HHS Public Access
Author manuscript
Child Psychiatry Hum Dev. Author manuscript; available in PMC 2024 December 01.

Published in final edited form as:
Child Psychiatry Hum Dev. 2024 December ; 55(6): 1453–1462. doi:10.1007/s10578-023-01510-3.

Callous-unemotional traits and emotion recognition difficulties: do stimulus characteristics play a role?

T. Powell[1], **R.C. Plate**[2], **C.D. Miron**[3], **N.J. Wagner**[1,^], **R. Waller**[2,^]

[1]Department of Psychological and Brain Sciences, Boston University, USA

[2]Department of Psychology, University of Pennsylvania, USA

[3]Grossman School of Medicine, New York University, USA

Abstract

Emotion recognition difficulties are linked to callous-unemotional (CU) traits, which predict risk for severe antisocial behavior. However, few studies have investigated how stimulus characteristics influence emotion recognition performance, which could give insight into the mechanisms underpinning CU traits. To address this knowledge gap, children aged 7-10 years old (*N*=45; 53% female, 47% male; 46.3 % Black/African-American, 25.9% White, 16.7% Mixed race or Other, 9.3% Asian) completed a new emotion recognition task featuring static facial stimuli from child and adult models and facial and full-body dynamic stimuli from adult models. Parents reported on CU traits of children in the sample. Children showed better emotion recognition for dynamic than static faces. Higher CU traits were associated with worse emotion recognition, particularly for sad and neutral expressions. Stimulus characteristics did not impact associations between CU traits and emotion recognition.

Keywords

Emotion recognition; callous-unemotional traits; conduct problems; dynamic stimuli; full-body stimuli

Stimulus characteristics, emotion recognition, and callous-unemotional traits

Appropriate recognition of and response to emotions is critical for effective social interactions (Decety & Jackson, 2004). Infants as young as 5-7 months old detect and discriminate between emotional facial expressions (Vaillant-Molina et al., 2013) with emotion recognition improving across childhood and adolescence (Herba & Phillips, 2004). Throughout childhood, social interactions become increasingly complex, requiring children to use emotion recognition skills to support the initiation and maintenance of social

Correspondence: Rebecca Waller, Department of Psychology, Stephen A. Levin Building, 425 South University Avenue, Philadelphia, PA, 19104; rwaller@sas.upenn.edu. Nicholas Wagner, Department of Psychological and Brain Sciences, Boston University, 64 Cummington Mall, Boston, MA 02215; njwagner@bu.edu.
^joint senior authors

Disclosure: The authors report no conflicts of interest.

relationships (Rubin et al., 2007). Consequently, children with better emotion recognition commonly have higher peer status, friendship quality, and social competence (Denham et al., 2003; Trentacosta & Fine, 2010; Wang et al., 2019). Conversely, emotion recognition difficulties pose barriers to healthy child development and confer risk for psychopathology (Fine et al., 2003). Thus, a better understanding of the mechanisms underpinning childhood emotion recognition can provide insight into adaptive and maladaptive socioemotional development.

In standard emotion recognition tasks, participants categorize or provide labels for static and disembodied photographs of adult models posing prototypical facial configurations associated with specific emotions, such as a furrowed brow for anger (e.g., Ekman & Friesen, 1976; Tottenham et al., 2009). However, other cues beyond static facial configurations facilitate emotion recognition (Barrett et al., 2019), including dynamicity (e.g., expression speed; Sowden et al., 2021) and bodily cues (e.g., posture, hand position; de Gelder et al., 2010; Ross & Flack, 2020). Moreover, research suggests that emotion recognition performance may be influenced by characteristics of the models including their age. For example, one study reported that children show better emotion recognition for adult versus child expressers for angry faces (Demetriou & Fanti, 2021). To address such methodological variability and improve our understanding of emotion recognition development, studies are needed that explore emotion recognition across a range of stimulus features (e.g., static and dynamic faces, facial and full-body expressions) and models (e.g., child and adult expressers).

Disambiguating the contribution of stimulus features within tasks may be especially useful to improve understanding of the emotion recognition deficits implicated in various psychopathologies, including callous-unemotional (CU) traits. CU traits are defined by a lack of empathy, prosociality, and guilt (Waller et al., 2020) and signal risk for later violence, psychopathy, and crime (Cardinale & Marsh, 2020; Frick et al., 2014; McMahon et al., 2010). CU traits are associated with emotion recognition deficits for fear and sadness, as evidenced through studies using static faces (Bedford et al., 2017; Marsh & Blair, 2008; Moore et al., 2019; Rehder et al., 2017), static body postures (Muñoz, 2009), and vocal expressions (Dawel et al., 2012). These difficulties are thought to contribute to the core behavioral characteristics associated with CU traits, including a lack of empathy (Waller et al., 2020), proactive aggression (Blair et al., 2001; Marsee & Frick, 2010), and failure to develop lasting social bonds with others (Miron et al., 2020). Thus, emotion recognition may represent an important treatment target for children with CU traits (Dadds et al., 2008).

