THE COGNITIVE AND AFFECTIVE CHARACTERISTICS OF YOUTH WITH AND WITHOUT CALLOUS-UNEMOTIONAL TRAITS: A SYSTEMATIC REVIEW OF EVIDENCE

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Abstract

Background: The vast heterogeneity within children and adolescents with conduct problems has led to a number of subtyping approaches for defining more meaningful subgroups of antisocial youth. One method of subtyping that has gained widespread acceptance in research and practice is the distinction of antisocial children and adolescents based on the presence or absence of callous-unemotional (CU) traits. The purpose of this thesis is to provide a comprehensive and systematic review of the available research on CU traits in children and adolescents in order to determine whether the subgroup with CU traits differ on theoretically important characteristics that could suggest different causal processes underlying their behavioral disturbance. **Methods:** The Web of Science, PubMed, and PsycInfo databases were searched to identify studies investigating CU traits and its social, emotional, and behavioral correlates in children and adolescents (0-18-year-olds). 52 studies were included in the review. **Results and Conclusion:** Based on this existing research, there appears to be strong support for the role of CU traits in designating a more severe group of antisocial children who show substantial variations in the emotional and cognitive correlates of their aggressive behaviors. This supports the contention that there may be different causal processes underlying the behavioral disturbance of subgroups of children with conduct problems. Further, children and adolescents with serious conduct problems and elevated CU traits appear to be at risk for more severe and persistent antisocial outcomes, which supports the clinical importance of designating this group in diagnostic classification systems. Finally, recognizing this subgroup highlights the need for interventions that are tailored to the unique emotional, cognitive, and interpersonal styles of different subgroups.

Key words: callous-unemotional traits, childhood conduct problems, Violence Inhibition Mechanism, empathy

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Contents

1. Introduction

Disruptive Behavior Disorders (DBDs) are characterized by aggressive and antisocial behaviors that violate age-appropriate societal norms (e.g. active defiance of requests from authority figures) or the rights of others (e.g. physical aggression to people and animals, destruction of property) (American Psychiatric Association, 2013). DBDs are among the primary reasons for a childhood referral to mental health services (Canino, Polanczyk, Bauermeister, Rohde, & Frick, 2010) and are highly associated with other social, emotional, and academic difficulties in childhood (Pardini, Stepp, Hipwell, Stouthamer-Loeber, & Loeber, 2012). In addition, recent evidence indicates that childhood conduct problems predict life-course persistent antisocial problems (McMahon, Witkiewitz, & Kotler, 2010) as well as criminal behavior in adulthood (Byrd, Loeber, & Pardini, 2011). These data have led to the stark realization that serious conduct problems represent a significant public health concern. As a result, research into the causes and correlates of serious conduct problems, as well as into the development of effective intervention programs for their treatment, has grown rapidly in recent years.

The most consistent finding from this line of research is the significant heterogeneity within youth who show serious conduct problems. Indeed, children and adolescents with conduct problems constitute a very heterogeneous group who show substantial variations in terms of the causes of their behavior problems, the types of behaviors they display, the developmental course of their aggressive behaviors, and their response to treatment (Frick, 2012). From a developmental psychopathology perspective, this heterogeneity could be explained by the concept of "equifinality", which proposes that children can arrive at the same developmental outcome (e.g., antisocial behavior) as a result of many different developmental processes (Cicchetti & Rogosch, 1996). The concept of equifinality is important for causal theories of childhood conduct problems since it suggests that focusing on only one type of

causal process is likely to be inadequate for explaining the development of aggressive behavior patterns in children (Richters, 1997). Equifinality has equally important implications for the treatment of serious conduct problems in that interventions that use the same approach for all children with DBDs are also likely to be inadequate (Frick, 1998).

Evidence for heterogeneity within children and adolescents with conduct problems has led to a number of subtyping approaches for defining more meaningful subgroups of antisocial youth. One method of subtyping that has gained widespread acceptance in research and practice is the distinction of antisocial children and adolescents based on the presence or absence of callous-unemotional (CU) traits. CU traits refer to a specific affective and interpersonal profile that is characterized by a lack of guilt and empathy, callous use of others for one's own gain, and shallow or deficient affect (Christian, Frick, Hill, Tyler, & Frazer, 1997). These characteristics correspond closely to the affective dimension of psychopathy in adults (Hare & Neumann, 2008). Prior research highlights the importance of the CU dimension for designating a subgroup of antisocial youth who engages in more severe (Frick, Stickle, Dandreaux, Farrell, & Kimonis, 2005) and persistent (Byrd et al., 2011) patterns of antisocial behavior. Children with conduct problems who also show CU traits tend to be less reactive to threatening and emotionally distressing stimuli (Stevens, Charman, & Blair, 2001), are more impaired in their moral reasoning and empathic concern toward others (Dolan & Fullam, 2010), and prefer aggressive strategies as a means to achieve their goals (Helseth, Waschbusch, King, & Willoughby, 2015). In addition, their conduct problems seem to be more heritable and less strongly associated with hostile and coercive parenting practices (Viding, Jones, Moffitt, & Plomin, 2008). Finally, children with conduct problems and CU traits are less responsive to interventions than are other children with conduct problems (Hawes & Dadds, 2005). In response to this extensive body of research, CU traits have been recognized in the Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM-

5; American Psychiatric Association, 2013) with the inclusion of the "with Limited Pro-social Emotions" specifier for the diagnosis of Conduct Disorder.

In contrast, children and adolescents with conduct problems who do not show CU traits tend to be highly reactive to threatening and emotionally distressing stimuli (Ezpeleta et al., 2017) and respond more strongly to perceived provocation (Helseth et al., 2015). The conduct problems of this group appear to be more strongly associated with dysfunctional parenting practices (Edens, Skopp, & Cahill, 2008) and deficits in verbal intelligence (Loney, Frick, Ellis, & McCoy, 1998). These findings suggest that antisocial children with normative levels of CU traits may have difficulties in behavioral and emotional regulation that are related to high levels of emotional reactivity. High emotional arousal in low-CU children can, in turn, lead to volatile and unplanned aggressive behaviors for which the child has the capacity to feel remorseful for (Frick et al., 2003). Taken together, prior research suggests that children and adolescents with conduct problems and varying levels of CU traits show differences in the correlates of their problem behavior, the types and severity of conduct problems they display, and the developmental course and trajectory of their aggressive behaviors (Frick & Ellis, 1999). This supports the contention that there may be different causal processes leading to behavior problems across subgroups. The presence of CU traits may designate a "cold" and emotionally underaroused pathway that is associated with poor reactivity to distress cues and a preference for aggressive strategies to obtain desired outcomes, leading to more calculated and proactive forms of aggression (Helseth et al., 2015). On the other hand, conduct problems in the absence of CU traits may represent a "hot" pathway that is related to problems in emotional and behavioral regulation, particularly with overreactivity to emotional stimuli, and may lead to unplanned and impulsive antisocial acts for which the child may be remorseful afterward but may still have difficulty controlling in the future (Pardini, Lochman, & Wells, 2004).

In the next section, I will briefly describe two developmental accounts of psychopathy that explain how specific cognitive and emotional deficits associated with psychopathic traits can interfere with moral socialization and put the individual at risk for developing high levels of instrumental, goal-directed antisocial behavior.

2. Overview of Attention-based and Emotion-based Accounts of Psychopathy

Currently, there are two main positions that attempt to explain why psychopathic individuals show emotional dysfunctional and poor socialization: attention-based models and emotion deficit models of psychopathy. The most influential attention-based account of psychopathy is the response modulation hypothesis of Newman and colleagues (Newman, 1998; Patterson & Newman, 1993). According to this position, the emotion-processing deficits of individuals with psychopathic tendencies can be explained by a deficiency in selective attention that prevents the processing of information that is outside their primary focus of attention and, in turn, hinders the appropriate examination and modification of behavior (Lorenz & Newman, 2002). Alternatively, the low-fear explanation suggests that individuals with psychopathic tendencies are poorly socialized due to an inability to experience fear. More specifically, the model posits that an inability to experience fear precludes individuals with psychopathic traits from adjusting their behavior following the negative consequences (e.g., punishment) that their behavior has led to (Lykken, 1957; Patrick, 1994). The Violence Inhibition Mechanism (VIM) model (Blair, 1995) can be considered as a more tightly specified form of the low-fear account. Blair (1995) suggests that the emotional dysfunction and poor socialization in psychopathic individuals is a developmental consequence of deficits within the VIM. According to this model, humans possess a cognitive device (i.e., VIM) which, when activated by non-verbal communications of distress (e.g., the sight of a sad facial expression), initiates a withdrawal response (Blair, 1995). For healthy individuals, the arousal generated by the activation of the VIM is

interpreted as one of the moral emotions (e.g., guilt, remorse, empathy) and are experienced as aversive stimuli (Blair, 1995). Thus, through classical conditioning, the child with adequate VIM is negatively reinforced by distress cues every time he or she engages in antisocial behavior. Hence, over time, the healthy child is less likely to engage in violent actions. In contrast, the VIM model predicts that a deficit in this cognitive mechanism leads to reduced arousal in response to the display of distress cues. This means that distress cues do not act as aversive unconditional stimuli for children without VIM. As a result, the child with dysfunctional VIM does not learn to avoid committing behaviors that cause harm to others and will commit them if, by doing them, he or she can achieve a goal (Blair, 1995). In line with this theory, both children with psychopathic tendencies (Cheng, Hung, & Decety, 2012) and adult psychopaths (Blair, Jones, Clark, & Smith, 1997) exhibit reduced autonomic arousal to sad but not angry facial expressions. In addition, children with psychopathic tendencies show impaired recognition of sad and fearful facial expressions (Blair, Colledge, Murray, & Mitchell, 2001; Woodworth & Waschbusch, 2007) and deficient responding to sad vocal tones (Stevens et al., 2001). Throughout the review, I will make an explicit effort to examine findings from empirical studies in light of attention-based and emotion-based accounts of psychopathy in order to determine which model better explains the current evidence.

3. Aims

The purpose of this thesis is to provide a comprehensive and systematic review of the available research on CU traits in children and adolescents in order to determine whether the subgroup with CU traits differ on theoretically important characteristics that could suggest different causal processes underlying their behavioral disturbance. More specifically, I will review the distinct emotional, cognitive, neural, and behavioral characteristics of children and adolescents with CU traits, which could suggest different etiological factors underlying their behavior problems relative to other youths with conduct problems. I also focus on whether

CU traits can help in the classification of children and adolescents with severe behavior problems by adding to the prediction of concurrent and future impairment. I interpret these results in light of emotion-based accounts and attention-based accounts of psychopathy to clarify which would better explain the current findings. Recognizing subgroups of children with distinct emotional, cognitive, and behavioral correlates could be critical for guiding future research on the causes of severe conduct problems in youth. In addition, understanding the heterogeneity of childhood conduct problems can have important implications for the diagnostic classification and prediction of youths who are at risk for more severe and chronic forms of antisocial behavior. Finally, a review of the research on subtypes of children with conduct problems could have a dramatic impact on how we approach the prevention and treatment of severe antisocial behavior in youth. More specifically, it can reveal the need for designing interventions that are tailored to the specific needs of subgroups of children with severe conduct problems.

4. Systematic Review Method

I conducted an exhaustive search for studies investigating either CU traits or psychopathic traits in samples of children and adolescents, utilizing three electronic databases (i.e., PsychINFO, PubMed, Web of Science) and reviewing the reference lists of published studies. The search strategy combined the following terms to identify studies investigating CU traits and its social, emotional, and behavioral correlates: (callous* OR psychopathy OR psychopathic OR psychopath OR unemotional) AND (cognition OR cognitive OR emotion* OR behavior*) AND ("conduct disorder" OR "oppositional defiant disorder") AND (child* OR preschool* OR school-age* OR "school age*" or youth OR adolescent OR adolescence). The initial search returned 888 studies after removing duplicates.

