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Empathic Responsivity and Callous-Unemotional Traits Across Development

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EMPATHIC RESPONSIVITY AND CALLOUS-UNEMOTIONAL TRAITS ACROSS DEVELOPMENT

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Abstract

Callous-unemotional (CU) traits are associated with deficits in empathy and emotional responses to others. Specifically, CU traits are consistently correlated with under-reactivity to others' distress cues. However, it is unknown whether CU traits are also associated with more general deficits in emotional reactivity (e.g., to situations involving threat to the self). Further, the relationship between CU traits and the ability to accurately identify others' emotions is not well established, and prior work often has not considered possible developmental changes in this relationship. To address these questions, the current study recruited a school-based community sample of children from kindergarten, third, and sixth grades and their parents and teachers. Children completed two cognitive, computer-based tasks to assess reactivity to various types of stimuli and accuracy in facial expression recognition, while their teachers completed ratings of level of CU traits and conduct problems. Overall, the results did not support a direct association between CU traits and emotional reactivity to others' distress or threat situations. However, the association between CU traits and reactivity was moderated by level of conduct problems, such that at low levels of conduct problems, CU traits were negatively associated with reactivity but there was no significant relationship between CU traits and reactivity at high levels of conduct problems. Additionally, CU traits were negatively associated with emotion recognition accuracy and this relationship was not moderated by child age. However, the relationship between CU traits and emotion recognition was moderated by level of conduct problems and the child's gender, such that at high levels of conduct problems, CU traits were associated with impairments in emotion recognition and CU traits were associated with deficits in emotion recognition specifically for girls. The implications of these findings for future research and clinical work are discussed.

Introduction

Empathy is often considered a fundamental human trait. Infants show empathic responses mere days after birth (Sagi & Hoffman, 1976; Simner, 1971), and by eighteen months, children engage in prosocial behavior to comfort another child in distress (Decety & Jackson, 2004; Hawes & Dadds, 2012; Zahn-Waxler, Radke-Yarrow, & King, 1979). The ability to understand and vocalize others' perspectives develops around age four (Hawes & Dadds, 2012). Thus, the basic components of affective empathy are present in infants, and cognitive empathy arises by early childhood.

In order to conceptualize and study empathy development, researchers have distinguished between two main components of empathy: affective and cognitive responses to others' emotions. Affective empathy captures the emotional reaction one has to another person's experience, whereas cognitive empathy relates to the ability to take another person's perspective (Blair, 2005; Blair & Blair, 2009; Hawes & Dadds, 2012). More specifically, affective empathy includes both emotional responses to others (e.g., general negative arousal in response to seeing another person in distress) and "emotion contagion", or sharing another person's emotion (Hatfield, Rapson, & Le, 2009). Cognitive empathy, on the other hand, is the ability to recognize and identify emotional expressions, and to understand another person's emotions and perspective (Ickes, 2009).

Although clearly related, these two components of empathy do appear to be separable. For example, their developmental onset differs. Specifically, young children become upset when another child is in distress, even before they have the ability to accurately identify the other child's emotion (Roth-Hananiaa, Davidov, Zahn-Waxler, 2011). Cognitive empathy, on the other hand, increases throughout childhood, as children become increasingly skilled at recognizing and

discerning others' feelings (Hawes & Dadds, 2012; Singer, 2006). The ability to correctly understand others' emotions does not require an emotional reaction in oneself; for instance, it is possible to witness someone who is irate and to not become angry. However, affective empathy and cognitive empathy are closely related; a child who becomes negatively aroused to others' distress is motivated to understand what led to the distress to avoid their own feelings of negative arousal in the future (Frick, Ray, Thornton, & Kahn, 2014a). Notably, the observer does not necessarily share in the other person's emotion, but rather experiences general negative arousal in response to viewing another human in distress.

This negative arousal in response to viewing another person in distress provides motivation to learn perspective-taking and engage in prosocial behaviors. By identifying and understanding another person's emotions, one can learn how to avoid upsetting others, thereby avoiding negative arousal. This desire to avoid negative arousal promotes prosocial behaviors (Frick et al., 2014a). Additionally, empathy serves as an inhibitory factor for interpersonal aggression and promotes constructive problem-solving for interpersonal conflict (Kaukiainen et al, 1999; Miller & Eisenberg, 1988; Richardson, Hammock, Smith, Gardner, & Signo, 1994). For example, a child might take another child's toy, causing that child to begin crying. This crying is aversive to the first child, and thus this child becomes negatively aroused. This negative arousal leads to motivation to identify the other child's emotion (in this case, sadness) and to understand its cause in order to avoid experiencing the same negative arousal in the future. Over time, the child learns that stealing a toy leads to the other child becoming upset, which leads to negative arousal in the child who stole the toy. Thus, to avoid this unpleasant feeling, the child stops stealing other children's toys. This basic affective reaction to another child's crying provides the motivation to learn to recognize others' signs of distress and avoid causing distress

in others. Thus, though clearly closely related, affective and cognitive empathy are not interchangeable. More importantly, it is clear that deficits in empathetic arousal and cognitive perspective taking could lead to a number of problematic developmental outcomes.

Abnormal Empathy Development

Deficits in the affective and cognitive components of empathy have been associated with certain forms of psychopathology in children. For example, individuals with autism spectrum disorder (ASD) often become upset when others are distressed but have difficulty identifying and understanding others' emotions. Specifically, research has consistently shown that children with ASD show impairments in their abilities to label and understand others' emotions (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Smith, 2009) but do react when they see another person in distress. This finding has been replicated across a variety of measures of affective empathy (e.g., electrodermal responsivity, heart rate, and self-report; Blair, 1999; Sigman, Dissanayake, Corona, & Espinosa, 2003; Jones, Happe, Gilbert, Burnett, & Viding, 2010). Thus, ASD appears to be consistently related to impairments in cognitive empathy, while affective empathy remains intact in this population.

A second example of a form of psychopathology that is related to atypical empathy development is psychopathy, in which there is evidence for an affective empathy deficit but intact cognitive empathy (Hare, 1991; 2003). Psychopathic traits are a constellation of certain personality traits that are present in a relatively small subset of individuals engaging in antisocial behavior (see Skeem, Polaschek, Patrick, & Lilienfeld, 2011, for a review). Rather than being defined by antisocial behavior (e.g., criminal lifestyle, inability to maintain a consistent job, multiple short-term sexual partners), psychopathy focuses on the affective (e.g., lack of guilt and remorse, uncaring, shallow emotions) and interpersonal (e.g., use of others for own gain,

irresponsibility, narcissism) characteristics of the individual (Cleckley, 1976). Psychopathic traits also include glibness, superficial charm, and the ability to manipulate others (Hare et al., 1990). Individuals with psychopathic traits perform similarly to adults without psychopathic traits on theory of mind tasks (Blair et al., 1996), suggesting that cognitive empathy is not impaired for this population. However, emotional reactivity to others does appear to be compromised as individuals with psychopathic traits show reduced reactivity to others' emotions on both behavioral and physiological measures (e.g., Blair, Jones, Clark, & Smith, 1997; Lorber, 2004; Patrick, Bradley, & Lang, 1993; Verona, Patrick, Curtin, Bradley, & Lang, 2004).

Callous-unemotional (CU) traits focus specifically on the affective features of psychopathy and have been studied in a number of samples of children and adolescents. CU traits capture shallow emotionality, unconcern regarding others' evaluations, and lack of guilt and empathy (Frick & Ray, 2015; Frick, Ray, Thornton, & Kahn, 2014b). Paralleling the construct of psychopathy in adults, children with CU traits show a pattern of more severe, violent and chronic antisocial behavior (see Frick et al., 2014b for a review). Thus, CU traits appear to designate a clinically important group of children that is defined, at least in part, by empathy deficits. Research on the emotional correlates of CU traits has attempted to determine if youth with these traits show deficits in affective empathy but have intact cognitive empathy, which would be consistent with research on psychopathic traits in adults.

CU Traits and Emotional Reactivity

Research examining CU traits and reactivity to others' emotions (i.e., affective empathy) has consistently found that CU traits are associated with a lack of reactivity to others' distress and to negatively valenced stimuli in general. Children with CU traits often self-report lower levels of caring about others' feelings (Jones et al., 2010; Kahn, Frick, Golmaryami, & Marsee,

2017; Michonski & Sharp, 2010; Pardini, 2011; Pardini & Byrd, 2012; Pardini, Lochman, & Frick, 2003) and show a lack of autonomic responsivity to others' negative emotions (Anastassiou-Hadjicharalambous & Warden, 2008; de Wied, van Boxtel, Matthys, & Meehus, 2012). When viewing other people experiencing pain or fear, amygdala activity is lower for children with high levels CU traits compared to their peers with normative levels of CU traits (Jones, Laurens, Herba, Barker, & Viding, 2009; Marsh et al., 2008; Viding et al., 2012). Further suggesting that CU traits are tied to a lack of emotional reactivity, studies using cognitive measures of emotional reactivity (e.g., lexical decision tasks, dot-probe tasks) have found reduced cognitive orienting towards negatively valenced stimuli in youth with elevated CU traits. However, this association often only emerged after accounting for potential moderators of conduct problems, anxiety, or exposure to violence (Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012; Kimonis, Frick, Fazekas, & Loney, 2006; Kimonis, Frick, Munoz, & Aucoin, 2008; Loney, Frick, Clements, Ellis, & Kerlin, 2003; though see Kahn et al., 2017 for contradictory findings), demonstrating that the exact nature of the relationship between CU traits and emotional reactivity is not fully understood, and possible third variables may account for some of the variance found in this association.

Overall, prior research consistently suggests that CU traits are associated with a lack of reactivity to negatively valenced emotional stimuli, including facial expressions, words, and images of people in distress. Additionally, there is some indication that CU traits may be associated with under-reactivity to situations involving threats to the self, not just threats to others. If this is the case, the lack of reactivity to others described above may not be specific to empathetic concern but instead may be part of a broader deficit in emotional reactivity.

In fact, CU traits are defined, in part, by a lack of deep emotional experience. In the DSM-5, the conduct disorder specifier "with limited prosocial emotions" includes a symptom of "shallow or deficient affect", which was based on self-report and informant ratings in multiple large samples across various countries (Kimonis et al., 2015). Further, adolescents with CU traits (as well as adults with psychopathic traits) are often thought to express emotions for the purpose of manipulating others, rather than because they are truly experiencing a change in affect (Barnett & Thompson, 1985; Hawley, Little, & Pasupathi, 2002; McIlwain, 2003). Although this lack of emotional depth is often considered to be quite broad, children with CU traits are most often described as having "fearless" temperaments or having low levels of arousal to threatening and dangerous situations (e.g., Dolan & Rennie, 2007; Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999; Klingzell et al., 2016; Pardini, 2006). Studies examining responses to vignettes with threat directed toward the reader have found that youth with CU traits show reduced emotional reactivity compared to youth without CU traits (Fanti, Panayiotou, Lazarou, Michael, & Georgiou, 2016; Fanti, Panayiotou, Lombardo & Kyranides, 2016). Additional research testing anticipatory responsivity to aversive stimuli found that CU traits are associated with a lack of autonomic responsivity (i.e., electrodermal reactivity and cortisol release) to loud noises and stress-inducing tasks such as public speaking and arithmetic tests (Fung et al., 2005; Isen et al., 2010; Stadler et al. 2011). Further, longitudinal work has found that fearless temperament at ages two and three, as measured by parent and research assistant ratings of approach or avoidance behavior to novel and threatening stimuli, predicted levels of CU traits at ages thirteen and twenty-eight years (Barker, Oliver, Viding, Salekin, & Maughan, 2011; Glenn, Raine, Venables, & Mednick, 2009).

Thus, reduced emotional reactivity in children with elevated CU traits may not be specific to empathic concern and may include other forms of emotional reactivity as well - most notably, fear responses to potential threat. This opens up the possibility that children with elevated CU traits may show under-reactive empathetic responses to others because they do not experience sadness and fear themselves. Without the experience of these emotions, children with CU traits may be unable to understand those feelings in others. Thus, the basis of the empathic under-reactivity exhibited by this population may be in their inability to experience emotions in the self, rather than in solely the ability to parallel one's own feelings with others' expressions of emotion.