Notably, however, some studies have not found emotion recognition impairments among children with CU traits (Bedford et al., 2020; Ciucci et al., 2015; Martin-Key et al., 2021; Wolf & Centifanti, 2014; Woodworth & Waschbusch, 2008). One possible explanation for the inconsistent findings is that characteristics of the stimuli used in tasks might impact the association between CU traits and emotion recognition. For example, CU traits were related to worse emotion recognition among 7-year-old children using static expressions, but no association was found using dynamic expressions (Bedford et al., 2020). Indeed, eye-tracking studies suggest that when presented with static emotional faces, children with elevated CU traits attend less to the eye region than typically developing peers (Dadds et al., 2008; Demetriou & Fanti, 2021). Thus, the use of dynamic expressions could scaffold attention to emotionally salient parts of the face, such as the eyes, thus promoting better emotion recognition. At the same time, other studies have reported no association between CU traits and emotion recognition using both static and dynamic full-body emotional expressions (Martin-Key et al., 2021; Wolf & Centifanti, 2014), suggesting that bodily cues may also mitigate reported emotion recognition difficulties among children with CU traits. Studies that explicitly test whether and how stimulus characteristics may attenuate the links between emotion recognition deficits and CU traits would provide insight into underlying mechanisms and inform the development of targeted interventions. However, no studies have included direct comparisons of multiple stimulus characteristics when investigating associations between emotion recognition and CU traits.

The goal of the current study was thus to investigate how stimulus characteristics impact children's emotion recognition using a new task specifically designed to make direct comparisons between stimuli. We also tested whether CU traits were related to emotion recognition as a function of stimulus characteristics. Our first aim was to evaluate whether emotion recognition differed based on stimulus characteristics using static child faces, static adult faces, dynamic adult faces, and dynamic full-body adult displays. We hypothesized better performance for dynamic versus static facial stimuli, dynamic full-body versus dynamic facial stimuli, and adult versus child (static) expressers (Demetriou & Fanti, 2021). Given evidence for emotion-specific difficulties in recognition (Bedford et al., 2020; Demetriou & Fanti, 2021; Marsh & Blair, 2008), we also evaluated whether emotion recognition differed for happy, sad, angry, fearful, and neutral expressions. We hypothesized the highest accuracy for recognizing happy expressions but left open the possibility of differences between negative-valanced emotions. We also examined whether emotion-specific differences varied as a function of stimulus characteristics, but given the dearth of prior research in this area did not specify a priori hypotheses. Our second aim was to investigate associations between emotion recognition, stimulus characteristics, and CU traits. We hypothesized that CU traits would be related to worse overall emotion recognition, but that these deficits would be mitigated with dynamic or full-body stimuli. Consistent with prior research, we also hypothesized that CU traits would be associated with poorer recognition of negative emotions (e.g., sad, fear) specifically (Blair et al., 2001; Dadds et al., 2008; Muñoz, 2009).

Method

Participants

Participants were children (7-10 years, N=45, M_{age}=9.12, SD_{age}=1.13; 53% female, 47% male) recruited from two cities in the northeastern United States (Boston, n=19; Philadelphia, n=27) through community advertising (e.g., flyers, online advertisements, and newsletters). Parents reported their child's race (46.3 % Black/African-American; 25.9% White; 16.7% Mixed race or Other; 9.3% Asian; 1.9% declined to respond) and ethnicity (24.1% Hispanic/Latinx; 75.9% Not Hispanic/Latinx).

Procedure

Data were collected as part of the multi-site Family and Child Emotion Socialization (FACES) study, which included a 3-hour laboratory visit featuring computerized tasks, parent-child interaction tasks, a parent demographic interview, and child- and parent-report questionnaires. Parents provided informed written consent and children provided verbal assent. Families were compensated $120. All procedures were approved by the Institutional Review Boards at Boston University and the University of Pennsylvania.

