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Regular Article

More than a feeling? An expanded investigation of emotional responsiveness in young children with conduct problems and callous-unemotional traits

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Abstract

Children with conduct problems and high callous-unemotional (CP+CU) traits are characterized by dampened emotional responding, limiting their ability for affective empathy and impacting the development of prosocial behaviors. However, research documenting this dampening in young children is sparse and findings vary, with attachment-related stimuli hypothesized to ameliorate deficits in emotional responding. Here we test emotional responsiveness across various emotion-eliciting stimuli using multiple measures of emotional responsiveness (behavioral, physiological, self-reported) and attention, in young children aged 2–8 years (*M* age = 5.37), with CP+CU traits (CP+CU; *n* = 36), CPs and low CU traits (CP−CU; *n* = 82) and a community control sample (CC; *n* = 27). We found no evidence that attachment-related stimulus ameliorated deficits in emotional responding. Rather, at a group level we found a consistent pattern of reduced responding across all independent measures of responsiveness for children with CP+CU compared to the CC group. Few differences were found between CP+CU and CP−CU groups. When independent measures were standardized and included in a regression model predicting to CU trait score, higher CU traits were associated with reduced emotional responding, demonstrating the importance of multimodal measurement of emotional responsiveness when investigating the impact of CU traits in young children.

Keywords: callous-unemotional traits; children; oppositional defiant disorder; conduct problems; emotional responsiveness

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Introduction

How we respond to each other's emotional cues differentiates us from other species. Those with typical emotional responding and processing can recognize distress cues in others, be physiologically moved in response, and then intuit the other person's emotional experience (Hoffman, 2001). This process of registering and responding to other's emotional states serves as the basis for the development of prosocial beliefs and behaviors (e.g., Schwenck et al., 2017). Conversely, a lack of emotional responsiveness may lead to chronic and persistent antisocial behaviors (e.g., Beauchaine, 2012; Raine et al., 2014).

Children with conduct problems (CPs, i.e., those meeting criteria for oppositional defiant disorder or conduct disorder) and high callous-unemotional (CU) traits (i.e., lack of empathy, remorse, apparent disregard for the rights of others; Frick & Marsee, 2018), are at risk of developmental trajectories leading to antisocial behavior and psychopathic traits in adulthood (Frick & Marsee, 2018). Children with CP and high CU traits (CP+CU) are differentiated from their peers with CPs and low CU traits (CP−CU) by their aggressive behavioral profiles (McMahon et al., 2010), punishment insensitivity (Fisher & Blair, 1998), low social affiliation (Waller et al., 2021), and relatively poor treatment prognoses (Hawes & Dadds, 2007; Hawes et al., 2014). Children with CP+CU traits are considered to have emotional deficits, including reduced emotional responsiveness to the distress cues of others (e.g., Kimonis et al., 2017). However, this association is not consistently represented within previous findings and studies examining associations with young children are sparse. Given the potential importance of emotional responsiveness to etiologies of antisocial behavior (e.g., Marsh et al., 2013), further clarification and investigation within young children is required.

Theoretically, CU traits map on to the affective-interpersonal factor of Hare's model of psychopathy (Hare & Neumann, 2009; Viding & Kimonis, 2018). In adults with high psychopathic traits, the affective factor has been associated with dampened emotional responsiveness to social-emotional stimulus, reflected in physiological under arousal typically indexed by measures of autonomic nervous system (ANS) activation such as electrodermal activity (EDA; i.e., the variation of the electrical conductance of the skin in response to sweat secretion, Christopoulos et al., 2019) and heart rate (e.g., Beauchaine, 2012; Ellis et al., 2017; Glenn, 2019; Raine et al., 2014). Reduced emotional responsiveness is associated with

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impaired affective empathy (e.g., Blair, 2017; Marsh et al., 2013), resulting in diminished capacity to be moved by another's distress cues (Decety, 2015). Impaired affective empathy may disrupt emotional learning, disrupting links with actions that cause another's distress and subsequent experiences of personal distress (e.g., Blair, 2013). In other words, emotional responsiveness changes how individuals experience others in distress, affecting their subjective representations and behaviors in response (Decety et al., 2008).

The measurement of emotional responsiveness is complex and there are several conceptual issues that warrant consideration. Firstly, emotional responsiveness can be measured in many ways and typical responding on one measure may not be consistent with responding in others (Kreibig, 2010; Levenson, 1992). As described by Mauss et al. (2005), there are three primary emotional response systems that can be used to index responsiveness. These include observations of behavior (i.e., largely unconscious behaviors underlying socially elicited emotional experiences (i.e., mimicry) such as facial affect or self-regulation attempts; Dimberg, 1997; Dimberg et al., 2000; Fanti et al., 2018), physiological measures (such as mapping of neural activity or peripheral physiological measures that capture ANS activation, such as EDA; Fowles et al., 2000; Kreibig, 2010; Lorber, 2004), and self-reported experience (i.e., subjective reports of affect or arousal; Bradley & Lang, 1994; Mauss & Robinson, 2009). Each of these indexes of emotional responsiveness plays a key role in broader emotional processing (Ekman, 1992; Levenson, 2007; Mauss et al., 2005). Therefore, investigations of emotional responsiveness deficits, especially for those with high CU traits, require a multimodal measurement approach.

The second measurement issue is that how emotional measurement is indexed within specific measurement methods varies. Emotional responsiveness can be indexed with "activity" (i.e., magnitude of response to a stimulus) or "reactivity" (i.e., change from baseline after exposure to stimulus; Fanti, 2018; Lorber, 2004). Both measurements index important aspects of emotional responsiveness (Levenson, 1992). However, as obtaining a "true" baseline measure (i.e., one that reflects the "basal" condition, which is achieved by participants being at complete rest, without sleeping – that is, lying down, unmoving, with their eyes closed; Pollak, 1991) with young children with CPs and common comorbid externalizing difficulties is a challenge. Further, achieving such baseline measures are dependent on participant's compliance, with externalizing disorders, anxiety, and excitement related to being in a novel environment found to interfere in obtaining a true reading (e.g., Jennings et al., 1992; Jorgensen & Schreer, 1990). Given these difficulties, measurements of activity instead of reactivity may be best suited for young children with CPs.

Evidence of the impact of emotional responsiveness on presentations of CP+CU traits in children is limited and studies yield mixed results. Given the broad range of methods used to measure emotional responsiveness, and the various methods for eliciting emotion, these mixed results are not surprising and speak to the notion that children with high CU traits may not be unemotional in all contexts. Northam and Dadds (2020) provide a framework for considering the broad range of results, finding that results across studies are more consistent when considered based on (1) the age of the child, (2) the type of emotional measurement used, and (3) the type of emotion-eliciting paradigm.

Regarding age, studies of adolescents and older children (e.g., 10 years and above) were more likely to find that high CU traits were associated with reduced emotional responsiveness than studies with younger children (Northam & Dadds, 2020). When examining the results of studies with adolescent/older child samples, peripheral physiological measures may consistently demonstrate an association of reduced responsiveness and high CU traits, regardless of whether it was measured at baseline (e.g., de Wied et al., 2012; Thomson & Centifanti, 2018), for activity (e.g., Fanti et al., 2016; Isen et al., 2010; Perlstein et al., 2021) and for reactivity (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; Dackis et al., 2015; Fanti et al., 2016; Kimonis et al., 2008, 2017; Muñoz et al., 2008). Behavioral measures of emotional responsiveness are less consistent in studies investigating adolescents, with some showing negative associations (e.g., Hwang et al., 2016; Loney et al., 2003), while others showing no association (e.g., de Wied et al., 2012). Similarly, self-reported measures have shown negative associations with CU traits (e.g., Helseth et al., 2015; Yoder et al., 2016) and no differences in reports of emotion type (e.g., de Wied et al., 2012; Martin-Key et al., 2017) and arousal (e.g., Masi et al., 2014; Schwenck et al., 2017).

Regarding the type of emotion-eliciting stimulus, studies employ a wide range of methods to elicit emotion. Given the nature of CU traits, different emotion-eliciting stimulus may impact emotional responsiveness differently. For example, stimuli that are designed to elicit frustration or disappointment – that is, emotions that are self-orientated, may be less impacted by CU traits than stimuli designed to elicit feelings of sympathy or concern for others – that is, emotions that are other-orientated (Northam & Dadds, 2020). Additionally, stimuli may be impacted by specific emotional content. For example, it has been well established that those with high CU traits are a "fearless" temperament and are less responsive to fear-inducing stimuli (e.g., Blair et al., 1999; Kimonis et al., 2017; Mills-Koonce et al., 2015). However, the influence of high CU traits on responsiveness to other stimuli, such as those designed to elicit sadness or happiness, is less known.

To our knowledge, there are only two studies investigating emotional responsiveness and CU traits in young children (i.e., mean age of 8 years and under) with CPs. The first study tested for differences in emotional responding based on CU and CP status with school children aged 8 years of age, measured behaviorally with task reaction time to a go/no-go task (Ezpeleta et al., 2017). The task involved responding to static images of human faces depicting various facial affects (happy, anger, sadness, fear). They found no differences in task reaction times for CP+CU and CP−CU and a nonclinical group. While this study provides evidence for the general indexing of emotional responsiveness in 8-year-olds, the results are limited as they provide only one measure of responsiveness (i.e., behavior), with very limited application for understanding emotional responsiveness in social situations.

The second study was conducted by Dadds et al. (2016). They argued that previous research investigating CU traits and emotional responsiveness had several methodological flaws. Given previous work has suggested children with CP+CU traits may demonstrate intact emotional processing under certain conditions (i.e., Dadds et al., 2006), they argued that studies using simple emotion-eliciting stimuli (such as static images) that contained no meaningful content (such as the faces of strangers), were insufficient to test the bounds of emotional deficits. Given the effect of attachment relationships on mitigating the risks associated with CU traits (e.g., Waller et al., 2021), they suggested a complex (i.e., video) attachment-related stimulus may provide the sufficient conditions to demonstrate intact emotional responsiveness.

Accordingly, Dadds et al. (2016) investigated whether children with CP+CU traits were able to demonstrate similar emotional responsiveness (as measured with observed affect and self-regulatory behaviors) to a complex attachment-related stimulus inducing

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fear and sadness across two scenes. Participants were children aged 4–14 years (*M*age = 7.80) who were classified into one of three groups: CP+CU, CP−CU, and a CC group. Results showed that all groups demonstrated similar frequencies of distress-related facial affect (i.e., sadness, worry/concern) and self-regulatory behaviors. However, a difference was found between groups and scenes for the expression of "joy": children from the CP+CU group demonstrated more frequent instances in the fear scene than the sadness scene and compared to children in the other groups. The fear scene included a brief humorous moment, absent from the sadness scene. It was suggested that children with CP+CU traits found it easier to disengage from the fearful content and laugh at the humorous moment. There are two potential implications from this study: (1) attachment-related material may ameliorate deficits in responsiveness for children with CP+CU traits; (2) impaired emotional responsiveness for those with CU traits may be emotion-specific as there was more aberrant responding associated with "fear" than "sadness." However, the study has several flaws that limit the implications of the findings.

Firstly, only one measure of emotional responsiveness was used (behavior). As only one measure was used, it is possible that the attachment-related stimulus ameliorated deficits in emotional responsiveness in all emotional systems (behavioral, physiological, and self-report). Alternatively, the stimulus may have influenced behavioral measures only, meaning children with CP+CU traits appeared to be as emotional as other children, but experienced dampened physiological responding. Given the apparent reliability of physiological measures to show reduced responsiveness in those with CP+CU traits, Dadds et al. (2016) requires replication with the addition of multiple measures of emotional responsiveness. Secondly, implications are limited due to issues with the sample – the sample size was small ($N = 76$), and ages varied widely (4–14 years of age). To adequately address the reoccurring question age effects on emotional responsiveness, future studies require a larger sample of restricted and younger age. Thirdly, given previous findings that children with CP+CU traits have poorly modulated attention to the distress cues of others (e.g., Blair & Mitchell, 2009; Kimonis et al., 2008), it is possible that children in the Dadds et al. (2016) study were attending to different content on the screen. Inclusion of attentional measures may enhance understanding of emotional responding deficits.