If the emotional deficits associated with CU traits are broader than under-reactivity to distress in others, this could have important implications for both advancing knowledge on the underlying causes of CU traits and designing interventions to target the emotional deficits that may lead to the development of these traits. However, a conclusive answer to this question has been limited by the fact that no prior study has used the same paradigm to compare reactivity to both threats directed toward others and threats directed toward the self. Comparing these different types of emotional responses using the same paradigm would ensure that any differences found were due to the type of stimuli and not to the way the emotional response is measured. Because past research has not used the same methodology to test reactivity to these stimuli, it is impossible to disentangle differences due to true variation in responses to the stimuli from differences in measurement.

CU Traits and Emotion Recognition

Again, research on adults with psychopathic traits has consistently documented that these traits are related to deficits in emotional empathy but not deficits in cognitive empathy or

problems in emotional recognition. As noted above, there is also consistent evidence for impairments in emotional reactivity in youth with elevated CU traits. However, the findings for deficits in emotion recognition are less clear in youth. Some studies report that CU traits are related to worse recognition of emotional expressions, particularly sadness and fear (e.g., Aspan et al., 2014; Schwenck et al., 2014; Woodworth & Washbusch, 2008). However, many of the studies purportedly measuring emotion recognition utilize a morphing task paradigm, in which the stimuli face slowly shifts from neutral to highly expressive and the participant identifies the emotion as soon as he/she is able to recognize it (Blair, Colledge, Murray, & Mitchell, 2001; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009). Thus, these studies capture rapidity of response to others' emotions. Measuring reaction times to others' distress conflates a person's reactivity to the expressed emotion, which increases attentional orienting and shortens reaction times, with the ability to accurately identify emotions (e.g., Hart, Green, Casp, & Belger, 2010; Schupp et al., 2007).

Additionally, a study examining emotion recognition across simple (e.g., sadness, anger, happiness) versus complex (e.g., annoyance, shame, guilt, nervousness) emotions found that children with CU traits only showed errors when identifying complex emotions (Sharp, Vanwoerden, Van Baardewijk, Tackett, & Stegge, 2015). This impairment in recognizing only complex emotions mirrors the morphing task findings that emotions that are harder to discern are the ones that children with CU traits have difficulties identifying. Again, it may be the case that lower emotional reactivity to others' expressions results in lack of motivation to learn the subtleties of others' emotional expressions, thus resulting in worse abilities to quickly identify emotions.

Further, studies directly examining CU traits and emotion recognition (i.e., using tasks that solely focus on the accuracy of identifying emotions) have reported mixed results. Some studies have found that youth with higher CU levels performed worse than their peers in their ability to recognize sadness (Aspan et al., 2014; Fairchild et al., 2009; 2010; Stevens, Charman, & Blair, 2001; Woodworth & Waschbusch, 2008) and fear (Aspan et al., 2014; Fairchild et al., 2009; Leist & Dadds, 2009; Stevens et al., 2001). However, when children with elevated CU traits are compared to those with ASD, children with CU traits show impaired affective empathy but intact cognitive empathy and theory of mind (Jones et al., 2010; Lockwood, Bird, Bridge, & Viding, 2013; Schwenck et al., 2012). Similarly, some studies comparing emotion recognition abilities between children with elevated CU traits and typically developing children have found that CU traits were not associated with deficits in accurately recognizing expressions of certain basic emotions (Sharp et al., 2015), including fear (Schwenck et al., 2014; Woodworth & Washbusch, 2008). Additionally, studies investigating attentional orienting to emotional stimuli (e.g., emotional words and pictures) suggest that CU traits are associated with reduced reactivity to a variety of negative emotional stimuli, especially those related to distress in others. However, the rating accuracy of these emotional stimuli were not related to CU traits, indicating that CU traits did not affect the ability to identify emotionality of the stimuli (Loney et al., 2003).

Developmental Changes in Emotional Recognition in Youth with Elevated CU Traits

Thus, in contrast to the clear association between CU traits and deficits in reactivity to certain types of emotional stimuli, the association between CU traits and emotional recognition is less consistent. A possible explanation for these mixed findings is that the deficits in emotional recognition associated with CU traits may change over development. As discussed above, without emotional reactivity to others' distress, children with elevated CU traits may not be

motivated to learn to identify others' emotions. However, a lack of intrinsic motivation does not necessarily mean that children with CU traits *cannot* learn to identify others' emotions over time. It is possible that as youth with CU traits mature, they become extrinsically motivated to learn to identify other's emotions because it allows them to use social cues to their advantage. That is, being able to understand others' emotions may allow children with CU traits to manipulate others and guide social interactions in ways to their own benefit. Supporting this possibility, studies examining emotion recognition deficits and psychopathic traits with adult samples find that psychopathic traits are not associated with emotion recognition deficits (Blair, 2005; Deeley et al., 2006; Kosson, Suchy, Mayer, & Libby, 2002).

Unfortunately, there are almost no studies examining changes in emotion recognition over development for children with CU traits. One study that provides some data suggesting that recognition abilities improve over time examined the associations of CU traits with different types of empathy in four age groups: three to four, five to six, seven to nine, and nine to thirteen years of age (Dadds et al., 2009). The results indicated that for boys, CU traits were negatively associated with parent ratings of affective empathy across all age groups, whereas CU traits were negatively related to cognitive empathy only in the two younger age groups. As a result, these authors suggested that boys with high CU traits improve in their ability to understand others' emotions over the course of childhood. These findings provide an intriguing explanation for some of the inconsistencies in past findings on the emotional recognition deficits associated with CU traits and how these deficits may change across development. However, there are some significant limitations to this study that need to be considered when making these interpretations. Most importantly, the cognitive empathy measure was a parent rating of their child's empathy (e.g., "my child has trouble understanding other people's feelings", Dadds et al., 2009, p. 600)

and thus did not directly capture the child's ability to recognize others' facial expressions. Further, the CU rating used to characterize the children combined CU scores and ratings of antisocial behavior. Thus, it is not clear whether the findings were due to CU traits specifically. As a result of these limitations, the findings of this study, though provocative, need to be replicated using different methodology before firm conclusions can be made.

Although no study has directly compared children across age groups when examining emotion recognition abilities and CU traits, an inspection of the ages of the samples that have found conflicting results is not consistent with an improving developmental trajectory in youth with CU traits. Specifically, CU traits are not associated with emotion recognition deficits in preadolescent children (i.e., ages ten to twelve), but are associated with deficits later in development (i.e., ages thirteen to eighteen; Aspan et al., 2014; Fairchild et al., 2009; 2010; Leist & Dadds, 2009; Sharp et al., 2015). Such findings do not support the theory that children with CU traits improve in their abilities to recognize emotions in others. One possible explanation for this pattern across ages is that all children may be poor at recognizing emotions when they are young and therefore, this deficit is not specifically associated with CU traits in younger samples. Over time, children typically improve in their emotional recognition abilities (Batty & Taylor, 2006; Tonks, Williams, Frampton, Yates, & Slater, 2007), but this may take longer for those with elevated CU traits because they lack the intrinsic motivation to learn emotion recognition skills. In other words, it is possible that younger children, regardless of level of CU traits, struggle with accurately identifying emotions, and therefore the association between CU traits and emotion recognition deficits is not consistently found earlier in development (Durand, Gallay, Seigneuric, Robichon, & Baudouin, 2007; Tonks et al., 2007). As children mature, those without CU traits improve in their emotion recognition abilities, but those with CU traits do not,

resulting in a disparity between the two groups and leading to the association between CU traits and emotion recognition deficits found in adolescent samples. However, the paucity of studies directly comparing deficits in emotional recognition across different age groups using the same methodology necessitates further testing of these possible developmental changes.

Statement of the Problem

In summary, prior research has established that children and adolescents with elevated levels of CU traits show deficits in their empathic responses to others. Although research consistently finds that CU traits are associated with deficits in emotional reactivity to others' distress, the underlying cause of this hyporeactivity remains unclear. It is possible that children with CU traits may react less strongly not only to threat directed at others and others' distress, but also to threat directed at themselves. This possibility is important to consider because a deficit in general emotional processing could lead to an inability to understand and recognize emotions in others. For example, if a child never experiences fear himself, he would be unable to understand others' experiences of fear. If general emotion processing is impaired, the focus of research on CU traits and empathy deficits should be on the more general shallow emotional experience, rather than specifically on the response to others' distress cues. However, studies to date have been limited by using different methodologies to assess reactivity to threat (i.e., fear) and reactivity to distress in others (i.e., affective empathy). Thus, the current study directly compared responses to threat to the self, threat to others, and others' distress cues using similar methods in order to ensure that any differences are due to the type of emotional stimuli and not due to the way in which the emotional response is measured.

A second area of uncertainty in prior research is whether CU traits are associated with deficits in the ability to recognize others' emotions. Studies in this area are highly inconsistent,

with some prior work finding that CU traits are related to problems in emotional recognition, while other studies find no association. A possible explanation for these discrepant responses is that prior research often has not considered developmental changes in emotion recognition abilities and how these developmental changes may differ for children with elevated CU traits. Specifically, there are two possible developmental pathways that may explain these differences in findings. One pathway suggests that children with elevated CU traits learn to accurately recognize emotions in others over time, despite not having typical levels of emotional reactivity, because of the social advantages of accurately recognizing others' emotions. This possible pathway is supported by the finding that CU traits are associated with parent ratings of cognitive empathy at young ages but are unrelated in adolescence (Dadds et al., 2009). A second possibility is that children overall improve in their emotional recognition skills over time but those with CU traits improve more slowly and, as a result, these traits are more highly associated with emotional recognition deficits in adolescence when these differences in developmental trajectories are more apparent. Supporting this possibility, some prior research has found that young children perform similarly on emotion recognition tasks, regardless of level of CU traits, but by adolescence, youth with CU traits lag behind their peers (Aspan et al., 2014; Fairchild et al., 2009; 2010; Leist & Dadds, 2009; Sharp et al., 2015). Unfortunately, research directly testing developmental changes in the association between CU traits and emotion recognition is sparse and has been limited by a number of methodological issues.

In the current study, these questions were addressed by comparing responses to a facial affect recognition task across three age groups: kindergarteners, third graders, and sixth graders. By using the same task across these age groups, developmental differences in abilities were able to be examined. The present study addressed the limitations in past research by using two

cognitive tasks that measured (1) how participants reacted to emotional stimuli and (2) their accuracy in identifying emotional expressions. In the first task (the Self/Other task), participants responded to situations involving threat to themselves, threat to another person, and facial expressions of distress. Stimuli were presented at the subliminal levels to provide the opportunity to compare emotional priming effects of these three types of stimuli. The second task (the NimStim) assessed accuracy in emotion recognition by asking participants to view an image of a person expressing an emotion and identify the emotion that was depicted. To address the question of whether emotion recognition varies over development, the present study utilized a cross-sectional design with three age groups (young, middle, and older childhood). By comparing responses to the same tasks across age groups, possible developmental changes in children's emotional abilities were able to be examined.

Study Hypotheses

In the current study, the following hypotheses were tested:

1. CU traits would be positively associated with deficits in emotional reactivity to others' facial expressions of distress and this would not be moderated by age of the child.

    1a. CU traits would also be positively associated with deficits in emotional reactivity to situations in which others are experiencing a threat (without showing facial cues of distress) and situations in which there is a threat directed toward the self and these associations would not be moderated by age of the child.

2. The association between CU traits and emotion recognition abilities would be moderated by the age of the child.

    2a. The form of this moderation would be tested to determine which of two theories the data supported. If the association between CU traits and accuracy in recognizing

emotions is others was significantly negative in younger grades but became non-significant in older grades, this would have supported the theory that children with CU traits improve in their emotion recognition over time. In contrast, if the association between CU traits and accuracy in recognizing emotions in others was non-significant in younger children but became significantly negative in older grades, this would have supported the possibility that all children have poor emotion recognition abilities initially and those with CU traits develop this skill at a slower rate than their peers.