Measures

Emotion Recognition—We assessed emotion recognition in children using the Dynamic Affect Recognition Task (DART), which was created in SR Research Experiment Builder 1.10.165. DART includes child static faces, adult static faces, adult dynamic faces, and adult dynamic full-body expressions showing either a happy, sad, angry, fearful, or neutral emotion. Child static faces are a subset of images from the National Institute of Mental Health Child Emotional Faces Picture Set (NIMH-ChEFS) with equal numbers of males and females and a racial composition of 50% Black/African-American and 50% White (Egger et al., 2011; Figure 1a). We created adult static faces, adult dynamic faces, and adult dynamic full-body emotion expressions by photographing and filming amateur actors (50% female, 50% male; 36.67% Black/African-American, 33.33% Non-Hispanic White, 13% Asian, 16% Hispanic/Latinx) with standardized luminosity and distance (Figure 1b–d). The same actors were used across all adult stimuli. A pictorial response scale consisting of a row of line drawings of faces depicting prototypical facial configurations (Ekman & Friesen, 2003) in the same order (happy, sad, neutral, scared, and angry) was presented with the corresponding emotion word displayed below each image (Figure 1e;Chester et al., 2022). During the task, each trial involved the presentation of a 1 s static image (adult or child faces) or 1 s dynamic video of an actor's face or full body (adult expressers only) showing happy, sad, angry, fearful, or neutral emotional expressions. Following the stimulus presentation, participants clicked on the image they believed to best represent the emotion shown. If the participant did not select an image within 6 s, the trial was invalid. Participants with <70% valid trials were excluded (n=2). There were 80 trials total (20 of each stimulus type; 4 of each emotion per stimulus type, resulting in 16 displays for each emotion) presented in random order. Participants completed two practice trials. On average, participants completed the task in 8.66 minutes.

Callous-Unemotional (CU) Traits—We assessed child CU traits using the parent-version of the Inventory of Callous Unemotional traits (ICU; Essau et al., 2006), which includes 24 items rated on a four-point scale (1=*do not agree at all* to 4=*strongly agree*). The ICU assesses a lack of empathy (e.g., unconcerned about the feelings of others), uncaring behavior (e.g., always tries best – reverse scored), and unemotionality (e.g., hides feelings), and has been extensively validated in clinical and community samples of children and adolescents (Kimonis et al., 2008; Waller et al., 2015). The internal consistency of the total score was high (α=.86).

Conduct Problems (CP)—CP often co-occur with CU traits (Frick & Kemp, 2021). To isolate specific effects for CU traits, rather than severity of CP, we assessed CP using the 5-

item Conduct Problem subscale of the parent-report Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) with items rated on a four-point scale (1=*not true* to 4=*certainly true*) and based on child behavior in the last six months (e.g., often loses temper). The internal consistency of the CP scale was acceptable (α=.75).

Demographic Information—Child age, sex, race, and ethnicity were reported by parents during an interview.

Analytic Plan

For all models, a mixed model ANCOVA approach was used with mean emotion recognition accuracy as the dependent variable. To address Aim 1 and examine associations between stimulus type and emotion recognition, the following analyses were conducted. First, we conducted a one-way mixed effects ANCOVA with stimulus type as the independent variable. Next, we conducted a one-way mixed effects ANCOVA with emotion as the independent variable. Finally, we conducted a two-way mixed effects ANCOVA including an interaction term with stimulus type and emotion. To address Aim 2 and test whether CU traits were related to emotion recognition, we conducted a one-way mixed effects ANCOVA with emotion recognition as the dependent variable and CU traits (mean-centered) as the independent variable. We than added two-way interaction terms, first between CU traits and stimulus type and then between CU traits and emotion. Finally, we examined the three-way interaction. Child sex (female=−.5, male=.5), child age (in years, mean-centered), and data collection site (Boston=−.5, Philadelphia=.5) were included in all models as covariates. For models examining CU traits, co-occurring CP (mean-centered) was also included. The Tukey method was used to adjust *p*-values for multiple comparisons.

We used R version 4.1.2 for all analyses (R Core Team, 2021), including the tidyverse package (Wickham et al., 2019) for data organization, stats package (R Core Team, 2021) for mixed model analysis of covariance (ANCOVA) to test study aims, emmeans package (Lenth, 2022) to obtain estimated marginal means and contrasts, and ggplot2 package (Wickham, 2016) for visualization. DART stimuli, deidentified data, and analysis code are available at [https://osf.io/zvsh9/?view_only=d97dfc19492c4b959e120c9518a931ca].

Results

Descriptive statistics and bivariate correlations between study variables are presented in Table 1 and Table S1 as relevant.