To address these gaps, this study aimed to replicate and expand on Dadds et al. (2016). To address questions about the influence of age, this study has limited the age range to include only young children (2–8 years of age). To account for potential differences in emotional measurement approaches, multiple measures of emotional responsiveness were used, expanding on the Dadds et al. (2016) study with the inclusion of physiological and self-report measures of emotion. To test whether attention to emotional stimulus differed by group, an analysis of attentional patterns in key scenes was conducted. Specifically, we investigated differences in emotional responsiveness by participant group (CP+CU, CP−CU, and CC), emotional measurement type (observed behavior, physiological and self-report), and scene (fear and sadness).

In keeping with extant literature, we expected to find mixed patterns of responding for CP+CU and CP−CU and CC groups, in the emotional measurement methods used and by scene. Specifically, in replication of Dadds et al. (2016), for behavioral measures, we expected that children from the CP+CU traits group would demonstrate similar, or greater, levels of responsiveness (observed affect and self-regulatory behaviors) to the fear and sadness scenes, when compared to children from the CP−CU and CC groups, but more instances of joy in the fear scene. Drawing from evidence collected in adolescent samples, we expected that this pattern of responding would be consistent in the additional measures of self-reported responsiveness, but inconsistent with measures of physiological responsiveness (heart rate and EDA), for which we expected children from the CP+CU group to demonstrate lower responsiveness. We expected that when standardized, and considered in a model, lower scores on individual measures of emotional responsiveness would predict higher CU traits. Finally, given previous findings of poorly modulated attention to emotional cues (e.g., Blair & Mitchell, 2009; Kimonis et al., 2008), we expected that children with CP+CU traits would be less likely to attend to characters in distress in several particularly salient emotional moments in the stimulus.

Method

Participants

Ethics approval was granted from the University of Sydney Human Ethics Committee and informed consent/assent obtained from all families. Participants included 145 children aged between 2 and 8 years (M = 5.37 years, $SD = 1.85$ years), predominantly Caucasian in ethnicity (68% Caucasian, 4% east Asian, 2% southeast Asian, 26% "other" or "no identified ethnicity"), and male ($n = 103$, 71%), who were recruited from the University of Sydney's Child Behaviour Research Clinic (CBRC). Participants were primarily recruited for a study investigating the effects of a Behavioral Parent Training intervention on child CPs (i.e., the clinical sample: $n = 118$ children, 82%). All children in the clinical sample met DSM-5 criteria (American Psychiatric Association, 2013), for a primary diagnosis of Oppositional Defiant Disorder ($n = 101$; 86%) and/or Conduct Disorder ($n = 25$; 21%). Comorbidity included attention-deficit/hyperactivity disorder ($n = 27$; 23%) and mood disorders ($n = 12$; 10%). To manage potential confounds, children were excluded from this study if they met DSM-5 criteria for autism spectrum disorder higher than severity level 1 or had a major neurological/physical illness or developmental disability. Data for this study were collected prior to starting the intervention.

The remaining participants were recruited as part of a nonclinical CC group ($n = 27$; 18%), who were recruited from social media. These participants contacted the CBRC and were asked screening questions about child behavior and emotional problems. If parents endorsed problems, or problems were observed during the assessment, referral information was provided and the family was withdrawn from the study ($n = 2$).

Measures

Diagnostic and child functioning measures

Diagnostic interview. The Diagnostic Interview Schedule for Children, Adolescents, and Parents (DISCAP; Johnson et al., 1999) was used to provide diagnosis for children in the clinical sample to ensure they met criteria for Oppositional Defiance Disorder or Conduct Disorder. Interviews and final ratings were conducted by clinical psychologists. An updated DSM-5 version of the DISCAP (Tissue et al., in press) was used to index severity of diagnostic symptoms in the current study by a team of psychologists who were masked to the primary clinician's diagnosis. Kappa agreement on primary and secondary diagnoses were $\kappa = .87$ and $\kappa = .79$, respectively.

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Depression, anxiety, and stress scales. The depression, anxiety, and stress scales (DASS) were used to measure current parental maternal mental health symptoms to ensure there were no differences between the groups which may account for changes in parent ratings of CU traits (Lovibond & Lovibond, 1995). Reliability as measured by Cronbach's α were "good" to "excellent" for each of the three subscales (depression $\alpha = .94$; anxiety $\alpha = .79$; stress $\alpha = .83$).

University of New South Wales scales. CU traits were rated by parents using the University of New South Wales (UNSW) system of combining items from the antisocial process screening device (Frick & Hare, 2001) and the prosocial scale of the Strengths and Difficulties Questionnaire (Goodman, 1997). This method has been validated by principal components analysis (see Dadds et al., 2005) and has been used in previous research (e.g., Dadds et al., 2012; Kimonis et al., 2016; Pasalich et al., 2014a). The UNSW CU traits scale includes items such as "*lacks empathy*," "*is unkind*," and "*doesn't care about other's feelings*," rated on a 3-point Likert scale (from 1 = "Not true" to 3 = "Certainly True").

The original validation study of the UNSW Scales (Dadds et al., 2005) found that the item "*does not show feelings*" did not sufficiently load on to the CU traits scale and was subsequently excluded. However, given this study's focus on child emotion, this item was added to the CU subscale. Cronbach's alpha for the 9-item CU scale was considered "good" to "excellent" (Mother $\alpha = .74$; Father $\alpha = .77$; Teacher $\alpha = .82$), which differed minimally from alphas using the 8-item scale originally proposed by Dadds et al. (2005; Mother $\alpha = .75$; Father $\alpha = .76$; Teacher $\alpha = .86$). In line with Cicchetti's (1994) recommendations for the intraclass correlation coefficient (ICC) agreement score cutoffs, the ICC between mothers, fathers and teachers was considered "fair" ($\alpha = .53$ with a 95% confidence interval from .35 to .67; $F(99, 198) = 2.14$, $p < .001$). This is in keeping with literature on multi-informant, multi-setting reporting in child psychopathology (van der Ende et al., 2012). Agreement between parents was "good" to "excellent" ($\alpha = .74$).

Participant group classification. Participant groups were determined by scores on the UNSW Scales CU traits subscale. Remaining consistent with other studies (e.g., Kimonis et al., 2016), mothers' ratings were used to define participant groups. Given the CBRC is known for treatment of CP+CU children they tend to be over-represented in referrals and a conservative approach to group classification based on CU traits was taken using a high cutoff score for CU traits, in this case 9 or greater on the UNSW Scale (see Dadds et al., 2005). Based on this scoring, children in the CP+CU group represented 19% of the clinical sample. Prevalence estimates of high CU traits in conduct problem samples are estimated at approximately 30% (e.g., Pardini et al., 2010). Those scoring "8" or below were classified in the CP−CU group. Mothers of children in the community sample completed the same questionnaire measures as those in the clinical groups; $n = 1$ received a score commensurate with high CU traits and was excluded from the study. To ensure creating participant groups based on mother's ratings did not produce different results from using father of teacher ratings, the data were analyzed separately based on group classifications for each rater. No substantial differences were found, and these data are available upon request.

Table 1 presents sample characteristics for the three groups (CP+CU, CP−CU, and CC). Mother's education level and depression, anxiety, and stress scores (measured by the DASS) were the only variables to differ significantly across participant groups and were therefore included as covariates in all subsequent analyses.

Experimental measures

Behavioral measures. Two postgraduate psychology students who were masked to the participant groups coded the children's facial affect and emotion regulation behaviors from recordings of the experiment using the child behavior coding scheme (CBCS; Fink, 2011). The CBCS can be used to code a wide range of emotional responses, but given the study goals, we will report observed facial expressions (i.e., fear, sadness, worry/concern, anger, and joy) and emotion regulation behaviors that have a social communicative effect (i.e., agitation and self-soothing).

The CBCS is a validated coding scheme, developed from the AFFEX coding system by Izard et al., 1983), and has been successfully used in past research (e.g., Dadds et al., 2016). Emotional responses were coded according to the CBCS at 15-s intervals, which translated to a total of 26 intervals over 6.5 min (or 390 s). More specifically, to correspond with the physiological measures, intervals for each scene were: 1 interval for the baseline scene (15 s, starting at 0.05), 12 intervals for the fear scene (180 s, starting at 0.30), and 12 intervals for the sadness scene (180 s, starting at 3.30). Emotional responses were coded once per interval and a "total" score for each response was calculated to represent the percentage of the clip each response was expressed in. Both coders rated 30% of cases ($n = 45$) to test for interrater reliability. In line with Cicchetti (1994) recommendations for ICC agreement score cutoffs, the average ICC on these cases was found to be "excellent": $\alpha = .912$, with a 95% confidence interval from .902 to .921 ($F(1375, 1375) = 11.385$, $p < .001$).

Physiological measures. The E4 wristband by Empatica (Empatica, Milano, Italy) was used to collect physiological data (heart rate and EDA). The E4 has been found reliable for use in children as young as 2 years of age (Gilmore, 2016). Heart rate was calculated from interbeat intervals taken from the blood volume pulse at 5 Hz. EDA was sampled at 4 Hz, with a resolution of 1 digit ~900 pico Siemens and a range of 0.01–100 microsiemens.

Subjective ratings of emotions. After watching the excerpt, children were briefly separated from their parents and asked several questions about their emotional experiences while watching the excerpt. Participants were asked "*what emotion did you feel when watching the movie*?" and given an image with six photos of people of varying gender and race displaying the six basic emotions (i.e., anger, fear, sadness, happiness, disgust, and neutral) as defined by Izard et al., 1983) and used in similar studies previously (e.g., Dadds et al., 2008). The faces of the people used were taken from the FACES task (Dadds et al., 2008), which has been shown to be a valid tool for children as young as 2 years to correctly recognize expressions of affect type. Underneath this image was a scale taken from the Self-Assessment Manikin (Bradley & Lang, 1994), in which participants were also asked to identify the intensity of the emotion from 0 (*no intensity*) to 4 (*highest intensity*). The use of subjective ratings of emotion in young children aged from 2 years up, has been found to be valid and is considered a useful adjunct to other measures of emotion (Russell & Widen, 2002).

Attentional measures. Attentional data were collected with the Tobii 4C eye-tracker, a device with strong technical specifications which can collect a range of research-grade data (Gibaldi et al., 2017). A unique program was written for this experiment on

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Table 1. Sample characteristics

	CC ($N = 27$)	CP−CU ($N = 91$)	CP+CU ($N = 24$)	
Age	$M = 4.75$, $SD = 1.72$	$M = 5.38$, $SD = 1.90$	$M = 5.92$, $SD = 1.44$	$F(2, 139) = 2.37$
Parent DASS-21				
Depression	$M = 1.97$, $SD = 2.16$	$M = 2.19$, $SD = 3.86$	$M = 4.53$, $SD = 5.42$	$F(2,137) = 3.82$*
Anxiety	$M = 0.97$, $SD = 1.36$	$M = 1.55$, $SD = 2.41$	$M = 3.40$, $SD = 4.30$	$F(2, 137) = 5.86$*
Stress	$M = 4.27$, $SD = 3.44$	$M = 6.30$, $SD = 3.94$	$M = 7.63$, $SD = 5.16$	$F(2, 137) = 4.27$*
Gender	52% Male	74% Male	75% Male	χ^2 (2) = .07
Household income	52% >160k	45% >160k	54% >160K	χ^2 (12) = .84
Ethnicity	77% Caucasian	89% Caucasian	68% Caucasian	χ^2 (14) = .02
Mother's education	93% Tertiary degree or higher	73% Tertiary degree or higher	74% Tertiary degree or higher	χ^2 (8) = .04*
Parent marital status	92.3% Married/De facto	85.9% Married/De facto	95% Married/De facto	χ^2 (4) = .69
Medication use	82% no medication	64% no medication	63% no medication	χ^2 (8) = .06
CU traits	$M = 1.44$, $SD = 4.25$	$M = 6.01$, $SD = 2.25$	$M = 11.38$, $SD = 1.40$	$F(2, 140) = 88.61$**
Conduct problems	$M = 4.12$, $SD = 2.56$	$M = 8.03$, $SD = 4.82$	$M = 12.07$, $SD = 3.97$	$F(2, 140) = 24.07$**

Note. CC = community control group; CP−CU = conduct problem and low CU traits; CP+CU = conduct problems and high CU traits. [a]ADHD inattentive, hyperactive, or combined type. [b]Separation anxiety disorder, generalized anxiety disorder, social anxiety disorder, specific phobia, or major depressive disorder. [c]As measured by the UNSW scales. *$p < .05$; **$p < .001$.