Method

Participants

217 children from two school districts in the southeastern United States completed the study measures. Children who performed at chance or worse on the cognitive tasks were removed from analyses in order to remove variance due to children's lack of attention to the tasks. Thus, the final sample was comprised of 142 children (31 kindergarteners, 71 third graders, 40 sixth graders) and their primary caregivers and teachers. This sample size provided adequate power (0.80) to detect a small effect size ($|r| = .23$) at the $p = .05$ level in correlations between CU traits and levels of emotional reactivity and recognition accuracy, collapsing across grade levels (Faul, Erdfelder, Buchner, & Lang, 2007). Within each grade level, the sample size provided adequate power (0.80) to detect a moderate effect size ($|r| = .40$ - $.48$) at the $p = .05$ level in correlations between CU traits and emotional reactivity and recognition accuracy (Faul et al., 2007). In prior research, a small to moderate effect size has been found when examining CU traits and emotional reactivity (Aspan et al., 2014; Leist & Dadds, 2009).

The children ranged in age from 5.14 to 14.27 years old, with an average age of 9.20 (SD = 2.28). 40.8% of the children were boys, 58.5% were girls (one child's gender was not reported), and parents identified their children primarily as Black/African American (45.1%), with a large portion identifying their children as Non-Hispanic White (28.9%) and Biracial/Mixed (12.0%). The highest level of education completed by the majority of parents was receiving a high school diploma (44.4%). Equal percentages of parents were married (34.5%) and single, never married (33.8%). The majority of families reported their income level as less than $19,999 (31.7%) or between $20,000 - $39,999 (26.1%). Table 1 provides a summary of the participant demographic characteristics.

Table 1. Frequency and Distribution of Participant Demographics

	Mean/ Percentage	Standard Deviation	Minimum	Maximum
Age (years)	9.20	2.28	5.14	14.27
Gender				
Male	40.8			
Female	58.5			
Ethnicity				
Non-Hispanic White	28.9			
Black/African American	45.1			
Latino/Hispanic American	4.2			
East Asian/Asian American	2.1			
South Asian/Indian American	0.0			
Middle Eastern/Arab American	1.4			
Native American/Alaskan Native	0.0			
Biracial/Mixed	12.0			
Other	0.7			
Parent marital status				
Married	34.5			
Single, never married	33.8			
Divorced	13.4			
Separated	4.9			
Widowed	0.7			
Remarried	0.7			
Other (e.g., engaged)	1.4			
Parent education level				
High school	44.4			
GED	9.2			
Trade school certificate	11.3			
Associate's	8.5			
College	10.6			
Graduate degree	2.1			
Parent income level				
Less than $19,999	31.7			
$20,000-$39,999	26.1			
$40,000-$59,999	12.7			
$60,000-$79,999	4.9			
$80,000-$99,999	8.5			
$100,000+	5.6			

Main Study Measures

Inventory of Callous-Unemotional Traits (ICU; Frick & Ray, 2015). The ICU is a widely used twenty-four item continuous measure of CU traits (Frick & Ray, 2015; Kimonis et al., 2008b). Although factor analyses uncover several dimensions of CU traits as assessed by the ICU, the current recommendation is to use the total scale score in analyses, given concerns over the reliability and validity of the subscales (Ray, Frick, Thornton, Steinberg, & Cauffman, 2016). The measure was developed from the CU scale from the Antisocial Process Screening Device (APSD; Frick & Hare, 2001) and was created to focus specifically on capturing CU traits. The measure consists of a four-point Likert-type scale ranging from zero ("Not at all true") to three ("Definitely true") on which participants indicate how much each statement describes the child. Statements include items such as, "Does not care who he/she hurts to get what he/she wants", "Is concerned about schoolwork", and "Does not show emotions". Positively worded items are reverse coded. The ICU total score has been shown to be internally consistent (α = .82–.85; Kochanska, Kim, Boldt, & Yoon, 2013; Somech & Elizur, 2012) with samples of young children. Additionally, prior research has found the ICU is positively correlated with laboratory measures of emotional reactivity in children and adolescence (Jusyte, Mayer, Kunzel, Hautzinger, & Schonenberg, 2015; Kimonis et al., 2006, 2008a, 2012; Loney et al., 2003). Given the age range of the sample, teacher report of CU traits was used. Teachers serve as informants who see the child relative to a large number of same-aged peers and thus can rate the child with the knowledge of their peers' normative development (Frick, Barry, & Kamphaus, 2010). The total scale showed excellent internal reliability in the current sample (α = .90).

Self/Other Reactivity Task. The Self/Other task was created for the proposed study to assess the specificity of the emotional under-reactivity associated with CU traits. This task is

based on emotional priming paradigms used in prior work to assess attentional orienting (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Greenwald, McGhee, & Schwartz, 1998). Prior studies using affective priming tasks have found that responses are facilitated when the priming stimuli are congruent in emotional valence to the target stimuli, even when the prime is presented at a subconscious level (e.g., Fazio et al., 1986; Lamy, Amunts, & Bar-Haim, 2008; Murphy & Zajonc, 1993; Niedenthal, Halberstadt, & Setterlund, 1997; Wentura, 1999). Additionally, emotional priming tasks have been used with children and adolescents (ages six to nineteen years) to examine emotional face processing, reactivity to threat, automatic emotional responses to peers, and implicit biases at both subliminal and supraliminal exposure levels (Degner, Wentura, Gniewosz, & Noack, 2007; Kamio, Wolf & Fein, 2006; Spence, Lipp, Liberman, & March, 2006). These studies found emotional priming effects for threat-associated images, images of out-group members, and images of emotional facial expressions.

The Self/Other task consists of multiple trials with the following sequence. First, a fixation asterisk appears in the middle of the screen for 500ms. After this attention orienting image, a stimuli image appears for 250ms. Next, the participant views a cartoon picture depicting either a clearly positive emotion (e.g., smiling, happy) or clearly negative emotion (e.g., frowning, sadness; see appendix). The participant must sort the cartoon picture into one of two categories: positive or negative. The positive category is denoted by a thumbs up, and the negative category is indicated with a thumbs down (see appendix). Participants press either the "e" key or the "i" key on the keyboard to sort the cartoon picture into one of the categories. The "e" key is associated with whichever category is presented in the left upper corner of the screen, and the "i" key is associated with the category presented in the right upper corner of the screen. The presentation order of the stimuli images and cartoon images is random, as is the placement

of the categories for sorting (i.e., in some trial blocks, the positive category is on the left, while in others, it is on the right, and the position is randomly assigned throughout the task). Counterbalancing the positive and negative category labels by block ensures that reaction times are not influenced by placement of the category label on the screen.

The task uses images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) set of stimuli pictures as well as similar pictures from online open sources. The IAPS contains images of various content that have been pretested for levels of emotional arousal and valence with children and adults. IAPS threat pictures have detected emotional priming effects in children (ages seven to fourteen years) in prior work (Spence et al., 2006). The images in this task included situations in which there is a threat directed at the viewer, situations in which there is a threat to another human, and depictions of other humans showing distressed facial affect. The other-threat and self-threat stimuli were matched for type of threat. For example, the IAPS includes an image of an angry dog facing the viewer, which constitutes a self-threat situation. The matching other-threat situation contains an angry dog facing another human. In order to isolate the effects of threat versus distress, the images in which another human is in threat did not have clear images of faces, thereby ensuring that participants' reactions are in response to another person in danger, not to another person's expression of distress. Additionally, there were trials of viewer-directed neutral situations and matching neutral situations directed toward another person. Including these neutrally valenced situations allowed for a difference score to be calculated between the threat situations and neutral situations, thereby accounting for general reactivity to visual stimuli.

Within each block of trials, each priming stimulus image type (self-threat, other-threat, self-neutral, other-neutral, distress) was shown, followed by the target cartoon images with

positive or negative valences. Each pairing (e.g., self-threat with a negative cartoon) was repeated twice with the category sorting labels switching location between the trials. In other words, each participant viewed the same stimulus image pairing with cartoon valence with the positive category label on the left side of the screen, and again with the positive category label on the right side of the screen. Thus, there are a total of four images per stimuli type in each block (cartoon valence: *positive, negative* by positive category label placement: *left, right*). Overall, this task follows a within-subjects five (stimuli type: *self-threat, other-threat, self-neutral, other-neutral, distress*) by two (cartoon valence: *positive, negative*) by two (location of category: *positive on left, positive on right*) design per block. There are four blocks of trials to ensure that each pairing of stimuli type and cartoon image valence is repeated an adequate number of times. In order to ensure that participants do not become familiar with the stimuli images, each image was only repeated once. If no images were repeated, the task would require a total of sixteen original images per stimuli type, as each stimuli type is shown four times per block of trials, and there is a total of four blocks of trials. Thus, to reduce the number of images needed, each image was repeated once, resulting in a total of eight images per stimuli type.

Due to the need for eight images per stimuli type, supplemental images in addition to IAPS images were required. IAPS images were used whenever possible; however, IAPS images were included only if (1) they had been used in prior studies with child participants and (2) they aligned with one of the stimuli category types. These requirements narrowed down the IAPS images considerably. Specifically, there were very few self-neutral and other-neutral images. All supplemental images were chosen because they were similar in content to the IAPS images, and were pilot-tested alongside the IAPS images to ensure they were of similar valence and arousal (see Preliminary Analyses for details about the pilot testing procedure and results).

This task yielded several different scores. First, to examine emotional reactivity to others' distress, the difference in reaction time between congruent (e.g., a facial expression of distress followed by a negative target cartoon) and incongruent (e.g., a facial expression of distress followed by a positive target cartoon) trials was calculated. This difference score provided a measure of facilitation to a negative target when viewing another person expressing distress. Second, to examine emotional priming effects of situations with threat directed at the self and situations with threat directed toward another person, two different scores were calculated. One score consisted of the difference in reaction time between congruent trials and incongruent trials, exactly as was the case for the distress primes. That is, a difference score was calculated between trials in which the priming image and target image matched in emotional valence (e.g., a self-directed threat situation followed by a negative cartoon) and trials in which the priming image and target image did not match in emotional valence (i.e., a self-directed threat situation followed by a positive cartoon). This difference score provided a measure of facilitation for sorting negative cartoons after viewing images of self-directed threat and other-directed threat. The second score used the difference in reaction time between congruent trials and trials with a neutral emotional prime. Specifically, the difference score was calculated between trials in which the priming image and target image matched in emotional valence (e.g., a self-directed threat situation followed by a negative cartoon) and trials in which the priming image was neutral. As some neutral priming images were followed by positive cartoons and others were followed by negative cartoons, these trials were collapsed across to form a general neutral response time latency score. That is, the neutral condition latency score was the mean of reaction times of neutral primes followed by positive cartoons and neutral primes followed by negative cartoons, and was created separately for other- and self-directed neutral images. This difference score

provided a measure of emotional priming of self- and other-directed threats by removing the variance due to reactions to stimuli in general. In other words, this score captures the emotional priming effect of a self- or other-directed threat while controlling for general responsivity to viewing images.

NimStim Affective Facial Recognition Task (Tottenham et al., 2009). The NimStim Affective Facial Recognition Task measures accuracy in facial expression recognition. The NimStim is a compilation of color photographs of adults expressing happiness, sadness, anger, disgust, fear, or neutral facial expressions. The adults range in ethnicity and are both male and female. The design of this task was modeled after the University of New South Wales Facial Emotion Task (FACES; Dadds, Hawes, & Merz, 2004) in that each of the six expressions is displayed by each adult (resulting in thirty-six stimuli slides) for 2 seconds, and presented in random order. In addition, each emotion has both open and closed mouth expressions to account for possible perceptual differences in stimuli that may bias responses (Kestenbaum & Nelson, 1990). After each facial expression stimulus is presented, a screen appears with all six emotion options, asking the participant to choose which emotion was just portrayed. In order to ensure that all age groups (including kindergarteners) were able to understand the response options, children could click on the word to hear the word read aloud before selecting their response. Participants were given a practice run of six trials (one per emotion) prior to beginning the experiment in order to ensure they understood the task. The outcome variable is the percentage of facial expressions correctly identified. Thus, higher scores indicate higher accuracy in categorizing emotional expressions.

