, ADHD carries a large financial burden ranging from $36 billion to $52.4 billion annually (W. E. Pelham, Foster, & Robb, 2007). Given that ADHD is a chronic disorder associated with various consequences across the lifespan (Kuriyan et al., 2013; Malloy-Diniz, Fuentes, Leite, Correa, & Bechara, 2007; Merrill et al., 2016), it is imperative to identify early indicators, or mechanisms, in early childhood. Of interest to the current study is emotion dysregulation (ED), which has gained significant attention as a contributor to these lifelong impairments in individuals with ADHD (Barkley & Fischer, 2010; Bunford, Evans, & Wymbs, 2015; Graziano & Garcia, 2016; Shaw, Stringaris, Nigg, & Leibenluft, 2014).

Emotion regulation (ER) is defined as the extrinsic and intrinsic processes responsible for the monitoring, evaluation, and modification of emotional reactions to meet situational demands and promote adaptive behaviors that are necessary for to achieving one's goals (Gross, 2011). Emotion dysregulation (ED) occurs when an individual has difficulty exercising any or all aspects of the ER process to such a

degree that it results in the individual functioning below his or her baseline and failing to meet situational goals (Bunford et al., 2015). Children with ADHD who are emotionally dysregulated can be described as being emotionally impulsive, have a difficult time actively regulating their emotions, and can even display inappropriate emotions or moods (Bunford et al., 2015). Given the complex and multifaceted nature of emotions and the manner in which individuals process them (Gross, 1998), a recent meta-analysis (Graziano & Garcia, 2016) identified four levels of ED that may account for the heterogeneous nature of ED-related impairments in youth with ADHD: emotion recognition/understanding (ERU), emotional reactivity/negativity/lability (ERNL), emotion regulation (EREG) and callous-unemotional (CU) traits. The current study focused on examining the clinical utility of these ED dimensions as it relates to the diagnosis of ADHD and comorbid conduct problems (CP) such as Oppositional Defiant Disorder (ODD) among preschool children.

Emotion recognition/understanding (ERU). Aligned with Gross' model of emotion generation (1998), once an individual is exposed to an emotional stimulus, it is necessary for him or her to identify and process the specific emotion. Thus, the first domain of ED that may be impaired by ADHD is the youth's ability to identify a range of emotional cues (i.e., facial expressions, gestures, changes in speech prosody). Some studies have found that children with/at risk for ADHD have a limited emotion vocabulary (Kats-Gold & Priel, 2009) and are worse at emotion recognition (Sjöwall, Roth, Lindqvist, & Thorell, 2013). For young children, greater ERU is associated with improved academic (DuPaul et al., 2004) and social

(Hinshaw, 1992) outcomes. A recent study found preschool children with ADHD performed worse on two emotional understanding tasks (matching expression and expression-situation matching); however, there were no differences between groups on labeling emotions (Lugo-Candelas, Flegenheimer, McDermott, & Harvey, 2017). While most studies have examined differences in ERU between typically developing (TD) children and children with/at-risk for ADHD, Waller and colleagues examined differences in ERU among children with ADHD, ODD, and callous-unemotional (CU) behaviors (Waller et al., 2014). Findings from this study indicated that children with ADHD had poorer emotional knowledge compared to preschoolers with ODD and CU behaviors. Although many of these studies have provided useful information about ED in young children with and without ADHD, none to date have identified the clinical utility or diagnostic importance of ERU when diagnosing ADHD in preschoolers.

Emotion regulation (EREG). EREG refers to an individual's ability to modulate his or her emotional arousal (Bunford et al., 2015; Calkins, 2007, Gross, 2011) as well as generate and sustain emotions (Cole, Martin, & Dennis, 2004). EREG problems are developmentally appropriate in young children (Eisenberg, Valiente, & Eggum, 2010) and prevalent across childhood psychiatric disorders (Aldao et al., 2010; Graziano et al., 2019; Shaw et al., 2014; Zlomke & Hahn, 2010). Across both observational tasks and parent/teacher ratings, studies have documented that children with ADHD experience significant EREG deficits, compared to TD children (Babb, Levine, & Arseneault, 2010; Melnick & Hinshaw, 2000). Such EREG deficits are particularly salient when measuring children's regulation of negative

emotions or during tasks with a negative valence (i.e., frustrating, challenging, disappointing; (Nigg, 2006). Of note, some studies have documented that children with ADHD also have difficulty regulating positive emotions (Musser et al., 2011). Not only are EREG deficits more readily seen among children with ADHD, such deficits importantly contribute to other functional impairments within the social (Bunford, Evans, & Langberg, 2018), cognitive (Berlin, Bohlin, Nyberg, & Janols, 2004), and adaptive domains (Anastopoulos et al., 2011). Finally, while comorbid CP are also associated with EREG deficits (Nigg, Goldsmith, & Sachek, 2004), they do not fully account for its link with ADHD (Graziano & Garcia, 2016). Examining how EREG deficits relate to ADHD and comorbid CP with preschoolers would provide an important next step towards understanding its clinical utility for early intervention targets.

Emotional reactivity/negativity/lability (ERNL). The second domain of ED identified by Graziano and Garcia (2016) as being highly impaired among children with ADHD involves a child's ability to modulate the intensity or lability of their emotional response. Children with ADHD tend to exhibit higher levels of emotional excitability/exuberance or anger/irritability compared to TD (Barkley & Fischer, 2010). In a large sample (N = 1168) of children (ages 6-18) with ADHD, children with ADHD + ODD were reported by parents/teachers as having greater levels of emotional lability compared to children without the comorbid presentation (Sobanski et al., 2010). One of the few studies with a younger sample (M^{age} = 6.51), also found that children with ADHD were rated by parents as being more emotionally labile relative to TD children (Lugo-Candelas et al., 2017). A significant limitation in the

literature examining ERNL is the reliance on parent and/or teacher ratings (Graziano & Garcia, 2016). One of the only studies with a younger sample, to our knowledge, to include an observational task found that children with ADHD exhibited more anger across suppression and reactivity tasks compared to TD children (Lugo-Candelas et al., 2017). Thus, more work is needed with younger samples examining multiple measures of ERNL to determine its association not only with ADHD, but importantly with comorbid CP. As pointed out by Overgaard and colleagues (2018) in a large (N = 495) clinical sample of preschool children with and without ADHD, children with ADHD and greater ODD symptoms were rated by parents as being more emotionally labile compared to controls. Considering emotional reactivity/lability is a transdiagnostic feature in ADHD and ODD, it is crucial to understand how this domain of ED is clinically relevant and/or necessary when making diagnostic decisions.

Callous-unemotional traits (CU). CU traits (or behaviors when considering young children) refers to low levels of empathy, guilt, and caring for others (Frick, Ray, Thornton, & Kahn, 2014a). As recognized by the addition of a CU specifier to the DSM-5's diagnosis of conduct disorder ("with limited prosocial emotions"), this subset of children engage in the most pervasive, severe, and aggressive patterns of antisocial behavior (Frick et al., 2013). While CU traits are a cornerstone of psychopathic disorders (Blair, 2007), CU behaviors can be reliability identified in preschool and school-aged children (Bansal, Goh, Lee, & Martel, 2020; Kimonis et al., 2006; Waller, Hyde, Grabell, Alves, & Olson, 2015). Various studies have documented how the impairments associated with ADHD are amplified by the

presence of CU behaviors (Graziano et al., 2016; Haas, Becker, Epstein, & Frick, 2018; Waschbusch, Graziano, Willoughby, & Pelham Jr, 2015). CU behaviors are also related to children's attenuated responses to evidence-based treatments (Bansal et al., 2019; Garcia, Graziano, & Hart, 2018; Haas et al., 2011; Waschbusch et al., 2019). It is important to note that while children with ADHD and ODD are at increased risk for developing CP (Frick, Ray, Thornton, & Kahn, 2014b), not all children with ADHD and/or ODD will exhibit problematic levels of CU (Frick et al., 2014b; Waller et al., 2015). As noted by Graziano & Garcia (2016), while comorbid CP moderated the link between ADHD and CU, a significant independent association between ADHD and CU (d = .25) remained. Thus, it remains important to examine how CU behaviors along with the other ED dimensions contribute to the early identification of ADHD and/or comorbid CP in young children.

Current study

In summary, children with ADHD have significant impairments across four domains of ED; emotion recognition/understanding (ERU), emotional reactivity/lability/negativity (ERNL), emotion regulation (EREG), and callous-unemotional traits (CU; Graziano & Garcia, 2016). While there is ample evidence suggesting school-aged children with ADHD have higher levels of ED compared to their typically developing peers, less is known about ED in young children, specifically preschoolers with ADHD. There have been a few studies to explicitly examine ADHD and domains of ED in preschool samples (ages 3-5; Sjowall et al., 2015; Stringaris et al., 2015; Waller et al., 2014). From a developmental psychopathology perspective, preschool-aged children are the ideal population to start

examining ADHD since 3-5% of preschoolers carry an ADHD diagnosis (Lavigne, LeBailly, Hopkins, Gouze, & Binns, 2009). Considering a large percentage of preschoolers with ADHD also carry a comorbid ODD diagnosis, it is crucial to understand how ODD symptoms are associated with the heterogeneity of ED in preschoolers with ADHD.

Thus, the current study attempts to address a significant gap in the literature by examining all four domains of ED within a preschool sample of children with and without ADHD. This is the first study, to our knowledge, to examine each domain of ED, in a clinical and non-clinical TD sample of preschool children. As documented by prior research, we also examined how comorbid CP related to ED. First, we sought to examine if diagnostic groups (i.e., TD, ADHD-only, ADHD+ODD) differed across domains of ED. Given the mixed literature associated with ERU in children with ADHD, especially in young children (Lugo-Candelas et al.,2017), we did not anticipate significant ERU differences across groups. In regard to ERNL and EREG we hypothesized that children in the ADHD-only and ADHD+ODD groups would have significantly greater levels of ERNL and poorer EREG compared to the TD groups. We also anticipated that preschoolers in the ADHD+ODD group would have significantly higher levels of CU behaviors compared to preschoolers in the TD and ADHD-only groups, given the higher levels of CU behaviors in children with co-occurring behavior problems (Waller et al., 2015). Lastly, given the transdiagnostic nature of ED, we sought to explore which domain(s) of ED had the best predictive value in correctly classifying children in their respective diagnostic groups.

Considering that this is the first study to examine all four domains of ED in preschool children with and without ADHD, we took an exploratory approach to this aim.

Methods

Participants and Recruitment

Children and their caregivers were recruited from local schools and mental health agencies via brochures, radio and newspaper ads, and open houses/parent workshops. Legal guardians contacted the clinic and were directed to the study staff for screening questions to determine eligibility. For the ADHD sample, if the parent (1) endorsed clinically significant levels of ADHD symptoms (six or more symptoms of either Inattention or Hyperactivity/Impulsivity according to the DSM-5 (Association, 2013) OR a previous diagnosis of ADHD), (2) indicated that the child is currently displaying clinically significant academic, behavioral, or social impairments as measured by a score of 3 or higher on a seven-point impairment rating scale (Fabiano et al., 2006), and (3) were not taking any psychotropic medication, the parent and child were invited to participate in an assessment to determine study eligibility. For the TD sample, if the parent (1) endorsed less than 4 ADHD symptoms (across either Inattention or Hyperactivity/Impulsivity according to the DSM-5), (2) less than 4 Oppositional Defiant Disorder (ODD) symptoms, and (3) indicated no clinically significant impairment (score below 3 on the impairment rating scale), the parent and child were invited to participate in an assessment to determine study eligibility. Participants were also required to be enrolled in school during the previous year, have an estimated IQ of 70 or higher (M = 98.69, SD = 12.91), have no confirmed history of an Autism Spectrum Disorder, and be able to attend an 8-week

summer treatment program (STP-PreK; Graziano et al., 2014) prior to the start of the next school year (ADHD groups only).