Studies were included if they a) were published or accepted for publication after 1990; b) conducted with samples with children and adolescents up to 18 years old at baseline; c)

described group comparisons with at least one group of participants scoring high on either CU traits or psychopathy or described CU traits using a dimensional approach; d) measured CU traits or psychopathy via parent, teacher, or youth self-report using measures that are supported by psychometric investigation. No additional criteria were specified; however, only peer-reviewed, empirical studies published in the English language were retained. This procedure yielded 47 publications.

Our second search strategy was to screen the reference lists of the selected empirical studies and previous relevant reviews and meta-analyses retrieved from the electronic data base search, by using the same inclusion and exclusion criteria as mentioned above. Five additional studies were identified in the reference lists of the selected studies, while the reference lists of the reviews and meta-analyses did not yield additional results. Thus, our final set consisted of 52 publications (see detailed descriptions of reasons for exclusion in Figure 1).

I excluded studies published or accepted for publication before 1990, since the conceptualizations of CU and psychopathic traits prior to 1990 were largely based on the definition of undersocialized subtype of conduct disorder (see Frick, Ray, Thornton, & Kahn, 2014 for a detailed description of the undersocialized subtype). In addition, the date restriction allowed the review to focus on the most current research on conduct disorder in children and adolescents.

Further, in order to capture a more comprehensive review of the literature, I performed an online search that was sensitive to both CU traits and psychopathic traits. Such studies were judged to be relevant since CU traits are substantially correlated with global measures of psychopathy (Frick & Ray, 2014) and seem to be among the key features and precursors of adult psychopathy (Skeem & Cooke, 2010). I acknowledge that the inclusion of studies that measured psychopathy globally (i.e. impulsivity, narcissism, antisocial behavior) makes it

difficult to determine whether it is CU traits or other dimensions of psychopathy that explain the results (Frick et al., 2014). Consequently, I have made every effort throughout the review to report which studies measure CU traits specifically and which measure psychopathic traits more generally. In cases where measures of CU traits and broader measures of psychopathy were used simultaneously in the same study, only findings related to CU traits were reported. As can be seen below, the majority of studies provided data on CU traits and, as a result, interpretations were largely drawn from studies that used measures specific to CU traits. Finally, different publications that used either partially or completely overlapping samples were included only if they added significant incremental value to the thesis (Frick et al., 2014). As demonstrated below, all publications that used overlapping samples were ultimately included in the review and are specified in the tables.

The review is organized into two primary sections. In the first section, I review research related to the question of whether CU traits can designate a distinct causal pathway to serious conduct problems. This research includes studies investigating the emotional, cognitive, and behavioral correlates to CU traits, as well as studies investigating the neural markers to CU traits. In the second section of the review, I review research related to clinical utility of CU traits, which includes studies examining the relationship between CU traits and the severity or developmental trajectory of aggression, delinquency, and antisocial behavior. More specifically, this section focuses on whether CU traits are associated with more severe antisocial outcomes, both concurrently and longitudinally, and whether this association remains even after controlling for conduct problem severity, common problems in comorbidity, or the age of onset of conduct problems.

5. Emotional characteristics

In Table 1, I summarize 14 studies investigating the emotional characteristics associated with psychopathic (n = 4) or CU (n = 10) traits in children and adolescents. One consistent finding from these studies is that CU traits are associated with deficits in one's responsiveness to and recognition of emotions in others (Bowen, Morgan, Moore, & Goozen, 2014; Blair et al., 2001; Dolan & Fullam, 2010; Ezpeleta et al., 2017; Pasalich et al., 2012; Schwenck et al., 2014; Stevens et al., 2001; Woodworth & Waschbusch, 2007). However, there is debate about whether children with conduct problems and varying levels of CU traits have a global deficit in identifying emotions or have difficulties in identifying specific emotions, such as fear and sadness. For example, two meta-analyses on the link between emotion recognition deficits, CU traits and antisocial behaviors reached different conclusions: While Marsh and Blair (2008) reported specific difficulties in fear and sadness recognition, Dawel and colleagues (2012) concluded that emotion recognition deficits in psychopathy are pervasive across emotions, even though the effect size for fear was significantly greater. The heterogeneity of findings is likely due to the wide range of paradigms used across different studies to measure emotion recognition. Most studies so far have used static facial stimuli (Bowen et al., 2014; Ezpeleta et al., 2017), while several others have used more ecologically valid paradigms such as dynamic facial expressions of emotions (e.g., morphing task; Martin-Key, Graf, Adams, & Fairchild, 2018; Blair et al., 2001; Schwenck et al., 2014), emotional vignettes (Woodworth & Waschbusch, 2007) and vocal cues (Stevens et al., 2001). An additional methodological issue involves the number of emotions presented: Some studies have presented images expressing the six basic emotions (i.e., happiness, sadness, fear, anger, disgust, surprise), while others have used four or five of these emotions. Investigations that use fewer emotions may not be able to achieve a thorough assessment of facial emotion recognition in this population.

Notwithstanding, the majority of studies included in this review have reported that children with conduct problems and elevated CU traits have deficits in emotion recognition and reactivity that are specific to negative emotions (i.e., fear and sadness), and these deficits have been observed in both younger (Schwenck et al., 2014; Woodworth & Waschbusch, 2007) and older (Blair et al., 2001; Bowen et al, 2014; Martin-Key et al., 2018; Stevens et al., 2001) age groups. For instance, using printed pictures and a clinical sample of 7 to 12-year-olds, Woodworth and Waschbusch (2007) showed that children with conduct problems and CU traits were less accurate than their low-CU peers and normal controls in identifying sad facial expressions, but they were equally able as controls in identifying anger, disgust, happiness and surprise. Importantly, and of particular relevance to the discussion above, these researchers did not find any group differences when emotion recognition was assessed using a more ecologically valid paradigm (i.e., emotional vignettes; Woodworth & Waschbusch, 2007). In another study using a morphing task, boys (aged 9-17) with behavior problems and psychopathic tendencies were more likely to mistake full-intensity fearful expressions for another expression, and needed significantly more stages before they could successfully recognize sad facial expressions compared to boys with behavior problems only (Blair et al., 2001). Finally, Stevens, Charman and Blair (2001) reported that boys with behavior problems and psychopathic tendencies showed impaired recognition of sad and fearful facial expressions and sad vocal tones compared to boys with behavior problems and normative levels of psychopathic traits. Of note, the two groups did not differ in their recognition of happy or angry facial expressions, or fearful, happy, and angry vocal tones (Stevens et al., 2001). These findings support the claim that children and adolescents with conduct problems and significant CU traits have a deficit in emotional response that is specific to negative, aversive stimuli.

Interestingly, several studies reported superior fear recognition in children with conduct problems and elevated CU traits (Ezpeleta et al., 2017; Martin-Key et al., 2018; Schwenck et al., 2014). For instance, in a clinical sample of 8 to 16 year-old-girls, those with conduct problems and high levels of CU traits were better at identifying fearful facial expressions than those who were low on CU traits or healthy controls (Schwenck et al., 2014). Similarly, within a group of adolescent offenders with CD, elevated CU traits were related to enhanced recognition of fearful expressions (Martin-Key et al., 2018). Although these findings are in contrast with the majority of extant literature that has demonstrated an inverse association between CU traits and sensitivity to fearful expressions, a possible explanation is that being more successful in responding to and recognizing fearful expressions facilitates high CU children's ability to manipulate others (Woodworth & Waschbusch, 2007). Indeed, an improved ability to identify facial expressions of fear does not preclude individuals with high CU traits from having an inability to be negatively affected by fearful emotions in others, or from proceeding with planned aggressive behavior despite having accurately identified a fearful context, as past research has shown (Blair et al., 2001; Patrick, 2001). More specifically, it is possible that children with high CU traits use the ability to recognize fearful expressions for their own purposes, yet lack the ability to process or understand fear at a more fundamental level (Woodworth & Waschbusch, 2007). This explanation is in line with the contention that for psychopathic individuals, fearful facial expressions are not processed as distressing stimuli that produces aversive arousal and subsequent avoidance of antisocial behavior as it does in typically developing individuals (VIM model of aggression; Blair, 1995). It is also in line with Blair's (1995) VIM model of aggression (Blair, 1995), which suggests that psychopathic individuals may not necessarily have a deficit in recognizing fearful expressions, but rather a deficit in using such cues to inhibit aggressive behavior, and more generally, to internalize such cues as aversive stimuli that contribute to the development

of moral conscience. In fact, for individuals with high CU traits, fearful cues may actually signal a victim's *weakness* and may ultimately facilitate their aggressive behaviors. Additional research is needed to clarify how children with severe conduct problems and high levels of CU traits recognize and process fearful contexts.

Considerable attention has been devoted to elucidating the causal mechanisms that underlie these differences in emotion recognition between subgroups. A number of studies suggest that a failure to focus on the eye region of others' faces may be one factor that leads to deficient emotional responding in children and adolescents with significant CU traits. For example, boys with high CU traits exhibited deficits in their attention to the eye region of others' faces compared to boys low on CU traits, but they showed similar patterns of fear recognition when they were explicitly instructed to attend to the eyes of others (Dadds et al., 2006; Dadds, El Masry, Wimalaweera, & Guastella, 2008). Thus, deficits in emotion recognition in children with high psychopathic traits are partly explained by a reduced attention to other people's eyes. This has raised an important question in the literature– how does impaired attention to the eyes of attachment figures in childhood contribute to the development of psychopathic traits? In a seminal study, Dadds and colleagues (2011) reported that compared to low CU traits boys, conduct problem boys (aged 5-16) with high CU traits made less eye contact with both parents in free play and "emotion talk" situations, and impairments in the level of eye contact were associated with the boys' empathy levels and their ability to recognize fearful faces. Importantly, impairments in eye gaze towards parents were not related to the quality of the parent-child relationship or family environment, but rather to low eye contact in fathers (Dadds, Jambrak, Pasalich, Hawes, & Brennan, 2011). These results were replicated with younger samples in more naturalistic settings: During affectionate interchanges with their parents, 4 to 8 year-old-children with conduct problems (regardless of their level of CU traits) displayed lower levels of reciprocated verbal and

physical affection, but only those with high CU traits also rejected their mother's eye contact (Dadds et al., 2012; Dadds et al., 2013). Again, impairments in eye contact were unrelated to maternal behaviors (i.e., mother's positive feelings toward the child, mother's attachment-related behaviors of sensitive responding and mutuality, use of corporal punishment), and instead were driven by psychopathic traits or fearlessness in fathers. These findings have a number of theoretical implications. First, they are consistent with past research showing that conduct problems in children with CU traits have strong genetic influences and are less responsive to environmental risk factors (e.g., harsh parental discipline; Edens et al., 2008) and parenting interventions (Hawes & Dadds, 2005). In fact, findings suggest that a failure to attend to critical aspects of parents' communications (e.g., eye region of faces) might explain why children with high CU traits are less sensitive to quality of parenting (Dadds et al., 2011). Second, the results are consistent with Skuse's idea that eye contact with attachment figures is a precursor to understanding the emotional state of others, as well as for the healthy development of empathy and moral conscience (Skuse, 2003). Indeed, across two different samples, impairments in eye contact were associated with emotion recognition deficits and low trait empathy. All in all, these studies suggest that eye contact with attachment figures scaffolds the development of simple and more complex affective abilities, and thus, impairments in this domain not only compromise the influence of parenting, but also lead to a series of errors in the development of moral conscience and empathy.