MATLAB by this study's second author, including functions from Psychophysics Toolbox Version 3 (Kleiner et al., 2007). Data files contained gaze point and positioning/calibration measures, for each individual eye at 90 Hz. Four key sequences, two in the fear scene (referred to as "Fear Sequence 1" and "Fear Sequence 2") and two in the sadness scene (referred to as "Sadness Sequence 1" and "Sadness Sequence 2"), depicting a character in emotional distress were identified. For each sequence, an emotional region of interest (ROI) variable (i.e., proportion of time gaze was within ROI of character expressing distress), a distractor ROI variable (i.e., proportion of time gaze was within ROI of where a peripheral character was shown) and a control ROI variable (i.e., proportion of attention anywhere on the screen) were identified (see Supplementary Information for specific details).

Procedure

To measure emotional responsiveness and attention, children and their parents were asked to watch a 6.5-min excerpt from Disney's *The Lion King* (1994). This excerpt has been demonstrated to elicit emotional responses independent of age, gender, or prior exposure to the material (Blau & Klein, 2010). The excerpt is broken into two scenes: (1) the fear scene (0.30–3:30), which depicts a threat to an attachment figure, is designed to elicit fear; and, (2) the sadness scene (3:31–6:31), which depicts the death of an attachment figure, is designed to elicit sadness.

Prior to watching the video, children were fitted with the E4 wristband on the nondominant hand. Children were directed to sit on a stool in front of a desktop computer on a small child-sized desk, which was fitted with the Tobii 4C eye-tracking device. A wall-mounted camera was positioned in front of the computer to record facial expressions and behaviors. The MATLAB software program was then started.

Participants completed a number of eye-tracking calibration exercises to ensure accurate gaze point calculation (Tobii Pro AB, 2014). After successful completion, directions were given to watch the excerpt "*like they were at home,*" parents were reminded to return the child to the specified position on the stool in front of the computer if children stood up and instructed not to touch their child during the clip. The experimenter left the room for the duration of the task and children were recorded watching the clip. Utterances made by parents during the excerpt were transcribed by a research assistant. These were rare and when they occurred the most frequent content was parents re-directing the child's attention to the screen. The footage was saved for subsequent coding and data extraction. After the excerpt was finished, children were separated from their parents and the self-report measures were administered.

Data analysis

A custom software program was designed in MATLAB by the second author to combine data points from the eye-tracking files with those from the E4 wristband in a single, time-matched data set. Data were extracted for each of the three scenes: (1) neutral (0.00–0.20), (2) fear (0.30–3.30), and (3) sadness (3.30–6.30). The fear and sadness scenes were originally 180 and 192 s, respectively. We time-matched the sadness scene to the fear scene to allow for a wider variety of analysis between the two scenes. This means that the final 2 s of the sadness scene was excluded from the analysis, which was deemed appropriate given the primary sadness eliciting material was in the start and middle of the sadness scene.

For heart rate data, the mean of each scene was used for the analyses. EDA data was pre-processed with a continuous decomposition analysis (CDA) performed with the Ledalab toolbox (V3.4.9; Benedek & Kaernbach, 2010) in MATLAB (v18b; Mathworks Inc.). A first-order Butterworth high pass filter (0.0159 Hz) was applied to the data to remove low-frequency noise. Raw data was plotted to investigate large artifacts which were removed with the Ledalab preprocessing artifact correction function. The neutral, fear, and sadness scenes were then defined in the data. A CDA was performed for each scene separately to produce the number of skin conductance responses (SCR) and the average phasic activity for each scene. SCRs were defined as peaks in the EDA waveform with a minimum height of 0.02 microsiemens and interpeak distance of 1 s, which has been found to be a reliable method to identify instances of arousal (e.g., Christopoulos et al., 2019).

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Twenty-seven participants did not want to wear the E4 device and accordingly were excluded from the physiological analyses. Participant group and gender was not associated with collection of psychophysiological data. Additional participants were excluded from the physiological analyses due to a high level of artifacts and noise in the recordings ($n = 15$ for heart rate data and $n = 14$ for EDA data). Due to the effects of psychiatric medication on physiological systems (e.g., Licht et al., 2008), children who were taking antidepressants ($n = 7$), antipsychotics ($n = 4$) or stimulants ($n = 13$) were excluded from physiological based analyses.

Statistical analyses were performed using SPSS version 25. Inspection of boxplot distributions suggested departure from normality was mild, with exception to observations of "anger," which violated assumptions of univariate and multivariate outliers and was accordingly removed from subsequent analyses. Conduct problem severity was not associated with any of the emotional responsiveness variables. Consequent assumption testing for multicollinearity and homogeneity of variance−covariance matrices were satisfied, and thus data were considered acceptable for parametric analysis.

To answer the research questions, repeated measures multivariate analysis of covariance (MANCOVA) was used. First, to investigate whether emotional responsiveness differed between groups and scenes, we examined the significance of group (CP+CU, CP−CU, and CC) and emotion-eliciting clip (fear, sadness) on mean heart rate, number of SCRs, average phasic SCR, expressed affect, and emotion regulation behaviors. Next, to investigate whether attention to distress cues varied by participant group, we examined the significance of group (CP+CU, CP−CU, and CC) and attention (emotional ROI, distractor ROI, attention anywhere on the screen) for each distress scene. Mother's education level, and anxiety, and stress DASS scores were included as covariates in these models as they were significantly correlated with CU traits (see Table 1). To test for differences between groups (CP+CU, CP−CU, and CC) in self-reported affect (sadness, fear, anger, happiness, disgust, neutral) and arousal after watching the clip, a Pearson's chi-square (χ^2) test of independence was used. Finally, to test for the effect of CU traits on emotion response coherence for the fear scene and sadness scene, we transformed each emotion measurement method to a *z*-score and conducted separate regression analyses for each scene, predicting CU traits, to test the combined effect of each emotion measurement type on severity of CU traits.

Results

Systems of emotional responsiveness

Behavioral measures

Observed affect. To test for between-group differences in observed affect (fear, joy, worry/concern, sadness) for each scene (fear and sadness), a 3 (participant group) × 2 (scene) MANCOVA was conducted including each of the target affects as dependent variables (CC group $n = 24$; CP−CU group $n = 81$; CP+CU group $n = 21$). Using Pillai's Trace, a significant multivariate main effect of participant group and scene on expressed affect was found, ($F(8, 252) = 2.79$, $p = .006$, $\eta_p^2 = .08$).

Univariate group by scene interaction effects were found for fear ($F(2, 128) = 9.20$, $p < .001$, $\eta_p^2 = .13$) and sadness ($F(2, 128) = 6.85$, $p = .001$, $\eta_p^2 = .10$). These showed a significant difference in observed fear and sadness by scene and group in the expected directions: the fear scene was associated with more frequent expressions of fear, and the sadness scene was associated with more frequent expressions of sadness, with more frequent expressions of both fear and sadness from the CC group (see Table 2). No scene or group effects were found for observations of joy or worry/concern.

As described in Table 2, further post hoc analysis of pairwise comparisons for observed fear, using the Bonferroni correction, demonstrated that during the fear scene, the CC group ($M = 32.61\%$; $SE = 4.36$) demonstrated significantly more instances of fear than the CP+CU group ($M = 8.60\%$; $SE = 4.41$) and the CP−CU group ($M = 14.50\%$; $SE = 42.20$). Similarly, in the sadness scene the CC group ($M = 65.79\%$; $SE = 6.99$) demonstrated significantly more instances of sadness than the CP+CU group ($M = 33.89\%$; $SE = 7.07$) and the CP−CU group ($M = 36.66\%$; $SE = 3.53$). No differences were found between CP+CU and CP−CU for expressions of fear or sadness in either scene.

Emotion regulation behaviors. To test for between-group differences in emotion regulation behaviors (agitation and self-soothing) for each scene (fear and sadness) a 3 (participant group) × 2 (scene) MANCOVA was conducted including each of the target emotion regulation behaviors as dependent variables (CC group $n = 24$; CP−CU group $n = 81$; CP+CU group $n = 21$). Using Pillai's Trace, a significant multivariate main effect of participant group and scene on emotion regulation behaviors was found ($F(4, 256) = 5.69$, $p < .001$, $\eta_p^2 = .08$).

A univariate group by scene interaction effect was only found for agitation ($F(2, 128) = 9.83$, $p < .001$, $\eta_p^2 = .13$), where participant groups demonstrated more instances of agitation in the fear scene than the sadness scene. As described in Table 2, post hoc analyses with Bonferroni correction for the fear scene indicated that the CP+CU group showed significantly fewer instances of agitation ($M = 42.02\%$; $SE = 5.41$) than the CC group ($M = 59.07\%$, $SE = 5.35$) and the CP−CU group ($M = 54.23\%$, $SE = 2.70$). This association was not found in the sadness scene – no differences were found between CP+CU and the other groups. However, the CC group ($M = 37.39\%$, $SE = 5.51$) demonstrated less agitation in the sadness scene compared to the CP−CU trait group ($M = 50.34\%$, $SE = 2.78$).

As described in Table 2, post hoc analysis with Bonferroni correction indicated that the CC group demonstrated more instances of self-soothing behaviors in both the fear scene ($M = 31.47\%$; $SE = 3.91$) and the sadness scene ($M = 24.52\%$; $SE = 3.48$), then those with CP−CU (fear scene: $M = 5.31\%$; $SE = 1.97$; sadness scene: $M = 5.15\%$; $SE = 1.71$) and the CP+CU group (fear: $M = 2.13\%$; $SE = 3.95$; sadness: $M = 2.53\%$; $SE = 3.53$).

Physiological measures

Heart rate. A 3 (Group) × 2 (Scene) MANCOVA was used to investigate the effect participant group and scene (fear and sadness) had on heart rate (CC $n = 22$; CP−CU $n = 65$; CP+CU $n = 15$). Using Pillai's Trace, with inclusion of the covariates, the MANCOVA was not significant ($F(2, 95) = .46$, $p = .63$, $\eta_p^2 = .01$), indicating that there was not a multivariate effect of participant group and scene on heart rate.