During intake, ADHD diagnosis (and comorbid disruptive behavior disorders) was assessed through a combination of parent structured interview (Computerized-Diagnostic Interview Schedule for Children; (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) and parent and teacher ratings of symptoms and impairment (Disruptive Behavior Disorders Rating Scale, Impairment Rating Scale; Fabiano et al., 2006; Pelham, Gnagy, Greenslade, & Milich, 1992), as is recommended practice (J. Pelham, William E, Fabiano, & Massetti, 2005). Dual Ph.D. level clinician review was used to determine diagnosis and eligibility.

The final participating sample included 152 young children (75% boys; mean age = 5.52, SD = .84, 83.4% Latinx) with an equivalent distribution of children diagnosed with ADHD (51%) and those characterized as TD (49%). Additionally, within the ADHD group, 69% had a co-occurring ODD diagnosis. More than 60% of parents reported currently being married/living with the child's other biological parent. Although children in ADHD group were required to be medication naïve, 2 children (2.5%) had a history of taking psychostimulants. However, at the time of recruitment, parents reported their child was no longer taking medications.

Study Design and Procedure

This study was approved by the university's Institutional Review Board. All families participated in a one-time assessment, which included completion of the ADHD, ODD, and Conduct Disorder (CD) modules on the C-DISC (Shaffer et al., 2000) and various questionnaires regarding their children's behavioral, academic, and

emotional functioning. Children also completed a series of social-emotional tasks in the laboratory. Families of children with ADHD received the intervention (STP-PreK) at either no cost via a federal grant or at a subsidized cost via a local grant, and all families received compensation ($100 gift card for completing the assessment). Similar questionnaires were also obtained from children's teachers. Teachers also received compensation ($50 gift card) for completing the questionnaires.

ADHD and ODD Symptomology

Parents and teachers completed the Disruptive Behavior Disorders (DBD) Rating Scale (W. E. Pelham, Gnagy, Greenslade, & Milich, 1992), adapted for DSM-5 terminology. The DBD rating scale asks the respondent to rate on a 4-point scale ranging from 0 (not at all) to 3 (very much), the degree to which children display symptoms of ADHD, ODD, and CD. The DBD Rating Scale's responses range from 0 (not at all) to 3 (very much). Consistent with prior work (Hartman, Rhee, Willcutt, & Pennington, 2007; Sibley et al., 2010), parent and teacher ratings were combined by taking the higher of the two ratings for each item to create composites: hyperactivity/impulsivity, inattention, and impulsivity. The mean score for each inattention, (α = .88), hyperactivity/impulsivity, (α = .92), and ODD symptoms were examined (α = .85).

Emotion recognition/understanding (ERU)

Children completed a standardized emotion knowledge (EK) task (Denham, 1986) that required children to both expressively and receptively identify 8 different emotions (sad, happy, angry, afraid, surprised, disgusted, embarrassed, guilty) as presented visually via cartoon faces. Children scored 1 point for each correct

expressive and subsequent receptive answer. A total of 16 points was possible with higher scores indicative of better emotional awareness/knowledge.

Emotional regulation (EREG)

Parents and teachers completed the Brief Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Retzlaff, & Espy, 2002; Gioia, Espy, & Isquith, 2003). The parent and teacher versions contain 63 items rated on a 3-point likert scale (never, sometimes, often) that provided five distinct but correlated clinical scales (inhibit, shift, emotional control, working memory, and plan/organize). For the purposes of the current study, the Emotional Control scale t-score was used ($\alpha = .92$). Specifically, the highest t-score between parent and teacher reports was used, with higher scores indication poorer emotional control skills.

Children completed two frustration tasks adapted from the Lab-TAB (Goldsmith & Rothbart, 1996): I'm Not Sharing and Impossibly Perfect Circles. In the I'm Not Sharing task, an assistant brings a container of candy and tells the experimenter to share it equally with the child. The experimenter initially divides the candy equally. Eventually, the examiner takes more candy, eats a piece of the child's candy, then proceeds to take more candy, until they take all of the child's candy. In the Impossibly Perfect Circles task, children were asked to draw circles repeatedly and were criticized (e.g., too large, too small) after each attempt. The tasks were discontinued if the child was highly distressed or cried for more than 30s. If the child was not highly distressed, the tasks was terminated after 3 minutes and 30 seconds in which the child was praised for their effort and provided a small prize from a treasure chest (e.g., stickers, pencils, candy). The Global Regulation measure was coded on a

scale from 0 (dysregulated) to 4 (well regulated). For each code, 20% of the videos were coded for reliability. The reliability Kappas for global regulation codes in this study were all above .80. For data reduction purposes, the most severe rating of dysregulation between the two tasks was used for the current study.

Emotional reactivity/negativity/lability (ERNL)

During the I'm not sharing and Impossibly Perfect Circles tasks, research assistants coded affect lability. Affect lability was coded on a scale from 0 = stable to 4 = very unstable. Twenty percent of the observations were coded by a second rater for reliability purposes (kappa = .83).

Parents and teachers also completed the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). The ERC is a 24-item questionnaire that uses a 4-point Likert scale (1=almost always to 4=never). The ERC and yields two subscales: Negativity/Lability scale (15 items), which represents negative affect/mood lability, and the Emotion Regulation (ER) scale (eight items), which assesses processes central to adaptive regulation. For the present study, the highest Negativity/Lability score between parent/teachers was used, with higher scores indicating greater levels of negativity/lability (α = .93).

Callous-unemotional behaviors (CU)

Parents and teachers completed an abbreviated version of the Inventory of Callous-Unemotional Traits (ICU; (Frick, 2004) consisting of 12 items identified by Hawes et al. (2014) as showing psychometric properties similar to those of the full ICU. The items were rated on a four-point Likert scale ranging from 0 (not at all) to

3 (very much), and a CU composite was created by averaging these 12 items (α = .72). Once again, the highest score among parent and teacher reports was used.

Data Analyses

All analyses were conducted using SPSS Version 25. There was no missing data for any predictors or variables of interest. Pearson's correlations between study variables were examined. Within a general linear model framework, multivariate analyses of covariance (MANCOVA) were conducted to examine if there were significant differences across diagnostic groups (i.e., TD, ADHD-only, ADHD+ODD) on domains of ED, while controlling for relevant demographic variables (i.e., age and sex) and cognitive functioning (Graziano & Garcia, 2016). Lastly, a linear discriminant analysis (LDA) was conducted to examine which domains of ED were predictive of membership to each diagnostic group. LDA is a method used in machine learning analyses which allows for linear classifications which fit the data to best predict categorical group membership. Given we had three diagnostic groups (TD, ADHD-only, ADHD+ODD), a binary logistic regression was not used. LDA has been shown to be an effective strategy to correctly identifying children with and without ADHD (Duda, Ma, Haber, & Wall, 2016; Pineda, Ardila, & Rosselli, 1999; Sadatnezhad, Boostani, & Ghanizadeh, 2011). Domains of ED that were significantly different across diagnostic groups were entered into the LDA along with relevant demographics variables as predictors of group membership.

Results

Preliminary Analyses

Descriptive statistics are presented in Table 1. Analyses of demographic variables revealed that child IQ was significantly associated with diagnostic group,

such that TD children had higher IQs than children in the ADHD only and ADHD + ODD groups F (2, 146) = 6.22, p <.01. Additionally, age was significantly related to ERU, such that older children performed better on the emotion knowledge task, r = .49, p <.001. Sex was significantly related to CU, such that males were rated by parents and teachers as having greater levels of CU-behaviors, r = -.19, p < .05. There were no other demographic differences between diagnostic groups. Thus, all subsequent analyses controlled for child sex, age, and IQ.

Examination of ADHD and ODD symptoms and domains of ED

As seen in Table 2, severity of symptoms of ADHD (inattention and hyperactivity) and CP (ODD), measured continuously, were significantly associated with several domains of ED. Within the EREG domain, greater severity of inattention, hyperactivity, and ODD symptoms were associated with greater emotional control problems as reported by parents/teachers, r = .67, r = .71, r = .83, ps <.001, respectively. Similarly, greater severity of ODD, inattention, and hyperactivity symptoms were associated with poorer observed ER strategies, r = -.19, r = -.25, r = -.26, ps <.05, respectively. Overall, children with greater severity of ADHD and ODD symptoms had greater emotional control problems as reported by parents/teacher and had poorer emotion regulation skills during an emotionally eliciting laboratory task.

Within the ERNL domain, greater severity of inattention, hyperactivity, and ODD symptoms were associated with higher levels of negativity, as reported by parents/teacher, r = .69, r = .82, r = .89, ps <.001. Children with greater severity of ADHD and ODD symptoms were reported by their parents/teachers as being more

emotionally labile and reactive. There were no significant associations between ADHD nor ODD symptoms on an observation of affect lability. Similarly, no significant associations emerged between ADHD nor ODD symptoms and children's performance on an ERU task. Lastly, ADHD and ODD symptoms were significantly associated with CU behaviors. Greater severity of inattention, hyperactivity, and ODD symptoms were related to greater levels of CU behaviors, $r = .60$, $r = .60$, and $r = .67$, ps, <.001, respectively.

Primary Analyses: Group level differences on domains of ED

As seen in Table 1, after accounting for sex, age, and IQ, there were no significant differences between groups on a measure of ERU, F (2,145) = .45, $p > .05$, or observed ERNL, F (2, 145) = .44, $p > .05$. On the other hand, there were significant differences between parent reported ERNL, such that children in the ADHD+ODD group were rated as more emotionally negative and labile compared to children in the ADHD-Only (Cohen's $d = 1.29$, $p <.001$) and the TD groups ($d = 2.70$, $p <.001$). Children in the ADHD-Only group were rated as more emotionally negative and labile compared to children in the TD group ($d = 1.46$, $p <.001$).

Within the EREG domain, there was a significant difference between groups on the BRIEF-Emotional Control T-score, F (2, 145) = 95.76, $p < .001$. Specifically, children in the ADHD+ODD group were rated as having greater levels of emotional control problems relative to children in the ADHD-Only ($d = 1.35$, $p <.001$) and TD groups ($d = 2.74$, $p <.001$). Additionally, children in the ADHD-Only group were rated as having greater levels of emotional control problems relative to children in the TD group ($d = 1.35$, $p < .001$). We also found significant group differences on the

observed global regulation code, F (2, 144) = 5.46, p <.01, such that children in the ADHD+ODD group displayed poorer EREG strategies relative to children in the TD group (d = -.61, p <.01). There were no differences between the ADHD-Only and TD groups (p = .32) or between the ADHD – Only and ADHD + ODD groups (p = 1.00).

Lastly, there was a significant group difference on parent/teacher reported CU behaviors between diagnostic groups, F (2,145) = 48.75, p > .001. Specifically, children in the ADHD+ODD group were rated as having the highest levels of CU-behaviors compared to children in the ADHD-Only (Cohen's d = .87, p <.001) and TD groups (Cohen's d = 1.91, p > .001). Additionally, children in the ADHD-Only were rated as having higher levels of CU behaviors compared to children in the TD group (Cohen's d = .95, p < .001).