Previous research has supported the validity of the facial stimuli in diverse undergraduate and community adult samples by examining the agreement between the labels the participants

assigned to each facial expression and the intended facial expression (Tottenham et al., 2009). The overall percentage correct was high (M = .81), and the kappa level of concordance was high (M = .79) across actors. In this same validation sample, participants rated all images at two time points (20 minutes apart) and the faces were presented in random order during both trials. Test-retest reliability was high, with agreement between times one and two reaching a mean reliability score of 0.84 (Tottenham et al., 2009). Additionally, the NimStim facial stimuli have been used to examine emotion recognition with children age five and older (e.g., LoBue, 2009; Pérez-Edgar et al., 2011; Rump et al., 2009; Tanaka et al., 2012). These studies have found that NimStim images are able to detect attentional biases for emotional expressions, particularly threatening ones such as anger (LoBue, 2009; Pérez-Edgar et al., 2011) and fear (LoBue, 2009). Additionally, studies have used the NimStim facial stimuli to examine emotion recognition and ASD in children (ages five to seven years; Rump et al., 2009) and adolescents (ages five to eighteen years; Tanaka et al., 2012), finding that ASD is associated with inaccuracy in recognizing emotional expressions.

However, these studies used different paradigms than the task used in the current study. The same task paradigm used in the current study was used with a different facial stimuli set (FACES; Dadds et al., 2004) to examine deficits in emotion recognition in children and adolescents (ages eight to eighteen years) with CU traits (Dadds, El Masry, Wimalaweera, & Guastella, 2008; Dadds et al., 2006; Leist & Dadds, 2009). These studies consistently found that CU traits were associated with impairments in fear recognition. This exact task (i.e., same stimuli, same paradigm) was used in one prior study to assess the relationship between facial expression recognition accuracy and CU traits in a sample of adolescents (Kahn et al., 2017).

This study found that CU traits were correlated with higher accuracy in recognition of fearful expressions (Kahn et al., 2017).

Measures – Supplementary

Cognitive Screener. A short form version of Raven's Progressive Matrices, Standard Progressive Matrices (SPM; Bilker et al., 2012) was used as a brief screener of cognitive ability in order to assess the potential effects of intellectual ability on the study findings. The SPM is a nonverbal test of analytic intelligence that is normed for use with children (ages six to sixteen years) and can be administered in both individual and group settings (Carpenter, Just, Shell, 1990; Raven, Raven, & Court, 1998; 2003). Initially designed to provide a basic measure of cognitive functioning that could be easily administered, interpreted, and used in research, the SPM has also been used to assess cognitive abilities in educational settings (Raven, 2000). The SPM correlates highly (e.g., 0.74 - 0.84) with Full Scale IQ scores on the Wechsler Adult Intelligence Scale-Revised (O'Leary, Rusch, & Guastello, 1991), and has high internal consistency (.88; "Raven's Standard Progressive Matrices (SPM) Evidence of Reliability and Validity", 2017). The full-length, sixty-item SPM takes forty-five to sixty minutes to administer (Raven, Raven, & Court, 2003). However, a shorter version consisting of nine items has been developed as a brief cognitive screener. This version of the SPM reduces the administration time by at least 75%, and takes approximately ten minutes to complete (Bilker et al., 2012). Though the SPM were initially designed as a paper booklet administration, this study used a computer-based administration. Computer-based, automated versions of the SPM have been shown to be similarly accurate to the traditional booklet administration (Arce-Ferrer & Guzmán, 2009; Calvert & Waterfall, 1982; Williams & McCord, 2006), and the revised version of the SPM will

include online administration ("Raven's 2", 2019). Thus, it was deemed acceptable to use computer-based administration for the current study.

Disruptive Behavior Disorder Scale (DBD; Pelham, Gnagy, Greenslade, & Milich, 1992). The DBD is a 45-item measure designed to measure the symptoms of disruptive behavior disorders (oppositional defiant disorder, conduct disorder, and attention deficit/hyperactivity disorder) according to DSM-5 criteria. Teachers rate the extent to which the child exhibits each symptom on a 4-point scale ranging from "Not at all" to "Very much". In the current study, the subscales for ODD and CD were used to determine if the associations between CU traits and the various measures of emotional reactivity and emotional recognition were influenced by the child's level of conduct problems. The combined ODD and CD scale used in analyses had excellent internal reliability in the current sample ($\alpha = .94$).

Procedure

After receiving approval from the Louisiana State University Institutional Review Board and the superintendent of the New Iberia and St. Mary parish schools, principals at the elementary and middle schools were approached. After receiving approval from the principal of each school, each kindergarten, third grade, and sixth grade teacher was asked for their participation. With the help of the teachers, packets were sent home to parents with parental informed consent forms and parent-report of demographics. Parents were also provided a copy of the consent form for their records. Parents returned the sealed envelopes with their completed forms to their child's school. Parental consent forms were required to be returned by certain dates prior to administration of the student portion of the study. After receiving parental consent, children were asked for their assent to participate. The study tasks were described orally to all students, as well as presented in an informed assent form, to ensure they gave fully informed

assent. All child-report measures were administered during the school day, in a group setting, on school computers. The student tasks took approximately thirty minutes to complete.

Consent forms were sent home to the parents of 874 children from the two participating school districts. 257 parents returned the consent form, resulting in a response rate of 29.41%. Although all children whose parents returned the consent form also assented to the study, several children were absent on days of study administration or had left the school, resulting in a total of 217 children completing the cognitive measures. For all participating children (i.e., those who returned parental consent and who provided assent), teachers completed the ICU and DBD. Teachers completed their informed consent forms, the ICU, and the DBD for each student on a computer, and they were able to complete these measures at their convenience. To compensate teachers for their time and effort, and to encourage participation, each classroom received ten dollars per participating child to be used for purchasing classroom supplies (e.g., a class of ten participating students received one hundred dollars for classroom supplies). Children were also provided with snacks to thank them for their participation.

Results

Preliminary Analyses

Pilot Tests of Added Images. The first preliminary analyses were conducted on a pilot sample of 176 undergraduate college students. In this sample, participants followed the same procedure as was used to validate the IAPS images (Lang et al., 2008). Participants rated each image's valence and arousal, and based on these ratings, the internal reliability of the various images within each rating of valence and arousal were tested. These tests of internal reliability provided evidence for whether the images (i.e., both IAPS and added images) formed internally consistent indicators of each construct. The Cronbach's alphas of the various image types were as follows. Other-directed neutral images had alphas of .66 for valence and .80 for arousal and the added images showed similar item-total correlations as the original IAPS images (all .32 and above). Self-directed neutral images had alphas of .63 for valence and .72 for arousal, and again the added images showed similar item-total correlations as the original IAPS images (all .21 and above). Other-directed threat had alphas of .81 for valence and .87 for arousal and the added images showed similar item-total correlations as the original IAPS images (all .51 and above). Self-directed threat had alphas of .85 for valence and .89 for arousal, item-total correlations for added images were similar to those of the original IAPS images (all .60 and above). Finally, images depicting others in distress had alphas of .79 for valence and .90 for arousal, and again, the item-total correlations for added images were similar to the those of the original IAPS images (all .44 and above). Thus, all categories of image types showed high internal reliability levels, with the exceptions of valence for the neutral image categories, which were in the adequate range.

Data Reduction. The data for each trial in the Self/Other task consisted of response latencies in milliseconds. Prior to conducting further analyses, distributions of these latencies were examined. As is common with response time measures, the distributions were skewed such that most participants responded fairly quickly to the target image. In order to address the skew in distribution, several steps were taken, as recommended by prior studies using similar cognitive tasks (e.g., Fazio, 1990; Greenwald et al., 1998). First, as noted above, participants who performed at chance or worse on either of the two cognitive tasks were removed from all further analyses. Next, the data were examined for outliers. Outliers were windsorized to 2.5 standard deviations above or below the mean. The distributions of latency times on the Self/Other task continued to be positively skewed, with most responses falling below the mean. In order to correct for this, a log transformation was used. The log transformed data was used in all further analyses. After each latency score distribution was log transformed, the difference scores among reaction times between incongruent-congruent trials and incongruent-neutral trials were created. For example, the log transformed response times to other-directed threat followed by a congruent target stimulus were subtracted from the log transformed response times to other-directed threat followed by an incongruent target stimulus. This process was repeated to create the various facilitation indices.

Manipulation Check. To test whether the emotional priming had the intended effects, the overall sample difference in reaction times on congruent trials and incongruent trails was compared. Based on prior studies, congruent trials should be associated with faster reaction times than incongruent trials (e.g., Fazio et al., 1986; Lamy et al., 2008; Murphy & Zajonc, 1993; Niedenthal et al., 1997; Wentura, 1999). This finding held true for the reaction times for distress (congruent trials $M = 3.091$, $SD = 0.158$, incongruent trials $M = 3.162$, $SD = 0.148$; $t(141) =$

6.979, $p < .001$, $d = 0.586$) and other-directed threat conditions (congruent trials $M = 3.124$, $SD = 0.166$, incongruent trials $M = 3.149$, $SD = 0.161$; $t(141) = 2.593$, $p = .011$, $d = 0.218$). However, when primed by self-directed threat images, there was no significant difference in reaction times to congruent versus incongruent stimuli, indicating that the self-directed threat prime did not succeed in emotionally priming participants (congruent trials $M = 3.129$, $SD = 0.167$, incongruent trials $M = 3.127$, $SD = 0.152$; $t(141) = -0.173$, $p = .863$, $d = 0.015$). When comparing the reaction times to positive and negative stimuli after being primed by images of neutral content, no significant differences arose, indicating that the neutral prime conditions did not lead to emotional priming, and thus appear to have been effective at presenting emotionally neutral content. That is, the reaction time to other-directed neutral images followed by positive content ($M = 3.124$, $SD = 0.163$) did not significantly differ from the reaction time to other-directed neutral images followed by negative content ($M = 3.127$, $SD = 0.145$; $t(141) = -0.371$, $p = .711$, $d = 0.031$), and the reaction time to self-directed neutral images followed by positive content ($M = 3.120$, $SD = 0.177$) did not significantly differ from the reaction time to self-directed neutral images followed by negative content ($M = 3.124$, $SD = 0.155$; $t(141) = -0.360$, $p = .720$, $d = 0.030$). Overall, the emotional priming images for others in distress and other-directed threat appear to have effectively negatively emotionally primed participants, while the self-directed threat images did not. The neutral images appear to have been true neutral primes as reaction times to positive and negative targets shown after these neutral images were comparable. Thus, valid facilitation indices include others in distress (incongruent vs congruent trials) and other-directed threat (incongruent vs congruent trials, incongruent vs neutral trials). As the self-directed threat images did not appear to serve as valid emotional primes, this condition was not included in future analyses.

Descriptive Analyses. The distributions of the main study variables and demographic variables after the data cleaning described above are provided in Table 2. Though there were missing data for some participants, there did not appear to be a pattern to the missing data. 35 participants were missing at least one demographic variable (i.e., gender, ethnicity, parent marital status, parent education level) and 18 participants were missing at least one teacher report variable (i.e., level of conduct problems and/or level of CU traits). To test for non-random missingness in the data, a count variable was created to examine the number of variables for which each participant had missing data. This count variable was then correlated with all demographic and main study variables to see if any demographic or main study variables were associated with missing data. None of these correlations were significant (all rs $\leq .17$, all ps $\geq .06$), indicating that data was missing at random. Therefore, cases were deleted from analyses list-wise when a variable was missing (i.e., the participant was removed from a specific analysis if a variable required for the analysis was missing). Finally, skew in the data was assessed for all variables other than the Self/Other task (these distributions were already corrected, as noted above) by examining histograms and dividing the skew and kurtosis statistics by their standard error to ensure this number was less than 1.96 (as recommended by Field, 2013; Tabachnick & Fidell, 2001). Overall emotion recognition accuracy and accuracy in recognition of fearful faces were slightly negatively skewed, indicating that most participants had high rates of correctly identifying these expressions. Given that this skew is representative of emotion recognition abilities in the general population, this variable was not transformed. Level of CU traits was slightly positively skewed, indicating that most participants had lower levels of CU traits. Again, as this distribution is representative of the population, it was left untransformed. Finally, conduct problems was highly positively skewed, indicating that most participants had low levels of

conduct problems. Given that this skew is representative of the distribution of conduct problems in childhood, it was not transformed.