Two additional studies support the contention that distinct mechanisms underlie the emotion processing deficits in different subgroups of children with conduct problems. Consistent with emotion-based models of psychopathy (Blair, 1995; Lykken, 1957; Patrick, 1994), as well as studies reported above, it appears that children with conduct problems and high CU traits primarily have an emotional deficit, whereas those with normative levels of CU traits primarily have an impulsivity deficit. For instance, Ezpeleta et al. (2017) demonstrated

that compared to the comparison group, the pure oppositional group (High ODD – Low CU) showed impairments in both the quality of the response (lower accuracy) and reaction time (faster responding with high errors) when identifying emotions, whereas the High ODD – High CU group only showed deficits in the quality of response. These results indicate that children with pure oppositionality were very sensitive to emotions, reacting faster to facial expressions of anger, happiness, sadness and fear, which led to higher error rates for these children (Ezpeleta et al., 2017). In contrast, children with oppositionality and high CU traits showed deficits in accuracy but not reaction time, meaning that these children were less sensitive to other's emotions but did not make errors of impulsivity. Schwenck and colleagues (2014) also reported that girls with conduct problems and low levels of CU (but not those with elevated CU traits) exhibited deficits in reaction time to happy, sad, and fearful facial expressions compared to healthy controls. Although more investigations are needed, these studies are quite promising in suggesting that different emotion processing deficits explain aggressive behaviors in children with high and low levels of CU traits. Accordingly, individuals high on CU traits are less sensitive to other's emotions and consequently they fail to inhibit actions with negative consequences. In contrast, those with normative levels of CU traits are highly impulsive and experience high aversive arousal in reaction to emotional cues, which facilitates their aggressive behaviors.

To summarize, CU traits are associated with specific deficits in the responsiveness to and recognition of negative emotional cues, particularly fear and sadness. These deficits are observed early in development and appear to be relatively stable from childhood to adolescence. Importantly, children with high CU traits may actually show elevated fear recognition under certain conditions, for example, when their goal is to manipulate or prey on others. A review of the literature also suggests that there are different mechanisms that underlie the emotional deficits of children with conduct problems and high and low CU traits.

One factor that contributes to the early development of psychopathic traits is impaired eye contact with primary caregivers. Several studies have shown that a failure to make eye contact with attachment figures not only reduces the influence of parenting, but also leads to a series of cascading errors that affect the development of low-level processes of paying attention to emotionally salient stimuli, as well as higher-order human functions of empathic concern and moral conscience (Dadds et al., 2011; Dadds et al., 2012; Skuse, 2003). This impairment in eye contact is present in children with conduct problems as young as 4 years, is largely independent of maternal behavior, and separates children with high CU traits from their low-CU and healthy peers. On the other hand, the presence of conduct problems without CU traits is associated with higher impulsivity and aversive arousal in reaction to emotional cues. These findings are in line with the VIM model of aggression (Blair, 1995) which proposes that awareness and emotional response to distress cues in other people is necessary to develop the ability to inhibit actions that have negative consequences for oneself and others (Dadds et al., 2012). More generally, these findings support the heterogeneity of childhood conduct problems and highlight the need for tailored treatment components for each subgroup.

6. Empathy and moral reasoning

Table 2 provides a summary of 10 studies that investigated the association between CU traits and high-order human functions such as empathy and moral socialization. Given that CU traits are defined by a lack of guilt and concern for the feelings of others, it is surprising that previous investigations of empathy in youths with conduct problems and varying levels of CU traits yielded inconsistent findings (see Lovett and Sheffield, 2007 for a review). The inconsistency of results is likely due to the wide range of definitions of empathy in the literature, as well as the use of heterogeneous paradigms across studies. Indeed, empathy has been variously defined as vicarious affective arousal (Anastassiou-Hadjicharalambous & Warden, 2008), emotion recognition and perspective-taking

(O'Kearney, Salmon, Liwag, & Fortune, 2017), or as the capacity to deduce the intensity and valence of feelings experienced by another (Zaki, Bolger, & Ochsner, 2008). In an attempt to bring these together, recent theories propose that empathy is a multidimensional construct that comprises of a cognitive (i.e., understanding what others are feeling without necessarily resonating with that feeling state) and an affective component (i.e., the ability to resonate with other's feelings while understanding that they are distinct from one's own) (Waal, 2008; De Vignemont & Singer, 2005).

Differential associations between CU traits and various components of empathy may go some way toward explaining previously inconsistent findings. This contention is supported by evidence indicating that CU traits are associated with deficits in affective but not cognitive facets empathy (Anastassiou-Hadjicharalambous & Warden, 2008; Cheng et al., 2012; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Schwenck et al., 2011). For example, Jones et al. (2010) directly compared affective empathy and cognitive perspective-taking abilities of four groups of children (aged 9-16 years): boys with conduct disorder (CD) and psychopathic tendencies, CD only, autism spectrum disorder (ASD), and normal controls. The results indicated that boys with CD and psychopathic tendencies felt less fear and less empathy for victims of aggression than did comparison boys, whereas their cognitive perspective-taking abilities were intact (Jones et al., 2010). Interestingly, boys with CD did not differ from the control group on any of the empathy or perspective-taking measures, indicating that difficulties in affective empathy are only characteristic of those with significant levels of CU traits. A similar investigation by Schwenck et al. (2011), conducted in a clinical sample of boys aged 6-17, found that boys with conduct problems and CU traits were less affected by the emotional situation of another individual than were healthy boys, although they were equally proficient in taking the perspective of another individual. Again, boys with CD did not differ from the control group in any of the measures, which suggests that the affective

empathy deficit is specific to those with CU traits, rather than being common to all boys with conduct problems (Schwenck et al., 2011).

The use of heterogeneous paradigms across studies, such as self-report questionnaires or objective tests, may also account for the inconsistent findings related to empathy in this population. Previous literature suggests that children with conduct problems exhibit diminished social desirability response biases (Cohen & Strayer, 1996), as well as diminished verbal skills (for the pure conduct problems group only; Fontaine, Barker, Salekin, & Viding, 2008). Consequently, compared to objective measures, self-reports may underestimate the capacity of some children with CD for affective empathy (Anastassiou-Hadjicharalambous & Warden, 2008; Martin-Key, Brown, & Fairchild, 2016). For instance, one study employed both heart rate and a self-report questionnaire measure of empathy (i.e., Bryant Empathy Index; Bryant, 1982) to compare vicarious affective arousal in children (aged 7-11 years) with CD and elevated CU traits (CD/HCU), CD with low CU traits (CD/LCU), and normal controls (Anastassiou-Hadjicharalambous & Warden, 2008). Physiological data mirrored behavioral studies that document affective empathy deficits in children with high CU traits: Compared to both CD/LCU and controls, CD/HCU children displayed lower baseline heart rate as well as lower magnitude of heart rate change while watching an emotionally evocative film clip. In contrast, scores on the Bryant Empathy Index (Bryant, 1982) did not reveal any significant differences between the CD/HCU and CD/LCU groups. Similarly, O'Kearney and colleagues (2017) examined the performance of young children (aged 4-8 years) across a wide range of emotional competencies using behaviorally assessed measures (i.e., the Denham Affective Knowledge Tests; Denham, 1986; Denham, 1994) and parent-reported cognitive and affective empathy. In the Affective Knowledge tests (Denham, 1986; Denham, 1994), boys with ODD and high levels of CU traits showed marked deficits in emotion perspective-taking and in understanding ambivalent emotions compared to low CU ODD boys, whereas

parent-report measures of cognitive and affective empathy did not differentiate between ODD subtypes (O'Kearney et al., 2017). Taken together, findings indicate that impairments in affective empathy are uniquely related to the presence of CU traits and may contribute to defective social and moral reasoning in children high on these traits.

Two studies also found that the capacity to appreciate more complex, mixed and ambivalent emotions is varied across subgroups. For instance, when attributing emotion states to story protagonists in the moral/conventional distinction task, children with disruptive behaviors only were more ambivalent than were children with psychopathic tendencies (Blair, 1995; Blair, 1997). Additionally, in the study by O'Kearney and colleagues (2017), ODD boys with high levels of CU traits had marked deficits relative to low CU ODD boys in understanding how conflicting emotions can co-occur. These findings have important theoretical implications related to the development of moral emotions and prosocial reasoning in children with psychopathic tendencies. Past research shows that experiencing a conflict of goals in emotional and interpersonal contexts, along with the negative affect that can arise out of such experiences, is critical for the development of moral emotions (e.g., guilt) that facilitate prosocial responding and/or inhibit aggression (Dunn, Brown & Maguire, 1995). The finding that children with high CU traits failed to appreciate mixed emotional contexts indicates that they are less likely to be negatively aroused by such situations and to learn from the discordance between their emotional experience and societal norms (O'Kearney et al., 2017). Consequently, deficits in understanding ambivalent emotional contexts can impede the healthy development of moral emotions and, in the long-term, prosocial responding.

Accordingly, two studies reported that children with high levels of CU traits display notable deficits in the ability to attribute moral emotions to oneself and others. For example, the study by Jones et al. (2010) reported previously showed that boys with psychopathic tendencies were less likely to make self-attributions of fear and guilt (at trend levels) than

boys in the other three groups. Additionally, children with psychopathic tendencies were less likely to attribute moral emotions (i.e., guilt and sadness) to hypothetical story characters than children with disruptive behaviors only (Blair, Monson, & Frederickson, 2001). These findings point to a pervasive inability to experience negatively valenced "self-conscious" emotions in high CU individuals. Other studies investigating moral reasoning in aggressive youths have documented differences in how those elevated on psychopathic traits evaluate moral transgressions (i.e., actions defined by their consequences for the rights and welfare of others) and conventional transgressions (i.e., actions defined by breaking social rules) (Blair, 1997). These studies showed that compared to youths with behavioral problems and normative psychopathic traits, those with high psychopathic traits made less clear distinctions between moral and conventional transgressions (Blair, 1997; Dolan & Fullam, 2010). It is important to note, however, that none of these studies measured CU traits specifically, and more research is needed to clarify how children high on these traits evaluate situations involving moral and social transgressions.

Collectively, studies that investigated empathic abilities in children with CU traits have documented deficits in the affective but not cognitive facets of empathy. The behavioral findings of impaired affective empathy in children with elevated CU traits paralleled physiological data which indicated a relative insensitivity to physical pain and lower autonomic arousal in this group. Studies also found marked deficits in the ability to understand mixed emotional responses in children with elevated CU traits. The capacity to deal with affectively ambivalent situations is thought to have a critical role for the development of social emotions that facilitate prosocial responding and/or inhibit antisocial conduct. As such, an impairment in the ability to understand mixed emotions, combined with deficits in affective empathy, might partly explain the difficulties children with high CU traits have in more advanced emotional competencies (e.g., attributing moral emotions and

evaluating moral/conventional transgressions). These data support the VIM model of psychopathy, which argues that the ability to accurately recognize emotion expressions is a key process that underpins empathic concern (Blair, 1995). Indeed, findings demonstrated that children who had the most pronounced difficulties in identifying emotional expressions (i.e., those with elevated CU traits) also exhibited a blunted empathic response to other's distress. It seems intuitive that difficulties in identifying emotion expressions would lead to poor emotional responsivity and diminished autonomic arousal to affective cues in the environment. All in all, it could be argued that the association between emotion recognition and affective empathy, where difficulties in the former affect the latter, influences the development of moral conscience. Problems in the development of moral conscience can, in turn, increase the risk of aggression in children high on CU traits.

7. Cognitive Characteristics

The previous section demonstrated that children with conduct problems and elevated CU traits have a unique affective (e.g., failure to recognize and respond to distress cues, lack of remorse) and interpersonal (e.g., failure to show empathy) profile that places them at heightened risk for showing severe aggressive behaviors. These affective impairments differentiate children with high CU traits from their low-CU peers, who tend to be highly reactive to emotional and threatening stimuli. Here, I turn to research that focuses on specific social information processing errors that may contribute to the development and maintenance of aggressive behaviors in different subgroups of antisocial youth. Table 3 provides a summary of eight studies that have explored these questions.