Primary Analyses: Domains of ED predicting diagnostic group membership

A linear discriminant analysis (LDA) was performed to determine the capability of our selected ED variables to correctly classify children into the TD, ADHD-Only, and ADHD+ODD diagnostic groups. Only variables with significant ANOVA results from the previous analyses were used. This method increases a model's ability to optimize significant classifiers, or predictors, in order to effectively classify subjects (Yao, Lu, Li, Xu, & Han, 2014). Tables 3 and 4 present the results from the LDA. The Wilks lambda (.14) for only the first function was significant (p <.001), suggesting the predictors in the model were statistically significant. As seen in Table 2, parent/teacher reported EREG, parent/teacher reported ERNL, and parent/teacher reported CU were moderately to largely associated with the function predicting group membership (standardized coefficients = .45 - .53). On the other

hand, observed EREG (global regulation) was negatively associated with the function, -.09. Taken together, parent/teacher reports of emotional control problems, negativity/lability, and CU behaviors (as well as the covariates; age, sex, IQ) accounted for 75% of the variance in the function predicting diagnostic group membership (canonical value = .864). Overall, the model correctly classified 84.7% of the children in the study (see Table 3). The correct classifications for each group were: 94.6 % for TD, 41.7% for ADHD-Only, and 90.4% for ADHD+ODD.

Discussion

This is the first study to our knowledge, to use a multi-informant and multi-modal approach to examine differences in multiple domains of ED across young children with ADHD-Only, ADHD+ODD, as well as a TD comparison group. Once these differences were identified, we sought to understand how useful, or "clinically relevant" these differences in ED were in classifying children into their diagnostic groups. We found that children with ADHD+ODD were rated by their parents and teachers as having significantly greater impairments in EREG, ECUT, ERNL compared to both children with ADHD only and TD children. Children with ADHD-Only also had greater impairments in EREG, ECUT, and ERNL compared to TD children. In terms of observational tasks, young children in the ADHD+ODD group displayed poorer EREG skills compared to children in the ADHD-Only and TD groups. There were no differences across groups on a standardized ERU task or observed ERNL. Additionally, the significant domains of ED correctly classified 84.7% of children in the sample. The domains of ED most associated with the predictability of group membership were parent/teacher reported EREG,

parent/teacher reported ERNL, and parent/teacher reports of CU behaviors. Almost 85% of participants were correctly classified. Implications from these findings are discussed in further detail below.

In domains of ED with multiple measurements (questionnaire and observation), we found several differences between groups across parent/teacher reports (EREG, ERNL, CU); however, when examining observed measures, we only found significant differences between groups on an observed measure of EREG. Aligned with previous work examining ERU differences in young children with and without ADHD, we did not find any difference between groups on an expressive and receptive task of emotion knowledge (Lugo-Candelas et al., 2017). Additionally, we did not find significant differences on behavioral observations of ERNL. These findings have been replicated across the literature, such that behavioral observations may represent the child's "best performance" at any given point, while parent/teacher ratings capture a general trend and/or pattern of functioning (Melnick & Hinshaw, 2000; Toplak et al., 2013). Thus, the children's responses during the frustration tasks may not be an accurate depiction of their typical emotional functioning, specifically emotional reactivity/lability, across a longer period of time at school and/or at home. Additionally, the global code used in the current study to measure ERNL examined the number of changes in affect as opposed to the valence of their emotions (positive to negative). Some studies have found significant differences in the expression of positive emotions, more specifically, exuberance (Sjöwall & Thorell, 2019) in children with ADHD compared to TD children. Given the heterogenous nature of ERNL, future studies should include observational tasks which allow for the

examination of exuberance as well as negativity/lability to best classify children with and without ADHD and co-occurring CP.

Aligned with findings from Graziano and Garcia (2016)'s meta-analysis of ED, it seems as though children with ADHD may be "less equipped" to respond (ERNL), modulate (EREG), and empathize (CU) following emotional events, compared to TD. Similarly, these strong findings were robust when examining ADHD symptoms (inattention and hyperactivity) continuously within our whole sample. Not surprisingly, when ODD symptoms and domains of ED were examined, we found even stronger associations between ODD symptoms and reports of EREG and parent/teacher reports of ERNL. These findings highlight the deficits in top-down emotional processing deficits in children with ADHD (Petrovic & Castellanos, 2016). We also found that ED problems were exacerbated by the presence of other disruptive behavior disorders, such as ODD. In fact, children with ADHD+ODD were rated by their parents/teachers as having poorer EREG skills and higher levels of CU behaviors compared to both the ADHD only and TD groups. These increased ED problems in children with comorbid ADHD and ODD have been noted extensively in the literature (Factor, Reyes, & Rosen, 2014; Graziano & Garcia, 2016; Graziano et al., 2019; Sobanski et al., 2010). Our current study extends the literature by examining these highly co-occurring problems in an understudied sample of young children from a predominantly Latinx background (La Greca, Silverman, & Lochman, 2009).

From a developmental psychopathology perspective, examining a transdiagnostic feature, such as ED, may serve as a useful risk factor related to the

multiple pathways associated with the development of ADHD, ODD, and more serious conduct problems (Loeber, Burke, & Pardini, 2009; Nigg et al., 2004). While there is evidence to suggest these pathways exist in school-aged children (Rowe, Costello, Angold, Copeland, & Maughan, 2010; Viding & McCrory, 2012), there is a significant gap in the literature which focuses on these early behavioral and emotional problems in preschool children. Thus, the findings of the current study suggest this is a crucial developmental period to examine when considering the onset of ADHD, ODD and other CPs.

In terms of the LDA, our predictors sub-optimally classified children in the ADHD-Only group. Gross' emotion generation model (1998) suggests cognitive abilities play a key role throughout multiple steps of ED. Although we controlled for cognitive functioning, we did not examine how differences in executive function (EF) were associated with ED. Recent work by Landis and colleagues (2020) have identified how EF and ED are highly associated with the symptoms of ADHD in a sample of preschool children. Thus, it may be the case that children with ADHD-Only had greater EF deficits, which were not captured in the classification analyses. However, these findings highlight the transdiagnostic nature of ED as well as the high ADHD/ODD comorbidity rate in preschoolers with ADHD. Future studies and clinical services would benefit from examining both EF and ED when determining if a child meets criteria for ADHD.

Some limitations need to be addressed. First, it is important to point out that of the 78 children with ADHD, the vast majority (83%) met criteria for the combined type presentation. Thus, it was not possible to examine differences in ED according to

ADHD presentation. Nonetheless, we did note via our continuous examination of ADHD symptoms and ED, with the whole sample, that both inattention and hyperactivity/impulsivity symptoms similarly related to ED deficits. Nevertheless, more work is needed examining ED within children with ADHD, predominantly inattentive type. Additionally, our observational frustration tasks were limited to an interaction with a confederate, thus making it difficult to assume their observed reaction would generalize to other individuals (e.g., parents) outside of the laboratory. It would also be important for future work to examine the utility of observing children's empathy/CU behaviors within the lab setting. Understanding the physiological reactivity associated with ED in children with ADHD may help elucidate the heterogeneity of ED in preschool children. For example, recent work by Morris (2019) and colleagues found significant differences in psychophysiological correlates (as measure by respiratory sinus arrhythmia [RSA] and electrodermal activity [EDA]) between school-aged children with and without ADHD. Lastly, while this may be a strength, our sample was predominately Latinx given the geographic location of the study. It is possible that these results may not generalize to other races/ethnic backgrounds. Nonetheless, these are rich findings about Latinx children, whom are part of the largest growing and understudied group in the United States (La Greca, Silverman, & Lochman, 2009).

In sum, our findings suggest there are distinct ED differences between TD children, ADHD-Only, and ADHD+ODD. Specifically, preschool children with ADHD+ODD are having significantly higher levels of ED across multiple domains (ERNL, EREG, and CU behaviors) compared to children with ADHD-Only and TD

children. Given the persistent and chronic nature of ADHD across the lifespan (Kuriyan et al., 2013; Malloy-Diniz et al., 2007; Merrill et al., 2016), identifying these emotional impairments during the preschool period can inform early intervention efforts targeting preschoolers with ADHD and comorbid ODD. The classification predictors used in our analyses suggests that most of the ED domains (EREG, ERNL, and CU behaviors) are excellent in correctly classifying children with ADHD+ODD (as well as TD) but not necessarily children with only ADHD. Given the important role of EF in both regulatory domains of ED (Blair & Ursache, 2011) as well as its role within ADHD etiology (Antshel, Hier, & Barkley, 2014; Barkley, 2000; Schoemaker et al., 2012), future work should examine the joint contributions of EF and ED as way to improve our classification of children with ADHD-Only versus those with comorbid CP. Finally, it will be important for future studies to incorporate biological correlates of ED and EF (i.e., heart rate variability during cognitive and emotional tasks, neural correlates) as a way to examine the heterogeneity of children with ADHD.

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Table 1

Descriptive Statistics and Outcomes.

	ADHD-Only[a] N = 24		ADHD + ODD[b] N = 54		TD[c] N = 74			
Variables	Mean	*SD*	Mean	*SD*	Mean	*SD*	*p*-value	
Demographics								
Age	5.81	.88	5.51	.75	5.44	.88	*ns*	
Sex (% male)	66.7%	---	77.8%	---	75.7%	---	*ns*	
Ethnicity (% Hispanic)	83.3%	---	81.5%	---	83.8%	---	*ns*	
IQ	95.00[a]	12.90	95.38[a]	14.21	102.27[b]	10.98	**.003**	
	Mean	*SE*	Mean	*SE*	Mean	*SE*	*F* (2, 145)	*P - values*
Symptoms								
ADHD HI Mean Sxs-DBD (C)	2.12	.10	2.46	.07	.63	.06	215.45***	ac***, bc***, ab*
ADHD INATT Mean Sxs-DBD (C)	2.19	.11	2.20	.07	.45	.06	203.78***	ac***, bc***
ODD Mean Sxs -DBD (C)	.77	.10	1.86	.07	.32	.06	153.60***	ab***, ac***, bc***
ED Domains								
ERU: Emotion Knowledge Total Score (O)	20.76	.62	21.00	.41	21.39	.35	.45	*ns*
EREG: BRIEF Emotional Control (C)	61.07	2.16	75.35	1.44	46.80	1.23	110.20***	ab***, ac***, bc***

	Global Regulation (O)	2.87	.16	2.70	.11	3.18	.09	5.46**	bc**
ERNL:	ERC-Negativity Subscale (C)	2.17	.04	2.78	.05	1.62	.04	155.74***	ab***, ac***, bc***
	Affect Lability (O)	1.81	.14	1.83	.10	1.67	.08	.44	*ns*
CU:	ICU Mean Item Score (C)	1.03	.08	1.36	.05	.68	.04	48.75***	ac***, bc***, ab***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, ns = no significance. All analyses controlled for sex, age, and IQ. C = Combined parent and teacher report, O = Observation, ADHD = Attention-deficit/hyperactivity disorder, HI = Hyperactivity/Impulsivity, INATT = Inattention, ODD = Oppositional Defiant Disorder, Sxs = Symptoms, DBD = Disruptive Behavior Disorders Rating Scale, TD = Typically Developing, BRIEF = Behavior Rating Inventory of Executive Functioning, ERC = Emotion Regulation Checklist (Shields & Cicchetti, 1997), ERU= Emotion Understanding, EREG= Emotion Regulation, ERNL= Emotional reactivity/negativity/lability, CU= Callous-unemotional behaviors

Table 2
Partial Correlations Between Study Variables.