Table 2. Frequency and Distribution of Main Study Variables

	Mean/ Percentage	Standard Deviation	Minimum	Maximum
Covariates				
Cognitive Ability (z-scores within grade level)	0.05	1.04	-1.20	3.40
Conduct problems (DBD; scale from 1-4)	1.96	0.71	1.50	3.95
Callous-unemotional traits (ICU; scale from 0-72)	27.07	7.61	12.00	47.12
Emotional Reactivity – log transformed milliseconds				
Latency responding to others distress (incongruent trials-congruent trials)	0.07	0.12	-0.29	0.32
Latency responding to threat towards others (incongruent trials-congruent trials)	0.02	0.11	-0.23	0.38
Latency responding to threat towards others (incongruent trials-neutral trials)	0.02	0.10	-0.18	0.29
Emotional Recognition – percentage correct				
Facial expression recognition (overall)	67.84	15.73	33.33	97.22
Facial expression recognition (fear)	59.62	32.76	0.0	100.0
Facial expression recognition (sadness)	55.05	22.80	0.0	100.0

Next, correlations between the demographic variables and main study variables were run (see Table 3). The demographic variables of grade, cognitive ability, gender, and parent education level were associated with one or more main study variables, and thus were controlled for in all further analyses. Specifically, grade level was positively associated with accuracy in recognizing facial expressions (overall: $r = .53$, $p < .001$; sadness: $r = .27$, $p = .001$; fear: $r = .39$,

$p < .001$). This finding indicates that children in higher grade levels were more accurate in their recognition of facial expressions. Cognitive ability was positively associated with accuracy in recognizing facial expressions (overall: $r = .26$, $p = .002$; fear: $r = .26$, $p = .002$) and level of CU traits ($r = .21$, $p = .016$), indicating that children with higher cognitive abilities were more accurate in recognition of expressions and were higher in level of CU traits, as rated by their teachers. Gender was positively correlated with expression recognition accuracy (overall: $r = .21$, $p = .011$; sadness: $r = .18$, $p = .037$; fear: $r = .17$, $p = .049$), indicating that girls demonstrated higher accuracy in recognizing emotions than boys. Parent education level was negatively associated with reaction time difference scores when responding to threat directed at others (incongruent vs congruent facilitation score: $r = -.23$, $p = .011$; incongruent vs neutral latency score: $r = -.19$, $p = .039$), indicating that children of parents with higher education levels showed more similar reaction times on incongruent and congruent or neutral trials (i.e., their difference scores decreased).

Hypothesis 1. CU Traits and Emotional Reactivity

To test the first hypothesis that CU traits would be negatively associated with reactivity to others' distress and that this association would not be moderated by age, a two-step hierarchical linear regression analysis was run. Demographic variables (i.e., grade, cognitive ability, gender, and parent education level), CU trait level, and grade level were entered as predictors in step one, and the interaction term between CU traits and grade level added as a predictor in step two, with the dependent variable being the facilitation score of categorizing target images when primed with an expression of a distress (incongruent – congruent reaction times). Higher facilitation scores indicate a faster reaction time to congruent than incongruent trials. As noted in Table 4, and contrary to hypotheses, there were no significant main effects or

Table 3. Zero Order Correlations among Main Study Variables and Demographics

	Child CU level	Child conduct problems	Child grade	Child cognitive ability	Child ethnicity	Child gender	Parent marital status	Parent education level	Parent income level
Emotional Reactivity									
Latency responding to others distress (incongruent trials-congruent trials)	.07	.08	.07	.06	.11	.02	-.02	-.03	-.05
Latency responding to threat towards others (incongruent trials-congruent trials)	.06	-.05	.03	-.03	-.13	.01	-.17	-.23*	-.05
Latency responding to threat towards others (incongruent trials-neutral trials)	.08	-.04	.04	-.08	.04	-.07	.05	-.19*	.04
Emotional Recognition									
Expression recognition accuracy: overall	-.09	-.13	.53***	.26**	-.01	.21*	.04	-.06	.02
Expression recognition accuracy: sadness	-.05	-.09	.27***	.08	-.01	.18*	-.04	.04	-.06
Expression recognition accuracy: fear	.00	.00	.39***	.26**	.06	.17*	.05	.05	.10
Covariates									
Child CU level	1	.67***	.08	.21*	.02	-.09	.04	-.04	-.11
Child conduct problems	.67***	1	.00	.07	.08	-.11	-.06	.04	.00

Note. CU = callous-unemotional traits; Ethnicity: 0 = Minority; 1 = Caucasian; Gender: 0 = Male; 1 = Female; Marital Status: 0 = Not Married; 1 = Married. *p < .05, ** p ≤ .01, *** p ≤ .001

interaction effects. Thus, the results reported in Table 4 are from the model without the interaction term.

To test the hypothesis that CU traits would be negatively associated with emotional reactivity to threat towards other people and that this association would not be moderated by age, another two-step hierarchical linear regression analysis was run. Demographic variables, CU trait level, and grade level were entered as predictors in step one, and the interaction term between CU traits and grade level was added as a predictor in step two, with the dependent variable being the facilitation score of categorizing target images when primed with an other-directed threat image. As noted previously, the facilitation scores were calculated in two ways: (1) the difference score between congruent and incongruent trials and (2) the difference score between congruent and neutral primed trials. Thus, two regressions were run with the two different facilitation scores as the dependent variable. As noted in Table 4, contrary to hypotheses, there were no significant main effects or interaction effects. As such, the results reported in Table 4 are from the model without the interaction term.

Hypothesis 2. CU Traits and Emotion Recognition

To test the second hypothesis that CU traits would be associated with impairments in emotion recognition and that the nature of this relationship would differ based on age, a two-step hierarchical linear regression analysis was run. Demographic variables (i.e., grade, cognitive ability, gender, and parent education level), CU trait level, and grade level were entered as predictors in step 1, and the interaction term between CU traits and grade level added as a predictor in step two, with the dependent variable being overall accuracy in emotion recognition. As noted in Table 5, there were main effects of IQ, grade level, and CU traits but no significant interaction between CU traits and grade. Thus, the results reported in Table 5 are from the model

without the interaction term. As shown from these results, both higher IQ and grade level were associated with greater accuracy in recognizing emotions. Further, CU traits were negatively associated with accurate emotional recognition, when controlling for the demographic variables. The same linear regressions were run with accuracy in recognizing sadness and accuracy in recognizing fear and, again, there was no interaction between CU traits and grade in their association with emotional accuracy. As noted in Table 5, the main effects of CU traits did not reach statistical significance in these models, although the parameters were in the expected direction.

Post-Hoc Sensitivity Analyses

Prior research has found a moderating effect of conduct problems on the relationship between CU traits and emotional responsivity, with the effects of CU traits only being apparent in youth with high levels of conduct problems (e.g., Fairchild et al., 2009, 2010; Kimonis et al., 2006; 2008a; Woodworth & Waschbusch, 2008). This finding has been explained as being due to the fact that very few children high on CU traits are low on conduct problems and the fact that those children high on conduct problems tend to show a very different pattern of emotional reactivity if they are low on CU traits (e.g., hyper-reactivity) than if they are high on CU traits (e.g., hypo-reactivity; Kimonis et al., 2006). Such a moderating role of conduct problems has not been consistently considered for emotional recognition, although the theoretical link between emotional reactivity as a motivator for emotional recognition would make such tests important. Additionally, many of the studies examining emotional responsivity and CU traits have included participants that are either solely male or female, rather than a mixed-gender group (e.g., Aspan et al., 2014; Bowen et al., 2014; Jones et al., 2009; Schwenck et al., 2014). Thus, it is possible that gender may moderate the relationship between CU traits and emotional responsivity, as it

Table 4. Multiple Regression Analyses Testing the Main and Interactive Effects of Callous-Unemotional Traits and Grade on Emotional Reactivity

Variable	Grade	IQ	Gender	Education	CU	R^2	*F (df 5, 110)*
Facilitation Indices							
Others' Distress (congruent vs incongruent trials)	0.005 [-0.006, 0.017]	0.008 [-0.015, 0.017]	-0.001 [-0.049, 0.047]	-0.003 [-0.018, 0.012]	0.001 [-0.002, 0.004]	.019	0.420
Threat towards others (congruent vs incongruent trials)	0.002 [-0.009, 0.012]	-0.003 [-0.024, 0.017]	0.001 [-0.041, 0.044]	-0.017* [-0.031, -0.004]	0.00 [-0.003, 0.003]	.061	1.438
Threat towards others (congruent vs neutral trials)	0.004 [-0.005, 0.013]	-0.006 [-0.024, 0.011]	-0.017 [-0.054, 0.020]	-0.010 [-0.022, 0.001]	0.00 [-0.002, 0.003]	.046	1.006

Note. Parameters reported in the table are the unstandardized beta, with the 95% confidence intervals provided in parentheses. CU = callous-unemotional traits. Including the interaction term between grade and CU traits did not add significantly to the prediction of any facilitation indices (R^2 change ranged from 0.000 – 0.006). *$p < .05$, ** $p \leq .01$, *** $p \leq .001$

Table 5. Multiple Regression Analyses Testing the Main and Interactive Effects of Callous-Unemotional Traits and Grade on Accuracy in Emotion Recognition

Variable	Grade	IQ	Gender	Education	CU	R^2	*F (df 5, 110)*
Expression Recognition							
Overall accuracy	4.091*** [2.915, 5.267]	4.129*** [1.756, 6.501]	1.887 [-3.071, 6.846]	0.081 [-1.479, 1.642]	-0.375* [-0.695, -0.056]	.383	13.645***
Sadness	2.588* [0.574, 4.601]	2.848 [-1.215, 6.912]	5.164 [-3.328, 13.657]	0.861 [-1.812, 3.534]	-.303 [-0.851, 0.244]	.101	2.459*
Fear	6.995*** [4.321, 9.668]	6.641* [1.246, 12.036]	4.440 [-6.836, 15.716]	2.640 [-0.909, 6.189]	-0.362 [-1.090, 0.365]	.260	7.712***

Note. Parameters reported in the table are the unstandardized beta, with the 95% confidence intervals provided in parentheses. CU = callous-unemotional traits. Including the interaction term between grade and CU traits did not add significantly to the prediction of any facilitation indices (R^2 change ranged from 0.001 – 0.011). *$p < .05$, ** $p \leq .01$, *** $p \leq .001$

has not been thoroughly examined in prior studies. In order to test for potential moderating effects of conduct problems and gender, a series of supplementary analyses were run.

First, the regression analyses testing the main study hypotheses were repeated with demographics, CU traits, conduct problems, and the interaction term between CU traits and conduct problems entered as predictors of the various emotion recognition and facilitation score variables. In regards to the facilitation indices, there were no main effects of CU traits or conduct problems, though their interaction term did significantly predict facilitation to others' distress (b = 0.007, p = .007), the overall model was not significant, $F(1, 95) = 1.569$, $p = 0.154$, $R^2 = .104$. This interaction was decomposed using the regression equation in the full sample and plotting predicted values of the facilitation to others' distress at high and low levels of both CU traits and conduct problems (see Figure 1). Additionally, the simple slopes (i.e., the associations between CU traits and facilitation to others' distress at high and low levels of conduct problems) were tested for significance using the procedure recommended by Holmbeck (2002). Results indicated that at high levels of conduct problems, CU traits were not significantly associated with facilitation to others' distress (b = .004, p = .163). However, at low levels of conduct problems, CU traits were significantly negatively associated with facilitation to others' distress (b = -.006, p = .029). This finding indicates that children with higher levels of conduct problems did not differ as much as their peers in their reaction times to incongruent vs congruent trials based on their level of CU traits. However, at low levels of conduct problems, children with higher levels of CU traits showed less reactivity to others' distress primes compared to their peers with lower levels of CU traits.