Studies that investigated the cognitive characteristics associated with psychopathic and CU traits in youth have mostly used behavioral paradigms that assess how individuals with these features respond to cues of punishment while they are engaged in goal-directed behavior. For example, in the Reward Dominance Task (O'Brien & Frick, 1996), participants

who want to earn the maximum amount of points must change an initially established reward-oriented response since, as the game continues, the frequency and amount of punishment increases (Pardini et al., 2003). Studies utilizing such tasks consistently found that children with psychopathic tendencies played more trials despite increasing loss of points, suggesting a reward-dominant response style that is specific to this group (Fisher & Blair, 1998; Frick et al., 2003b; O'Brien & Frick, 1996). These results indicate that children with psychopathic features tend to focus on indicators of rewards and disregard cues of punishment when they are engaged in goal-oriented tasks (Pardini, Frick, & Lochman, 2003).

The reward-dominant response style in children with psychopathic traits might be related to their difficulties in gauging the likelihood that various outcomes can occur as a result of aggression (i.e., outcome expectancy) or the disproportionate values they place on the rewarding and punishing consequences of antisocial behavior (i.e., outcome values) (Pardini et al., 2003). Indeed, in a sample of adjudicated adolescents between the ages of 11-18, the callous/unemotional dimension (C/U) of psychopathy was associated with increased expectations and values for the positive consequences of aggression (i.e., tangible rewards and dominance) and a decreased regard for the negative consequences of aggression (i.e., punishment; Pardini et al., 2003). In contrast, the impulsivity/conduct problems (I/CP) factor of psychopathy was not associated with measures of outcome expectancy or outcome values when the effects of C/U were controlled for. This indicates that a lack of concern for the negative consequences of antisocial behavior and a tendency to focus on the positive consequences of aggression can explain the reward-dominant response style associated with CU traits. Importantly, the two factors also exhibited differential associations with scales measuring emotional distress in response to stressful and threatening situations: The I/CP factor was positively related to measures of personal distress and fearfulness, while the C/U dimension was negatively related to these measures (Pardini et al., 2003). This finding is

consistent with past research indicating that children with pure conduct problems display high emotional arousal to threatening stimuli (Ezpeleta et al., 2017) and tend to respond more strongly to perceived provocation (Helseth et al., 2015). The results are also in line with emotion-based accounts of psychopathy (Blair, 1995; Lykken, 1957; Patrick, 1994) which suggest that individuals with psychopathic features are less sensitive to distress cues that motivate healthy individuals to inhibit actions that have negative consequences for themselves and others. More generally, these studies indicate that children with conduct problems and varying levels of CU traits show substantial variations in the cognitive and emotional correlates of their aggressive behaviors, and these variations might reflect different causal pathways through which their behavioral difficulties develop (Frick et al., 2003).

Another study included in this review supports the contention that developmental processes leading to problem behaviors may be different for subgroups of children with conduct problems. Specifically, Frick and colleagues (2003b) found that, in a sample of non-referred children, the presence of CU traits was associated with a lack of behavioral inhibition: Children with conduct problems and significant CU traits showed a preference for novel and dangerous activities, a decreased sensitivity to cues of punishment when a reward-oriented set was primed, and a lower reactivity to negative emotional stimuli. In contrast, conduct problems in the absence of CU traits were uniquely related to hostile attribution biases. Indeed, a tendency to react strongly and negatively to emotional stimuli and perceived provocation was specific to children with conduct problems who did not show CU traits (Frick et al., 2003b). This indicates that children with pure conduct problems may be formulating responses based on faulty interpretations of ambiguous social stimuli, causing them to overreact in an emotional and aggressive manner (Helseth et al., 2015).

Collectively, these studies indicate that children with conduct problems display different emotional and behavioral profiles depending on the presence or absence of CU traits.

The group with conduct problems and CU traits tends to be more thrill and adventure seeking, less sensitive to cues of punishment when a reward-oriented response set is primed, and less reactive to threatening stimuli than other children with conduct problems. The reward-dominant response style in antisocial children with CU traits may be due to a lack of concern for the negative consequences of antisocial behavior and an oversensitivity to potential rewards that may be associated with such behaviors (Pardini et al., 2003). These characteristics suggest that children with conduct problems who also show CU traits have a temperamental style associated with low emotional reactivity to aversive stimuli which is manifested behaviorally by low fearfulness to novel or threatening situations and a decreased sensitivity to cues of punishment and danger (Kagan & Snidman, 1991). In contrast, children with pure conduct problems have a tendency to be highly reactive to emotionally distressing stimuli and to attribute hostile intent to social situations involving provocation. These findings suggest that children with conduct problems who do not show CU traits display and emotionally and behaviorally dysregulated profile that is related to high emotional arousal. The current results of increased reward dependence and decreased punishment sensitivity in children with psychopathic traits are in line with emotion-based accounts of aggression (Blair, 1995; Lykken, 1957; Patrick, 1994). The low-fear position argues that psychopathic individuals are poorly socialized as a result of a failure to adequately process impending threat or punishment (Lykken, 1957; Patrick, 1994). Consistent with this proposition, children with CU traits exhibited difficulties in encoding and attending to cues associated with negative consequences of aggression, suggesting that they experience less fear when they are punished. In a similar vein, the VIM model argues that for empathy development to occur, children must have the ability to experience emotional distress when they are punished for transgressions or when they see others in pain (Blair, 1995). In line with this position, studies in Table 3 showed that children with psychopathic tendencies have an early dysfunction in

their capacity to be aroused by punishment or by other's distress, which may ultimately impede the development of empathic concern in this group.

Importantly, the different patterns of emotion and behavior regulation in subgroups of children with conduct problems might lead to differences in how these subgroups react to their socializing environments (Frick et al., 2003b). For example, the tendency to favor aggressive strategies to achieve social outcomes combined with a decreased sensitivity to punishment cues might lead to more calculating, merciless forms of aggression for children with CU traits (Helseth et al., 2015). On the other hand, for children with pure conduct problems, difficulties with emotion regulation can lead to impulsive and unplanned aggressive acts after which the child is capable of feeling remorseful for (Pardini et al., 2004). In the next section, I focus on research related to the question of whether subgroups of children with conduct problems exhibit differences in the types of aggressive behaviors they display.

8. Behavioral Characteristics

Several studies indicate that CU traits are differentially related to proactive and reactive forms of aggression (see Table 3 for a summary of studies investigating the behavioral profiles of children with conduct problems and varying levels of CU traits). Proactive aggression refers to aggressive behaviors that occur in the absence of provocation (e.g., threatening or hurting others to win a game), whereas reactive aggression occurs in response to perceived threat or provocation (e.g., hurting others as a response to teasing) (Price & Dodge, 1989). The majority of studies in this review found that children with CU traits tend to show aggression that is both reactive and proactive in nature, while their low-CU peers show lower levels of aggression and, when they do, their aggressive behaviors tend to be reactive in nature (Fanti, Frick, & Georgiou, 2009; Helseth et al, 2015; Stickle, Marini, & Thomas, 2012). For example, in a sample of adolescent offenders between the ages 11-17, CU traits distinguished youths who showed combined reactive and proactive aggression from

those who showed reactive aggression only (Stickle et al., 2012). In another study using hypothetical peer provocation scenarios, children (aged 6-12) with severe conduct problems and CU traits exhibited higher aggression prior to and in response to low peer provocation, compared to children with pure conduct problems and healthy controls (Helseth et al., 2015). Importantly, all groups reported minimal levels of anger during the tasks, indicating that children with conduct problems and CU traits behaved more aggressively than other children, and did so even when they were not provoked and when they did not feel angry (Helseth et al., 2015). The pattern of findings related to proactive aggression is highly consistent with theoretical conceptualizations of CU traits. Indeed, across several studies, youths with CU traits exhibited a cold and uncaring interpersonal profile that differentiated them from their low-CU peers: They viewed aggression as an effective means for achieving goals and disregarded the extent to which aggression causes victims to suffer. In contrast, children with pure conduct problems exhibited reactive forms of aggression in high-provocation conditions only. This provides partial support for past research linking high emotional arousal (Ezpeleta et al., 2017) and specific deficits in social-information processing (i.e., hostile attribution bias) to reactive aggression (Frick et al., 2003b). Taken together, these studies are in line with the contention that subgroups of children with conduct problems display distinct patterns of aggressive behavior which may reflect different developmental processes underlying their behavioral disturbance.

9. Neural Correlates

9.1 Function

Table 4 summarizes 11 studies investigating various neural correlates to CU traits in children and adolescents. One consistent finding from these studies is that children and adolescents with conduct problems and varying levels of CU traits show opposing patterns of amygdala reactivity, where youths with elevated levels of CU show reduced responsiveness in

the right amygdala to emotional distress cues (Hwang et al., 2016; White et al., 2016), and those with low levels of CU show heightened amygdala responsiveness to such cues (Sebastian et al., 2012; Viding et al., 2012). For example, youth with disruptive behavior disorders and high levels of CU traits showed lower right amygdala recruitment when viewing threat stimuli than did those with normative levels of CU traits and healthy controls (Hwang et al., 2016), and they showed significantly reduced right amygdala response compared to their low CU peers when retaliating in response to provocation (White et al., 2016). Further, when externalizing behaviors and CU traits were considered simultaneously within the same conduct problems group, right amygdala responses to fearful facial expressions were positively associated with externalizing behaviors and negatively associated with CU traits, providing further evidence that amygdala responses to affective stimuli are differentially associated with these dimensions (Lozier, Cardinale, VanMeter, & Marsh, 2014). The same research group reported that amygdala hypo-activation mediates the relationship between CU traits and proactive aggression, but not between CU traits and reactive aggression (Lozier et al., 2014). Interestingly, one imaging study suggests that these differences in amygdala reactivity extend to early stages of information processing. Utilizing a backward masking paradigm, Viding and colleagues (2012) found that, compared to healthy controls and the low CU group, boys with conduct problems and elevated CU traits displayed reduced right amygdala responsiveness to fearful faces that were presented below the level of conscious awareness. Given that salient distress cues, such as fearful facial expressions, activate the amygdala and elicit empathy and inhibit aggression in healthy children and adults (Blair, 2005; Marsh and Ambady, 2007), it is not surprising that reduced amygdala responsiveness to such cues leads to increased proactive aggression observed in youths with CU traits (Crowe and Blair, 2008). Taken together, these studies are consistent with the VIM model of

aggression (Blair, 1995) in that they suggest children with CU traits do not learn to inhibit behaviors that cause harm to others because to them, other's distress cues are not aversive.

Importantly, one imaging study demonstrated that youth with conduct problems exhibit amygdala impairments that extend beyond difficulties in affective processing. Compared to healthy controls, youths with DBDs had reduced responses to faces relative to objects within the amygdala and regions of the temporal cortex (i.e., lateral fusiform gyrus/parahippocampal gyrus), and greater failure to differentiate faces and objects in amygdala responding was associated with increased CU traits (Thornton et al., 2017). Converging evidence indicates that amygdala response to animacy information is critical for social engagement (Ochsner, 2008; Wheatley, Millevile, & Martin, 2007). As such, these findings tentatively suggest that dysfunctional animacy processing in the amygdala contributes to the development and maintenance of disturbed social interactions in children with conduct problems and elevated CU traits.