	1	2	3	4	5	6	7	8	9
ADHD and CP Sxs									
1. Inattention (C)	-								
2. Hyperactivity/Impulsivity (C)	.84***	-							
3. ODD (C)	.66***	.77***	-						
ERU									
4. Emotion Knowledge (O)	.07	.07	.05	-					
EREG									
5. BRIEF-Emotion Control (C)	.67***	.71***	.83***	.08	-				
6. Global Regulation (O)	-.25**	-.26**	-.19*	-.14*	-.33***	-			
ERNL									
7. Negativity (C)	.69***	.82***	.89***	.03	.85***	-0.24**	-		
8. Affect Lability (O)	-.01	.07	.10	.10	.15	-.42***	.12	-	
CU									
9. CU behaviors (C)	.60***	.60***	.67***	.00	.49***	-.08	.66***	-.01	-

Note. *** $p < .001$, ** $p < .01$, * $p < .05$. Partial correlations controlling for age, sex, and IQ. ADHD = Attention-deficit/hyperactivity disorder, ODD = Oppositional Defiant Disorder, Sxs = Symptoms, C = Combined parent and teacher report, O = observed measure, BRIEF = Behavior Rating Inventory of Executive Functioning, ERU= Emotion Understanding, EREG= Emotion Regulation, ERNL= Emotional reactivity/negativity/lability, CU= Callous-unemotional behavior

Table 3
Discriminant Function Coefficients for Emotion Dysregulation Domains.

Variable	Standardized Coefficients
EREG: BRIEF-Emotional Control T-Score (C)	.43
Global Regulation (O)	-.09
ERNL: ERC- Negativity Subscale (C)	.54
CU: ICU Mean Item Score (C)	.35

Note. C = Combined parent and teacher report, O = Observation, BRIEF = Behavior Rating Inventory of Executive Functioning, EREG= Emotion Regulation, ERNL= Emotional reactivity/negativity/lability, CU= Callous-unemotional behaviors, ERC = Emotion Regulation Checklist (Shields & Cicchetti, 1997), ICU = Inventory of Callous-Unemotional Traits (Frick, 2004)

Table 4
Classification Results for ED Domains Predicting Diagnostic Groups.

	Predicted (%)			
Group	TD	ADHD-Only	ADHD + ODD	Centroid
TD (*n* = 74)	93.2	5.4	1.4	-1.62
ADHD Only (*n* = 24)	33.3	41.7	25.0	.36
ADHD + ODD (*n* = 54)	3.8	3.8	92.3	2.14

Note. 84.7 % of original cases correctly classified. ED = Emotion dysregulation, TD = Typically developing, ADHD = Attention-deficit/hyperactivity disorder, ODD = Oppositional Defiant Disorder

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ORIGINAL ARTICLE

Response to Time-Out Among Preschoolers with Externalizing Behavior Problems: The Role of Callous-Unemotional Traits

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Abstract
This study examined the role of callous-unemotional (CU) traits in preschoolers with externalizing behavior problems (EBP) and their response to time-out (TO). One hundred ninety preschoolers (76% boys, $M^{age} = 4.92$) with at-risk/clinically elevated levels of EBP participated in an 8-week summer treatment program (STP-PreK). Total number of minutes spent daily in TO for intentional aggression (IA) and repeated non-compliance (RNC) were recorded during the initial (T1) and final (T2) phases of the STP-PreK. After accounting for severity of EBP and levels of TO at T1, higher levels of CU traits predicted greater total levels of TO at T2. An interaction also emerged between symptoms of oppositional defiant disorder (ODD) and CU traits in predicting IA. Specifically, greater ODD symptoms predicted fewer number of IA related TO at T2, but only for children with low CU traits. Implications for treatment are discussed.

Keywords Behavioral treatment · Callous-unemotional traits · Conduct problems · Preschoolers · Time-out

Introduction

Externalizing behavior problems (EBP) such as attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD) affect 5–10% of children and adolescents and represent the most common referrals to mental health clinics [1, 2]. EBP are even more common in preschoolers, with prevalence rates ranging from 14 to 52% [3]. A percentage of these children, ranging from 7 to 25% [4, 5], also display a range of conduct problems (CP) such as aggressive, defiant, and anti-social behaviors (AB) that are known to violate the rights of others and major societal norms [6]. Multiple longitudinal studies show that at least half of preschool children with moderate to severe CP continue to show similar behaviors at school age [7–9]. Given the stability [10] and detrimental outcomes (i.e., cognitive impairments, aggression, delinquency, and emotional impairments) [11] associated with early CP, it is important to consider risk factors that influence the course of early CP.

Callous-unemotional (CU) traits have emerged as important factor in understanding the heterogeneity in emotion dysregulation for children with EBP [12], and of particular interest to the current study, CP [13]. Children displaying CU traits are typically defined as having low levels of guilt, empathy, and caring for others. The subgroup of children with CP that display CU traits experience the most pervasive, severe, and aggressive patterns of antisocial behavior [14]. For example, children with CP exhibiting CU traits have higher rates of property delinquency (i.e., destruction of property), violent delinquency (i.e., physical altercations), and police contact than children who only have CP or CU alone [15]. Children with CP and CU traits have been shown to exhibit impairments across domains (e.g., academic, social, and behavioral) in the classroom setting [16]. Additionally, the stability of CU traits has been documented during the preschool [17], early childhood [18], and adolescent years [19, 20]. Given the relatively high stability of CU traits from childhood to adolescence [21], it is imperative to examine CU traits among younger children.

CU Traits in Preschoolers

As highlighted by Waller et al. [22], there are relatively few studies investigating CU traits in preschoolers with emerging evidence suggesting that CU traits can be identified as early as age three [23]. Early CU traits have been found to predict later ODD and CD diagnoses [24]. Even fewer studies have

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examined the role of CU traits among preschoolers with CP in terms of impairment across domains (e.g., social function, academics). For example, with regard to social functioning, Graziano et al. [25] reported that preschool children with CP can correctly identify peers who engage in behaviors indicative of CU traits and are more likely to dislike and socially reject them. In the academic domain, preschool children with CU have been found to be more likely to experience academic underachievement [26, 27]. Due to the stability and array of impairments children with CU traits experience across domains, it is crucial to intervene early to help attenuate some of their behavioral and emotional deficits.

Treatment of CP in Preschoolers

Evidence-based treatments (EBT) have been shown to be an effective way to reduce the severity of CP [28–30]. Eyberg et al. [28] proposed when selecting EBT for young children (ages 2–5), behavioral parent training (BPT) should be the first line of approach rather than medication. In BPT, negative behaviors are decreased through two key phases, which include increasing positive interactions between the parent and child, and providing consistent consequences for negative behaviors [29, 31, 32]. According to a meta-analysis conducted by Kaminski et al. [29], the first phase of treatment primarily focuses on positive interactions that are reward driven, while the second phase uses consequences or punishments, like time-out (TO), to address negative behaviors. However, relatively few studies have examined the extent to which young children with CU traits respond to specific treatment components like TO.

The few studies to date that have examined the treatment response of children with CU traits have yielded mixed findings. For example, one study showed that parents found TO to be less effective for boys who had higher CU traits [33], suggesting the boys in the study were less sensitive to punishment, regardless of parenting strategies. This may be related to emerging evidence suggesting that children with CU traits are insensitive to punishment and may be more sensitive to reward related goals [34, 35]. However, a systematic review by Waller et al. [36], found that parent-focused interventions appeared to be effective in reducing CU traits in children. For example, in the context of a behavioral family intervention based on Sanders and Dadds [37], BPT was found to be an effective treatment on reducing the level of CU traits and CP in young children [18].

In addition to BPT, multimodal interventions that target children and parents separately have also been effective in improving CP [38, 39]. For example, the Summer Treatment Program (STP) [40] is effective in reducing CPs such as aggression [41] as well as improving children's social functioning [42]. Yet it is important to note the effect of the STP on reducing CP was significantly lower among children displaying CU traits [35, 43]. On the other hand, an abbreviated version of Coping Power [44], which is another multimodal program targeting aggression, was effective in reducing children's CP, regardless of CU traits [45]. Given the mixed findings in school-aged children with CPs, the extent to which CU traits attenuate the effectiveness of such multimodal interventions in young children, primarily preschoolers, remains unclear.

Current Study

In summary, emerging evidence points to the stability of early CU traits during the preschool period [46, 47] and significant behavioral, academic, social, and familial impairment [24–26, 36]. Very few studies have examined preschoolers with CU traits' response to established EBT for CP [48]. Given evidence with older children suggesting that CU traits are associated with a deficit in punishment sensitivity [34, 35], a clinically relevant question becomes the extent to which preschoolers with CU traits are responsive to a widely used therapeutic component, TO. Examining young children's response to TO is crucial given that TO is part of almost every EBT for CP [28, 29]. Most notably, the few studies that have examined the link between children's response to treatment in the form of TO and CU traits were done with older samples [35, 43, 46].

Hence, the current study is the first to our knowledge to examine the role of CU traits in preschoolers with CP and their response to TO. Within the context of a comprehensive multimodal Summer Treatment Program for Pre-K kindergarteners (STP-PreK) [49] in a sample of preschoolers with EBP, we examined the extent to which CU traits (as rated by parents/preschool teachers) at pre-treatment predicted (a) baseline levels of TO during the initial phase of the STP-PreK (Time 1) and (b) change in the levels of TO from the initial to final phase of the STP-PreK (Time 2). TO was examined both in terms of total number of daily minutes during the STP-PreK as well as the number of TO due to either intentional aggression (IA) or repeated non-compliance (RNC). After accounting for demographic variables that may relate to CU traits (e.g., sex) [50, 51] as well as severity of CP [52, 53], we hypothesized that preschoolers with higher levels of CU traits would spend more minutes in TO during the initial and final phases of the STP-PreK.

Methods

Participants and Recruitment

Children and their caregivers were recruited from local preschool and mental health agencies via brochures, radio and newspaper ads, and open houses/parent workshops. Legal

guardians contacted the clinic and were directed to the study staff for screening questions to determine eligibility. Participants were required to (a) have an externalizing problems composite t-score of 60 or above on the parent ($M = 64.30$, $SD = 13.17$) or teacher ($M = 65.31$, $SD = 13.41$) BASC-2 [54], (b) be enrolled in preschool during the previous year, (c) have an estimated IQ of 70 or higher ($M = 94.13$), (d) have no confirmed history of an Autism Spectrum or Psychotic Disorder, and (e) be able to attend an 8-week summer treatment program (STP) prior to the start of the next preschool or kindergarten year.

The final participating sample consisted of 190 preschool children (76% boys) with at-risk or clinically elevated levels of EBP whose parents provided consent to participate in the study. The mean age of the participating children was 4.92 years and more than half of the parents reported currently being married/living with the child's other biological parent (60%). According to the C-DISC [55], which was conducted by mental health graduate students under the supervision of a licensed psychologist, 42% percent of children met DSM-IV criteria for both ADHD and ODD while an additional 24% met criteria for ADHD-only.

Study Design and Procedure

This study was approved by the university's Institutional Review Board. Children were recruited across 2 years and participated in the STP-PreK [49]. All families participated in a pre-treatment assessment prior to the start of the STP-PreK, which included completion of the ADHD, ODD, and CD modules on the C-DISC [55] and various questionnaires regarding their children's behavioral, academic, and emotional functioning. Other than receiving the intervention at either no cost via a federal grant or at a subsidized cost via a local grant, families did not receive compensation for completing the pre-treatment assessment. Similar questionnaires were also obtained from children's preschool teachers.