A univariate effect for group was found for both the fear scene ($F(2, 95) = 5.66$, $p = .05$, $\eta_p^2 = .11$) and the sadness scene ($F(2, 95) = 5.36$, $p = .05$, $\eta_p^2 = .10$). As shown in Table 2, post hoc analysis of pairwise comparisons for heart rate, using the Bonferroni correction, demonstrated that during the fear scene, the CP+CU group ($M = 95.03$; $SE = 2.97$) demonstrated significantly reduced heart rate activity than the CP−CU group ($M = 103.38$; $SE = 1.39$) and the CC group ($M = 108.44$; $SE = 2.50$). The same effect was

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Table 2. Emotional activity measurement type by group and scene

Scene	EMT	CC	CP−CU	CP+CU	
Fear	Observed fear	*M* = 32.61, *SD*= 23.08[a,e]	*M* = 14.50, *SD*= 20.26[e]	*M* = 8.60, *SD*= 15.90[a]	*F*(2, 128) = 8.57**
	Observed sadness	*M* = 5.47, *SD*= 10.65	*M* = 4.23, *SD*= 12.37	*M* = 3.37, *SD*= 7.53	*F*(2, 128) = .18
	Observed worry	*M* = 47.45, *SD*= 22.01	*M* = 55.03, *SD*= 32.20	*M* = 54.59, *SD*= 37.44	*F*(2, 128) = .50
	Observed joy	*M* = 5.66, *SD*= 9.36	*M* = 8.67, *SD*= 12.89	*M* = 4.09, *SD*= 9.16	*F*(2, 128) = 1.64
	Observed anger	*M* = .0, *SD* = 00	*M* = .66, *SD* = 2.28	*M* = .43, *SD* = 1.45	*F*(2, 128) = 1.48
	Observed agitation	*M* = 59.07, *SD*= 29.84[f]	*M* = 54.23, *SD* = 23.86[b]	*M* = 42.02, *SD* = 25.80[b,f]	*F*(2, 128) = 2.74
	Self-soothing	*M* = 31.47, *SD*= 34.68[a,e]	*M* = 5.30, *SD* = 11.85[e]	*M* = 2.13, *SD* = 5.95[a]	*F*(2, 128) = 19.20**
	Heartrate	*M* = 108.44, *SD* = 12.29[a]	*M* = 103.38, *SD* = 11.19[b]	*M* = 95.03, *SD* = 9.95[a,b]	*F*(2, 95) = 5.66*
	Number of SCR	*M* = 69.43, *SD* = 51.11	*M* = 46.62, *SD* = 42.03	*M* = 36.93, *SD* = 48.40	*F*(2, 97) = 2.35
	Av. Phasic SCR	*M* = .16, *SD* = .16[c]	*M* = .09, *SD* = .11[c]	*M* = .08, *SD* = .12	*F*(2, 97) = 2.78
Sadness	Observed fear	*M* = 4.17, *SD*= 7.78	*M* = 3.22, *SD* = 8.62	*M* = 1.13, *SD*= 5.10	*F*(2, 128) = .76
	Observed sadness	*M* = 65.79, *SD*= 28.11[e,f]	*M* = 36.66, *SD*= 33.27[e]	*M* = 33.89, *SD* = 30.72[f]	*F*(2, 128) = 7.30
	Observed worry	*M* = 24.09, *SD*= 19.96[f]	*M* = 47.44, *SD*= 35.27	*M* = 48.41, *SD*= 35.03[f]	*F*(2, 128) = 4.47*
	Observed joy	*M* = .71, *SD*= 2.22	*M* = 5.49, *SD*= 13.91	*M* = 1.07, *SD*= 9.49	*F*(2, 128) = 2.16
	Observed anger	*M* = .0, *SD* = 00	*M* = 2.17, *SD* = 2.97	*M* = 1.39, *SD* = 6.80	*F*(2, 128) = 1.06
	Observed agitation	*M* = 36.84, *SD*= 26.69[c]	*M* = 50.22, *SD*= 25.15[c]	*M* = 51.33, *SD*= 25.35	*F*(2, 128) = 2.13
	Self-soothing	*M* = 24.54, *SD* = 26.371[a,e]	*M* = 5.15, *SD* = 13.25[e]	*M* = 2.53, *SD* = 7.64[a]	*F*(2, 128) = 13.32**
	Heartrate	*M* = 104.82, *SD* = 9.70[f]	*M* = 101.77, *SD* = 11.28[b]	*M* = 92.45, *SD* = 10.75[b,f]	*F*(2, 95) = 5.36*
	Number of SCR	*M* = 73.66, *SD* = 46.64[c,f]	*M* = 46.67, *SD* = 43.50[c]	*M* = 23.85, *SD* = 35.57[f]	*F*(2, 97) = 4.95*
	Av. Phasic SCR	*M* = .170, *SD* = .13[c,f]	*M* =.10, *SD* = .12[c]	*M* = .04, *SD* = .05[f]	*F*(2, 97) = 5.13*

Note. CC = community control; CP−CU = conduct problems and low CU traits; CP+CU = conduct problems and high CU traits; EMT = emotion measurement type; SCR = skin conductance response; Fear scene = 0.20–4.00 min) and sadness scene (4.00–6.46 min). [a] = *p* < .001 between CC and CP+CU; [b] = *p* <.05 between CP−CU and CP+CU; [c] = *p* <.05 between CC and CP−CU; [d] = *p* <.001 between CP−CU and CP+CU; [e] = *p* <.001 between CC and CP−CU; [f] = *p* <.05 between CC and CP+CU. * *p* < .05; ***p* <.001.

found in the sadness scene, with the CP+CU group (*M* = 92.45; *SE* = 2.99) demonstrating significantly reduced heart rate activity than the CP−CU group (*M* = 101.77; *SE* = 1.37) and the CC group (*M* = 104.83; *SE* = 2.51).

Number of SCRs. A 3 (Group) × 2 (Scene) MANCOVA was used to investigate the effect participant group and scene (fear and sadness) had on the number of SCRs (CC *n* = 22; CP−CU *n* = 68; CP+CU *n* = 14). Using Pillai's Trace, and including covariates, a significant multivariate main effect of participant group and scene of EDA was not found ($F(2, 97) = .04$, $p = .18$, $\eta_p^2 = .04$).

A univariate effect for group was only found in the sadness scene ($F(2, 97) = 4.95$, $p = .01$, $\eta_p^2 = .09$). As demonstrated in Table 2, post hoc analyses with Bonferroni correction indicated that while the CP+CU traits group had a lower number of SCRs (*M* = 23.85; *SE* = 12.36) during the sadness scene when compared to the CP−CU trait group (*M* = 46.67; *SE* = 5.42), this difference was not significant. However, the CC group demonstrated significantly more frequent numbers of SCRs (*M* = 73.66; *SE* = 9.99) than the CP+CU (*M* = 23.85; *SE* = 12.36) and the CP−CU trait groups (*M* = 46.67; *SE* = 5.42).

Average phasic SCR. A 3 (Group) × 2 (Scene) MANCOVA was used to investigate the effect participant group and scene (fear and sadness) had on the average phasic SCR (CC *n* = 22; CP −CU *n* = 68; CP+CU *n* = 14). Using Pillai's Trace, and including covariates, a significant multivariate main effect of participant group and scene of EDA was not found ($F(2, 97) = 1.61$, $p = .20$, $\eta_p^2 = .03$).

A univariate effect was only found for the sadness scene ($F(2, 97) = 5.13$, $p = .01$, $\eta_p^2 = .10$). The average phasic SCR activity levels for the fear and sadness scenes were in the directions expected by the hypothesis (see Table 2), with the CC group scoring the highest average, followed by the CP−CU group and then the CP+CU group. When post hoc analyses with Bonferroni correction were run, in response to the fear scene, the only significant group difference was between the CC group (*M* = .16; *SE* = .03) and the CP−CU group (*M* = .09; *SE* = .02). In response to the sadness scene, the CC group demonstrated higher phasic activity (*M* = .170; *SE* = .03) than the CP−CU group (*M* =.10; *SE* = .01) and the CP+CU group (*M* = .04; *SE* = .03). No differences were found between the clinical groups for either the fear or sadness scenes.

Self-reported emotion

A Person's chi-square test of contingencies (with α = .05) was used to evaluate whether there were differences between the groups for self-reported emotion while watching the emotion-eliciting stimulus (CC group *n* = 24; CP−CU group *n* = 81; CP+CU group *n* = 21). Most participants regardless of grouping reported feeling "sad." The chi-square test for differences in self-reported emotion across groups was statistically nonsignificant (χ^2 (10, *N* = 135) = 8.52, *p* = .58). Self-reported arousal (emotion intensity) also demonstrated no significant differences between the groups ($F(2, 130) = 1.62$, $p = .20$), suggesting that participants from all groups reported

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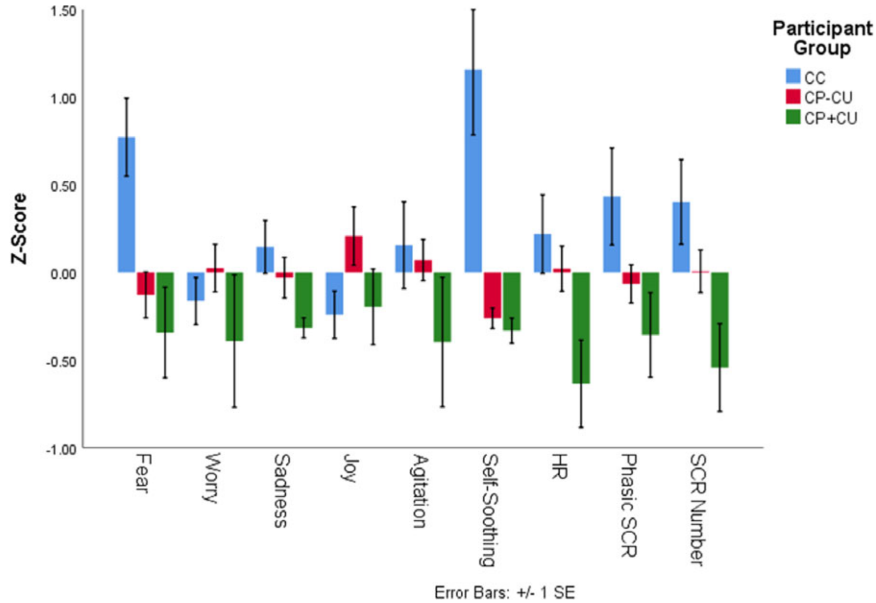

Figure 1. Independent measures of emotional responsiveness to fear eliciting scene. CC = community control; CP−CU = conduct problems and low CU traits; CP+CU = conduct problems and high CU traits; SCR = skin conductance response.

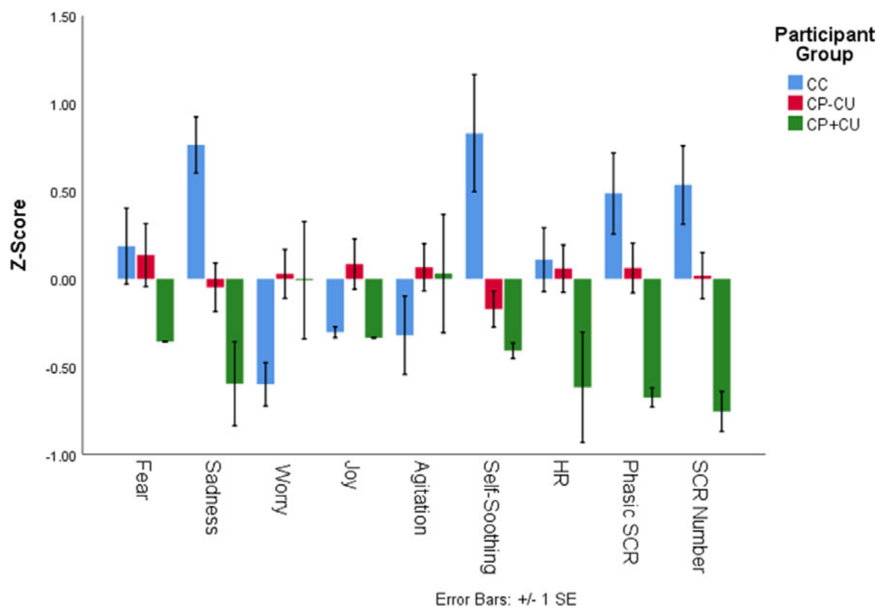

Figure 2. Independent measures of emotional responsiveness to sadness eliciting scene. CC = community control; CP−CU = conduct problems and low CU traits; CP+CU = conduct problems and high CU traits; SCR = skin conductance response.

similar emotional intensity levels; with the most common reported arousal level being 5/5 – very intense.