Aim 1: Emotion recognition varies as a function of stimulus characteristics

Overall emotion recognition accuracy was high (*M*=93.93%, *SD*=2.30%, *range*=75-100%). There was a main effect of stimulus type on emotion recognition (see model and pairwise contrasts in Table 2). In partial support of hypotheses, accuracy was higher for adult dynamic faces than child static faces. However, there were no differences between static and dynamic adult faces, adult and child static faces, or adult dynamic faces and bodies. There was also a main effect of emotion (see model and pairwise contrasts in Table 3). In partial support of hypotheses, accuracy was higher for recognizing happy as compared to sad expressions, but there were no differences between happy and fear or anger. The only within-negative-valence difference was between fear and sad, with lower accuracy for sad expressions.

There was also an interaction between stimulus type and emotion ($F(12,837) = 2.45$, $p=.003$; Figure 2). Children showed equally high accuracy across the different emotions when they saw dynamic faces (all contrasts $p>.60$). However, there were emotion-specific differences for adult and child static faces and dynamic bodies. For adult static faces, emotion recognition was higher for happy than fear ($b=.083$, $p=.02$). For child static faces, accuracy was higher for happy than sad ($b=.095$, $p=.007$), happy than neutral ($b=.13$, $p<.001$), fearful than sad ($b=.089$, $p=.01$), and fearful than neutral ($b=.12$, $p<.001$). For dynamic bodies, sadness had lower accuracy compared to happy ($b=-.095$, $p=.007$) and fearful ($b=-.085$, $p=.02$) displays. The model and pairwise contrasts are displayed in Table S2. Finally, there was a main effect of age across all models, such that older children evidenced better emotion recognition than younger children (all contrasts $p<.05$).

Aim 2: CU traits associated with worse emotion recognition for sad and neutral expressions

Consistent with hypotheses, children with higher CU traits demonstrated worse emotion recognition ($F(1,36) = 22.48$, $p<.001$; see full model in Table S3). Contrary to hypotheses, stimulus type did not moderate this relationship ($p=.18$; see full model in Table S4). There was, however, an interaction between CU traits and emotion ($F(4,196) = 5.99$, $<.001$; Figure 3). Higher CU traits were more strongly related to emotion recognition difficulties for sad (vs. happy and fearful) and neutral (vs. happy) expressions (Table 4). The three-way interaction between CU traits, stimulus type, and emotion was not significant ($p=.29$).

Discussion

We investigated the influence of stimulus characteristics on emotion recognition in school-aged children using a new emotion recognition task that included different-aged expressers, dynamic and static stimuli, and facial and full-body emotional expressions. We also examined the associations between CU traits and emotion recognition, and we tested whether and how stimulus characteristics influenced these links. In line with prior studies (Dobs et al., 2018; Martin-Key et al., 2018), children were better at recognizing adult dynamic than child static faces. However, contrary to expectations (de Gelder et al., 2010; Ross & Flack, 2020), the dynamicity of stimuli did not support better emotion recognition across all contrasts (e.g., adult static vs. adult dynamic faces and full-bodies). Taken together, the current findings provide some support for the notion that spatio-temporal cues, including the dynamic sequence of facial actions as the expression unfolds, may be important to facilitating facial emotion recognition (Dobs et al., 2014; Krumhuber & Scherer, 2016). However, additional research is needed to further elucidate the relative contribution of dynamicity to emotion recognition performance.

We also found that associations between stimulus type and emotion recognition differed as a function of the emotion shown, with more pronounced emotion-specific differences for static stimuli. Specifically, children were better at recognizing happy static faces for both adult and child expressers. Previous studies have found that happiness is the easiest emotion for children to identify (Ekman & Friesen, 1976), with one study demonstrating ceiling effects for happiness recognition in 5-year-old children (Richoz et al., 2018). Conversely, for adult dynamic faces, children performed equally well regardless of the emotion shown. This finding suggests that when dynamic cues are available, emotion-specific difficulties may be mitigated.

Under our second aim, higher CU traits were associated with worse emotion recognition across all stimuli. These results suggest that previous studies demonstrating emotion recognition deficits among children with elevated CU traits are not solely attributable to methodological artifacts of stimuli (i.e., static stimuli lacking ecological validity) nor limited to recognition of fear and sadness (Dawel et al., 2012; Marsh & Blair, 2008; Moore et al., 2019). Although lower recognition was found across all stimuli, we replicated some prior work showing that higher CU traits were more strongly related to emotion recognition difficulties for sad and neutral expressions (Dadds et al., 2006, 2018; Hartmann & Schwenck, 2020; Marsh & Blair, 2008). Difficulties recognizing sadness are consistent with the reported behavioral features of children high on CU traits who lack empathy (Waller et al., 2020) and fail to perceive the negative impact of their actions on others (Blair et al., 2001). Treatments for children with CU traits might benefit from targeting sadness recognition to promote more affiliative and empathic behavior (Waller & Wagner, 2019). Difficulties recognizing neutral expressions may be akin to a hostile attribution bias (i.e., the tendency to interpret ambiguous cues as negative or hostile), although this type of profile has traditionally been reported among children with CP without CU traits (Dodge et al., 1997; Helseth et al., 2015). Finally, in contrast to the hypothesis that dynamic cues would scaffold attention to relevant regions of the face, such as the eyes (Dadds et al., 2008; Demetriou & Fanti, 2021), the association between CU traits and worse emotion recognition was similar across different stimulus types (i.e., not mitigated with dynamic stimuli). Future studies using eye-tracking could inform potential attentional mechanisms underlying the emotion recognition deficits associated with CU traits for both static and dynamic stimuli.