In examining the potential moderating effect of conduct problems on the relationship between CU traits and emotion recognition, there were no significant main effects of CU traits or

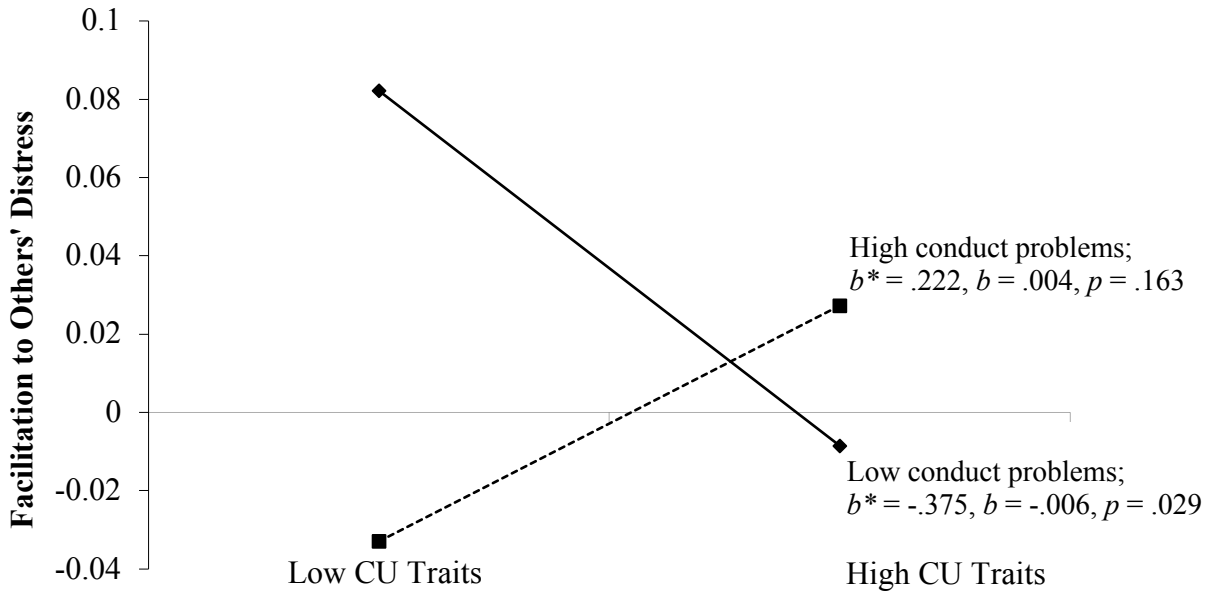


Figure 1. Facilitation to Others' Distress Predicted by Level of Callous-Unemotional Traits for Children at High and Low Levels of Conduct Problems. Note. Higher y-axis values indicate slower reaction to incongruent trials compared to congruent trials.

conduct problems, but their interaction term was a marginally significant predictor of overall emotion recognition (b = -0.477, p = .051) and the overall model was also significant, $F(1, 95)$ = 9.591, $p < .001$; R^2 = .414). This interaction effect was decomposed in the same manner as above, using the full regression equation to plot the association between CU traits and accuracy in overall emotion recognition at high and low levels of conduct problems (see Figure 2). Results indicated that at low levels of conduct problems, level of CU traits was not a significant predictor of accuracy in overall emotion recognition (b = .063, p = .834). However, at high levels of conduct problems, CU traits were negatively associated with overall emotion recognition accuracy (b = -0.593, p = .036).

The interaction term between CU traits and conduct problems was also a significant predictor of accuracy in recognition of fearful expressions (b = -1.176, p = .031), though no main effects of CU traits or conduct problems were significant predictors (the overall model was also

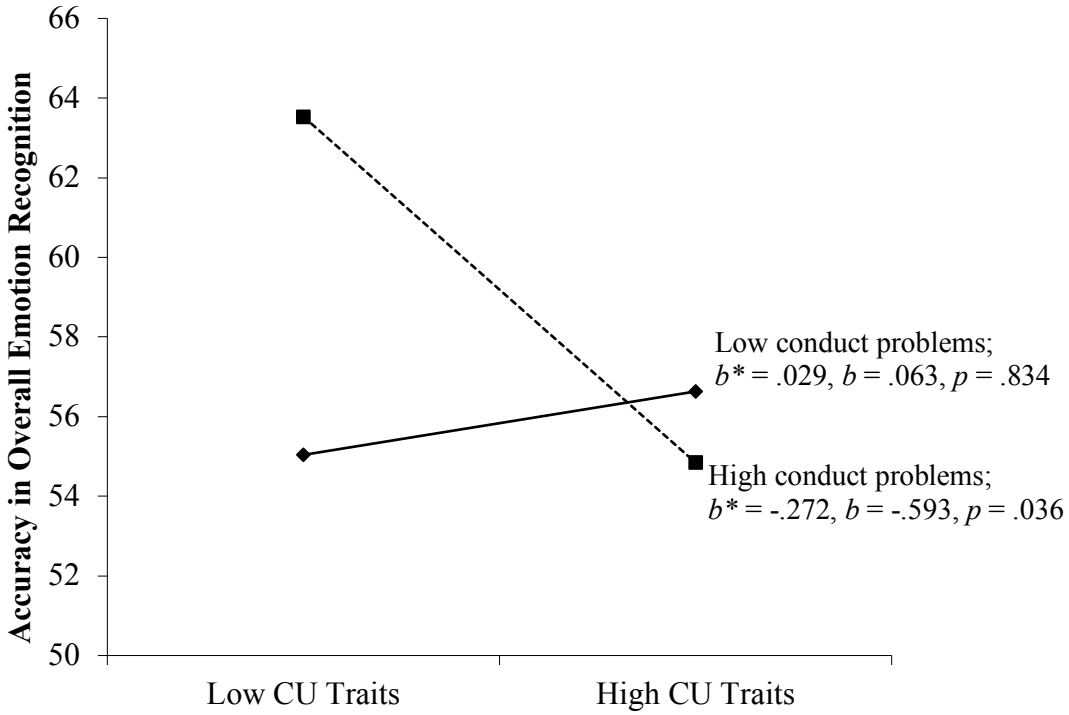


Figure 2. Accuracy in Overall Emotion Recognition Predicted by Level of Callous-Unemotional Traits for Children at High and Low Levels of Conduct Problems.

significant, $F(1, 95) = 5.842$, $p < .001$; $R^2 = .301$). This interaction effect was decomposed in the same manner as above, using the full regression equation to plot the association between CU traits and accuracy in emotion recognition of fearful expressions at high and low levels of conduct problems (see Figure 3). Results indicated that at low levels of conduct problems, CU traits were not significantly associated with accuracy in fearful expression recognition ($b = .635$, $p = .360$). Similarly, at high levels of conduct problems, CU traits were not significantly associated with accuracy in fearful expression recognition ($b = -1.028$, $p = .113$). Although the simple slopes indicate no significant association between CU traits and accuracy in recognition of fearful faces at different levels of conduct problems, at low levels of conduct problems, the association is directionally positive, whereas at high levels of CU traits, the association is directionally negative, leading to the significant interaction effect in the overall model.

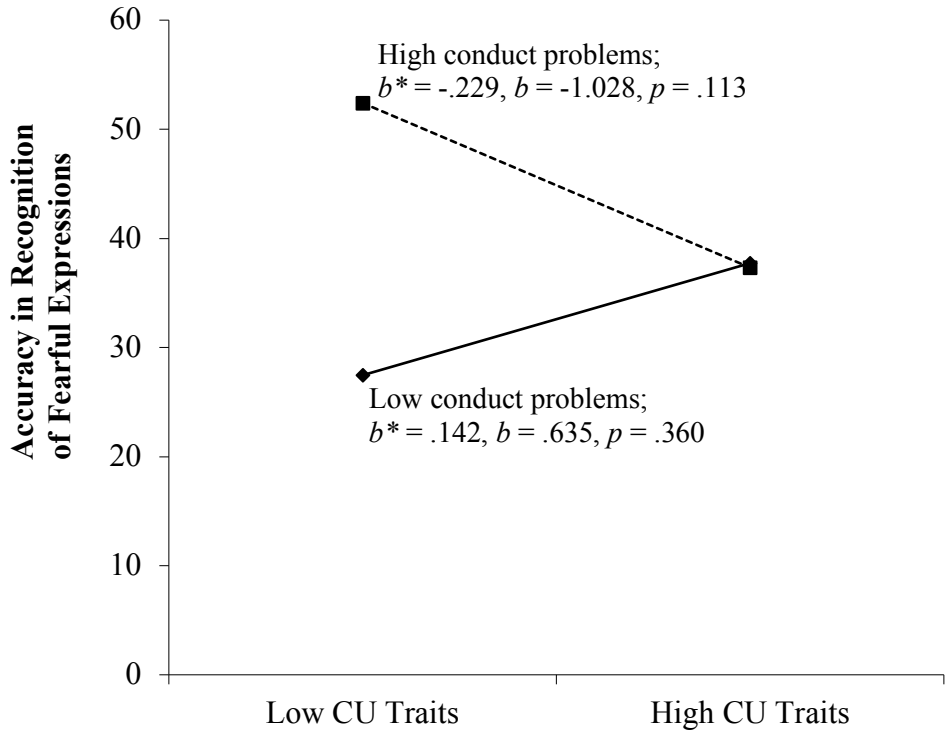


Figure 3. Accuracy in Recognition of Fearful Expressions Predicted by Level of Callous-Unemotional Traits for Children at High and Low Levels of Conduct Problems.

Next, three-way interactions between conduct problems, CU traits, and grade level in predicting overall emotion recognition and recognition of fearful expressions were run. These three-way interactions were tested because of the significant interaction effects between conduct problems and CU traits, and the hypothesized interaction between grade level and CU traits. Demographic variables, CU traits, conduct problems, and grade level were entered as predictors in step one. In step two, the two-way interaction terms between conduct problems and CU traits and between grade level and CU traits were added. Finally, in step three, the interaction term between conduct problems, grade level, and CU traits was added. However, both three-way interactions were non-significant (overall emotion recognition: $b = -.014$, $p = .876$; recognition of fearful expressions: $b = .117$, $p = .573$).

In addition to potential moderating effects of conduct problems, regressions were run to examine a potential moderating effect of gender. Demographic variables, CU traits, gender, and the interaction between CU traits and gender were entered as predictors of the various outcome variables. The interaction term between CU traits and gender was a significant predictor for one outcome variable: accuracy in recognizing fearful expressions (b = -1.672, p = .024) and the overall model was also significant, $F(1, 109) = 7.545$, $p < .001$, $R^2 = .293$. In order to decompose the interaction effect, the full regression equation was used to plot the association between CU traits and accuracy in recognition of fearful expressions for boys and girls (see Figure 4). Additionally, the simple slopes (i.e., the associations between CU traits and fearful expression recognition accuracy for boys and girls) were tested for significance by running the regression with CU traits as a predictor for accuracy in fearful expression recognition separately for boys and girls. Results indicated that for boys, level of CU traits did not predict accuracy in recognition of fearful expressions (b = 0.711, p = .255). However, for girls, higher levels of CU traits were associated with worse accuracy in recognition of fearful expressions (b = -1.148, p = .014).

Given the significant interactions found between gender and CU traits and conduct problems and CU traits in predicting fearful expression recognition, a three-way interaction of conduct problems, gender, and CU traits was tested. Similar to above, demographic variables, CU traits, conduct problems, and gender were entered as predictors in step one. In step two, the two-way interaction terms between conduct problems and CU traits and between gender and CU traits were added. Finally, in step three, the interaction term between conduct problems, gender, and CU traits was added. However, the three-way interaction was non-significant (b = .433, p = .632).