In line with behavioral and physiological data discussed previously, neuroimaging data have revealed neurocognitive differences in empathic pain processing between subgroups. Compared to normal developing boys, boys with conduct problems showed reduced responses in the anterior insula (AI), anterior cingulate cortex (ACC), and inferior frontal gyrus when observing others in pain, and the severity of AI/ACC disruption was positively associated with the level of callous traits (Lockwood et al., 2013). Further, on a laboratory task measuring altruistic behavior, adolescents with conduct problems and limited prosocial emotions were more likely to make decisions that benefitted themselves while harming others (Sakai, Dalwani, Gelhorn, Mikulich-Gilbertson, & Crowley, 2012), and showed lower activation in the right AI when making such decisions compared to normal controls (Sakai et al., 2017). In a similar vein, Sebastian and colleagues (2013) measured neural responses in boys with conduct problems while they watched scenarios requiring

affective (i.e., understanding others emotions) versus cognitive theory of mind (i.e., understanding intentions and beliefs). Compared with matched controls, boys with conduct problems showed reduced activation of the right AI and right amygdala during affective theory of mind relative to cognitive theory of mind conditions and, once again, conduct problem symptoms and CU traits had opposing unique influences on amygdala activity. These findings are not surprising given that a core characteristic of psychopathy is the propensity to manipulate others (Hare, 2012), which requires an intact ability to understand other's intentions and beliefs. They are also in line with previous reports of deficient affective empathy (but spared cognitive empathy) abilities in children with conduct problems and CU traits (Anastassiou-Hadjicharalambous & Warden, 2008), and add to the growing literature that suggests disrupted empathic processing is important for understanding patterns of aggression in these youths.

Response inhibition is another form of pathophysiology that differentiates between CP/CU subtypes. Using a modified version of the dot probe task, Thornton and colleagues (2017) found that, compared to healthy individuals, youths with DBDs showed lower recruitment of regions implicated in response inhibition (i.e., bilateral inferior/lateral frontal cortex, right caudate, and the left inferior parietal cortex) during incongruent relative to congruent trials. Similarly, youths with DBDs showed decreased insula responsiveness to incongruent trials in the Affective Stroop Task compared to healthy youths, and insula responsiveness was inversely related to ADHD symptomatology in the youths with DBD (Hwang et al., 2016). Consistent with findings from Ezpeleta et al. (2017) and Schwenck et al. (2014) discussed previously, this study suggests that children with severe conduct problems and normative levels of CU traits have primarily an impulsivity deficit. The results support the contention that some youths with severe conduct problems show a pattern of

pathophysiology that is related to deficits in systems involved in response inhibition, which is not associated with CU symptomatology, but rather with impulsiveness.

Finally, several studies have indicated fronto-temporal connectivity deficits in youths with CP and elevated levels of CU traits. One study showed that when conduct problem symptoms and CU traits were modeled simultaneously, the severity of CU traits (but not the severity of externalizing behaviors) predicted lower white-matter integrity in primary pathways that connect prefrontal and temporal regions (i.e., bilateral uncinate fasciculus and stria terminalis/fornix; Breeden, Cardinale, Lozier, VanMeter, & Marsh, 2015). Moreover, reduced white-matter integrity in these regions was associated with lower amygdala activation in response to fearful faces, indicating that individuals who display the lowest WM integrity also exhibit the most pronounced amygdala hypo-activation in response to fear-relevant stimuli (Breeden et al., 2015). White and colleagues (2016) also found that, compared to healthy youth, youth with DBDs show reduced right amygdala and ventromedial prefrontal cortex (vmPFC) connectivity when responding to high provocation. Closely related is the finding of extreme reward dependence in youths with conduct problems and significant CU traits (Fisher & Blair, 1998; Frick et al., 2003b; O'Brien & Frick, 1996). Previous research suggests that the amygdala is responsible for coding the affective significance of external stimuli and feeding this information to the vmPFC to guide decision-making (Cardinale, Parkinson, Hall, & Everitt, 2002). These results indicate that fronto-temporal connectivity deficits might contribute to the shift in motivational balance towards decreased punishment sensitivity and enhanced reward sensitivity in children with CU traits. All in all, the inadequate signaling of reinforcement expectancies between the amygdala and prefrontal cortex may underlie the major behavioral deficits typically observed in CU youths.

9.2 Structure

Research comparing brain structure in subgroups of youth with conduct problems is more limited. Of particular relevance to whether structural differences might help designate an important subgroup of children and adolescents with severe conduct problems, Sebastian and colleagues (2015) directly compared boys (ages 10-16) with conduct problems and high levels of CU traits (CP/HCU; $n = 29$) to boys with CP and low levels of CU traits (CP/LCU; $n = 31$), and normal control boys (TD; $n = 29$). The CP/HCU group showed more widespread grey matter reductions than the CP/LCU group when compared to the TD group as evidenced by additional reductions in the right anterior cingulate cortex (ACC) and left orbitofrontal cortex (OFC), which were not displayed by the CP/LCU group. Whole brain analyses also confirmed grey matter reductions in the left middle frontal gyrus in CP/HCU relative to controls, which may point to an additional neurobiological marker for children with conduct problems and elevated levels of CU traits. Interestingly, no structural differences were found in the amygdala and the anterior insula (AI), which suggests that atypical amygdala and AI function may be more characteristic of CU traits than is atypical structure in these regions (Sebastian et al., 2015). In short, findings from this study indicate that grey matter volume in regions underlying emotional processing and reinforcement learning differentiate these two subgroups of children with conduct problems, and the more extensive grey matter reductions in the CP/HCU group might partly explain their different behavioral profiles (Frick and Viding, 2009).

In summary, neuroimaging research has elucidated several biological mechanisms that can explain the differing socio-cognitive and behavioral profiles observed in youths with high and low levels of CU traits. Overall, these studies have suggested that reduced amygdala responsiveness to threat stimuli, coupled with inadequate signaling between the amygdala and prefrontal cortex, underlie the emotional deficits observed in CU youths but not in youths with conduct problems more generally. Findings from these studies also suggest that problems

in empathic pain processing are specific to those with significant levels of CU traits. The deficits in amygdala responsiveness, fronto-temporal connectivity, and empathic pain processing may, in turn, lead to higher rates of proactive aggression in CU youths. In contrast, children and adolescents with conduct problems and unspecified levels of CU traits show a form of pathophysiology that is related to difficulties in response control. Taken together, findings support theories that link psychopathy to early amygdala dysfunction and consequent impairments in processing fearful and sad emotions (Blair, 2005). Such theories predict that individuals with psychopathic tendencies fail to process distressing cues in the environment (e.g., fearful and sad facial expressions) due to impairments in the amygdala and, as a consequence, do not learn to avoid behaviors that cause harm to others (Blair, 1995; Blair, 2005). In line with this contention, children with CU traits displayed amygdala hypoactivation in response to fearful and sad facial expressions (in other words, they were not as distressed by threatening cues in the environment), and this explained the increased risk of antisocial conduct in this group. More contentiously, these data are in line with theories that suggest youth with severe conduct problems with and without CU traits have different biological mechanisms that underlie their problem behaviors (Frick et al., 2003a). Indeed, they suggest that amygdala dysfunction is important in explaining the difficulties the group with conduct problems and CU traits have, whereas a deficit in the frontal cortex is more important for the pure conduct problems group. Although more imaging studies are needed, especially those directly comparing structural differences in children and adolescents with conduct problems with and without CU traits, the available research has been promising for uncovering the neurological markers for many of the emotional and cognitive characteristics associated with severe conduct problems and varying levels of CU traits.

10. Clinical Characteristics

The previous section reviewed research related to the question of whether subgroups of children with conduct problems exhibit distinct characteristics depending on the presence of CU traits and suggested that different causal mechanisms might underlie the development of problem behaviors across subgroups. I now turn to research that focuses on whether CU traits designate a unique subgroup with a more severe pattern of behavioral disturbance, and whether the presence of these traits adds to the prediction of concurrent and future impairment. Table 5 reviews nine studies that have explored these questions.

The most consistent finding is that CU traits are associated with more severe forms of aggression and higher rates of antisocial behavior, even after controlling for conduct problem severity, common problems in comorbidity (e.g., impulsivity), and age of onset of conduct problems (Christian et al., 1997; Frick, Cornell, Barry, Bodin, & Dane, 2003a; Frick et al., 2005; Stickle, Kirkpatrick, & Brush, 2009). For instance, using a non-referred sample of elementary school children, Frick and colleagues (2003a) reported that the group with conduct problems and elevated CU traits showed higher levels of aggression, particularly proactive aggression, and had higher rates of self-reported delinquent acts one year later compared to the group with conduct problems alone. Importantly, this poorer outcome for children with CU traits could not be accounted for by differences in initial level of conduct problem severity (Frick et al., 2003a). An additional 4-year follow-up with the same sample showed that children with both conduct problems and CU traits exhibited the highest rates of conduct problems, self-reported delinquency, and parent-reported police contacts across the four years of the study (Frick et al., 2005).

Studies that have examined this relationship over longer periods of time indicate that childhood CU traits demarcate youths who are at heightened risk for delinquency that persists into adulthood (Byrd et al., 2011; McMahon et al., 2010). For example, in a large prospective study of at-risk adolescents, parent-reported CU traits at grade 7 predicted higher levels of

self-reported delinquency and arrests in adulthood (McMahon et al., 2010). Similarly, in a community sample of at-risk boys, those who showed conduct problems and CU traits at age 7 were at heightened risk for delinquency engagement at age 25, even after controlling for co-occurring attention-deficit/hyperactivity disorder (ADHD), ODD, and CD symptoms (Byrd et al., 2011). Given that the age of onset of CD symptoms and the severity of other comorbidities are significant predictors of delinquency engagement over time (Frick & White, 2008), these results speak to the unique role of CU traits for enhancing the prediction of later delinquency and more severe antisocial outcomes.

Further evidence that CU traits may differ from other forms of antisocial behavior comes from studies of comorbidity. Specifically, CU traits have consistently been associated with greater levels of comorbidity and worse functioning overall in both clinic-referred and community samples. Indeed, children with CD and the CU specifier, as compared to those without the specifier, exhibit greater levels of externalizing disorder symptoms (CD, ODD, ADHD), bullying behavior, lower levels of academic achievement, and higher use of services over time (Ezpeleta, Granero, Osa, & Domenech, 2015; Kahn et al., 2012; Pardini et al., 2012; Rowe et al., 2010). The association between CU traits and internalizing problems seem to be more complex. In one study, girls (aged 6-8) with CD and elevated CU traits had higher levels of externalizing symptoms, relational aggression, and global impairment compared to girls with CD alone (Pardini et al., 2012). In contrast, girls with CD and low levels of CU traits tended to have more anxiety problems than girls with the CU subtype. Importantly, all girls with CD exhibited higher levels of depressive symptoms than girls in the control group, suggesting that CU traits may buffer children with severe conduct problems from experiencing anxiety problems, but not from problems with depression (Pardini et al., 2012). Another study using a sample of preschool children between the ages of 3 and 5 showed that high levels of ODD were associated with higher emotional reactivity and anxiety and

depressive symptoms after controlling for the presence of CU traits (Ezpeleta et al., 2015). It appears that CU traits are associated with lower levels of anxiety, while the presence of conduct problems without CU traits are positively related to anxiety. Taken together, these results indicate that both conditions are predictive of comorbidity and worse functioning, but high levels of CU traits contribute to a wider variety of negative outcomes.