There were a number of strengths to the study, including the use of a new task that allowed, for the first time, differentiation between emotion recognition for static versus dynamic faces, facial versus full-body expressions of emotion, and child and adult expressers of emotion in the same paradigm. However, the findings should be considered alongside several limitations. First, the database we used for child emotion stimuli contained only static images, preventing us from investigating recognition of dynamic or full-body child stimuli specifically. Additionally, the small sample size may have limited our ability to detect interaction effects (Leon & Heo, 2009), and our use of a community sample limited the severity of CU traits and CP. Future research is needed that leverages the DART task with larger samples drawn from clinical services or juvenile justice settings to ensure a greater range in severity of CU traits or CP. Finally, although we used dynamic stimuli to enhance the ecological validity of the emotional expressions, the dynamic expressions were generated by actors and may not generalize to spontaneous “real” emotional expressions (Barrett et al., 2019). Future studies are needed that can apply novel experimental designs (e.g., ecological momentary assessment to capture real-time emotion recognition – see De Ridder et al., 2016) and innovative tools (e.g., “real” recorded emotional reactions; Barrett et al., 2019) to capture the contextual complexity of emotion recognition as it occurs in daily life.

Summary

The present study provides evidence that stimulus characteristics influence emotion recognition in children. Overall, during late childhood, children benefited from dynamic cues to categorize emotional facial expressions. We provide further evidence that CU traits are associated with pervasive emotion recognition deficits, with particular difficulty recognizing neutral and sad expressions, which has implications for the design of child-focused treatments for CU traits. Future studies that include larger samples of children with variability in the severity of CU traits and CP, utilize prospective, longitudinal designs beginning early in childhood, and improve the ecological validity of stimuli can elucidate key mechanisms underlying emotion recognition deficits in CU traits and inform the development of personalized and more effective interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

This work was funded by institutional support from the University of Pennsylvania (RW) and from Boston University (NJW), and funding from the John and Polly Sparks Foundation (American Psychological Foundation) (RW).

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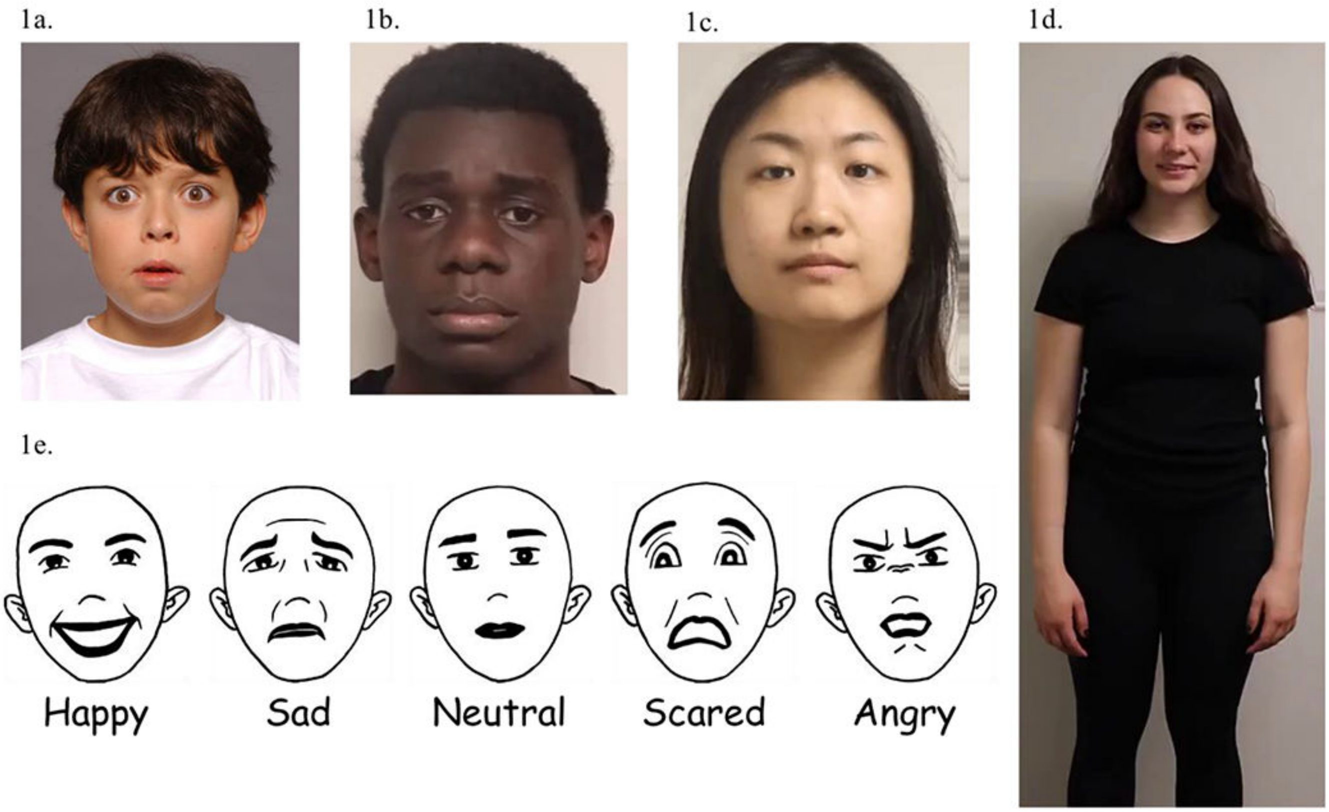