For this study, we were interested in examining the extent to which initial levels of parent and teacher ratings of children's CU traits were uniquely related to children's response to a component of the multimodal intervention, TO. Number of minutes spent in TO were recorded by a counselor in the STP-PreK [49]. Briefly, children were assigned TOs for the following three reasons: IA, intentional destruction of property (IDP), and RNC. Counselors followed the TO sequence used in Parent–Child Interaction Therapy (PCIT) [56].

A child would receive a TO for IA for instances of aggressive behaviors directed towards other children or staff members (e.g., hitting, spitting, biting). TOs for IDP were given for destructive behaviors towards the child's own belongings, the belonging of another person, or objects in the classroom (e.g., breaking pencil during seatwork, ripping up a classmates drawing, flipping a desk). TOs for IDP were not examined in the following study given the low frequency of such behaviors. Finally, RNC TOs were assigned when the child failed to comply with a command after being prompted two times by a counselor or teacher. Regardless of the reason for which the TO was assigned, children were expected to serve their TO appropriately for a total of 3 min followed by a 5 s moment of silence. Serving a TO appropriately was described to the child as staying on the TO chair in the corner of the classroom, quietly. If a child's behavior did not meet the criteria necessary to end the TO (being seated and silent after the 3 min and 5 s period), the counselor monitoring the TO would actively ignore these behaviors until the child was serving the final 5 s appropriately.

Measures

CP and ADHD Symptoms

Parents and teachers completed the Disruptive Behavior Disorders (DBD) Rating Scale [57]. The DBD rating scale asks the respondent to rate on a 4-point scale ranging from 0 (*not at all*) to 3 (*very much*), the degree to which children display symptoms of ADHD, ODD, and CD. The DBD Rating Scale's responses range from 0 (*not at all*) to 3 (*very much*). Consistent with prior work [58, 59], parent and teacher ratings were combined by taking the higher of the two ratings for each item to create composites. Of note we did not examine CD given our preschool sample. Rather, our CP measure was the mean score across the ODD symptoms ($\alpha = .85$). The mean score across the ADHD symptoms was also examined ($\alpha = .92$).

CU Traits

Parents and preschool teachers completed an abbreviated version of the inventory of callous-unemotional traits (ICU) [60] consisting of 12 items identified by Hawes et al. [48] as showing similar psychometric properties to those of the full ICU. The items were rated on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*very much*) and included: seems to enjoy being mean; is cold or uncaring; lacks remorse for misbehavior; does not seem to respond or care about punishment; and uses or cons other people to get what he/she wants. Consistent with prior work examining CU traits [19], parent and teacher ratings were combined by taking the higher of the two ratings for each item ($\alpha = .84$). This method is useful when one is attempting to avoid underreporting [15] behaviors that may occur across several settings.

Measurement of Minutes in TO

Consistent with previous work [61], counselors recorded the start and end time of each TO, the reason it was assigned

(IA, RNC), and the number of minutes spent in TO for the day. For the purposes of the current study, the first 2 weeks, Time 1 (T1) were used to examine initial levels of TO. The purpose of examining TO across the first 2 weeks was to account for the "honeymoon effect." The "honeymoon effect" suggests that clinically elevated behaviors may decline or "disappear" at the beginning of treatment, only to reemerge shortly thereafter. To examine the extent to which children responded to the TO component of the STP-PreK, we examined TO during the last 2 weeks of the STP-PreK, Time 2 (T2).

Data Analytic Plan

All analyses were conducted using the Statistical Package for Social Sciences, version 20 (SPSS 20). Missing values analyses revealed that only one child was missing data across TO domains at week 8. The lack of data for this child was due to absences during the last 2 weeks of the STP-PreK. Little's Missing Completely at Random (MCAR) test revealed the data was missing at random, $\chi^2 = 1.26$, $p = .74$. Preliminary data analyses were conducted to examine any associations between demographic variables and any outcome variables. Given the dependent variables in the current study were count variables, several assumptions for ordinary least squares (OLS) analyses were violated. First, all the outcomes had a right-skewed distribution (kurtosis range 5.50–23.04), violating the first assumption of OLS, conditional normality. Secondly, the variance for each outcome violated the assumption of homoscedasticity, such that the variances increased at different values of the predictors.

According to Coxe et al. [62], Poisson regressions are optimal for analyses involving count data. Predicted outcomes are transformed with a link function (natural log), that allow the dependent and independent variables to have different metric properties. For example, for every one-unit change in our predictors (i.e., ADHD, CP, CU traits), we expected a multiplicative ($e^{b1+b2+b3}$…) change in the outcomes (i.e., IA, RNC). The current study used nested overdispersed Poisson regressions to predicted T2 TO. First, we ran an intercept only model (model 1). Model 2 included age and T1 as covariates. The following model (model 3) included ADHD, CP, and CU traits as predictors. Finally, model 4 examined interactions between ADHD, CP, and CU traits.

Results

Preliminary Analyses

Descriptive statistics for all demographic variables are presented in Table 1. Preliminary analyses revealed a small association between age and symptoms of ADHD, $r = .15$, $p < .05$, such that older children were exhibiting more behaviors associated with ADHD. Age was also negatively associated with total number of minutes at T2, such that older children were in TO for less time than younger children, $r = -.15$, $p < .05$. There were no statistically significant associations between sex and our outcome variables, $ps > .05$. Regarding our variables of interest, there was a small association between CU traits and all three domains of TO at T2, $rs = .14 - .17$, $ps < .05$. A small association between ADHD symptoms and RNC at T1 suggest that children rated as having greater symptoms of ADHD received more TO for RNC at the beginning of the STP-PreK, $r = .15$, $p < .05$. Lastly, children rated as having greater levels of CP were more likely to receive a TO for IA at T1, $r = .23$, $p < .05$.

Table 1 Descriptive variables

	M	SD	Range	N
Demographic variables				
Child sex (% male)	76	–	–	190
Child race (% Hispanic)	82	–	–	190
Child age	4.92	.53	3.50–6.24	190
Marital status (% married)	60	–	–	190
Behavioral measures				
DBD: ADHD	1.94	.56	.28–2.94	190
DBD: CP	1.37	.68	0–3	190
ICU: CU	1.08	.42	.08–2.17	190
Mean count (per day)				
IA: Time 1	.64	.97	0–6.22	190
IA: Time 2	.52	.98	0–8.22	189
RNC: Time 1	1.54	1.93	0–11.33	190
RNC: Time 2	.94	1.48	0–10.00	189
Total number of minutes: Time 1	9.85	16.09	0–108.00	190
Total number of minutes: Time 2	4.15	4.54	0–32.00	189

DBD disruptive behavior disorder (DBD) Rating Scale (Pelham, et al. 1998), *ICU* inventory of callous-unemotional traits (ICU; Frick 2004), *CP* conduct problems, *CU* callous-unemotional traits, *ADHD* attention-deficit/hyperactivity-impulsive disorder. *TO* time-out, *IA* intentional aggression, *RNC* repeated non-compliance

Baseline Levels of TO

On average, children spent 9.85 minutes in TO per day during T1, $M = 9.85$, $SD = 16.09$. Paired *t* tests indicated that children were assigned a significant greater number of TO for RNC ($M = 1.54$, $SD = 1.93$) compared to IA ($M = .64$, $SD = .97$), $t(189) = 7.12$, Cohen's $d = .59$, $p < .001$. After accounting for age, CP was significantly related to total number of IA at T1, Wald's χ^2 (1) = 4.13, $p < .05$, suggesting children rated by parents/teachers as having higher levels of CP received more TO for IA at T1. Levels of ADHD prior to the start of the STP-PreK significantly predicted the

number of RNC TO at T1, χ^2 (1) = 4.50, $p < .05$. Children rated by their parents/teachers as having higher levels of ADHD symptoms received a greater number of RNC TO at T1. ADHD, CP, nor CU traits were associated with the total number of minutes children were in TO at T1, $ps > .05$ (Table 2).

Intervention Effects on TO

After controlling for age and T1, there were significant changes across TO domains. The average number of minutes spent in TO during T2 decreased significantly, $F(2, 186) = 36.14$, $p < .001$, Cohen's $d = -.49$. The average number of TO assigned for RNC and IA also decreased significantly, $F(2, 186) = 36.42$, $p < .001$, Cohen's $d = -.35$, $F(2, 187) = 78.73$, $p < .001$, Cohen's $d = -.12$, respectively.

Overdispered Poisson Regression Analyses

As seen in Table 3, four overdispered Poisson regression analyses (model 1–model 4) were tested to examine the association between CU traits and TO at T2 for IA, RNC, and total number of minutes in TO. Wald's χ^2 and pseudo R^2 change for the additional predictors in each model are reported in Table 2. T1 TO (model 2) were significantly associated with T2 across all TO domains ($ps < .001$). When ADHD, CP, and CU traits were added to the analyses (model 3), CP and CU traits were uniquely associated with IA, RNC, and total number of minutes in TO. ADHD was not related to any of the outcomes in the current study ($ps > .05$).

IA at T2

The addition of ADHD, CP, and CU traits (model 3) while controlling for IA and age at T1(model 2) accounted for 42% of the deviance. However, Wald's test revealed that only CU traits was a significant predictor of IA at T2, Wald χ^2 (1) = 4.20, $p < .05$. Children with higher levels of CU traits received greater amounts of TO for IA at T2. This main effect was qualified by a significant interaction (model 4) between CP and CU traits, Wald χ^2 (1) = 4.68, $p < .05$. Probing of the interaction revealed that CU traits moderated the association between levels of CP and TO for IA at T2, such that association between CP and number of IA TO at T2 was only present for children with low CU traits, Wald χ^2 (1) = 7.48, $p < .01$; see Fig. 1. For every one-unit increase in CP, there was a .24 multiplicative decrease in the number of TO assigned for IA at T2. This association did not hold for children with high CU traits, Wald χ^2 (1) = .05, $p < .82$.

RNC at T2

After controlling for T1 and age (model 2), ADHD, CP, and CU traits accounted for 32% of the deviance. There was a main effect for CP and CU traits, Wald χ^2 (1) = 8.96, $p < .01$, Wald χ^2 (1) = 6.03, $p < .05$, respectively. Children rated by parents/teachers as having higher levels of CP before starting the STP-PreK received less TO for RNC at T2. On the other hand, children with higher levels of CU traits before the start of the STP-PreK received more TO for RNC at T2. These main effects were then probed (model 4), however there were no interaction effects ($ps > .05$).