Combined emotional activity measures

To estimate the proportion of the variance in CU traits that can be accounted for by the emotional measurement types (i.e., SCR amplitude, heart rate, observations of fear, sadness, worry, agitation, and self-soothing), a standard multiple regression analysis was performed with $N = 89$ participants who had full data sets, using standardized scores for each emotion response type (see Figures 1 and 2).

In combination, the emotional measurement types in the fear scene (SCR amplitude, heart rate, observations of fear, sadness, worry, agitation and self-soothing) accounted for a significant 17% of the variability in CU traits (R^2 = .17, adjusted R^2 = .10, F = (6, 82) 2.70, p = .02). For the sadness scene, in combination the emotional measurement types (SCR amplitude, heart rate, observations of fear, sadness, worry, agitation and self-soothing) accounted for a significant 24% of the variability in CU traits (R^2 = .24, adjusted R^2 = .19, F = (6, 82) 4.39, $p < .001$). Unstandardized and standardized regression coefficients and square semi-partial correlations (sr^2) for each predictor in the regression models are reported in Table 3.

Attention to emotional stimuli

To test for whether attention to emotionally salient material differed by participant group, fixations within emotional ROIs, distractor ROIs, and control ROIs were investigated in each of the four targeted sequences (see Supplementary Information) using a MANCOVA (CC group $n = 22$; CP−CU group $n = 81$; CP+CU group $n = 20$). Using Pillai's Trace, with inclusion of the covariates, no differences were found between group in any of the four scenes in how participants attended to the ROIs.

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Table 3. Regression coefficients and descriptive variables for standardized emotion measurement measures to CU traits

Scene	Measurement type	Pearson's *r*	*B* [95% CI]	β	sr^2
Fear	Observed fear	−.261*	−.56 [−1.21–.10]	−.20	−.17
	Observed worry	−.017	−.06 [−.72–.60]	−.02	−.02
	Observed agitation	−.153	−.11 [−.78–.55]	−.04	−.04
	Observed self-soothing	−.23*	−.23 [−.81–.36]	−.09	−.08
	Heartrate	−.203*	−.57 [−1.19–.04]	−.19	−.19
	Av. Phasic SCR	−.243*	−.67 [−1.31 to −.03]	−.22*	−.21
Sadness	Observed sadness	−.31**	−.83 [−1.51 to −.16]	−.28*	−.24
	Observed worry	.15	−.25 [−.95–.45]	−.08	−.07
	Observed agitation	.19*	.50 [−.09–1.09]	.17	.16
	Observed self-soothing	−.33**	−.57 [−1.13 to −.01]	−.21*	−.19
	Heartrate	−.07	−.13 [−.72–.45]	−.04	−.04
	Av. Phasic SCR	−.29*	−.62 [−1.19 to −.06]	−.22*	−.21

Note. CC = community control; CP−CU = conduct problems and low CU traits; CP+CU = conduct problems and high CU traits; EMT = emotion measurement type; SCR = skin conductance response; Fear scene= 0.30–3.30 min) and sadness scene (3.31–6.31 min). *$p < .05$; **$p < .001$.

Each group's attention (fixations) was primarily focused on the emotional ROI in each sequence (Fear sequence 1, $F(6, 230) = .514$, $p = .80$, $\eta_p^2 = .03$; Fear sequence 2: $F(6, 230) = .844$, $p = .54$, $\eta_p^2 = .02$; Sadness sequence 1: $F(6, 230) = .327$, $p = .92$, $\eta_p^2 = .01$; Sadness sequence 2: $F(6, 230) = .940$, $p = .47$, $\eta_p^2 = .02$). Results are reported in Table 4 and indicate that all participant groups attended to the emotional material in similar ways.

Discussion

The relationship between emotional responsiveness and young children with CPs and high CU traits is unclear. This study attempted to clarify this relationship by replicating and expanding upon Dadds et al. (2016). Specifically, we investigated for differences in emotional responsiveness by participant group, tested whether results differed based on emotional measurement type and stimulus used, and tested whether attention to the emotional stimulus differed by group. First, we replicated Dadds et al. (2016) and investigated behavioral measures (observed affect and emotion regulation behaviors) of emotional responsiveness to a complex, attachment-related stimulus. In line with the original findings, we expected children in the CP+CU trait group would demonstrate similar or greater emotional responsiveness when compared to those in the CP−CU and CC groups. Our findings partly replicated those of Dadds et al. (2016) – no differences were found between the CP+CU and CP−CU trait groups for either fear or sadness scenes. However, the CC group was found to demonstrate significantly higher emotional reactivity than the two CP-based groups. Unlike in the original study, there was no scene or group effects for expressions of joy.

For the additional measures included to expand the original study, we expected to find no group differences in self-reported measures of emotional responsiveness (affect type and arousal), which was confirmed. For measures of physiological responsiveness (heart rate and EDA), we expected to find that the CP+CU group would be lower than the other groups in both the fear and attachment scenes – this was supported. When results of independent measures of emotional responsiveness were considered together using a continuous measure of CU traits, we expected higher CU traits to be predicted by lower responsiveness scores for both the fear scene and the sadness scene. This was also supported. Finally, we investigated attentional patterns to the emotional stimuli with eye-tracking, predicting that there would be differences in attention to the characters displaying distress in key scenes between CP+CU, CP−CU, and CC groups. This hypothesis was not supported – each group demonstrated similar patterns of focal fixations on the emotional area of interest, and similar proportions of attention anywhere on the screen, indicating that children from all groups attend to the screen and to the material on the screen in key emotional scenes in similar ways.

Overall, our results suggest four key findings. Firstly, we provide evidence that, in comparison to a typically developing group, young children with CP+CU traits have deficits in multiple measures of emotional responsiveness which are not influenced by differences in patterns of attention to emotional cues. The second, we provide evidence of limited differences in emotional responding between young children with CP+CU and CP−CU. Thirdly, we provide evidence for the importance of multimodal emotional measurement in children with high CU traits, as we found that CU traits were predictive of reduced emotional responding when all measures were considered, but the relationship was less consistent when measures were considered individually. Finally, we provide evidence that the emotional deficits seen in CP+CU groups are not ameliorated by attachment-related stimulus, or type of elicited emotion. These findings have implications for emotional learning and emotional processes required for building quality relationships.

The finding that CU traits were associated with lower emotional responsiveness when compared to the CC group, regardless of emotion responsiveness type and emotion-eliciting scene, was unexpected. These findings suggest that emotional responding in young children with CP+CU traits is reduced on multiple facets when compared to typically developing children. Given the results from Dadds et al. (2016), and the potential for attachment-related stimulus to be particularly emotionally salient for children with high CU traits (Dadds et al., 2009), we expected to see similarities in the groups for at least behavioral measures of emotional responsiveness. Also, our findings suggest that there was no influence of scene on patterns of responding, suggesting that deficits in emotional responding were not limited to fear-inducing stimuli for those with CP+CU traits, providing evidence that deficits in

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Table 4. Attention to emotional sequences: Results from MANCOVAs testing for difference in attentional patterns for fear and sadness scenes

			Community ($n = 22$)	CP−CU ($n = 81$)	CP+CU ($n = 20$)	
Fear sequences	1	E-ROI	$M = 67\%$, $SD = .33$	$M = 59\%$, $SD = .35$	$M = 63\%$, $SD = .35$	$F(2, 116) = .42$
		Distractor	$M = 9\%$, $SD = .15$	$M = 15\%$, $SD = .12$	$M = 11\%$, $SD = .18$	$F(2, 116) = .84$
		Screen	$M = 85\%$, $SD = .33$	$M = 86\%$, $SD = .30$	$M = 87\%$, $SD = .30$	$F(2, 116) = .11$
	2	E-ROI	$M = 36\%$, $SD = .06$	$M = 34\%$, $SD = .10$	$M = 37\%$, $SD = .06$	$F(2, 116) = .96$
		Distractor	$M = 39\%$, $SD = .11$	$M = 35\%$, $SD = .14$	$M = 32\%$, $SD = .13$	$F(2, 116) = .22$
		Screen	$M = 91\%$, $SD = .20$	$M = 93\%$, $SD = .21$	$M = 99\%$, $SD = .03$	$F(2, 116) = .97$
Sadness sequences	1	E-ROI	$M = 65\%$, $SD = .32$	$M = 59\%$, $SD = .27$	$M = 59\%$, $SD = .26$	$F(2, 116) = .38$
		Distractor	$M = 9\%$, $SD = .08$	$M = 10\%$, $SD = .12$	$M = 08\%$, $SD = .09$	$F(2, 116) = .31$
		Screen	$M = 85\%$, $SD = .33$	$M = 85\%$, $SD = .26$	$M = 81\%$, $SD = .30$	$F(2, 116) = .21$
	2	E-ROI	$M = 42\%$, $SD = .32$	$M = 43\%$, $SD = .31$	$M = 37\%$, $SD = .29$	$F(2, 116) = .29$
		Distractor	$M = 10\%$, $SD = .09$	$M = 7\%$, $SD = .07$	$M = 12\%$, $SD = .10$	$F(2, 116) = 2.69$
		Screen	$M = 82\%$, $SD = .33$	$M = 78\%$, $SD = .29$	$M = 79\%$, $SD = .28$	$F(2, 116) = .17$

Note. % = proportion of time attention (eye-gaze) was fixated within the region of interest; Community = Community control group; CP−CU = conduct problems and low CU traits; CP+CU = conduct problems and high CU traits; E-ROI = emotional region of interest; Distractor = Distractor region of interest; Screen = Attention anywhere within the screen; Fear scene 1: 0.33–0.35 s, frames: 770–851; Fear scene 2: 3.01–3.20 s, frames: 4601–4788; Sadness scene 1: 308.876–313.104 s, frames: 7285–7507; Sadness scene 2: 318.460–330.705 s, frames: 7635–7929.*$p < .05$.

emotional responsiveness may be related to a deficit in distress-related emotions more broadly. Our findings provide evidence that deficits in multiple domains of emotional responding are present in young children with high CU traits, and do not support the hypothesis made by Dadds et al. (2016) that attachment-related stimuli may ameliorate aberrant emotional responding.

Theories posturing on the impact of reduced emotional responsiveness on emotion-based learning for those with high CU traits are not new (e.g., Blair, 2017; Frick & Marsee, 2018; Decety et al., 2008). However, these theories typically focus on developmental pathways to antisocial behavior resultant from impaired associative learning from affective empathy deficits (e.g., Blair, 2017; Kochanska, 1997). Traditionally, "emotion" within CU traits literature has been considered within a "basic" emotion paradigm – that is, emotions are discrete and predestined, they are experienced by all people in a similar way (Ekman, 1992). In this view, people have a specific emotion, or they do not. This leads to a tendency to confine emotional deficits to occurring within specific emotional states, as opposed to exploration of broader mechanisms involved in emotion, such as the perception of valence (uncomfortable sensations have a negative emotional valence, pleasant sensations have a positive valence) and induction of arousal to other's distress cues. There is little nuance available in this approach and its application to emotional learning is limited.

Theoretically, adults presenting with high psychopathic traits also showed high CU traits in childhood (e.g., Hawes et al., 2018). Therefore, it is likely that a proportion of children with high CU traits have reduced emotional responsiveness from birth (Blair et al., 2006; Frick & Viding, 2009). Emotional learning develops with interpretation of physical sensations, or "core affect," of which there are two dimensions: valence and arousal (Barrett, 2017). Learning about emotions develops socially, parents provide labels to emotion states and teach soothing and affiliative reward with early interactions (Eisenberg et al., 1999). In combination, experiences of core affect and parental labeling help children to develop "emotion concepts," which map on to how we understand specific affect types, or "discrete" emotions (Hoemann et al., 2019). Therefore, if emotional responsiveness occurs at a low level (i.e., there is limited core affective response), the ability to learn associations between core affect and others' emotional cues will be impaired. Further, the opportunity for parental socialization of emotion will also be reduced. Our findings support this notion. We do not suggest that children with high CU traits are "unemotional," rather, that they are *less* responsive than their peers. Despite this association, children from all groups self-reported similar emotional responses, suggesting that dampened emotional responsiveness was not associated with changes to self-reported affect or arousal.