Figure 1: Experimental Stimuli for the Dynamic Affect Recognition Task

Note. 1a. Child static face, fear; 1b. Adult dynamic face, sad, freeze frame at 500 ms; 1c. Adult static face, neutral; 1d. Adult dynamic body, happy, freeze frame at 500 ms; 1e. Pictorial response scale

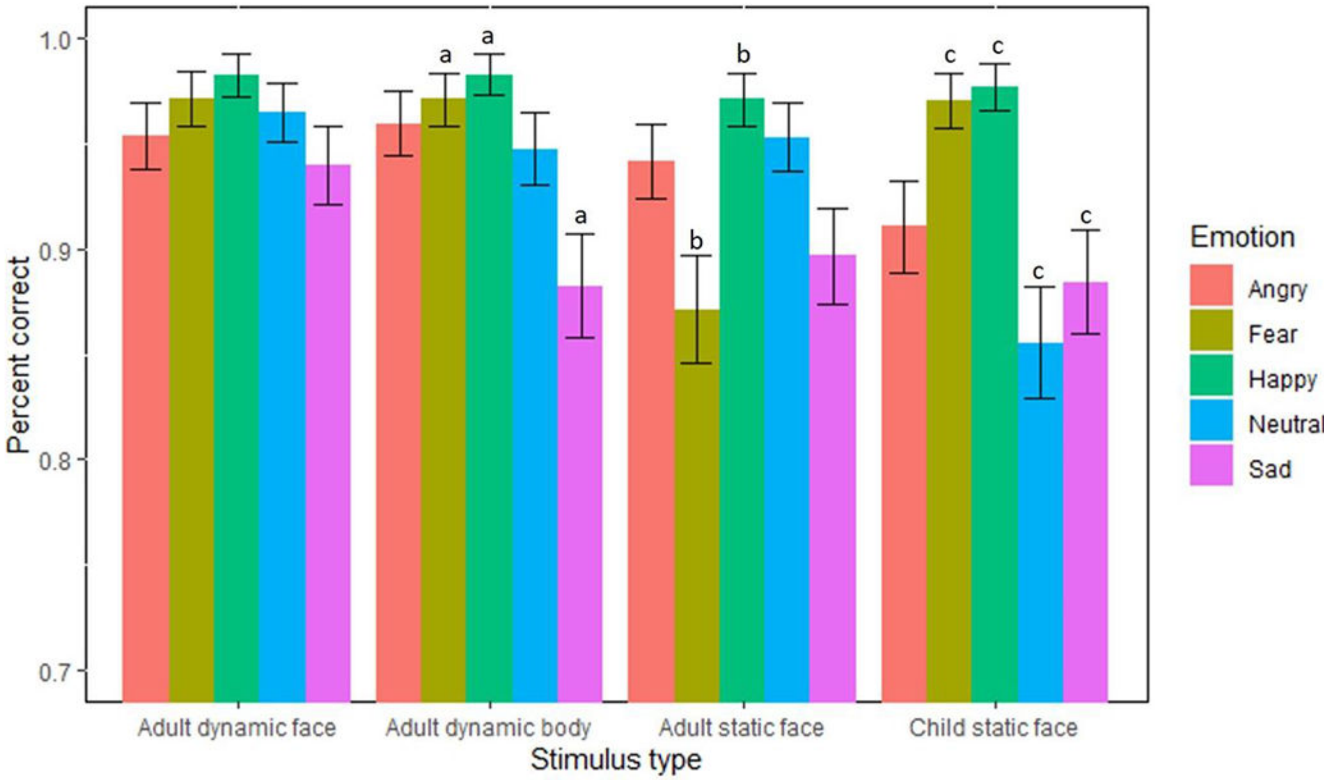

Figure 2. Emotion Recognition by Stimulus Type and Emotion

Note. The Tukey method was used to adjust *p*-values for multiple comparisons. For adult dynamic faces, children performed equally well regardless of the emotion shown. [a]Accuracy was lower for sad adult dynamic bodies than