Table 2 Correlations between study variables

	1	2	3	4	5	6	7	8	9	10	11
1. Age											
2. Sex	−.04										
3. DBD: ADHD (C)	.15*	−.11									
4. DBD: CP (C)	.00	−.03	.33**								
5. ICU: CU (C)	−.02	.03	.28**	.45***							
6. Total # Mins in TO: Time 1 (O)	−.08	−.04	.14	.13	.05						
7. Total # Mins in TO: Time 2 (O)	−.15*	−.11	.07	.09	.16*	.52***					
8. Number of RNC TO: Time 1 (O)	−.12	−.05	.15*	.06	.13	.60***	.46***				
9. Number of RNC TO: Time 2 (O)	−.08	.01	.03	−.09	.14*	.18*	.44***	.53***			
1. Number of IA TO: Time 1 (O)	−.05	−.08	.12	.23**	.18*	.42***	.37***	.44***	.28***		
11. Number of IA TO: Time 2 (O)	−.02	−.14	.13	.12	.17*	.24**	.46***	.36***	.42***	.66***	

C Combined teacher and parent report, *O* observed measure, *DBD* Disruptive Behavior Disorder Scale (DBD; Pelham et al. 1998), *CP* conduct problems, *ICU* inventory of callous-unemotional traits (ICU; Frick 2004), *CU* callous-unemotional traits, *ADHD* attention-deficit/hyperactivity-impulsive disorder

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

Table 3 Models for predicting daily TO outcomes at Time 2 (IA, RNC, Total)

	b	e^{bx}	95% CI	Wald's χ^2	Deviance	Pseudo R^2
Number of IA at Time 2 (O)						
Model 1: intercept model	1.55	4.71	(1.28, 1.82)	129.54***	1875.62	–
Model 2: age	−.06	.94	(−.40, .28)	.12	1144.61	.39
IA: Time 1 (O)	.06	1.06	(.05, .07)	151.74***	–	–
Model 3: ADHD (C)	.33	1.39	(−.05, .72)	2.95	1084.98	.42
CP (C)	−.22	.80	(−.56, .12)	1.66	–	–
CU traits (C)	.48	1.62	(.02, .95)	4.20*	–	–
Model 4: ADHD×CU	−.12	.89	(−1.00, .76)	.07	1051.49	.44
ADHD×CP	.09	1.09	(−.49, .67)	.10	–	–
ODD×CU	.65	1.92	(.06, 1.25)	4.68*	–	–
Number of RNC at Time 2 (O)						
Model 1: intercept model	2.14	8.50	(1.92, 2.36)	349.81***	2826.44	–
Model 2: age	.02	1.02	(−.33, .38)	.02	2082.38	.26
IA: Time 1 (O)	.03	1.03	(.21, .04)	62.74***	–	–
Model 3: ADHD (C)	−.02	.98	(−.38, .35)	.01	1933.14	.32
CP (C)	−.47	.63	(−.78, −.16)	8.96**	–	–
CU traits (C)	.59	1.80	(.12, 1.06)	6.03*	–	–
Model 4: ADHD×CU	−.39	.68	(−1.26, .48)	.77	1881.75	.33
ADHD×CP	.46	1.58	(−.12, 1.04)	2.42	–	–
ODD×CU	.41	1.52	(−.24. 1.05)	1.53	–	–
Total number of minutes in TO at Time 2 (O)						
Model 1: intercept model	3.62	37.34	(3.46, 3.78)	6917.75***	6917.5	–
Model 2: age	−.24	.79	(−.47, −.01)	4.02*	5361.19	.23
IA: Time 1 (O)	.002	1.00	(.002, .003)	66.15***	–	–
Model 3: ADHD (C)	−.05	.95	(−.30, .20)	.16	5198.27	.25
CP (C)	−.02	.98	(−.24, .20)	.05	–	–
CU traits (C)	.38	1.46	(.05, .72)	5.06*	–	–
Model 4: ADHD×CU	.32	1.38	(−.20, .85)	1.45	4965.88	.28
ADHD×CP	−.07	.93	(−.44, .31)	.121	–	–
ODD×CU	.46	1.58	(.05, .87)	4.73*	–	–

P parent report, *C* combined parent and teacher report, *O* observation, *CP* conduct problems, *CU* callous-unemotional, *ADHD* attention-deficit/hyperactivity-impulsive disorder, *TO* time-out, *IA* intentional aggression, *RNC* repeated non-compliance

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

Total Number of Minutes in to at T2

Unlike the aforementioned analyses, age significantly predicted the number of minutes children were in TO at T2, Wald χ^2 (1) = 4.02, $p < .05$, suggesting that younger children spent more minutes in TO at T2 compared to older children. Model 3 accounted for 25% of the deviance in the model. There was a main effect for CU traits, such that higher levels of CU traits predicted more minutes in TO at T2, Wald χ^2 (1) = 5.06, $p < .05$. This main effect was qualified by a significant interaction between CP and CU traits, Wald χ^2 (1) = 4.73, $p < .05$. However, there were no differences between the simple slopes for ODD at any level of CU traits, *ps* > .05.

Discussion

Within the context of a comprehensive multimodal STP for preschoolers with EBP, we examined the extent to which CU traits predicted TO levels during the initial and final phases of the STP-PreK. First, it is important to note that children's overall levels of TO significantly decreased from T1 to T2 of the STP-PreK. Second, CU traits did not predict initial levels of TO during the STP-PreK. Rather, CU traits was associated with greater levels of TO at T2 for total number of minutes, number of IA TO, and RNC TO. We elaborate on these findings below.

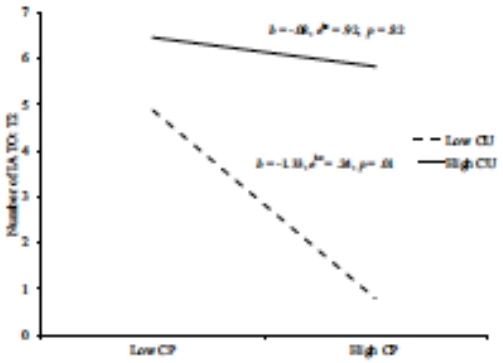

Fig. 1 CP by CU on number of IA TO assigned at T2. Analyses controlled for age, T1, IA, and ADHD. *IA* intentional aggression, *TO* time-out, *T1* Time 1, *T2* Time 2, *CP* conduct problems, *CU* callous-unemotional traits, *ADHD* attention-deficit/hyperactivity-impulsive disorder

At T1, children spent an average of 9.85 min in TO a day. However, by the end of the STP-PreK, T2, there was approximately a 58% reduction in daily number of minutes spent in TO ($M = 4.15$, $SD = 4.54$). This significant reduction speaks to the effectiveness of multimodal behavioral programs targeting children with EBP. Past studies have traditionally relied on post-treatment parent and teacher reports [63, 64] to measure treatment outcomes. For example, Hawes and Dadds [33] used parent reports to measure children's emotional reaction during TO. Additionally, classroom-based interventions have been shown to decrease externalizing and internalizing behaviors in the classroom, as reported by teachers [65]. Significantly less work has examined more objective behavioral measures within the context of treatment. To our knowledge, this is the first study that has examined more objective measures of preschoolers' disruptive behaviors by examining the amount of time they spent in TO. Due to the fact that the STP-PreK mimics the school setting, measuring the number of minutes spent in TO provides an ecologically valid measure of response to an important component of treatment, TO. By doing so, it allowed us to more accurately measure children's aggression and non-compliance within a classroom setting.

Consistent with our hypothesis, preschoolers with higher levels of CU traits, as reported by parents/preschool teachers, were less responsive to the use of TO during the STP-PreK. Specifically, even after accounting for initial levels of TO, CU traits predicted overall TO and RNC during the final phase of the STP-PreK. While there were overall decreases in the number of TO and the total number of minutes spent in TO, prior work that dichotomizes CU traits also found that children with higher CU traits did not respond to a multimodal treatment, compared to children with no/low CU traits [66, 67]. Several mechanisms may explain the reason why children with higher levels of CU traits do not respond as well to a behavioral intervention.

Previous research shows that children and adolescents with CU traits differ in their responses to emotional cues and the possibility of consequences for their actions [68, 69]. Furthermore, research by Pardini and Byrd [70] found that children with CU traits had "deviant social schemas" that increased instrumental aggression. More importantly, significant associations revealed that children with more CU traits were less fearful towards punishment. The current study shows that even within a young preschool sample, CU traits may suggest not only an inherent oppositionality [71], but perhaps a lack of emotional reactivity [15, 72] in terms of their lack of response to threat/punishment (e.g., receiving a TO warning for RNC).

It is also important to note that an interaction emerged between CP and CU traits as it relates to IA TO. Specifically, at high levels of CU traits, co-occurring CP had no impact on number of IA TO at T2. However, at low levels of CU traits, high CP was associated with fewer IA TO whereas low CP was associated with greater IA TO at T2. This finding suggests that children with higher levels of CP (without CU traits) responded more positively to the intervention. Indeed children with ODD do quite well in PT programs like PCIT where TO is a major component [73, 74]. On the other hand, our low CP group, which ended up with higher IA TO, may be more indicative of a group of children who engage in more covert acts of CP (which would explain their lower CP rating according to parents and teachers). Indeed, studies have distinguished children with early CU traits engage in more proactive versus reactive forms of aggression [23] with some studies indicating that proactive acts of aggression have worse outcomes in life [21, 75]. Future work examining the heterogeneity in young children with EBP's treatment response may want to examine different forms of aggression to determine which ones may be more amenable to the use of TO.

There were some limitations to the current study that need to be acknowledged. First, a TO was assigned based on a hierarchy such that a child could exhibit two behaviors, but only the most severe would be recorded as the reason for the TO. For example, if a child was instructed to return to his or her seat and received a TO warning for not complying, but then pinched a child as he or she was running around, he or she would be assigned a TO for IA, rather than RNC. This system could potentially reduce the average number of daily minutes a child spent in TO for non-compliant behaviors; however, it was very successful in capturing aggressive behaviors towards peers and staff. Second, although all teachers and counselors in the STP-PreK were trained in the operational procedures of assigning TO and were supervised

on a daily basis, it was not feasible to video record the classroom to more accurately capture the recordings of the TO. The in-vivo nature of the TO data collection may have also resulted in some children exhibiting behaviors which should have been resulted in TOs but were missed by a counselor (although given the high number staff to student ratio (1:3) in each classroom this is unlikely to have happened at significant rate). Lastly, another limitation was the cultural homogeneity of the current sample (82% Hispanic/Latino), due to the geographical location. Although such cultural homogeneity may be a strength due to the fact that Hispanic/Latino children are the fastest growing group of children in the United States [76], it is important to be cautious when generalizing the current study's findings to other cultural/racial groups.

In sum, total number of TO for aggressive and non-compliant behaviors significantly decreased over the course of our multimodal summer treatment intervention. However, our findings highlight that children with higher levels of CU traits experienced lower reductions in TO across the intervention. This is the first study, to our knowledge, to directly observe preschooler's response to a widely used treatment component (i.e., TO) and is consistent with past work showing that children with CU traits are less sensitive to punishment [14, 67]. In terms of implications, it is first important to note that most schools do not have the personnel and training to conduct TOs in the classroom. When viewed in conjunction with our finding that children with higher levels of CU traits did not respond as well to TO, alternative behavioral management strategies should be considered. Taking into account children with EBP's reward sensitivity [77, 78], several school-based intervention programs have been successful in reducing CP in the classroom, regardless of CU traits [79, 80]. Lastly, future intervention studies should examine the extent to which existing behavioral management and social-emotional curriculum are effective in not simply reducing CP but also in promoting children's empathetic and prosocial behaviors.

Summary

Externalizing behavior problems (EBP) such as attention-deficit/hyperactivity disorder (ADHD), ODD, and CD affect a substantial number of children and adolescents. EBP are even more present in preschool children. More recently, a subset of children with EBP have been identified as having CU traits. Children with CU traits are typically defined as having low levels of guilt, empathy, and caring for others. Several studies have identified these early antisocial behaviors in children as young as 3 years old. Longitudinal studies have found that children with CP and early CU traits continue to exhibit various functional impairments (i.e., academic, social, and behavioral) across development. For example, children with CP and CU traits have higher rates of aggressive behaviors as well as juvenile delinquency into adolescence.

While several EBT have shown to be successful in the reduction of CP, there is still mixed evidence at the effectiveness of these EBTs for children with CP and CU traits. More specifically, several studies have examined which components of treatment may be associated with behavioral improvements in children with CP and CU traits. Therefore, the current study sought to examine the role of CU traits, as reported by parents/preschool teachers, on the levels of time-out (TO) during an 8-week comprehensive multimodal STP for Pre-Kindergarteners (STP-PreK). TO is a crucial treatment component that is found in almost every EBT for CP. The current study examined TO at the initial phase/Time 1 (first 2 weeks; T1) and the final phase/Time 2 (last 2 weeks; T2) of the STP-PreK. We examined the total number of minutes children spent in TO, the number of IA, and RNC TO children received during the initial and final phase of the STP-PreK.