To summarize, CU traits play a key role in designating a particularly severe and chronic group of children with antisocial behaviors who are also at heightened risk for later delinquency. The presence of these traits predict higher levels of aggression, self-reported delinquency, and more frequent contact with the police, even after controlling for conduct problem severity, problems in comorbidity, and age of onset of conduct problems. Studies of comorbidity also indicate that CU traits identify a more severely troubled group within children with conduct problems. The presence of CU traits was consistently associated with greater co-occurrence of externalizing problems as well as worse functioning overall. Children with normative CU traits, on the other hand, exhibited higher levels of anxiety problems compared to their high-CU peers. Indeed, children in the combined CD/CU groups exhibited more problematic levels of all outcomes except for depression and anxiety. The pattern of findings related to anxiety are consistent with theories indicating that low fearfulness may contribute to the development of CU traits (Lykken, 1957; Patrick, 1994). All in all, these results are highly consistent with developmental theories which argue that within the group of children with severe antisocial behaviors, there are important subgroups which exhibit distinct characteristics that could suggest different causal processes underlying their behavioral disturbance.

11. Summary and Implications for Causal Models of Severe Conduct Problems

The purpose of the thesis was to provide a comprehensive and systematic review of the available research on CU traits in children and adolescents in order to determine whether

the subgroup with CU traits differ on theoretically important characteristics, which could suggest different causal processes underlying their behavioral disturbance. Based on this existing research, there appears to be strong support for the role of CU traits in designating a more severe group of antisocial children who show substantial variations in the emotional and cognitive correlates of their aggressive behaviors. Evidence from both behavioral measures and psychophysiological indices suggests that children with severe conduct problems and CU traits have difficulties in recognizing and responding to signs of fear and distress in others (Frick et al., 2014). Neuroimaging data have mirrored these findings in that youths with elevated levels of CU showed reduced responsiveness in the right amygdala to emotional distress cues across several studies. Children and adolescents with elevated CU traits also exhibit pronounced deficits in more advanced emotion competencies, such moral reasoning and empathic concern. In addition, they show a preference for novel and dangerous activities, view aggression as a means of attaining goals, and do not care about the negative consequences of their aggressive behaviors. As a result, children with conduct problems and CU traits are at risk for showing higher levels of calculated and planned forms of aggression (i.e., proactive aggression). Finally, children with CU traits exhibit a more severe pattern of behavioral disturbance and are at heightened risk for delinquency in adulthood.

In contrast, children with severe conduct problems and normative levels of CU traits display an emotionally and behaviorally dysregulated profile that is related to high emotional arousal. These children tend to be highly reactive to threatening and emotionally distressing stimuli and respond more strongly to perceived provocation. They are also more likely to make faulty interpretations of ambiguous social stimuli and formulate aggressive responses based on these interpretations. In addition, evidence from neuroimaging research indicates that these children show lower recruitment of regions implicated in response inhibition during incongruent task trials. However, they do not show deficits in neither cognitive nor affective

facets of empathy, indicating that they primarily have an impulsivity deficit. Finally, children with conduct problems and normative levels of CU traits exhibit higher levels of anxiety symptoms compared to their high-CU peers. As a result, children with pure conduct problems show lower levels of aggression overall, and when they do, their aggression tends to be unplanned and volatile (i.e., reactive aggression) in nature.

Taken together, prior research suggests that children and adolescents with conduct problems and varying levels of CU traits show differences in the correlates of their problem behavior, the types and severity of conduct problems they display, and the developmental course of their aggressive behaviors (Frick & Ellis, 1999). This supports the contention that there may be different causal processes underlying the behavioral disturbance of subgroups of children with conduct problems (Frick et al., 2003). Indeed, the presence of CU traits designates a "cold" and emotionally underaroused pathway that is associated with poor reactivity to distress cues and a tendency to view aggressive behaviors as a means of obtaining goals, which leads to more calculated and proactive forms of aggression (Helseth et al., 2015). On the other hand, conduct problems in the absence of CU traits represents a "hot" pathway that is related to problems in emotional and behavioral regulation, particularly with overreactivity to emotional stimuli, which leads to unplanned and impulsive antisocial acts for which the child can feel remorseful afterward, but may still have difficulty controlling in the future (Pardini et al., 2004).

These results are predicted by emotion-based accounts of aggression (Blair, 1995; Blair, 2005; Lykken, 1957; Patrick, 1994). Both models propose that the ability to adequately process fear and sadness is a precursor for the development of empathy and moral socialization. More specifically, the low-fear explanation suggests that individuals with psychopathic tendencies are poorly socialized due to an inability to experience fear. Accordingly, an inability to experience fear precludes individuals with psychopathic traits

from adjusting their behavior in response to the negative consequences that their behavior has led to in the past (Lykken, 1957; Patrick, 1994). Empirical support for this position was drawn from experiments showing that children with CU traits tend to disregard cues of punishment when they are engaged in goal-oriented tasks (Fisher & Blair, 1998; Frick et al., 2003b; O'Brien & Frick, 1996; Pardini et al., 2003). In a similar vein, the VIM model argues that the primary deficit in individuals with psychopathy is a dysfunction within the neurocognitive system which mediates the response to distress cues (Blair, 1995; Blair, 2005). The model assumes that distress cues (e.g., fearful and sad facial expressions) act as aversive unconditioned stimuli that modulate the probability that a particular behavior will be performed in the future (Blair et al., 2004). Because individuals with psychopathic tendencies have a dysfunctional VIM, they fail to adequately recognize and respond to such cues in the environment and, consequently, are not discouraged by their actions that cause fear and sadness in others. In other words, children and adolescents with psychopathic tendencies do not learn to inhibit behaviors that have negative consequences because to them, a victim's distress is not aversive. In line with this theory, children with elevated CU traits showed impaired recognition of sad and fearful facial expressions (Schwenck et al., 2014; Woodworth & Waschbusch, 2007) and sad vocal tones (Stevens et al., 2001). In addition, they exhibited a relative insensitivity to physical pain (Cheng et al., 2012) and reduced autonomic arousal in response to threat and danger cues (Anastassiou-Hadjicharalambous & Warden, 2008). Furthermore, children with significant levels of CU traits displayed pronounced deficits in empathy and moral reasoning: They were unable to experience negatively valenced self-conscious emotions (e.g., guilt; Blair et al., 2001) and made less clear distinctions between moral and conventional transgressions (Blair, 1997; Dolan & Fullam, 2010). These findings are consistent with the VIM model in that difficulties in more simple emotional abilities (e.g., identifying emotional expressions) hindered the development of more advanced emotional

competencies (e.g., moral reasoning and pro and antisocial decision-making) in children with elevated CU traits. Taken together, it appears that a dysfunction in the VIM may underlie the behavioral difficulties of children with severe conduct problems and CU traits, but not of children with conduct problems more generally.

The research reviewed in this thesis suggests that VIM dysfunction might be a consequence of a physiological deficit in the amygdala or an absence of early socialization experiences (Blair, 1995). Extant literature shows that the amygdala is implicated in aversive and appetitive conditioning (Everitt et al. 2000; LeDoux 2000) and is activated by sad and fearful facial expressions (Drevets et al. 2000). In addition, amygdala lesions have been consistently associated with impairment in the recognition of fearful expressions (Calder et al. 1997; Schmolck & Squire 2001). This indicates that the VIM might be an innately specified physiological structure (i.e., the amygdala). In line with this contention, neuroimaging data included in this review indicates that amygdala dysfunction is crucially involved in the development of CU traits. For instance, youth with disruptive behavior disorders and high levels of CU traits showed lower right amygdala recruitment when viewing threat stimuli than did those with normative levels of CU traits and healthy controls (Hwang et al., 2016), and showed significantly reduced right amygdala response compared to their low-CU peers when retaliating in response to provocation (White et al., 2016). Thus, the absence of VIM can be conceptualized as a physiological deficit in the amygdala. Alternatively, an absence of VIM may be a consequence of the very early experience of socialization to withdraw from certain distress cue contexts (Blair, 1995). Indeed, children with conduct problems and high levels of CU traits exhibited impaired eye contact with primary caregivers, which not only reduced the influence of parenting, but also led to a series of errors that affected the development of low-level processes of paying attention to emotional cues, as well as higher-order human functions of empathic concern and moral conscience (Dadds et al., 2011; Dadds et al., 2012). Thus, the

absence of VIM may be due to a deficit in a physiological structure or a result of the experience of early socialization events.

12. Implications for Diagnostic Classification and Treatment

The research included in this review indicates that the presence of CU traits designates a unique subgroup of antisocial youth who show a more severe and persistent pattern of behavioral disturbance. Indeed, CU traits were associated with more severe forms of aggression and higher rates of antisocial behavior, even after controlling for conduct problem severity, common problems in comorbidity (e.g., impulsivity), and age of onset of conduct problems (Christian et al., 1997; Frick et al., 2003a; Frick et al., 2005; Stickle, Kirkpatrick, & Brush, 2009). These children were also at heightened risk for showing delinquency that persists into adulthood (Byrd et al., 2011; McMahon et al., 2010). Collectively, these results support the inclusion of the "with Limited Pro-social Emotions" specifier for the diagnosis of Conduct Disorder in the DSM-5 (American Psychiatric Association, 2013). Indeed, adding the specifier to the diagnosis of Conduct Disorder can aid in the identification of youths who are at increased risk for showing more severe antisocial outcomes, both concurrently and longitudinally.

Finally, and perhaps most importantly, studies included in this review have the potential to guide novel approaches to the prevention and treatment of antisocial behaviors in youth. This work has demonstrated that children and adolescents with serious conduct problems exhibit substantial variations in the causes and correlates of their behavior problems, and as such, highlights the need for interventions that are tailored to the unique emotional, cognitive, and interpersonal styles of different subgroups. For example, interventions that more directly target the processes involved in children with CU traits, such as interventions that promote empathy or those that take advantage of children's extreme focus on rewards, may be more effective for this subgroup of antisocial youth (Frick et al., 2003a). Interestingly,

findings suggest that interventions designed to enhance emotion recognition skills may only make children with CU traits better manipulators of their victims, especially since they appear to have intact cognitive perspective-taking skills (Jones et al., 2010; Schwenck et al., 2011). On the other hand, for children with pure conduct problems, it may be important to emphasize a more balanced appraisal of other people's emotions, for example, through a process of explicit verbalization, which has already been shown to be effective in the treatment for anxiety disorder (see Hakamata et al., 2010 for a meta-analysis). All in all, it appears that the most promising approach to treating severely antisocial children is one that adopts an individualized approach to intervention and that targets the multiple factors that can underlie severe conduct problems (Frick et al., 2003a).

13. Conclusion

In conclusion, children with serious conduct problems constitute a very heterogeneous group who exhibit wide variations in the emotional and cognitive correlates of their antisocial behavior, suggesting that different developmental processes may be underlying their behavioral disturbance. The presence of CU traits may designate a "cold" and emotionally underaroused pathway that is associated with poor reactivity to distress cues and a preference for aggressive strategies as a means of achieving desired outcomes, resulting in more calculated and proactive forms of aggression (Helseth et al., 2015). In contrast, conduct problems in the absence of CU traits may represent a "hot" pathway that is related to problems in emotional and behavioral regulation, particularly with overreactivity to emotional stimuli, and leads to unplanned and impulsive antisocial acts for which the child can feel remorseful afterward (Pardini et al., 2003). Understanding the heterogeneity of childhood conduct problems can have important implications for diagnostic classification and could help to guide innovative treatment research. Indeed, these results indicate that recognizing the subgroup with CU traits in widely used diagnostic classification systems can aid in the

identification of youths who are at heightened risk for concurrent and future impairment. Having a more refined understanding of different subgroups can also lead to enhanced, tailored treatments for all children with severe conduct problems.