fear or happy. [b]For adult static faces, emotion recognition was better for happy than fear. [c]For child static faces, performance was better for happy and fear than sad or neutral.

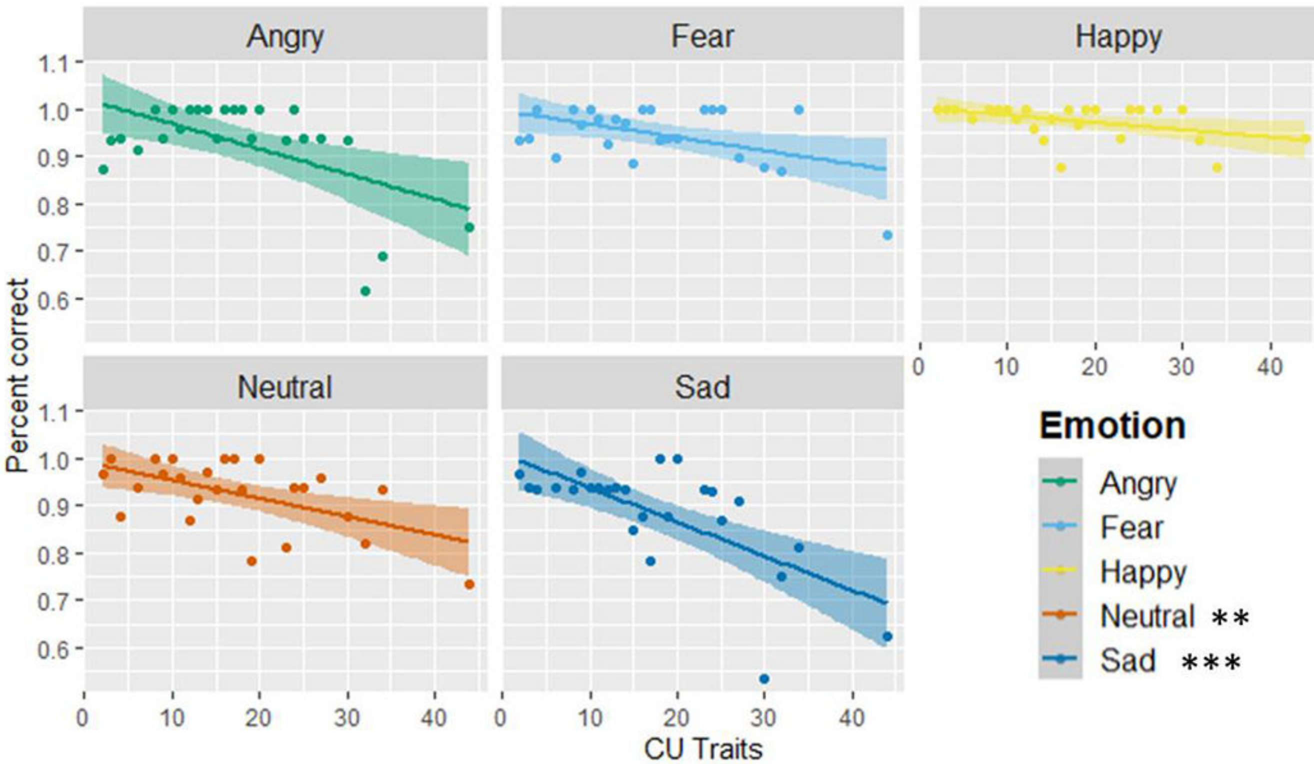

Figure 3. Emotion Recognition by CU Traits and Emotion

Note. Asterisks indicate emotions with slopes that were significantly more negative than at least one other emotion. Slopes were significantly steeper for sad than happy and fear and for neutral than happy, suggesting that children with elevated CU traits had greater difficulty recognizing sad and neutral expressions.