This study found that even after accounting for initial levels of EBP, CU traits were not associated with any TO outcomes at T1. However, CU traits and CP were significant predictors of IA at T2. After probing a significant interaction, we found that low CU traits moderated the association between CP and number of IA at T2. CU traits were also positively associated with the number of RNC as well as the total number of minutes spent in TO at T2. These findings suggest that preschoolers with a more pure ADHD or CP presentation seems to be more responsive to the TO component of treatment compared to preschoolers with a more comorbid ADHD/CP +CU traits presentation. Future work should examine other behavioral management strategies (rewards versus TO) that may help reduce impairments associated with CP and CU traits, while increasing prosocial and empathetic behaviors.

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Conflict between Parents and Adolescents with ADHD: Situational Triggers and the Role of Comorbidity

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Abstract

Objectives Little is known about factors that contribute to conflict between parents and adolescents with ADHD. The current study examines the frequency and intensity of arguments between adolescents with ADHD and their parents with attention to situational triggers and adolescent and parent characteristics that predict conflict.

Method Adolescents and parents ($N = 128$) completed a battery of rating scales at baseline intake into a randomized clinical trial.

Results The most frequent and clinically significant argument topics identified by parent were homework problems, personal hygiene, and bedtime. Similarly, homework problems were rated by parents as the most intense sources of arguments. Adolescents with ADHD who displayed higher comorbid depressive or aggressive symptoms had the most frequent arguments with their parents.

Conclusions Intervention and prevention programs targeting conflict between teens with ADHD and their parents might consider concurrent treatment of argument sources (i.e., disorganization, homework problems). Comorbid mood and behavior problems should also be addressed.

Keywords Adolescence · ADHD · Familial conflict · Comorbidity · Parenting

For typically developing youth, adolescence represents a time of increased parent-child conflict as teens strive to increase autonomy in the face of parental limits (Larson et al. 1996; Laursensen et al. 1998; Steinberg and Morris 2001). This conflict is particularly elevated for adolescents with Attention Deficit/Hyperactivity Disorder (ADHD; Edwards et al. 2001), who display low frustration tolerance and poor interpersonal and conflict resolution skills (Anderson et al. 1987; Fletcher et al. 1996; Sobanski et al. 2010; Wehmeier et al. 2010). These deficits can prominently emerge during arguments with parents (Shek 1998; Shek and Ma 2001) making dysfunctional parent-adolescent relationships one of the most impaired domains for adolescents with ADHD (Barkley et al. 1992; Edwards et al. 2001; Montemayor and Hanson 1985).

Adolescents who have frequent conflicts with parents are at elevated risk for a range of subsequent psychological problems (Bulanda and Majumdar 2009; Rueter et al. 1999; Shek 1998). As a result of family difficulties, youth may feel withdrawn and develop mood disorders such as depression, which can in turn exacerbate family problems and increase risky behaviors (Auerbach et al. 2007; Fendrich et al. 1990; Petersen et al. 1993; Semeijn et al. 2015). Moreover, parent-adolescent conflict is associated with poorer school adjustment, wellbeing, and psychological adjustment (Shek 1997; 1998). As a result, to prevent escalation of comorbid psychopathology in adolescents with ADHD, the parent-teen relationship is a pressing intervention domain for these youth.

Only a small amount of information is known about risk factors for conflicts between parents and adolescents with ADHD. Clarifying common situational and behavioral antecedents to conflict could be useful to conflict-reduction efforts. For example, it is unclear whether adolescents with ADHD argue about the same topics as typically developing teens (talking back to parents, use of

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drugs/alcohol, and school problems, helping around the house, cleaning up; Allison 2000) or if there are disorder-specific argument topics (i.e., homework problems, rule breaking) that require specific clinical attention. Knowing typical topical antecedents to conflicts would aid intervention efforts.

Additionally, parents and adolescents with ADHD may experience more frequent and intense arguments when the parent or teen possesses certain characteristics. For instance, it is well established that adolescents with ADHD who display comorbid oppositional or aggressive behaviors are more likely to display parent-teen conflict than those without these comorbidities (Edwards et al. 2001). However, less attention has focused on the increase prevalence rates of ADHD and co-occurring depression in adolescence (Kessler et al. 2012; Larson et al. 2011). Some evidence suggests that parent-child relationship problems may create risk for depression among children and adolescents with ADHD (Johnston and Mash 2001; Humphreys et al. 2013; Ostander and Herman 2006). However, it is unclear if depression in turn exacerbates parent-teen relationship problems (though there is evidence that adolescents with depression display increased interpersonal aggression; Sheeber et al. 2000). It is important to note that while parent-teen conflict may be a risk factor associated with both ADHD and depression, causal associations have yet to be found.

It is also possible that parent-teen conflict is exacerbated by parent psychological problems. For example, psychopathology is elevated among parents of ADHD youth and may lead to inconsistent or negative parenting (Burke et al. 2008; Chronis et al. 2003; Johnston and Mash 2001). Adolescents with ADHD may be most likely to displaying negative demeanor in response to a parent with their own mood or behavioral difficulties (Semeijn et al. 2015; Gotlib and Whiffen 1989). Understanding how adolescent and parent psychological characteristics contribute to conflict could also aid intervention efforts.

In conclusion, maximally effective conflict reduction interventions for adolescents with ADHD likely must target appropriate situational triggers, comorbid adolescent psychopathology, and interfering parental behaviors. However, little work has been done to understand processes through which parent-teen conflict unfolds among adolescents with ADHD. The purpose of this study is to examine: (1) situations that precede arguments between parents and adolescents with ADHD and (2) parent and adolescent characteristics that increase risk for frequent and heated arguments within this population. We hypothesized that parents would report arguments across a range of issues related to school and home problems. Moreover, we anticipated that elevated parent and youth psychological problems would increase risk for parent-teen conflict.

Methods

Participants

Data for the current study was collected from adolescents and their parents prior to being enrolled in a randomized controlled trial examining a psychosocial treatment for adolescents with ADHD ($N = 128$) at a large urban university research clinic between 2011 and 2013 (Sibley et al. 2016). The sample was approximately 61% Hispanic and 15% Black/African-American, which reflects the metropolitan area's ethnic diversity. Adolescents were between the ages of 11 to 15 ($M = 12.74$, $SD = 0.85$) and were 64.8% male. Sample characteristics are provided in Table 1.

Procedures

Participants were recruited through school mailings and parent inquiries and the primary caregiver was administered a phone screen containing the DSM-IV-TR ADHD symp-

Table 1 Diagnostic and demographic characteristics of the sample at baseline ($N = 128$)

Demographic variables	
Age (M, SD)	12.74 (.85)
Male (%)	83 (64.8%)
Female (%)	45 (35.2%)
Primary caregiver (Mother)	112 (88.2%)
Race/ethnicity (%)	
White non-Hispanic	9.4
Black non-Hispanic	8.6
Hispanic any race	75.8
Other	6.2
Diagnostic variables at baseline	
ADHD subtype	
ADHD-predominantly inattentive (%)	39.1
ADHD-combined (%)	60.9
ODD/CD (%)	57.8
Affective Problems (%)	19.4
Anxiety problems (%)	19.4
Learning disability (%)	8.8
Medicated for ADHD (%)	34.4
	Mean (SD)
WASI estimated full-scale IQ	100.77 (12.45)
WIAT reading achievement	104.49 (10.13)
WIAT math achievement	99.22 (16.33)

WASI Wechsler Abbreviated Scale of Intelligence, *IQ* intelligence quotient, *WIAT* Wechsler Individual Achievement Test, *ADHD* attention-deficit/hyperactivity disorder, *ODD* oppositional defiant disorder, *CD* conduct disorder

toms and questions about impairment. To participate in research, adolescents were required to: (a) meet DSM-IV-TR (American Psychiatric Association 2000) criteria for ADHD, (b) be enrolled in sixth through eighth grade, (c) display significant academic impairment, (d) have an estimated IQ > 80, (e) have no history of an autism spectrum disorder. At intake, informed consent was obtained and study eligibility was assessed.

ADHD diagnosis was assessed through parent structured interview (Computerized-Diagnostic Interview Schedule for Children; Shaffer et al. 2000) and parent and teacher rating scales (Pelham et al. 1992). Dual clinical review was performed by two licensed clinical psychologists to determine diagnosis and eligibility. As part of this process, clinicians used all available information to consider age of onset, chronicity, comorbid symptoms, and settings of impairment when making ADHD diagnoses. Sibley et al. (2016) provides more detailed information about screening and assessment. All measures for the current study were collected at intake assessment.

Measures

Issues checklist

Parents completed the Issues Checklist (IC: Prinz et al. 1979), a 44-topic questionnaire in which the respondent picks "yes" for topics they discussed with their son/daughter during the past two weeks or "no" if they have not been discussed. For each issue marked, as "yes" the parent must also use 5-point Likert scale to indicate how intense these discussions were and to provide an open-ended response to indicate the frequency with which these discussions occurred during the past two weeks. Argument intensity was rated on a 5-point scale, 1 being "calm" and 5 being "very angry." Two scores were obtained: the frequency of conflicts and the mean anger intensity. The Issue's Checklist possesses established validity as a measure of family conflict compared to direct observations and rating scale measures (Robin and Foster 1989). In the current study, alpha for frequency was .93 and for intensity was .86.

Adolescent ADHD symptoms

DSM-IV-TR ADHD symptoms were obtained using the Disruptive Behavior Disorders Rating Scale (DBD; Pelham et al. 1992). The DBD was completed by the parent who was the adolescent's primary caregiver. The DBD lists DSM-IV-TR symptoms of ADHD. Parent's provided ratings for each symptom using a 4-point Likert scale. The psychometric properties of the DBD rating scale are very good in both child and adolescent samples (Evans et al. 2013; Pelham et al. 1992). Mean ADHD symptoms was calculated by taking the average score of all the ADHD symptoms items ($\alpha = 0.91$).

Adolescent comorbid symptoms

Adolescents completed the Youth Self Report (YSR; Achenbach 1991), a self-administered broadband survey of youth psychopathology, to assess symptoms of comorbid depression. Adolescent report was chosen given evidence that self-report is the most valid source for youth internalizing symptoms (Hope et al. 1999). To measure depressive symptoms, adolescent T-scores from the 8 item Withdrawn/Depressed subscale dimension of was used ($\alpha = 0.71$; Achenbach and Rescorla 2001). Aggression was measured using the Child Behavior Checklist (CBCL; Achenbach 1991). The CBCL is a well-validated parent-report questionnaire in which the adolescent was rated on specific dimensions of behavioral and emotional problems. T-scores from the Aggression subscale served as an index of comorbid youth aggression ($\alpha = 0.94$ Achenbach and Rescorla 2001). Both the CBCL and YSR have been shown to have strong psychometric properties in assessing adolescent mental health disorders (Achenbach 1991), with strong internal consistency.