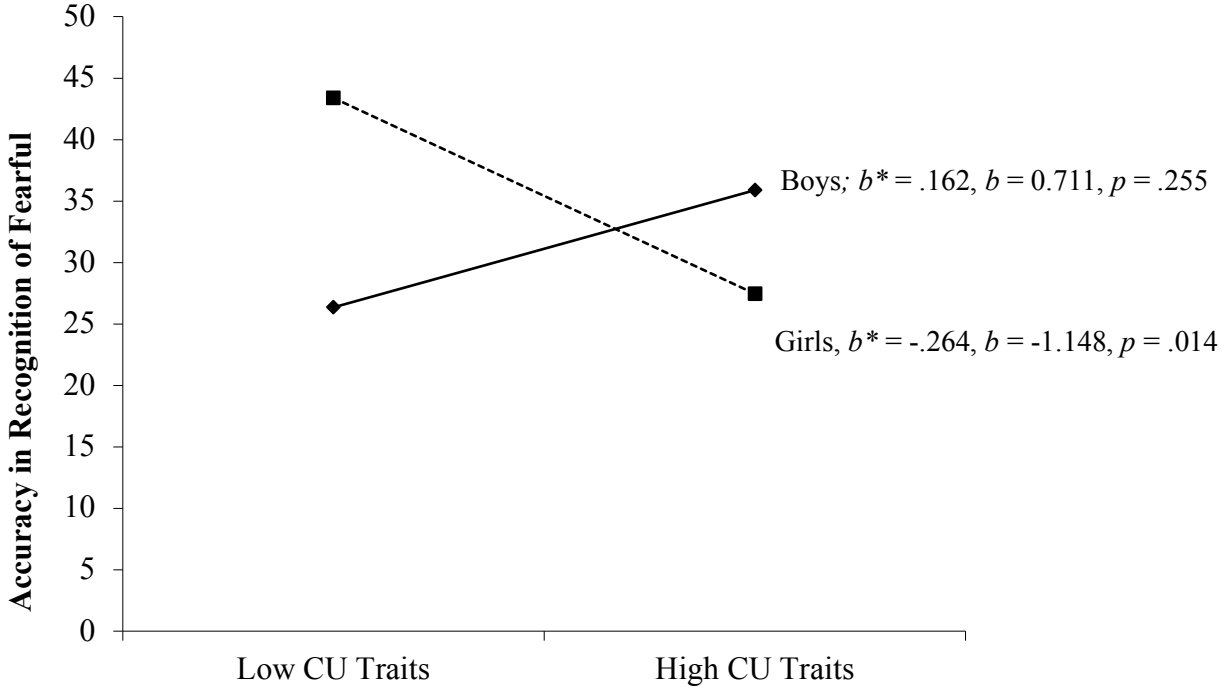


Figure 4. Accuracy in Recognition of Fearful Expressions Predicted by Level of Callous-Unemotional Traits for Boys and Girls.

Discussion

This study was designed to examine deficits in emotional reactivity and recognition in their association with CU traits, while addressing several limitations in prior studies. An initial goal was to compare the relationship between emotional reactivity and CU traits across a range of situations, using the same task paradigm to remove methodological variance. A cognitive task in which reaction time served as the measure of emotional reactivity was chosen because of past research in which similar cognitive tasks have been used successfully to capture emotional responsivity to stimuli (Kamio et al., 2006; Murphy & Zajonc, 1993; Spence et al., 2006). Further, the Self/Other task was created for this study in order to specifically examine the differential effects of emotionally priming images of people in distress and under threat, and situations in which the threat is directed at the viewer.

In examining the effects of the various emotional primes, the priming for images of others in distress and others under threat (without any facial cues) appeared to have been effective. However, the prime using images depicting a threat directed at the viewer did not lead to differences in reaction times to congruent and incongruent stimuli and thus, did not appear to serve as an effective emotional prime. This pattern of findings (i.e., the other-directed emotional primes were effective while the self-directed prime was not) suggests that overall, participants were more emotionally affected by the images involving others' negative emotions, rather than the images of threat directed at themselves. Interestingly, all distress and threat-related images were rated as having similar levels of valence and arousal during the pilot testing phase. However, it is possible that the ratings of valence and arousal may not translate into emotional reactivity. That is, the pilot study asked participants to think about and rate the valence and arousal of stimuli images, which were presented at a conscious level. The Self/Other task,

however, assessed automatic emotional reactivity to the same images presented at a pre-conscious level. Thus, it is possible that when given time to examine the images, all categories of images resulted in similar emotional affect but the images of others in distress and of other-direct threat had stronger influence on emotional responses than the images of self-directed threat. Finally, there is also the possibility that the differences in age of samples between the pilot sample and final sample resulted in differences in responses to self-directed threat across the two tasks.

In examining emotional reactivity, it was hypothesized that higher levels of CU traits would be negatively associated with emotional reactivity, as measured by difference in reaction times to stimuli when primed by emotionally congruent or incongruent images. However, analyses showed no association between CU traits and reaction times across any emotional priming conditions. In past research, there is a well-established association between higher levels of CU traits and lower emotional reactivity. This association has been found across research methodologies and participant ages (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; de Wied et al., 2012; Jones et al., 2010; Kahn et al., 2017; Kimonis et al., 2012; Marsh et al., 2008; Viding et al., 2012). However, the finding that CU traits are not associated with lower reactivity to threat cues is consistent with some past work, showing that CU traits may not be associated with lowered reactivity to all types of negative stimuli but may be more specific to stimuli depicting distress in others (Kimonis et al., 2006). Supporting this possibility, prior studies have found that CU traits were associated less responsivity to images of others' distress, but not associated with deficits in responsivity towards threat images (Blair et al., 1997; Kimonis et al., 2006).

Overall, the results of the current study are inconsistent with a great deal of research linking CU traits to deficits in emotional reactivity to others' distress. One possibility is that the cognitive task that was developed specifically for the present study (the Self/Other task) did not capture emotional reactivity in the same way as other tasks. For example, though the primes for others' distress and other-directed threat did appear to be effective emotional primes, it is possible they did not capture the type of emotional reactivity that the Self/Other task was designed to measure. Instead, these primes may have assessed the participants' ability to orient to environmental cues of danger in the environment, and these perceptual abilities may not be associated with CU traits. Further, past studies have assessed autonomic physiological responses and brain activation (Anastassiou-Hadjicharalambous & Warden, 2008; de Wied et al., 2012; Jones et al., 2009; Marsh et al., 2008; Viding et al., 2012) or used a single button push to denote the location of a stimuli (Kimonis et al., 2006; 2008a). In the current study, a slightly more complex response was required as participants had to assign a positive or negative value to a target image. Additionally, the location of category labels alternated between blocks of trials, which required the participant to re-learn the location of the category label. This type of response (i.e., the requirement to process and assign a valence label to the target image) created a brief delay between viewing the emotional priming image and giving a response, and may have shifted attention away from the emotional priming image and onto the target image. Thus, the response captured by the Self/Other task may not have been as immediate of a response as is captured in the studies assessing biological responses or studies in which participants indicated where on the screen the target image was located (rather than assigning a valence to the target image).

Another possibility is that some prior studies using cognitive tasks to assess emotional reactivity have found that CU traits are not directly associated with reaction times to images of others in distress, and that these associations only emerge once moderating variables are considered. One of the most consistently found moderators is level of conduct problems (Jusyte et al., 2015; Kimonis et al., 2006; 2008a). In past studies, the negative association between CU traits and reaction to others' distress has only been found in those high on conduct problems (e.g., Fairchild et al., 2009, 2010; Kimonis et al., 2006; 2008a; Woodworth & Waschbusch, 2008). This has been explained as being due to the fact that very few children high on CU traits are low on conduct problems and the fact that those children high on conduct problems tend to show a very different pattern of emotional reactivity if they are low on CU traits (e.g., hyper-reactivity) than if they are high on CU traits (e.g., hypo-reactivity; Kimonis et al., 2006). In the current study, an interaction was found between CU traits and conduct problems in their association with facilitation to others' distress. However, it was in the opposite direction as has been found in past work. CU traits were associated with a lack of facilitation to others' distress but only for children with lower levels of conduct problems. Given that this interaction was not predicted, nor is it consistent with past findings, it should be interpreted cautiously until it is replicated. It is possible that the findings are due to the high correlation between CU traits and conduct problems in the current sample ($r = 0.67$), which may have restricted the variability of conduct problems at low levels of CU traits. Also, it could again be associated with the task requirements that led to different emotional processes being assessed.

A second goal of the current study was to examine the relationship between CU traits and emotion recognition abilities, with a focus on considering possible developmental differences in this association. Some past research examining emotion recognition in relation to CU traits have

used morphing tasks, in which the participant responds as soon as he/she can identify the emotion being shown (Blair et al., 2001; Fairchild et al., 2009). However, responses on these tasks capture both emotional reactivity and emotional recognition. Therefore, the current study included a task specifically designed to measure only emotion recognition, and the outcome measure was percentage accuracy in recognizing the emotion, rather than a reaction time. In addition to methodological concerns in prior work, prior research shows mixed results even when using purely emotion recognition measures, as some studies have found a negative association between CU traits and emotion recognition, while others have not (e.g., Aspan et al., 2014; Leist & Dadds, 2009; Sharp et al., 2015; Woodworth & Washbusch, 2008).

This study addressed one potential reason for these inconsistent results: namely, that there may be changes in how CU traits are related to emotion recognition abilities across development. In order to assess for developmental changes in the relationship between CU traits and emotion recognition, the current study examined the association between CU traits and emotion recognition in three specific grades: kindergarten, third grade, and sixth grade. The results of the current study showed that CU traits were associated with lower accuracy in overall emotion recognition, consistent with a number of past studies (Aspan et al., 2014; Fairchild et al., 2009; 2010; Leist & Dadds, 2009; Woodworth & Waschbusch, 2008). Importantly, this finding was not moderated by a child's grade. That is, children with higher levels of CU traits performed worse than their peers in emotion recognition accuracy across the age range studied. This finding replicates prior studies with purely childhood samples (Woodworth & Waschbusch, 2008) and with purely adolescent samples (Aspan et al., 2014; Fairchild et al., 2009; 2010; Leist & Dadds, 2009), that have found CU traits are related to impairments in emotion recognition. Taken together, this body of research suggests that CU traits are associated with impairments in

emotion recognition across childhood and adolescence. However, there is also some prior work indicating that in adult samples, psychopathy is not associated with impairments in emotion recognition or theory of mind (Blair, 2005; Deeley et al., 2006; Kosson et al., 2002; although see Blair et al., 2004 for conflicting findings). Thus, it is possible that youth with CU traits continue to show impairments in emotion recognition across childhood and early adolescence, but develop emotion recognition abilities in late adolescence/early adulthood. There do not appear to be any studies (longitudinal or cross-sectional) examining this deficit throughout childhood and adolescence and into adulthood. Thus, it remains unclear if youth with CU traits develop emotion recognition abilities in early adulthood, which could explain the pattern of findings in prior work (i.e., deficits in childhood and adolescence, but not in adulthood).

In addition to a direct relationship between CU traits and deficits in emotion recognition, supplemental analyses indicated that conduct problems acted as a significant moderator of the relationship between CU traits and overall emotion recognition accuracy and CU traits and recognition of fearful expressions. Specifically, at low levels of conduct problems, CU traits were not significantly associated with overall emotion recognition accuracy, but at high levels of conduct problems, CU traits were negatively associated with overall emotion recognition accuracy. This finding is consistent with the fact that high levels of CU traits are often not present in children with low levels of conduct problems (which prevents finding an association at low levels of conduct problems) and the presence of different developmental pathways to conduct problems (Frick et al., 2014b). That is, these findings align with a significant number of past studies showing that children and adolescents with severe conduct problems differ in their emotional correlates, depending on the presence of CU traits (Frick et al., 2014b). Though these findings have often focused on differences in the child's emotional reactivity (e.g., Anastassiou-

Hadjicharalambous & Warden, 2008; de Wied et al., 2012; Michonski & Sharp, 2010; Pardini & Byrd, 2012), a number of studies have also shown that children with high levels of conduct problems are only deficient in their emotional recognition abilities when they also show elevated CU traits (Fairchild et al., 2009; 2010; Martin-Key et al., 2018; Schwenck et al., 2014).

Such findings have been used to develop theories for how the etiology of conduct problems may differ for those with and without elevated CU traits (Frick et al., 2014b). One possibility is that children with lower emotion recognition abilities and higher levels of CU traits may show more conduct problems because they do not experience the natural inhibitions on behaviors that their peers experience. That is, children who do not recognize others' emotions as readily cannot use these expressions to learn the effects of their behavior on others. On the other hand, those high on conduct problems but low on CU traits recognize others' emotions but have trouble regulating their behavior for other reasons, such acting without thinking of the consequences (Frick et al., 2014b).