One interpretation for these mixed results between independent and self-reported emotion is that children with high CU traits can learn what emotional states are socially expected in specific contexts (e.g., "fear" in the fear scene) and be able self-report the socially expected responses, despite not experiencing the same degree of emotional contagion, or the same "core affect" as their peers. This may speak to skills in understanding what is expected in social contexts and is consistent with past research showing that children with high CU traits have intact cognitive theory of mind (Satlof-Bedrick et al., 2019), but it is likely they still experience a gap in understanding and resonating with emotions in others. Indeed, research has suggested that reduced emotional responsiveness in children with high CU traits is less likely to be experienced in circumstances that directly to relate to their self (e.g., Helseth et al., 2015), but rather these deficits are most present in relation to the responses of others (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; Yoder et al., 2016). More work is required to understand the effects of dampened emotional responsiveness in those with early-onset high CU traits on emotional learning.

The few differences found between the CP+CU and CP−CU groups replicate the behavioral findings of Dadds et al. (2016). The CP+CU group showed fewer instances of agitation in the fear scene than the CP−CU trait group, but heart rate was the only measure to demonstrate a significant group effect in both scenes, with CP+CU group demonstrating a significantly lower average heart rate in both the fear and sadness scene than the CP−CU group. One explanation for these findings is that CPs, regardless of CU trait status, may be associated with reduced emotional responsiveness (Frick & Marsee, 2018), with physiological arousal thought to be especially salient (Beauchaine, 2012; Fanti, 2018).

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It is possible that no differences were found between the CP groups due to the CP−CU group already having reduced responsiveness and our study being underpowered. With a larger sample size, it is possible that a significant difference would have been consistently found between the CP+CU and CP−CU groups.

Another interpretation is that differences in emotional responsiveness between CP+CU and CP−CU groups were not consistently found due to age effects. Adolescents and adults with high CU traits have been found to demonstrate reduced emotional responsiveness between studies (e.g., Fanti, 2018; Northam & Dadds, 2020). We suggest that young children with CP+CU traits do indeed have reduced emotional responsiveness when compared to their peers with CP−CU traits and a CC group, but that this association may be weaker than what is observed in older ages and may be more reliably observed with multiple measures of emotional responsiveness. This may explain why results of studies are more likely to be inconsistent for young children with CU traits (e.g., Northam & Dadds, 2020). It is possible that this effect is strengthened over time as faulty emotional learning becomes more concrete and the influence of parent-child relationship becomes less salient. More research is needed to explore this potential effect and the potential importance of early developmental periods on early intervention.

Diminished emotional responsiveness may also impact parent-child relationship quality, which in turn may impair the development of social learning processes. Specifically, how parents interpret and respond to their child's social-emotional behaviors, including dampened responsiveness, may influence risk for further problems. Children with high CU traits show reduced social affiliation (e.g., Kochanska et al., 2013; Waller & Wagner, 2019; Waller et al., 2016), meaning they are less likely to seek out interpersonal connections. Reduced social affiliation, in combination with the hallmark symptoms of CU traits (e.g., apparent disregard for others, lack of empathy), likely contribute to the attachment difficulties (e.g., Wagner et al., 2016), negative parental attributions (Palm et al., 2019), and poor-quality parent-child relationships (Pasalich et al., 2014b) seen in this group.

Importantly, poorer parent-child relationships are associated with withdrawal of positive attention and sensitive and responsive parenting behaviors, which are vital components needed to help orientate children to socially appropriate responses to both intra- and interpersonal experiences of emotion (Pasalich et al., 2012). Poorer quality parent-child relationships may lead parents to underestimate the emotional responsiveness (Northam et al., 2021). Strong attachment relationships and high-quality parent-child relationships have been found to protect against harms associated with CU traits (e.g., Kroneman et al., 2011; Pardini et al., 2007; Pasalich et al., 2011; Waller et al., 2014), and that the risk of developing CU traits from low social affiliation is mitigated by warm, sensitive, and responsive parenting behaviors (Perlstein et al., 2021). Therefore, the influence of parents and the quality of parent-child relationships on early CU traits warrants further consideration, especially regarding intervention approaches.

Recently, attempts have been made to amend behavioral parent training interventions to increase efficacy for children with CP+CU traits (e.g., Dadds et al., 2019; Kimonis et al., 2019; Waschbusch et al., 2019). However, amended interventions show mixed effects, with the most promising results for early intervention found by Kimonis et al. (2019) who emphasized the importance of improving the quality of parent-child relationships by increasing sensitive and receptive parenting interactions. All recent interventions have incorporated an element of distress cue and emotion recognition training, with the goal of increasing empathy skills in children with high CU traits. These interventions have demonstrated an ability to reduce CPs and improve empathy when it is measured as an ability to identify emotion in others. While emotion recognition is an important skill, the ability to recognize emotion and distress cues does not mitigate the effects on social-emotional learning from dampened emotional responsiveness. More work is required to learn whether it is possible to address the effects of reduced emotional responsiveness on emotional and social development.

The findings of this study must be interpreted with consideration to several limitations. Firstly, this study tested emotional responsiveness under experimental conditions and thus generalizations to emotional responding in more socially complex settings cannot be made. This is especially so regarding attention. As the experimental room was deliberately dull with no distractors, children's attention was likely to be focused on the dynamic and engaging stimulus. In a naturalistic setting, the emotional stimulus may not have caught the attention of the participants in the same way, and thus, emotional responsiveness in naturalistic settings may be more limited than demonstrated in this study. Secondly, this study indexes emotional responsiveness with "activity" levels and does not include a measure of "reactivity," due to difficulties obtaining a baseline measure (e.g., Jennings et al., 1992; Jorgensen & Schreer, 1990). Additionally, the self-report tool was based on Izard et al., 1983) model of six basic emotions, which did not include the option to identify "worry/concern," limiting some comparisons between the independent measures and subjective measures of responsiveness. Despite these limitations, we are the first to investigate the effect of CU traits on emotional responsiveness in young children with multiple measurement methods, we provide comparison between clinical and community groups, and provide a measure of attentional patterns.

This study provides a replication and expansion of Dadds et al. (2016), with the goal of (1) testing whether the deficits in emotional responding commonly seen in children with high CU traits can be ameliorated in response to attachment-related stimulus, and (2) whether how emotional responsiveness is measured matters. We partly replicated the findings of Dadds et al. (2016), by finding no differences between CP+CU and CP−CU groups in behavioral measures of emotional responsiveness. However, we found that children with CP+CU demonstrated consistently lower levels of emotional responsiveness than children in the CC group in independent (i.e., observed behavior and physiological) measures and that lower responsiveness in independent measures of emotion predicted high CU traits on dimensional measures. We were the first study to investigate the impact of CU traits on multiple measures of emotional responsiveness in young children with varying levels of CPs and we provide evidence for the importance of multimodal measurement of emotion in young children with high CU traits. Our findings show that deficits in emotional responding are identifiable at young ages in both behaviorally observed and physiological measures, in comparison to typically developing children. This finding provides a vital piece in enhancing our etiological explanations of CU traits. Next steps for the field will be exploration of how diminished emotional responding effects emotional learning, with future research recommended to explore the effects of social/environmental effects on the construction of emotional learning and responding, with the goal to continue to enhance the already promising array of early interventions available.

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Ethical standards. Written informed consent was obtained from the parents, and assent from the children. Parents signed informed consent regarding publishing deidentified data.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Anastassiou-Hadjicharalambous, X., & Warden, D. (2008). Physiologically-indexed and self-perceived affective empathy in conduct-disordered children high and low on callous-unemotional traits. *Child Psychiatry & Human Development*, *39*(4), 503–517. https://dx.doi.org/10.1007/s10578-008-0104-y

Barrett, L. F. (2017). The theory of constructed emotion: An active inference account of interoception and categorization. *Social Cognitive and Affective Neuroscience*, *12*(1), 1–23. https://doi.org/10.1093/scan/nsw154

Beauchaine, T. P. (2012). Physiological markers of emotion and behavior dysregulation in externalizing psychopathology. *Monographs of the Society for Research in Child Development*, *77*(2), 79–86. https://doi.org/10.1111/j.1540-5834.2011.00665.x

Benedek, M., & Kaernbach, C. (2010). A continuous measure of phasic electrodermal activity. *Journal of Neuroscience Methods*, *190*(1), 80–91. https://doi.org/10.1016/j.jneumeth.2010.04.028

Blair, R. (2013). The neurobiology of psychopathic traits in youths. *Nature Reviews Neuroscience*, *14*, 786–799. https://doi.org/10.1038/nrn3577

Blair, R., & Mitchell, D. (2009). Psychopathy, attention and emotion. *Psychological Medicine*, *39*(4), 543. https://doi.org/10.1017/S0033291708003991

Blair, R., Morris, J., Frith, C., Perrett, D., & Dolan, R. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain: A Journal of Neurology*, *122*(5), 883–893. https://doi.org/10.1093/brain/122.5.883

Blair, R. J. R. (2017). Emotion-based learning systems and the development of morality. *Cognition*, *167*, 38–45. https://doi.org/10.1016/j.cognition.2017.03.013

Blair, R. J. R., Peschardt, K., Budhani, S., Mitchell, D., & Pine, D. (2006). The development of psychopathy. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 262–276. https://doi.org/10.1111/j.1469-7610.2006.01596.x

Blau, R., & Klein, P. S. (2010). Elicited emotions and cognitive functioning in preschool children. *Early Child Development and Care*, *180*(8), 1041–1052. https://doi.org/10.1080/03004430802674316

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, *25*(1), 49–59. https://doi.org/10.1016/0005-7916%2894%2990063-9

Christopoulos, G. I., Uy, M. A., & Yap, W. J. (2019). The body and the brain: Measuring skin conductance responses to understand the emotional experience. *Organizational Research Methods*, *22*(1), 394–420. https://doi.org/10.1177/1094428116681073

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, *6*(4), 284. https://doi.org/10.1037/1040-3590.6.4.284

Dackis, M., Rogosch, F., & Cicchetti, D. (2015). Child maltreatment, callous–unemotional traits, and defensive responding in high-risk children: An investigation of emotion-modulated startle response. *Development and Psychopathology*, *27*(4pt2), 1527–1545. https://doi.org/10.1017/S0954579415000929

Dadds, M. R., Allen, J. L., Oliver, B. R., Faulkner, N., Legge, K., Moul, C. . . . Scott, S. (2012). Love, eye contact and the developmental origins of empathy v. psychopathy. *The British Journal of Psychiatry*, *200*(3), 191–196. https://doi.org/10.1192/bjp.bp.110.085720

Dadds, M. R., El Masry, Y., Wimalaweera, S., & Guastella, A. J. (2008). Reduced eye gaze explains "fear blindness" in childhood psychopathic traits. *Journal of the American Academy of Child & Adolescent Psychiatry*, *47*(4), 455–463. https://doi.org/10.1097/CHI.0b013e31816407f1

Dadds, M. R., English, T., Wimalaweera, S., Schollar-Root, O., & Hawes, D. J. (2019). Can reciprocated parent-child eye gaze and emotional engagement enhance treatment for children with conduct problems and callous-unemotional traits: A proof-of-concept trial. *Journal of Child Psychology and Psychiatry*, *60*, 676–685. https://doi.org/10.1111/jcpp.13023

Dadds, M. R., Fraser, J., Frost, A., & Hawes, D. J. (2005). Disentangling the underlying dimensions of psychopathy and conduct problems in childhood: A community study. *Journal of Consulting & Clinical Psychology*, *73*(3), 400–410. https://doi.org/10.1037/0022-006X.73.3.400

Dadds, M. R., Gale, N., Godbee, M., Moul, C., Pasalich, D. S., Fink, E. . . . Hawes, D. J. (2016). Expression and regulation of attachment-related emotions in children with conduct problems and callous-unemotional traits. *Child Psychiatry & Human Development*, *47*(4), 647–656. https://doi.org/10.1007/s10578-015-0598-z

Dadds, M. R., Perry, Y., Hawes, D. J., Merz, S., Riddell, A. C., Haines, D. J. . . . Abeygunawardane, A. I. (2006). Attention to the eyes and fear-recognition deficits in child psychopathy. *British Journal of Psychiatry*, *189*, 280–281, https://doi.org/10.1192/bjp.bp.105.018150,

de Wied, M., van Boxtel, A., Matthys, W., & Meeus, W. (2012). Verbal, facial and autonomic responses to empathy-eliciting film clips by disruptive male adolescents with high versus low callous-unemotional traits. *Journal of Abnormal Child Psychology*, *40*(2), 211–223. https://doi.org/10.1007/s10802-011-9557-8

Decety, J., Michalska, K. J., & Akitsuki, Y. (2008). Who caused the pain? An fMRI investigation of empathy and intentionality in children. *Neuropsychologia*, *46*(11), 2607–2614. https://doi.org/10.1016/j.neuropsychologia.2008.05.026

Decety, J. K. A. (2015). Empathy. In Toga W. A. (Eds.), *Brain mapping: An encyclopedic reference*. vol. *3*, Elsevier; Academic Press Amsterdam, Netherlands: 191–194.