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Figure 1. Flow chart illustrating the inclusion and exclusion of publications

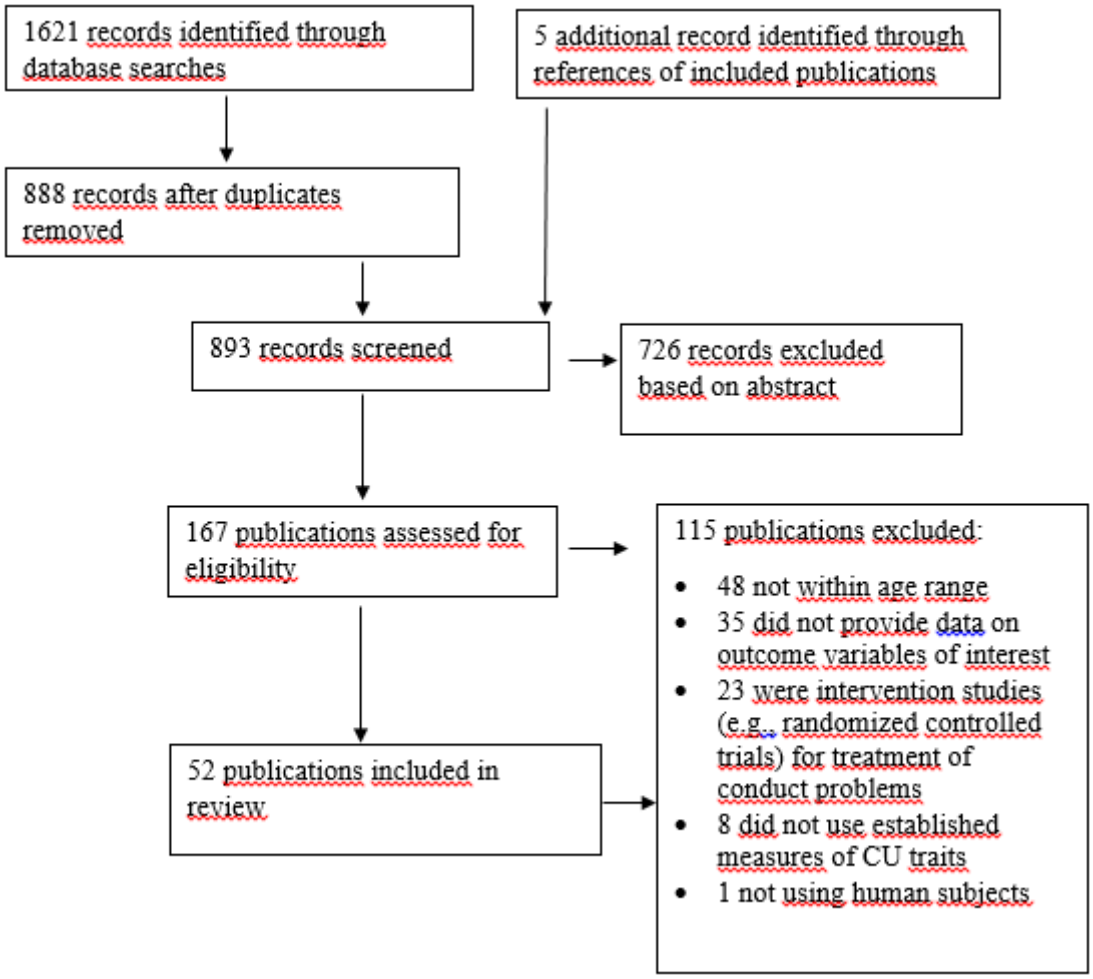

Table 1
Emotional Characteristics Associated with Callous-Unemotional (CU) traits

	Study	Sample	Key methods	Summary of results
1.	Blair et al. (2001)	*N* = 51; age = 9-17; 100% male; clinical sample.	Cross-sectional; teacher report of psychopathic traits including CU traits; morphing task.	Boys with behavior problems and psychopathic tendencies took more time before they could successfully recognize sad expressions compared to boys with behavior problems only.
2.	Bowen et al. (2013)	*N* = 100; age = 13-17; 100% male; forensic sample.	Cross-sectional; self-report of psychopathic traits including CU traits; facial emotion recognition task.	Young offenders were significantly were less accurate in identifying sadness, low intensity disgust and high intensity fear compared to controls; within the group of young offenders, levels of conduct disorder and psychopathic traits explained variation in sadness and disgust recognition.
3.	Dadds et al. (2013)	*N* = 99; age = 4-8; 58.6% male; mixed clinic-referred and community sample.	Cross-sectional; mother report of CU traits; observation of mother-child interactions during free play and "I love you" task.	CU traits were associated with less eye contact with mothers; low eye contact was correlated with psychopathic fearlessness in fathers but not

				with quality of attachment-related behaviors in mothers.
4.	Dadds et al. (2012)	*N* = 24; age = 4-8; 50% male; mixed clinic-referred and community sample.	Cross-sectional; parent report of CU traits; "I love you" task.	Children with conduct problems and significant CU traits showed lower levels of physical and verbal affection and made less eye contact with mothers; low eye contact was correlated with psychopathic fearlessness in fathers but not with maternal coercive parenting or feelings toward the child.
5.	Dadds et al. (2011)	*N* = 92; age = 5-16; 100% male; clinic-referred sample.	Cross-sectional; parent, teacher, and self-reports of CU traits; observation of family interactions during free play and "emotion talk" situations.	CU traits were associated with lower eye gaze from child to both parents and with low eye contact from father to child, controlling for hyperactivity and conduct problems.
6.	Dadds et al. (2008)	*N* = 100; age = 8-15; 100% male; community sample.	Cross-sectional; parent and self-reports of CU traits; measurement of multiple indices and eye-gaze.	Boys with elevated CU traits showed poorer fear recognition and lower attention to the eye region of other's faces compared to boys low on CU traits. Boys high on CU traits showed improved eye gaze when they

				were explicitly instructed to look at the eyes.
7.	Dadds et al. (2006)	*N* = 98; age = 8-17; 100% male; community sample.	Cross-sectional; self-report of CU traits; facial expression recognition task.	CU traits were associated with poorer recognition of fearful faces, controlling for antisocial behavior. High CU boys exhibited this deficit except when they were instructed to "look at the eyes". Boys low on CU traits did not show impairments in fear recognition.
8.	Dolan & Fullam (2010)	*N* = 84; age = 14-18; 100% male; forensic sample.	Cross-sectional; clinician rating of psychopathic traits including CU traits; laboratory task of emotional memory.	CU traits were negatively associated with emotional memory after controlling for impulsivity and antisocial behavior.
9.	Ezpeleta et al. (2017)	*N* = 320; age = 8; 51.6% male; community sample.	Cross-sectional; teacher report of CU traits; Go/No-Go task.	The Low CU-High ODD and High CU-High ODD groups were less accurate than the control group in recognizing happiness, fear, or neutral emotions. The High CU-High ODD reacted faster with more errors when identifying emotions. The Low CU-High ODD reacted

				faster than the comparison group.
10.	Martin-Key et al. (2017)	*N* = 101; age = 13-18; 51.4% male; mixed forensic and community sample.	Cross-sectional; self-report of CU traits; Emotional face categorization task.	Across the entire sample, higher levels of CU traits were associated with fear recognition deficits and reduced attention to the eye region of surprised faces. However, within the group with conduct disorder, CU traits were associated with superior fear recognition.
11.	Pasalich et al. (2012)	*N* = 59; age = 3-9; 100% male; clinic-referred sample.	Cross-sectional; parent report of CU traits; Emotional Reminiscing Task.	Frequencies of parents' emotion expression were not associated with the levels of CU traits in the sample. However, boys higher on CU traits were more expressive of negative emotions in conversation with their caregivers.
12.	Schwenck et al. (2014)	N = 64; age = 8-16; 100% female; clinic-referred sample.	Cross-sectional; parent report of CU traits; Morphing task.	Girls with conduct problems and high levels of CU traits were better at identifying fear compared to girls with low CU traits and controls. Girls with conduct problems without CU traits reacted more slowly to

				sad, fearful, and happy facial expression compared to the controls.
13.	Stevens et al. (2001)	*N* = 37; age = 9-15; 100% male; clinical sample.	Cross-sectional; teacher report of psychopathic traits including CU traits; laboratory task of labeling facial and vocal emotions.	Boys with behavior problems and psychopathic tendencies were less accurate in recognizing sad and fearful faces and sad vocal tones, compared to boys with behavior problems alone.
14.	Woodworth & Waschbusch (2008)	*N* = 73; age = 7-12; 81% male; clinic-referred sample.	Cross-sectional; parent and teacher reports of CU traits; task of labeling emotions from pictures of faces.	Children with high levels of CU showed deficits in identifying sad facial expressions controlling for the level of conduct problems. There was a trend for youths with elevated CU traits to show enhanced fear recognition compared to youths with conduct problems only.

Table 2

Research Investigating Empathic Concern and Moral Reasoning in Children and Adolescents with Callous-Unemotional (CU) and psychopathic traits

	Study	Sample	Key methods	Summary of results
1.	Anastassiou-Hadjicharalambous & Warden (2008)	*N* = 105; age = 7-11; 95% male; high-risk community sample and clinical sample.	Cross-sectional; combined parent and teacher reports of CU traits; electrocardiogram.	Children with conduct disorder and CU traits displayed lower baseline heart rate and lower magnitude of heart rate change while watching an emotional film compared to youths with pure conduct disorder and healthy controls.
2.	Blair (1997)	*N* = 42; mean age = 13.20 (CU) and 12.79 (controls); 100% male; residential treatment sample	Cross-sectional; teacher report of psychopathic traits including CU traits; moral/conventional dilemma vignettes.	Boys with psychopathic traits made worse judgments of moral/conventional distinctions and attributed less moral emotions to story characters than boys with disruptive behavior problems only.
3.	Blair et al. (2001)	*N* = 102; age = 8-16; 100% male; clinical sample.	Cross-sectional; teacher report of psychopathic traits including CU traits; moral/conventional dilemma vignettes.	Boys with behavior problems and psychopathic traits made worse judgments of moral/conventional distinctions and made fewer references to the welfare of others compared to boys with behavioral problems only.
4.	Cheng et al. (2012)	*N* = 43; age = 15-18; 100% male; mixed forensic and	Cross-sectional; clinician ratings of psychopathic traits including CU traits; event related	Young offenders both high and low on psychopathic traits had higher pain thresholds

		community sample.	potential (ERP) for empathy eliciting stimuli; pressure pain threshold measured by pressure algometer.	than healthy controls. Youths high on psychopathic traits exhibited decreased frontal N120, central P3, and late positive potential while responding to pictures showing others in pain.
5.	Dolan & Fullam (2010)	*N* = 115; age = 13-18; 100% male; forensic sample.	Cross-sectional; clinician rating of psychopathic traits including CU traits; moral/conventional vignettes.	Compared to young offenders low on psychopathic traits, offenders high on psychopathic traits viewed both transgression types as more permissible and conventional transgressions as less serious.
6.	Jones et al. (2010)	*N* = 102; age = 9-16; 100% male; high-risk, community and clinical sample.	Cross-sectional; teacher report of CU traits; vignettes to assess values on outcomes of aggression; self-report of attributions of emotion to self; multiple Theory of Mind Tasks.	Boys with conduct problems and CU traits reported less fear and less empathy for victims of aggression compared to boys with conduct problems only, boys with autism spectrum disorder, and controls. Boys with elevated CU traits were as successful as normal controls on cognitive perspective-taking or Theory of Mind tasks.
7.	Martin-Key et al., (2016)	*N* = 77; age= 13-18; 100% male; community sample.	Cross-sectional; self-reported CU traits; Empathic accuracy task.	There were no group differences between children with conduct disorder and high and low levels on CU traits in empathic accuracy.