Supplemental analyses also indicated that gender acted as a significant moderator on the relationship between CU traits and recognition of fearful expressions. Specifically, level of CU traits was not significantly associated with accuracy in recognition of fear for boys. However, for girls, higher levels of CU traits were associated with worse accuracy in recognition of fearful expressions. Prior research has found gender differences in emotion recognition abilities, particularly when examining the interaction between gender and CU traits in predicting empathic responsivity (Dadds et al., 2009; Martin-Key et al., 2018; though see Kimonis et al., 2006 for contradictory findings). However, the research examining gender differences in the association between CU traits and emotion recognition has been minimal. The one study directly examining this interaction found that CU traits and poorer emotion recognition show a stronger association

in girls (Dadds et al., 2009). Unfortunately, much of the past literature has used single-gender samples of participants, preventing conclusive statements about the role of gender as a potential moderator on the relationship between CU traits and emotional responsivity (e.g., Aspan et al., 2014; Bowen et al., 2014; Jones et al., 2009; Schwenck et al., 2014).

Limitations

The findings presented in the current study should be interpreted in the context of several limitations. First, the sample size was relatively small and thus reduced the power to detect small effects. Therefore, it is possible that with a larger sample, a significant association between CU traits and emotional reactivity may emerge. Further, the sample was not evenly distributed across grade levels, with about twice as many third graders (seventy-one) participating as compared to kindergarteners (thirty-one) and sixth graders (forty). Thus, there may not have been large enough numbers of participants within each grade to detect differences among grade levels. With a larger number of participants, significant interaction effects between grade and CU traits may have been found.

Second, the cognitive tasks were administered in a group setting at the child's school. Throughout administration, children often talked to each other or were otherwise not focused on the task at hand. Children may not have been motivated to engage with the cognitive tasks as they were told that their participation would not affect their grades and they received snacks as soon as they had completed the tasks, which may have caused them to rush through the tasks. The school setting and lack of motivation may have been the reason that seventy-five (34.6%) participants performed at chance or worse on the cognitive tasks and were removed from analyses. Further, even if a participant's data were included in the final analyses, there are likely some inaccuracies captured in the data (e.g., a trial on which the participant was not focused),

which could contribute to the lack of significant findings. In future studies, it would be helpful to have participants complete the cognitive tasks in an individual setting with minimal distractions.

Third, the reactivity task (the Self/Other task) was developed specifically for this study. Thus, this task may not have detected emotional reactivity in the same way as past work. For example, in past work examining CU traits and emotional reactivity, cognitive tasks have used a measure of reaction times to an attentional orienting task (Kimonis et al., 2006; 2008a) or a lexical decision-making task (Loney et al., 2003). Importantly, neither of these cognitive measures involved participants assigning valences to the target stimuli. Further, in the lexical decision-making task, the stimulus that participants responded to was the emotionally-charged stimulus, thus there was no delay between an emotional prime and the stimuli to which participants were responding. In the attentional orienting task, participants did see an emotional prime followed by a target stimulus, similar to the task in the current study. However, participants' responses were to indicate where on the screen the target stimulus was located, and thus did not involve any emotional processing after viewing the emotional prime. In the Self/Other task, the emotional processing of the target stimuli may have prevented capturing an immediate reactivity (i.e., reactivity to the emotional prime and the target image may have both influenced reaction times).

Additionally, some kindergarteners were unable to read the response options for the emotion recognition task. Although they were provided with the option of clicking the word to hear it read aloud, it is possible that by the time they finished hearing the various response options read aloud, they forgot the stimulus image. Therefore, it would be helpful to complete the tasks in a setting in which an examiner could facilitate completion of the task by providing the response options verbally and provide individual attention to help with task completion.

Fourth, the sample was recruited through school systems, and thus was a community volunteer sample. Given that the sample was community-based and volunteer, participants may have had a restricted range of CU traits. That is, very few children in the community show high rates of CU traits (Frick et al., 2014b). As a result, past research has often recruited samples from clinical populations (including schools for children with behavioral concerns) or justice-involved populations to increase the range of CU traits and severe behavior problems (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; Cheng et al., 2012; de Wied et al., 2012; Jusyte et al., 2015; Pardini et al., 2003). Additionally, given that the study description and informed consent forms sent to parents included a discussion of study variables of interest, it is possible that parents of children with higher levels of CU traits and/or conduct problems opted to not participate. They may have had concerns that their children could receive unfair treatment at school or that they may receive judgment as parents of children with higher levels of conduct problems. It would be beneficial for future work to include children from a range of settings in order to avoid the possibility of a restricted of range of CU traits and conduct problems.

Implications

While recognizing the limitations of this study, these findings also have important implications for future research and clinical work. Overall, the findings from the current study suggest that the relationship between CU traits and emotional responsivity needs further investigation to better understand the nuances in the deficits in emotional reactivity exhibited in children with CU traits. Past research has established a link between CU traits and under-reactivity to emotional situations across a variety of methodologies (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; de Wied et al., 2012; Jones et al., 2010; Kahn et al., 2017; Kimonis et al., 2012; Marsh et al., 2008; Viding et al., 2012). However, the current study and

some past work using cognitive tasks to assess for facilitation to threat and distress have not found evidence of a direct association between CU traits and emotional reactivity, and instead found that the moderating effect of conduct problems must be considered (Kahn et al., 2017; Kimonis et al., 2006; 2008a). Given that studies have found CU traits to be associated with lower physiological responses (e.g., Anastassiou-Hadjicharalambous & Warden, 2008; de Wied et al., 2012) and lower brain activation (e.g., Jones et al., 2009; Marsh et al., 2008; Viding et al., 2012) in response to emotional stimuli, and that children and their parents will often report lower levels of caring about others in children with higher levels of CU traits (e.g., Jones et al., 2010; Michonski & Sharp, 2010; Pardini & Byrd, 2012), it is likely that the Self/Other task used to measure emotional reactivity in this study did not capture this deficit in the same way as other methods. As discussed above, it is possible that the Self/Other task captured reactivity to the target stimuli in addition to the emotional priming image. Participants' responses included assigning a valence to a target stimulus, and thus their reactivity may have been affected by the target stimulus and not a pure reaction to the emotionally priming image. This confounding of responses to both the priming and target stimuli may have led to variance in participants' reaction times that did not truly reflect the reactions to the emotional priming images.

Prior studies that have found an association between CU traits and deficits in emotional reactivity have found this deficit when prompting participants to respond to others' in distress, including facial expressions of fear or distress (Jusyte et al., 2015; Kimonis et al., 2006, 2008a; Marsh et al., 2008; Viding et al., 2012), video clips involving others in danger or experiencing sadness or pain (Anastassiou-Hadjicharalambous & Warden, 2008; de Wied et al., 2012), and vignettes in which others are victims of aggression (Cheng et al., 2012; Jones et al., 2010; Pardini & Byrd, 2012). Thus, there appears to be substantial research suggesting that higher

levels of CU traits are related to deficits in reactivity to others' distress. However, given the findings of the current study, it appears that more work is needed to refine under what conditions these deficits emerge.

The specific deficits in emotional recognition associated with higher levels of CU traits also requires further study. The current study suggests that emotion recognition abilities are lower in children with higher levels of CU traits, which replicates prior findings (e.g., Fairchild et al., 2009; 2010; Schwenck et al., 2014; Woodworth & Washbusch, 2008). Further, results of the current study suggest that this finding is fairly robust across childhood and into adolescence, although this needs to be replicated using larger samples. Additionally, the results found suggest that future studies need to consider potential moderators of this association. Although considered post-hoc, moderating effects of gender and level of conduct problems were found. Specifically, girls with higher levels of CU traits showed worse emotion recognition, while boys showed no association between CU traits and emotion recognition. This moderation effect indicates the importance of considering gender differences when examining the emotional correlates of CU traits as they may differ for boys and girls. Additionally, CU traits were associated with impairments in emotion recognition both generally and specifically at high levels of conduct problems, which aligns with prior research suggesting that the emotional deficits associated with conduct problems may vary depending on the child's level of CU traits (see Frick et al., 2014b for a review). This moderation also aligns with an increasingly large body of research that has found distinct developmental pathways to conduct problems.

Research on the different deficits associated with conduct problems depending on level of CU traits could greatly impact clinical work. The findings from the current study are consistent with a large body of research (Frick et al., 2014b) indicating that CU traits denote a specific set

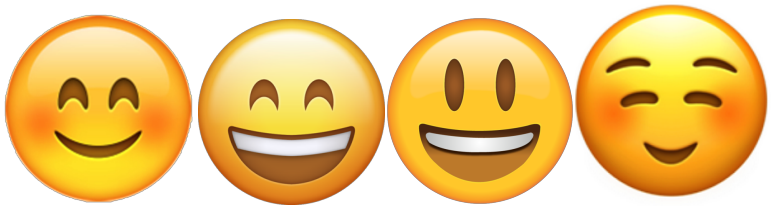
of impairments in empathy and emotionality that could be important treatment targets. In particular, high levels of conduct problems and high levels of CU traits were associated with reduced responsivity to and recognition of others' distress. This finding, along with prior work, suggests that interventions may require teaching young children how to interpret others' feelings (Kimonis et al., 2018). For example, Kimonis and colleagues (2018) tested an intervention for young children with high levels of conduct problems and CU traits that focused on emotional coaching. In this intervention, parents were taught to increase their verbal and physical expressions of warmth with their children. Children's emotional awareness was further targeted by instructing the child to focus on facial cues of distress in others, teaching and modeling prosocial behaviors, linking emotional expressions to situations that cause anger for the child, and increasing frustration tolerance through modeling and roleplay. Overall, results of this open trial were promising, with significant decreases in conduct problems and CU traits found both immediately following intervention and at a 3-month follow-up point.

Taken as a whole, this study highlights the need to continue to study the empathic deficits associated with CU traits, and to examine emotional reactivity and emotion recognition as separate phenomenon. The findings from this study suggest that children with higher levels of CU traits do not show broad deficits in emotional reactivity, as measured by some cognitive tasks, but do show difficulties in accurately identifying others' emotions. The significant interactions with level of conduct problems and gender also suggest potential moderating variables must be considered in future studies. Additionally, though the relationship between CU traits and emotion recognition did not change with grade level, grade level and cognitive ability were both positively associated with emotion recognition accuracy, suggesting that children improve in their emotion recognition abilities over time. Therefore, examining developmental

changes in empathic responses and CU traits remains an important aspect of this work. Overall, continued research in this area could lead to advances in clinical and applied work for children with higher levels of CU traits, and provide for better outcomes for this group of children.

Appendix A. Target Stimuli for Self/Other Task

Positive



Negative

Category labels:

Positive

Negative

Appendix B. IRB Approval Form for Main Study

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/research

TO: Paul Frick
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: October 17, 2017

RE: **IRB#** 3942

TITLE: Enhancing Student Successes through Community Collaborations

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited _X_ **Review date:** 10/11/2017

Risk Factor: Minimal ___X___ Uncertain _____ Greater Than Minimal_____

Approved_____X_____ **Disapproved**_____

Approval Date: 10/17/2017 **Approval Expiration Date:** 10/16/2018

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 1200

LSU Proposal Number (if applicable)**:**

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman _____

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

Appendix C. IRB Approval Form for Pilot Study

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/research

TO: Paul Frick
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: October 17, 2017

RE: **IRB#** 3940

TITLE: Rating Emotional Images

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited _X_ **Review date:** 10/11/2017

Risk Factor: Minimal ___X___ Uncertain _____ Greater Than Minimal_____

Approved_____X_____ **Disapproved**_____

Approval Date: 10/17/2017 **Approval Expiration Date:** 10/16/2018

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 150

LSU Proposal Number (if applicable)**:**

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman _____

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

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Vita

Julia Elizabeth Clark, born in Los Angeles, California, completed her Bachelor of Arts in Psychology at Whitman College. After her college graduation, she worked at Stanford University as a project manager in the Social Psychology Department for two years. Her interest in callous-unemotional traits led her to attend the University of New Orleans and receive her Master's of Science degree in Applied Developmental Psychology, working with Dr. Paul Frick. She then attended Louisiana State University's Clinical Psychology Doctoral Program and continued working with Dr. Paul Frick as her advisor. She completed her predoctoral clinical internship at the University of Utah Neuropsychiatric Institute in Salt Lake City, Utah. Upon completion of her doctoral degree, she plans to complete a post-doctoral clinical fellowship to facilitate her transition into working in a clinical setting.