Parent psychological characteristics

The Adult ADHD Self-Report Scale (ASRS; Adler et al. 2006) measured parent ADHD symptoms. Eighteen ADHD symptoms are rated on a five-point scale (0 = *never* and 4 = *very often*). The ASRS self-report rating scale correlates highly with clinician ratings of ADHD and displays strong internal consistency (Adler et al. 2006). ADHD symptoms were calculated for each parent by calculating the mean score of the ASRS items. Internal consistency for this scale was 0.92 in our study. Parents also completed the Symptom Checklist-90-Revised (SCL-90-R; Derogatis 1994), a 90-item broadband scale of adult psychopathology that measures nine symptom domains using a 5-point Likert scale. The SCL-90-R has good subscale internal consistency and possesses convergent, discriminant and predictive validity (Derogatis and Cleary 1977). T-scores from the depression (13 items) and hostility (6 items) subscales served as parental depression and hostility indexes. Internal consistency for the depression scale was 0.89 and for the hostility scale was 0.70.

Stimulant medication status

To control for naturalistic medication use, parents were asked to report if the adolescent was currently receiving naturalistic stimulant medications for ADHD at baseline (0 = no, 1 = yes).

Data Analyses

For each of the 44 topics on the Issues Checklist (IC; Prinz et al. 1979) we examined descriptive statistics for average frequency and intensity of arguments over the past two weeks. We pursued a norm-based approach to clinical thresholding using available sample norms (Edwards et al. 2001), setting our threshold to one standard deviation above the mean of non-ADHD teen IC scores. This resulted in a threshold of 2.9 for intensity. For frequency, there was no published item-level mean frequency data to inform a clinical threshold. As a result, we selected an ecologically valid frequency threshold of greater than 50% of days per week. We explored predictors of argument frequency and intensity using two separate multiple regression models. All assumptions of multiple regression were tested prior to analyses. At the first step of the model (covariates), adolescent ADHD symptom severity and medication status were entered. At the second step (teen factors), adolescent depression and aggression were entered. At the third step (parent factors), parent ADHD, depression, and hostility were entered.

Results

Parent-Adolescent Issues: Frequency and Intensity

Homework problems ($M = 7.20$, $SD = 4.16$), cleanliness (washing, showering, brushing teeth; $M = 7.05$, $SD = 4.68$), and going to bed on time ($M = 6.87$, $SD = 4.90$) exceeded the clinical threshold for argument frequency (at least 50% of days per week). Twenty-two other topics were identified by parents as occurring at a sub-threshold level (at least once per week; see Table 2). Only one topic met the clinical threshold for intensity (doing homework; $M = 3.04$, $SD = 1.19$).

Predictors of Frequency and Intensity

For frequency, at step 1, the model was not significant [$R^2 = 0.03$, F (2, 121) = 2.15, $p = 0.12$]. The incremental change in step 2 from the contribution of adolescent characteristics was significant [$R^2\Delta = 0.11$, $F(4,119) = 7.68$, $p < 0.001$]. During step 3, incremental model change when parental characteristics were added to the model was not significant [$R^2\Delta = 0.18$, F (7,116) = 1.43, $p = 0.24$]. Interpretation of step 2 indicated that after controlling for covariates, adolescents who displayed higher depression symptoms ($b = 0.04$, $SE = 0.02$, $\beta = 0.18$, $p = 0.04$) and aggression ($b = 0.05$, $SE = 0.02$, $\beta = 0.28$, $p < 0.001$) at home were more likely to be rated as having more frequent arguments with parents. There were no significant predictors for argument intensity, $R = 0.09$, F (2, 121) = 0.45, $p = 0.64$ (See Table 3).

Table 2 Frequency and Intensity of Arguments Between Parents and Adolescents

	Frequency mean (SD)	Intensity mean (SD)
Doing homework	7.20 (4.16)	3.04 (1.19)
Cleanliness (washing, showering, brushing teeth)	7.05 (4.68)	2.20 (1.08)
Bed time	6.87 (4.29)	2.48 (1.10)
Cleaning up bedroom	5.81 (4.69)	2.55 (1.12)
Putting away clothes	5.55 (4.58)	2.39 (1.08)
Using the television	5.11 (3.84)	2.36 (1.09)
Making too much noise at home	4.91 (3.69)	2.11 (0.92)
Fighting with brother and sisters	4.87 (6.48)	1.94 (1.80)
Getting low grades in school	4.73 (4.06)	2.56 (1.52)
How neat clothing looks	4.27 (4.65)	1.98 (1.05)
Talking back to parents	4.18 (4.52)	2.38 (1.67)
Getting up in the morning	4.17 (5.04)	1.54 (1.65)
Phone/internet	4.10 (4.78)	2.45 (1.12)
Helping out around the house	3.95 (4.58)	1.87 (1.42)
Which clothes to wear	3.44 (2.63)	1.93 (1.02)
Messing up the house	2.83 (4.70)	1.27 (1.48)
Table manners	2.56 (4.10)	1.93 (0.98)
What teenagers eat	2.56 (4.79)	0.87 (1.16)
Lying	2.28 (3.32)	1.53 (1.61)
Getting to school on time	2.27 (3.79)	1.02 (1.47)
Turning off lights in house	2.24 (4.28)	0.71 (1.02)
Taking care of records, games, toys, and things	2.11 (3.51)	1.02 (1.28)
How to spend free time	2.07 (3.20)	0.93 (1.14)
Getting in trouble in school	1.71 (3.17)	1.02 (1.59)
Cursing	1.31 (2.66)	0.74 (1.25)
What time to have meals	1.24 (2.84)	0.51 (1.00)
Who should be friends	1.10 (2.47)	0.56 (0.98)
Bothering parents when they want to be left alone	1.08 (2.29)	0.72 (1.24)
Putting feet on furniture	1.05 (3.07)	0.36 (0.78)

The following topics occurred less than once in a two week period: how money is spent, bothering adolescent when he/she wants to be left alone, selecting new clothing, playing music too loud, going to places without parents, buying things, picking books or movies, allowance, sex, coming home on time, drinking alcohol, going on dates, smoking

Discussion

The primary finding of this study are as follows: (1) parent-teen arguments for adolescents with ADHD are often triggered by impairments in homework and hygiene, as well as bedtime; (2) among these topics, arguments about homework problems have the greatest tendency to escalate in intensity; (3) arguments occur most frequently when teens with ADHD also possess comorbid mood and aggression symptoms. Perhaps surprisingly, parent characteristics did

Table 3 Predictors of parent/adolescent argument frequency

	$R^2\Delta$	$F\Delta$	$p\Delta$	b	SE	β	p
Step 1: covariates	0.03	2.15	0.12				
Adolescent ADHD symptoms (P)				0.21	0.22	0.08	0.36
Medication status				−0.52	0.28	−0.17	0.07
Step 2: adolescent characteristics	0.11	7.68	**<0.001**				
Withdrawn/depressed (A)				0.04	0.02	0.18	**0.04**
Aggression (P)				0.05	0.02	0.28	**<0.001**
Step 3: parent characteristics	0.03	1.43	0.24				
Parent ADHD symptoms (P)				0.04	0.20	0.02	0.85
Parent depression (P)				−0.01	0.02	−0.07	0.53
Parent hostility (P)				−0.02	0.02	−0.14	0.16

Step 2 was interpreted given the non-significant incremental change between Step 2 and Step 3

b unstandardized beta, *SE* standard error, β standardized beta, *P* parent report, *A* adolescent report

Bold values indicated significant *p*-values <0.05

not contribute to the frequency of parent-teen conflicts. We discuss each finding below.

Not surprisingly, difficulties with the daily routine (i.e., showering, brushing teeth, completing homework, getting to bed on time) were a major source of arguments in our sample, highlighting the impairing role of ADHD-related organization and self-management problems in adolescence. These argument topics appear to be unique to teens with ADHD. Previous studies report that talking back to parents, use of drugs/alcohol, and school problems are more commonly endorsed in typically developing youth (Coleman 2011; Papini and Sebby 1988; Papini et al. 1989). Thus, efforts to improve parent-teen conflict in youth with ADHD might simultaneously address communication skills *and* argument sources (i.e., self-management of the daily routine). Extant psychosocial treatments that address both parent-teen interactions and executive function skills training may be particularly indicated (e.g., Supporting Teens' Autonomy Daily [STAND]; Sibley et al. 2016).

Although a majority of adolescents with ADHD demonstrate the homework and daily routine difficulties (Harrison et al. 2011; Langberg et al. 2016), arguments were more frequently triggered when the teen possessed comorbid aggressive and/or depressive symptoms. Both of these symptom clusters contain an emotion regulation component that may increase risk for teen-initiated conflict with the parent when problem behaviors occur (Shaw et al. 2014; Graziano and Garcia 2016). However, it also may be the case that depression-related anhedonia or oppositional behaviors may contribute to increased problems with tasks of daily living—thereby increasing the incidence of triggers (Beck 2002; Katon et al. 2010). As a result, longitudinal research is greatly needed to understand the processes that underlie our cross-sectional findings.

Contrary to past work (Edwards et al. 2001), neither the frequency nor intensity of arguments were related to parent psychological problems. As a result, even parents who were psychologically healthy experience frequent arguments with teens who have ADHD (especially if the teen had comorbid mood or aggression problems). Thus, parenting interventions for teens with ADHD may require training in communication and conflict de-escalation skills that are outside the repertoire of typical parents. One study found that dyads with high parent-teen conflict had a reduced response to group parent training for adolescents with ADHD (Sibley et al. in press); in contrast, individualized approaches with tailored feedback and skill practice were particularly effective in higher conflict dyads. Thus, clinicians should carefully select treatments that are tailored to parent-teen conflict levels.

Limitations and Further Research Directions

Our study contains limitations that should be considered. First, this study was conducted with middle school aged adolescents who were primarily middle class and Hispanic. Therefore, these findings may not generalize to adolescents in high school or families with different cultural backgrounds. Next, it is important to note that the majority of the participants in this study were male (83%). Previous work on adolescent-parent conflict have identified that parents have different expectations for male versus female youth (Allison and Schultz 2001). Therefore, these findings may not generalize to female adolescents with ADHD. Participants in our study were patients at a university clinic; results also may not generalize to non-clinical, school-based, or community-clinical samples.

The IC was only completed by parents. It is possible that teen report would provide a unique perspective; on the other hand adolescents with ADHD notoriously under-report impairments, undermining the utility of self-report in research (Sibley et al. 2010). Direct observation of examine parent-teen conflict could also be examined in future studies. Furthermore, the norms used for the intensity of arguments

were based on predominately White/non-Hispanic samples (Edwards et al. 2001). Establishing a culture-specific threshold for parent-teen conflict is a direction for future research. Finally, the IC is not an exhaustive list of topics that trigger parent and teen arguments. It is possible that additional topics not listed on the IC could also be a significant source of conflict parent-teen ADHD dyads.

In conclusion, clinicians should carefully assess parent-teen conflict when planning treatment for adolescents with ADHD. Because stimulant medication does not produce meaningful effects on parent-teen relational variables (Pelham et al. 2017), psychosocial approaches may be indicated when conflict is high (Barkley et al. 2001; Sibley et al. 2013). Administering the IC, as well as comorbid mood and behavioral measures, may also illuminate whether treatment should first address reducing sources of arguments (i.e., difficulties with homework and the daily routine) versus managing adolescents' emotional reactions to their parents. Interventions that simultaneously address ADHD and depression are also emerging as a promising treatment direction (Meinzer et al. 2018) and could also demonstrate an impact on parent-teen conflict.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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Graziano, P., & Garcia, A.M. (2016). Attention-deficit hyperactivity disorder and children's emotion dysregulation: A meta-analysis. *Clinical Psychology Review*, 46, 106-123.

Garcia, A.M., & Graziano, P, A. (2017). The summer healthy-lifestyle intervention program (HIP) for young children who are overweight: Results from an open trial. Symposium presented at the Society of Pediatric Psychology Annual Conference, Portland, OR.

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