				The two groups did not differ on measures of emotion recognition or affective empathy.
8.	O'Kearney et al. (2016)	*N* = 119; age= 4-8; 57% male; community sample.	Cross-sectional; parent reports of CU traits; Denham Affective Knowledge Tests	Children with oppositional defiant disorder and CU traits showed deficits in emotion-perspective taking and understanding mixed emotions compared to their low-CU peers.
9.	Sakai et al. (2012)	*N* = 39; age= 14-18; 77% male; mixed clinic-referred and community sample.	Cross-sectional; self-report of CU traits; Altruism-Antisocial (AIAn's) Game.	Adolescents with conduct problems and CU traits were more likely to make decisions that benefitted themselves while harming others, even after controlling for externalizing behaviors.
10.	Schwenck et al. (2011)	*N* = 192; age = 6-17; 100% male; clinic-referred sample.	Cross-sectional; parent report of CU traits, computerized tasks assessing emotional and cognitive empathy.	Boys with conduct disorder and high levels of CU traits showed deficits in affective but not cognitive empathy. Boys with pure conduct disorder did not differ from the control boys on any measures of empathy.

Table 3
Cognitive and Behavioral Characteristics Associated with Callous-Unemotional (CU) Traits

	Study	Sample	Key methods	Summary of results
1.	Fanti et al. (2009)	*N* = 347; age = 12-18; 51% male; community sample.	Cross-sectional; self-report of CU traits; self-report of bullying and aggression.	CU traits were associated with both proactive and reactive forms of aggression. However, after controlling for the correlation between the two types of aggression, only the association with proactive aggression remained significant.
2.	Fisher & Blair (1998)	*N* = 39; age = 9-16; 100% male; clinic-referred sample.	Cross-sectional; multiple teacher reports of psychopathic traits including CU traits; laboratory measure of response modulation, moral/conventional vignettes.	Boys with behavior problems and psychopathic tendencies were less sensitive to cues of punishment when a reward oriented response was primed. This group also made poorer judgments of moral versus conventional distinctions compared to boys with behavior problems only.
3.	Frick et al. (2003a)*	*N* = 98; mean age= 12.34; 53% male; community sample.	Longitudinal; parent and teacher reports of CU traits;	Children with conduct problems and elevated CU traits were at heightened risk for showing aggression, particularly proactive aggression, and this relationship remained significant even after controlling for the initial level of conduct problem severity.

4.	Frick et al. (2003b)	*N* = 98; mean age = 12.36; 53% male; community sample.	Cross-sectional; parent and teacher report of CU traits; computer task of reward dominance; vignette procedure to assess hostile attributions.	Both boys and girls with conduct problems and high levels of CU traits were less sensitive to punishment when a reward-oriented response was primed, whereas boys with conduct problems did not show this deficiency. Boys with conduct problems and normative levels of CU traits had a tendency to show hostile attribution biases.
5.	Helseth et al. (2015)	*N* = 60; age = 6-12; 76.6% male; community sample.	Cross-sectional; Hypothetical peer provocation scenarios; Competitive Reaction Time Task	All children exhibited reactive aggression, but only children with conduct problems and CU traits exhibited proactive aggression as well.
6.	O'Brien & Frick (1996)	*N* = 132; age = 6-13; 78% male; clinical sample.	Cross-sectional; teacher report of CU traits; computer task of reward dominance.	Children with conduct problems and elevated CU traits and low anxiety showed poorer response to punishment when a reward-oriented response set was primed compared to their low-CU peers.
7.	Pardini et al. (2003)	*N* = 169; mean age = 15.81; 57.3% male; forensic sample.	Cross-sectional; self-report of psychopathic traits including CU traits; outcome values and expectancies questionnaires	The callous/unemotional factor of psychopathy was associated with low emotional reactivity, an increased focus on the positive aspects of aggression, and a decreased focus on

				the negative aspects of hostile acts. The impulsivity/conduct problems factor of psychopathy was associated with increased levels of dysregulated behavior and emotional distress.
8.	Stickle et al. (2012)	*N* = 150; age = 11-17; 60% male; forensic sample.	Cross-sectional; teacher, staff, and self-reports of CU traits	CU traits distinguished a group of children who displayed both reactive and proactive aggression from a group who only showed reactive aggression and a group who showed lower aggression overall.

Note. Asterisk (*) indicates studies that used overlapping samples with another study included in this review.

Table 4
Neural Correlates Associated with Callous-Unemotional (CU) Traits

	Study	Sample	Key methods	Summary of results
1.	Breeden et al. (2010)*	*N* = 47; mean age = 14.37; 57.1% male; community sample.	Cross-sectional; child and parent report of CU traits; diffusion tensor imaging; facial emotion processing task.	Both CU traits and externalizing behaviors were negatively correlated with white matter integrity in the uncinate fasciulus and stria terminalis/fornix. However, the association between externalizing behaviors and white matter integrity did not remain significant after controlling for CU traits.
2.	Hwang et al. (2016)	*N* = 63; age= 10-18; 58.7% male; community sample.	Cross-sectional; parent report of CU traits; Affective Stroop Task; functional MRI.	Youths with DBDs and high CU traits showed less activation of the ventromedial prefrontal cortex (vmPFC) and amygdala in response to negative stimuli compared to their low-CU peers and healthy controls. Within the sample with DBDs, CU traits were inversely related to vmPFC responsiveness.
3.	Lockwood et al. (2013)	*N* = 54; age = 10-16; 100% male; community sample.	Cross-sectional; parent and teacher reports of CU; functional MRI; neural responses to pictures of others	Children with conduct problems showed reduced blood oxygen level-dependent responses to others' pain in the anterior insula (AI), anterior cingulate

			in pain versus no pain.	cortex (ACC), and inferior frontal gyrus. In the conduct problems group, callous traits were negatively associated with responses to others pain in the AI and ACC.
4.	Lozier et al. (2014)*	*N* = 46; age= 10-17; 56.5% male; community sample.	Cross-sectional; self- and parent reports of CU; functional MRI; facial emotion processing task.	Amygdala responses to fearful faces was positively associated with externalizing behaviors and negatively associated with CU traits. Reduced amygdala mediated the relationship between CU traits and proactive aggression.
5.	Sakai et al. (2017)	*N* = 66, age = 15-18; 100% male; mixed clinic-referred and community sample.	Cross-sectional; functional MRI; AIAn's game.	Youth with conduct problems and CU traits showed reduced right anterior insula activation when making decisions that would benefit the self while harming others.
6.	Sebastian et al. (2015)*	*N* = 89; age = 10-16; 100% male; community sample.	Cross-sectional; parent and teacher reports of CU; voxel-based morphometry.	Children with conduct problems and high levels of CU traits showed reduced grey matter volume in the middle frontal gyrus compared to controls.
7.	Sebastian et al. (2012)*	*N* = 47; age= 10-16; 100% male; community sample.	Cross-sectional; parent and teacher reports of CU; functional MRI; Cartoon Vignette paradigm.	Children with conduct problems showed reduced activation in right amygdala and right anterior insula for affective versus cognitive theory of

				mind judgments. CU traits were negatively associated with amygdala reactivity after controlling for hyperactivity, depression/anxiety symptoms, or alcohol use ratings.
8.	Sebastian et al. (2014)*	*N* = 51; age = 10-16; 100% male; community sample.	Cross-sectional; parent and teacher reports of CU; functional MRI; facial emotion processing task.	Children with conduct problems and normative levels of CU traits showed increased amygdala responses and slower reaction times for fearful eyes compared to healthy controls.
9.	Thornton et al. (2017)	*N* = 49; age = 10-17; 61.2% male; community sample.	Cross-sectional; parent report of CU traits; functional MRI; The Animacy Attention Task.	Youth with DBDs showed reduced amygdala responses to faces relative to objects. Within the group with DBDs, higher levels of CU traits were associated with lower amygdala responses to faces relative to objects.
10.	Viding et al. (2012)	*N* = 46; age = 10-16; 100% male; community sample.	Cross-sectional; parent and teacher reports of CU traits; functional MRI; backward masking paradigm.	Boys with conduct problems and normative levels of CU traits showed greater amygdala response to fearful versus calm faces compared to their high-CU peers. These results were not explained by symptom levels of conduct disorder, attention-deficit/hyperactivity disorder, anxiety, or depression.

11.	White et al. (2016)	N = 56; age = 10-18; 59% male; community sample.	Cross-sectional; parent report of CU; functional MRI; Social Fairness Game.	Youth with DBDs and low CU traits showed greater increases in activation of threat circuitry when punishing others and dysfunctional down regulation of the vmPFC relative to those with high-CU traits and healthy controls.

Note. Asterisk (*) indicates studies that used overlapping samples with another study included in this review.

Table 5

Research Testing the Association Between Callous-Unemotional Traits and the Severity and Stability of Antisocial Behavior

	Study	Sample	Key methods	Summary of results
1.	Byrd et al. (2011)	*N* = 503; mean age = 7.43; 100% male; community sample.	Longitudinal; teacher and parent reports of CU traits; self-report and official records of criminal behavior.	CU traits at age 7 were associated with criminal behavior at age 25, even after controlling for attention-deficit/hyperactivity disorder, oppositional defiant disorder, and conduct disorder.
2.	Christian et al. (1997)	*N* = 120; age= 6-13; 80% male; clinic-referred sample.	Cross-sectional; parent and teacher reports of CU traits, clinical rating of conduct problems; parent report of police contact and parental history of antisocial behavior.	Children with conduct problems and elevated CU traits showed greater number and variety of conduct problems, earlier police contact, and stronger family history of antisocial personality disorder than their low-CU peers.
3.	Ezpeleta et al. (2015)	*N* = 622; age = 3; 50.9% male; community sample.	Longitudinal; teacher reports of CU.	Higher levels of CU traits at age 3 predicted higher levels of aggression, externalizing and global symptomatology, functional impairment and higher probability of comorbid disorders and use of services at age 5, even after controlling for conduct disorder symptoms and other comorbidity.
4.	Frick et al. (2005)*	*N* = 98; mean age = 12.36; 53% male;	Longitudinal; parent and teacher rating of	Children with conduct problems who also showed

		community sample.	psychopathic traits including CU traits; parent reports of police contact.	CU traits exhibited the highest rates of conduct problems, self-reported delinquency, and police contacts over four years.
5.	Kahn et al. (2012)	*N* = 1136; age = 5-18; 51.4% male; mixed community and clinic-referred sample.	Cross-sectional; parent report of psychopathic traits including CU traits.	In the clinic-sample, psychopathic tendencies were associated with higher rates of aggression and cruelty.
6.	McMahon et al. (2010)	*N* = 754; Grade 7; 58% male; high-risk community sample.	Longitudinal; parent report of CU traits, official records of arrests, self-report of antisocial personality.	CU traits in Grade 7 predicted higher rates of arrests and antisocial personality symptoms in adulthood, even after controlling for common problems in comorbidity. Those with conduct disorder and elevated CU traits showed worse antisocial outcomes than those with CD only.
7.	Pardini et al. (2012)	*N* = 1862; age = 6-18; 100% female; community sample.	Longitudinal; parent and teacher reports of psychopathic traits including CU traits.	Girls with conduct disorder and CU traits had higher levels of externalizing disorder symptoms, bullying, relational aggression, and global impairment than girls with CD alone. Girls with CD alone had more anxiety problems than those with the CU subtype.
8.	Rowe et al. (2010)	*N* = 5326; age = 5-16; nationally representative sample.	Longitudinal; parent report of CU traits; structured	Youth with conduct disorder and CU traits were more likely to have

			interview of psychopathology; parent, teacher, and self-reports of police contact.	retained a conduct disorder diagnosis 3 years later compared to those with conduct disorder alone at the initial assessment.
9.	Stickle et al. (2009)	*N* = 150; age = 11-17; 60% male; forensic sample.	Cross-sectional; self-report of CU traits; self-report of aggression	CU traits accounted for unique variance in self-reported aggression even after controlling for impulsivity and age of onset of antisocial behavior.