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

Table 1

Zero-order Bivariate Correlations Between Study Variables

Variable	M	SD	Range	1	2	3
1. Age (years)	9.12	1.13	7.08-10.92	-		
2. Emotion Recognition (% correct)	93.93%	5.26	75.64-100.00	.34*	-	
3. Callous-Unemotional Traits	15.70	9.32	2-44	−.22	−.57***	-
4. Conduct Problems	1.12	1.73	0-9	−.08	−.28	.60***

Note. Sites differed on emotion recognition (p=.006)

* $p < .05$,

** $p < .01$,

*** $p < .001$

Table 2

Results of Aim 1 Mixed Effect ANCOVA Model Examining Effect of Stimulus Type on Emotion Recognition

Predictor	***Percent correct response***			
	df	***SS***	***F***	***p***
Stimulus type	3	.06	4.78	.003**
Child age	1	.06	14.20	<.001***
Child sex	1	.01	2.72	.10
Site	1	.06	14.60	<.001***
Residuals	165	.66		
Contrast	**Estimate**	**SE**	**Adjusted *p***	
Adult static face vs. Child static face	.014	.01	.74	
Adult static face vs. Adult dynamic face	−.034	.01	.06	
Adult static face vs. Adult dynamic body	−.020	.01	.44	
Child static face vs. Adult dynamic face	−.048	.01	.003**	
Child static face vs. Adult dynamic body	−.034	.01	.06	
Adult dynamic face vs. Adult dynamic body	.014	.01	.75	

Note. Stimulus type influences emotion recognition. Recognition was higher for adult dynamic faces than child static faces, and marginally higher for adult dynamic faces than adult static faces and adult dynamic bodies than child static faces.

* $p < .05$,

** $p < .01$,

*** $p < .001$

Table 3

Results of Aim 1 Mixed Effect ANCOVA Model Examining Effect of Emotion on Emotion Recognition

Predictor	***Percent correct response***			
	df	***SS***	***F***	***p***
Emotion	4	.14	45.44	<.001 ***
Child age	1	.07	11.63	<.001 ***
Child sex	1	.01	2.17	.10
Site	1	.07	11.35	<.001 ***
Residuals	207	1.33		
Contrast	**Estimate**	**SE**	**Adjusted *p***	
Happy vs. Sad	.078	.02	<.001 ***	
Happy vs. Fearful	.028	.02	.47	
Happy vs. Angry	.037	.02	.21	
Happy vs. Neutral	.048	.02	.05	
Sad vs. Fearful	−.050	.02	.03 *	
Sad vs. Angry	−.041	.02	.11	
Sad vs. Neutral	−.031	.02	.38	
Fearful vs. Angry	.008	.02	.98	
Fearful vs. Neutral	.019	.02	.80	
Angry vs. Neutral	.011	.02	.97	

Note. Emotion recognition differs depending on the emotion shown. Recognition was higher for happy and fearful expressions than sad.

* $p<.05$,

** $p<.01$,

*** $p<.001$

Table 4

Results of Aim 2 Mixed Effect ANCOVA Model Examining Effect of Callous-Unemotional (CU) Traits X Emotion on Emotion Recognition

Predictor	***Percent correct response***			
	df	***SS***	***F***	***p***
Emotion X CU traits	4	.06	2.73	.03 *
Emotion	4	.14	5.99	<.001 ***
CU traits	1	.19	32.68	<.001 ***
Child age	1	.03	5.78	.01 *
Child sex	1	.00	.00	.99
Site	1	.06	9.72	.002 **
Conduct problems	1	.009	1.56	.21
Residuals	196	1.13		
Contrast	**Estimate**	**SE**	**Adjusted *p***	
Happy vs. Sad	.079	.01	<.001 ***	
Happy vs. Fearful	.029	.01	.40	
Happy vs. Angry	.038	.01	.15	
Happy vs. Neutral	.049	.01	.03 *	
Sad vs. Fearful	−.050	.01	.02 *	
Sad vs. Angry	−.041	.01	.10	
Sad vs. Neutral	−.030	.01	.36	
Fearful vs. Angry	.009	.01	.98	
Fearful vs. Neutral	.020	.01	.76	
Angry vs. Neutral	.011	.01	.96	

Note. The association between CU traits and emotion recognition is moderated by the emotion shown. Slopes are more negative for sad than happy and fearful, and more negative for neutral than happy, indicating that children with elevated CU traits may have particular difficulty recognizing sad and neutral expressions.

* $p < .05$,

** $p < .01$,

*** $p < .001$