Dimberg, U. (1997). Facial reactions: Rapidly evoked emotional responses. *Journal of Psychophysiology*, *25*(1), 52–53.

Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science*, *11*(1), 86–89. https://doi.org/10.1111/1467-9280.00221

Eisenberg, N., Fabes, R. A., Shepard, S. A., Guthrie, I. K., Murphy, B. C., & Reiser, M. (1999). Parental reactions to children's negative emotions: Longitudinal relations to quality of children's social functioning. *Child Development*, *70*(2), 513–534. https://doi.org/10.1111/1467-8624.00037

Ekman, P. (1992). Are there basic emotions? *Psychological Review*, *99*(3), 550–553. https://doi.org/10.1037/0033-295X.99.3.550

Ellis, J. D., Schroder, H. S., Patrick, C. J., & Moser, J. S. (2017). Emotional reactivity and regulation in individuals with psychopathic traits: Evidence for a disconnect between neurophysiology and self-report. *Psychophysiology*, *54*(10), 1574–1585. https://doi.org/10.1111/psyp.12903

Ezpeleta, L., Granero, R., de la Osa, N., & Domenech, J. M. (2017). Developmental trajectories of callous-unemotional traits, anxiety and oppositionality in 3-7 year-old children in the general population. *Personality and Individual Differences*, *111*, 124–133. https://doi.org/10.1016/j.paid.2017.02.005

Fanti, K. A. (2018). Understanding heterogeneity in conduct disorder: A review of psychophysiological studies. *Neuroscience & Biobehavioral Reviews*, *91*, 4–20. https://doi.org/10.1016/j.neubiorev.2016.09.022

Fanti, K. A., Kyranides, M. N., Petridou, M., Demetriou, C. A., & Georgiou, G. (2018). Neurophysiological markers associated with heterogeneity in conduct problems, callous unemotional traits, and anxiety: Comparing children to young adults. *Developmental Psychology*, *54*(9), 1634, https://doi.org/10.1037/dev0000505,

Fanti, K. A., Panayiotou, G., Lazarou, C., Michael, R., & Georgiou, G. (2016). The better of two evils? Evidence that children exhibiting continuous conduct problems high or low on callous-unemotional traits score on opposite directions on physiological and behavioral measures of fear. *Development and Psychopathology*, *28*(1), 185–198. https://doi.org/10.1017/S0954579415000371

Fink, E. (2011). *Emotion elicitation as a window on children's emotion regulation, empathy, and social adaptation*, (Unpublished doctoral dissertation), University of Sydney, Sydney.

Fisher, L., & Blair, R. (1998). Cognitive impairment and its relationship to psychopathic tendencies in children with emotional and behavioral difficulties. *Journal of Abnormal Child Psychology*, *26*(6), 511–519. https://doi.org/10.1023/A:1022655919743

Fowles, D. C., Kochanska, G., & Murray, K. (2000). Electrodermal activity and temperament in preschool children. *Psychophysiology*, *37*(6), 777–787. https://doi.org/10.1111/1469-8986.3760777

Frick, P. J., & Hare, R. D. (2001). *Antisocial process screening device: APSD*. Multi-Health Systems, Toronto.

Frick, P. J., & Marsee, M. A. (2018). Psychopathy and developmental pathways to antisocial behavior in youth. In Patrick C. J. (Eds.), *Handbook of psychopathy* (pp. 456–475). The Guilford Press.

Frick, P. J., & Viding, E. (2009). Antisocial behavior from a developmental psychopathology perspective. *Development and Psychopathology*, *21*(4), 1111–1131. https://doi.org/10.1017/S0954579409990071

Gibaldi, A., Vanegas, M., Bex, P. J., & Maiello, G. (2017). Evaluation of the Tobii EyeX Eye tracking controller and Matlab toolkit for research. *Behavior Research Methods*, *49*(3), 923–946. https://doi.org/10.3758/s13428-016-0762-9

Gilmore, R. O. (2016). From big data to deep insight in developmental science. *Wiley Interdisciplinary Reviews: Cognitive Science*, *7*(2), 112–126. https://doi.org/10.1002/wcs.1379

Glenn, A. L. (2019). Early life predictors of callous-unemotional and psychopathic traits. *Infant Mental Health Journal*, *40*(1), 39–53. https://doi.org/10.1002/imhj.21757

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, *38*(5), 581–586. https://doi.org/10.1111/j.1469-7610.1997.tb01545.x

Hare, R. D., & Neumann, C. S. (2009). Psychopathy: Assessment and forensic implications. *The Canadian Journal of Psychiatry*, *54*(12), 791–802. https://doi.org/10.1177/070674370905401202

Hawes, D. J., & Dadds, M. R. (2007). Stability and malleability of callous-unemotional traits during treatment for childhood conduct problems. *Journal of Clinical Child and Adolescent Psychology*, *36*(3), 347–355. https://doi.org/10.1080/15374410701444298

Hawes, D. J., Price, M. J., & Dadds, M. R. (2014). Callous-unemotional traits and the treatment of conduct problems in childhood and adolescence: A comprehensive review. *Clinical Child and Family Psychology Review*, *17*(3), 248–267. https://doi.org/10.1007/s10567-014-0167-1

Hawes, S. W., Byrd, A. L., Gonzalez, R., Cavanagh, C., Bechtold, J., Lynam, D. R. . . . Pardini, D. A. (2018). The developmental course of psychopathic features: Investigating stability, change, and long-term outcomes. *Journal of Research in Personality*, *77*, 83–89. https://doi.org/10.1016/j.jrp.2018.09.009

Helseth, S. A., Waschbusch, D. A., King, S., & Willoughby, M. T. (2015). Aggression in children with CPs and callous-unemotional traits: Social information processing and response to peer provocation. *Journal of Abnormal Child Psychology*, *43*(8), 1503–1514. https://doi.org/10.1007/s10802-015-0027-6

Hoemann, K., Xu, F., & Barrett, L. F. (2019). Emotion words, emotion concepts, and emotional development in children: A constructionist hypothesis. *Developmental Psychology*, *55*(9), 1830. https://doi.org/10.1037/dev0000686

Hoffman, M. L. (2001). *Empathy and moral development: Implications for caring and justice*. Cambridge University Press.

Hwang, S., Nolan, Z., White, S., Williams, W., Sinclair, S., & Blair, R. (2016). Dual neurocircuitry dysfunctions in disruptive behavior disorders: Emotional responding and response inhibition. *Psychological Medicine*, *46*(7), 1485–1496. https://doi.org/10.1017/S0033291716000118

Isen, J., Raine, A., Baker, L., Dawson, M., Bezdjian, S., & Lozano, D. I. (2010). Sex-specific association between psychopathic traits and electrodermal reactivity in children. *Journal of Abnormal Psychology*, *119*(1), 216. https://doi.org/10.1037/a0017777

Izard, C. E., Dougherty, L., & Hembree, E. A. (1983). *A system for identifying affect expressions by holistic judgements (Affex)*. University of Delaware, Information Services and University Media Services, Newark.

Jennings, J. R., Kamarck, T., Stewart, C., Eddy, M., & Johnson, P. (1992). Alternate cardiovascular baseline assessment techniques: Vanilla or resting baseline. *Psychophysiology*, *29*(6), 742–750. https://doi.org/10.1111/j.1469-8986.1992.tb02052.x

Johnson, S., Barrett, P. M., Dadds, M. R., Fox, T., & Shortt, A. (1999). The diagnostic interview schedule for children, adolescents, and parents: Initial reliability and validity data. *Behavior Change*, *16*(3), 155–164. https://doi.org/10.1375/bech.16.3.155

Jorgensen, R. S., & Schreer, G. E. (1990). Pre-task, base—line, cardiovascular activity: Pre-task anticipation as a possible contributor to pre-task cardiovascular activity. *Psychophysiology*, *27*, S43.

Kimonis, E. R., Fanti, K. A., Anastassiou-Hadjicharalambous, X., Mertan, B., Goulter, N., & Katsimicha, E. (2016). Can callous-unemotional traits be reliably measured in preschoolers? *Journal of Abnormal Child Psychology*, *44*(4), 625–638. https://doi.org/10.1007/s10802-015-0075-y

Kimonis, E. R., Fanti, K. A., Goulter, N., & Hall, J. (2017). Affective startle potentiation differentiates primary and secondary variants of juvenile psychopathy. *Development and Psychopathology*, *29*(4), 1149–1160. https://doi.org/10.1017/S0954579416001206

Kimonis, E. R., Fleming, G., Briggs, N., Brouwer-French, L., Frick, P. J., Hawes, D. J. . . . Dadds, M. R. (2019). Parent-child interaction therapy adapted for preschoolers with callous-unemotional traits: An open trial pilot study. *Journal of Clinical Child Adolescent Psychology*, *48*, 347–361. https://doi.org/10.1080/15374416.2018.1479966

Kimonis, E. R., Frick, P. J., & Aucoin, K. (2008). Callous-unemotional traits and the emotional processing of distress cues in detained boys: Testing the moderating role of aggression, exposure to community violence, and histories of abuse. *Development & Psychopathology*, *20*(2), 569–589. https://doi.org/10.1017/S095457940800028X

Kleiner, M., Brainard, D., & Pelli, D.. What's new in Psychtoolbox-3? Paper presented at the 30th European Conference on Visual Perception. Arezzo, Italy, 2007

Kochanska, G. (1997). Multiple pathways to conscience for children with different temperaments: From toddlerhood to age 5. *Developmental Psychology*, *33*(2), 228. https://doi.org/10.1037/0012-1649.33.2.228

Kochanska, G., Kim, S., Boldt, L. J., & Yoon, J. E. (2013). Children's callous-unemotional traits moderate links between their positive relationships with parents at preschool age and externalizing behavior problems at early school age. *Journal of Child Psychology and Psychiatry*, *54*, 1251–1260. https://doi.org/10.1111/jcpp.12084

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology*, *84*(3), 394–421. https://doi.org/10.1016/j.biopsycho.2010.03.010

Kroneman, L. M., Hipwell, A. E., Loeber, R., Koot, H. M., & Pardini, D. A. (2011). Contextual risk factors as predictors of disruptive behavior disorder trajectories in girls: The moderating effect of callous-unemotional features. *Journal of Child Psychology and Psychiatry*, *52*(2), 167–175. https://doi.org/10.1111/j.1469-7610.2010.02300.x

Levenson, R. W. (1992). Autonomic nervous system differences among emotions. *Psychological Science*, *3*(1), 23–27. https://doi.org/10.1111/j.1467-9280.1992.tb00251.x

Levenson, R. W. (2007). *Emotion elicitation with neurological patients*. Oxford University Press, Oxford.

Licht, C. M., de Geus, E. J., Zitman, F. G., Hoogendijk, W. J., van Dyck, R., & Penninx, B. W. (2008). Association between major depressive disorder and heartrate variability in the Netherlands Study of Depression and Anxiety (NESDA). *Archives of General Psychiatry*, *65*(12), 1358–1367. https://doi.org/10.1001/archpsyc.65.12.1358

https://doi.org/10.1017/S0954579421001590 Published online by Cambridge University Press

Loney, B. R., Frick, P. J., Clements, C. B., Ellis, M. L., & Kerlin, K. (2003). Callous-unemotional traits, impulsivity, and emotional processing in adolescents with antisocial behavior problems. *Journal of Clinical Child and Adolescent Psychology*, *32*(1), 66–80. https://doi.org/10.1207/15374420360533077

Lorber, M. F. (2004). Psychophysiology of aggression, psychopathy, and conduct problems: A meta-analysis. *Psychological Bulletin*, *130*(4), 531–552. https://doi.org/10.1037/0033-2909.130.4.531

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behavior Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

Marsh, A. A., Finger, E. C., Fowler, K. A., Adalio, C. J., Jurkowitz, I. T., Schechter, J. C. . . . Blair, R. J. (2013). Empathic responsiveness in amygdala and anterior cingulate cortex in youths with psychopathic traits. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *54*(8), 900–910, https://doi.org/10.1111/jcpp.12063,

Martin-Key, N., Brown, T. & Fairchild, G. (2017). Empathic accuracy in male adolescents with conduct disorder and higher versus lower levels of callous-unemotional traits. *Journal of Abnormal Child Psychology*, *45*, 1385–1397. https://doi.org/10.1007/s10802-016-0243-8

Masi, G., Milone, A., Pisano, S., Lenzi, F., Muratori, P., Gemo, I. . . . Vicari, S. (2014). ER in referred youth with disruptive behavior disorders: The role of the callous-unemotional traits. *Psychiatry Research*, *220*(1-2), 426–432, https://doi.org/10.1016/j.psychres.2014.07.035,

Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, *5*(2), 175–190. https://doi.org/10.1037/1528-3542.5.2.175

Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion: A review. *Cognition and Emotion*, *23*(2), 209–237. https://doi.org/10.1080/02699930802204677

McMahon, R. J., Witkiewitz, K., Kotler, J. S., & **Conduct Problems Prevention Research Group** (2010). Predictive validity of callous-unemotional traits measured in early adolescence with respect to multiple antisocial outcomes. *Journal of Abnormal Psychology*, *119*(4), 752, https://doi.org/10.1037/a0020796

Mills-Koonce, W. R., Wagner, N. J., Willoughby, M. T., Stifter, C., Blair, C., Granger, D. A. . . . Family Life Project Key Investigators (2015). Greater fear reactivity and psychophysiological hyperactivity among infants with later conduct problems and callous-unemotional traits. *Journal of Child Psychology and Psychiatry*, *56*(2), 147–154, https://doi.org/10.1111/jcpp.12289,

Muñoz, L. C., Frick, P. J., Kimonis, E. R., & Aucoin, K. J. (2008). Types of aggression, responsiveness to provocation, and callous-unemotional traits in detained adolescents. *Journal of Abnormal Child Psychology*, *36*(1), 15–28. https://doi.org/10.1007/s10802-007-9137-0

Northam, J. C., & Dadds, M. R. (2020). Is callous always cold? A critical review of the literature on emotion and the development of callous-Unemotional traits in children. *Clinical Child and Family Psychology Review*, *23*, 265–283. https://doi.org/10.1007/s10567-019-00309-w

Northam, J. C., Fisher, C. A., Burman, C., Hawes, D. J., & Dadds, M. R. (2021). No hard feelings: Maternal emotion socialization and callous-unemotional traits in children. *European Child & Adolescent Psychiatry*. Advance online publication. https://doi.org/10.1007/s00787-021-01835-1

Palm, S. M. E., Sawrikar, V., Schollar-Root, O., Moss, A., Hawes, D. J., & Dadds, M. R. (2019). Parents' spontaneous attributions about their problem child: Associations with parental mental health and child conduct problems. *Journal of Abnormal Child Psycholology*, *47*, 1455–1466, https://doi.org/10.1007/s10802-019-00536-3,

Pardini, D. A., Frick, P. J., & Moffitt, T. E. (2010). Building an evidence base for DSM-5 conceptualizations of oppositional defiant disorder and conduct disorder: Introduction to the special section. *Journal of Abnormal Psychology*, *119*(4), 683. https://doi.org/10.1037/a0021441

Pardini, D. A., Lochman, J. E., & Powell, N. (2007). The development of callous-unemotional traits and antisocial behavior in children: Are there shared and/or unique predictors? *Journal of Clinical Child and Adolescent Psychology*, *36*(3), 319–333. https://doi.org/10.1080/15374410701444215

Pasalich, D. S., Dadds, M. R., & Hawes, D. J. (2014a). Cognitive and affective empathy in children with conduct problems: Additive and interactive effects of callous-unemotional traits and autism spectrum disorders symptoms. *Psychiatry Research*, *219*(3), 625–630. https://doi.org/10.1016/j.psychres.2014.06.025

Pasalich, D. S., Dadds, M. R., Hawes, D. J., & Brennan, J. (2011). Do callous-unemotional traits moderate the relative importance of parental coercion versus warmth in child conduct problems? An observational study. *Journal of Child Psychology and Psychiatry*, *52*(12), 1308–1315. https://doi.org/10.1111/j.1469-7610.2011.02435.x

Pasalich, D. S., Dadds, M. R., Vincent, L. C., Cooper, F. A., Hawes, D. J., & Brennan, J. (2012). Emotional communication in families of conduct problem children with high versus low callous-unemotional traits. *Journal of Clinical Child & Adolescent Psychology*, *41*(3), 302–313. https://doi.org/10.1080/15374416.2012.668844

Pasalich, D. S., Waschbusch, D. A., Dadds, M. R., & Hawes, D. J. (2014b). Emotion socialization style in parents of children with callous-unemotional traits. *Journal of Child Psychiatry and Human Development*, *45*, 229–242, https://doi.org/10.1007/s10578-013-0395-5,

Perlstein, S., Waller, R., Wagner, N. J., & Saudino, K. J. (2021). Low social affiliation predicts increases in callous-unemotional behaviors in early childhood. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*. Advanced online publication. https://doi.org/10.1111/jcpp.13466

Pollak, M. H. (1991). Heartrate reactivity to laboratory tasks and ambulatory heartrate in daily life. *Psychosomatic Medicine*, *53*(1), 25–35. https://doi.org/10.1097/00006842-199101000-00003

Raine, A., Fung, A. L. C., Portnoy, J., Choy, O., & Spring, V. L. (2014). Low heartrate as a risk factor for child and adolescent proactive aggressive and impulsive psychopathic behavior. *Aggressive Behavior*, *40*(4), 290–299. https://doi.org/10.1002/ab.21523

Russell, J. A., & Widen, S. C. (2002). A label superiority effect in children's categorization of facial expressions. *Social Development*, *11*(1), 30–52. https://doi.org/10.1111/1467-9507.00185

Satlof-Bedrick, E., Waller, R., & Olson, S. L. (2019). Emotion versus cognition: Differential pathways to theory of mind for children with high versus low callous-unemotional traits. *Journal of Child Psychology and Psychiatry*, *60*(12), 1300–1308. https://doi.org/10.1111/jcpp.13078

Schwenck, C., Ciaramidaro, A., Selivanova, M., Tournay, J., Freitag, C. M., & Siniatchkin, M. (2017). Neural correlates of affective empathy and reinforcement learning in boys with conduct problems: fMRI evidence from a gambling task. *Behavioral Brain Research*, *320*, 75–84. https://doi.org/10.1016/j.bbr.2016.11.037

Thomson, N. D., & Centifanti, L. C. (2018). Proactive and reactive aggression subgroups in typically developing children: The role of executive functioning, psychophysiology, and psychopathy. *Child Psychiatry & Human Development*, *49*(2), 197–208. https://doi.org/10.1007/s10578-017-0741-0

Tobii Pro AB. (2014). Tobii Pro Lab User's Manual (Version 1). Tobii Pro, Danderyd, Sweden.

Tissue, A., Lechowicz, M., Dadds., M. R. & Hawes, D. (in press). Reliability and validity of the DSM-5 diagnostic interview schedule for children, adolescents, and parents (DISCAP-5) in externalizing disorders and common comorbidities. *Clinical Child Psychology and Psychiatry*.

van der Ende, J., Verhulst, F. C., & Tiemeier, H. (2012). Agreement of informants on emotional and behavioral problems from childhood to adulthood. *Psychological Assessment*, *24*(2), 293–300.

Viding, E., & Kimonis, E. R. (2018). Callous-unemotional traits. In C. J. Patrick (Eds.), *Handbook of Psychopathy* (pp. 144–164). The Guilford Press.

Wagner, N. J., Mills-Koonce, W. R., Propper, C. B., Willoughby, M. T., Rehder, P. D., Moore, G. A. . . . Cox, M. J. (2016). Associations between infant behaviors during the face-to-face still-face paradigm and oppositional defiant and callous-unemotional behaviors in early childhood. *Journal of Abnormal Child Psychology*, *44*(8), 1439–1453.

Waller, R., Gardner, F., Viding, E., Shaw, D. S., Dishion, T. J., Wilson, M. N., & Hyde, L. W. (2014). Bidirectional associations between parental warmth, callous unemotional behavior, and behavior problems in high-risk preschoolers. *Journal of Abnormal Child Psychology*, *42*(8), 1275–1285. https://doi.org/10.1007/s10802-014-9871-z

https://doi.org/10.1017/S0954579421001590 Published online by Cambridge University Press

Waller, R., Trentacosta, C. J., Shaw, D. S., Neiderhiser, J. M., Ganiban, J. M., Reiss, D. . . . Hyde, L. W. (2016). Heritable temperament pathways to early callous-unemotional behavior. *The British Journal of Psychiatry*, *209*(6), 475–482, https://doi.org/10.1192/bjp.bp.116.181503,

Waller, R., & Wagner, N. (2019). The Sensitivity to Threat and Affiliative Reward (STAR) model and the development of callous-unemotional traits. *Neuroscience & Biobehavioral Reviews*, *107*, 656–671. https://doi.org/10.1016/j.neubiorev.2019.10.005

Waller, R., Wagner, N. J., Flom, M., Ganiban, J., & Saudino, K. J. (2021). Fearlessness and low social affiliation as unique developmental precursors of callous-unemotional behaviors in preschoolers. *Psychological Medicine*, *51*, 777–785. https://doi.org/10.1017/S003329171900374X

Waschbusch, D. A., Willoughby, M. T., Haas, S. M., Ridenour, T., Helseth, S., Crum, K. I. . . . Pelham, W. E. (2019). Effects of behavioral treatment modified to fit children with conduct problems and callous-unemotional (CU) traits. *Journal of Clinical Child Adolescent Psychology*, *49*(5), 639–650. https://doi.org/10.1080/15374416.2019.1614000

Yoder, K. J., Lahey, B. B., & Decety, J. (2016). Callous traits in children with and without conduct problems predict reduced connectivity when viewing harm to others. *Scientific Reports*, *6*, 20216. https://doi.org/10.1038/srep20216

https://doi.org/10.1017/S0954579421001590 Published online by Cambridge University Press