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The better of two evils? Evidence that children exhibiting continuous conduct problems high or low on callous–unemotional traits score on opposite directions on physiological and behavioral measures of fear

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Abstract

The present study examines whether heterogeneous groups of children identified based on their longitudinal scores on conduct problems (CP) and callous–unemotional (CU) traits differ on physiological and behavioral measures of fear. Specifically, it aims to test the hypothesis that children with high/stable CP differentiated on CU traits score on opposite directions on a fear–fearless continuum. Seventy-three participants (M age = 11.21; 45.2% female) were selected from a sample of 1,200 children. Children and their parents completed a battery of questionnaires assessing fearfulness, sensitivity to punishment, and behavioral inhibition. Children also participated in an experiment assessing their startle reactivity to fearful mental imagery, a well-established index of defensive motivation. The pattern of results verifies the hypothesis that fearlessness, assessed with physiological and behavioral measures, is a core characteristic of children high on both CP and CU traits (i.e., receiving the DSM-5 specifier of limited prosocial emotions). To the contrary, children with high/stable CP and low CU traits demonstrated high responsiveness to fear, high behavioral inhibition, and high sensitivity to punishment. The study is in accord with the principle of equifinality, in that different developmental mechanisms (i.e., extremes of high and low fear) may have the same behavioral outcome manifested as phenotypic antisocial behavior.

A minority of children, representing 5% to 10% of the population, engage in continuous antisocial behaviors starting early in life (Fanti & Henrich, 2010; Moffitt, 1993). Supporting the process of equifinality (Cicchetti & Rogosch, 1996), different temperamental and personality traits lead to heterogeneous groups of children demonstrating the same maladaptive behavioral outcomes, manifested as conduct problems (CP; i.e., bullying, vandalism, lying, and stealing; Frick & Morris, 2004). Recent work suggests that callous–unemotional (CU; i.e., lack of remorse or empathy, callous use of others, and shallow or deficient emotions) traits can contribute to CP heterogeneity (Fanti, 2013; Frick & Viding, 2009). Theoretical perspectives (see Frick, Ray, Thornton, & Kahn, 2014; Frick & Viding, 2009, for reviews) indicate that children with CP low on CU traits have difficulties managing and regulating their emotions, show intense emotional arousal, and are oversensitive to social threat. In contrast, children high on both CP and CU traits are less likely to experience emotional distress, show diminished responses to punishment cues, and have deficits in processing emotions of fear and sadness.

The current study proposes that a dimensional system of low and high reactivity to fear can explain heterogeneity in CP, and may represent the temperamental dimension underlying the phenotypic presentation of CP with high versus low CU traits. To achieve the study's aims, children engaging in persistent CP differentiated on levels of CU traits were compared on a comprehensive set of measures associated with fearlessness/fearfulness, including physiological (i.e., fear startle potentiation) and behavioral indices measured through parent report and self-report (i.e., temperamental fear, behavioral inhibition, and sensitivity to punishment). Finding that children exhibiting high/stable CP and low CU traits are characterized by fearfulness and behavioral inhibition may explain the co-occurrence between externalizing and internalizing problems, including anxiety and distress (Fanti & Henrich, 2010; Frick & Viding, 2009). While fearlessness can serve a protective role against internalizing problems (Ross, Benning, Patrick, Thompson, & Thurston, 2009), being extremely low in fear, showing insensitivity to punishment, and having low behavioral inhibition are risk factors for severe and chronic antisocial behavior associated with psychopathic and CU traits (Frick & Morris, 2004; Frick & Viding, 2009). Children with normative levels of CP and CU

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traits are expected to score at medium levels of fearfulness, suggesting different patterns of deviations from normative development (i.e., opposite extremes on a fearful–fearless continuum).

The present study satisfies three fundamental developmental psychopathology principles by (a) studying biological and behavioral components of fear to provide information for individual variability in emotional responses; (b) investigating how different personality and temperamental traits, associated with important developmental processes (i.e., conscience development and emotional regulation), might place a child at risk for chronic CP; and (c) understanding normal and abnormal functioning by studying typical and atypical reactivity to fearful stimuli (Cicchetti & Cannon, 1999). Providing information of the processes underlying the development of CP for heterogeneous groups of children can aid in the formulation of appropriate interventions specific to each emotional and behavioral profile. Further, findings of the present study may provide construct validation evidence of the "limited prosocial emotions" specifier to conduct disorder (CD) criteria included in DSM-5 (American Psychiatric Association, 2013). Items from the Inventory of Callous Unemotional Traits (ICU), which was utilized in the current study, were used to guide the DSM-5 specifier's formation, referring to *lack of remorse or guilt*, *callous-lack of empathy*, *unconcerned about performance*, and *shallow or deficient affect* (Frick & Moffitt, 2010; see also Kimonis et al., 2014).

Fearfulness, Behavioral Inhibition, and Sensitivity to Punishment

Fearfulness is often viewed as a temperamental group of traits (Rothbart & Bates, 1998), related to a broad tendency toward experiencing fear or anxiety and sensitivity to punishment cues (i.e., distress about dangers in the physical world and fearful reactions in response to novelty and threat). Developmentally, fearfulness has also been studied as part of the temperament of behavioral inhibition (e.g., Kagan, Reznick, Clarke, Snidman, & Garcia Coll, 1984). The behavioral inhibition system (BIS) responds primarily to novel stimuli and signals of innate fear and frustrative nonreward, and is related to increased arousal, subjective feelings of anxiety, and avoidance (Carver & White, 1994; Muris, Meesters, de Kanter, & Timmerman, 2005; Viana & Gratz, 2012). Sensitivity to punishment reflects behavioral inhibition (passive avoidance) in situations of aversive consequences or in response to potential punishment and the worry induced by the threat of punishment (Torrubia, Avila, Moltó, & Caseras, 2001).

According to Frick and Morris (2004), Frick and Viding (2009), and others, temperamental fearlessness and deficits in response to cues of punishment are early emotional and biological manifestations of CU traits. These assertions are based on empirical evidence and theories of moral socialization suggesting that lack of anxiety and arousal in response to fear and punishment cues inhibits the normal development of morality and conscience (e.g., Fowles & Kochanska, 2000; Kochanska, 1993). Pardini (2006) found that low sensitivity to punishment mediated the association between temperamental fearlessness and CU traits, and suggested that lack of concern about negative consequences is an essential stepping-stone in the path to the development of severe CP.

In addition to the temperamental fearless pathway leading to CU traits and ultimately to antisocial behavior, Frick and Morris (2004) hypothesized a second developmental pathway leading to CP due to emotional and behavioral dysregulation. This assertion is supported by evidence that children with CP and normative levels of CU traits do not show abnormalities in the processing of punishment cues and show high rates of anxiety and distress (Fisher & Blair, 1998; Frick et al., 2003, 2014). It has been theorized that, because CP-only children are not socialized adequately, they do not learn to effectively regulate their behaviors and emotions, resulting in antisocial acts comorbid with anxiety problems (Frick & Viding, 2009). Because fearfulness, strong behavioral inhibition, and sensitivity to punishment are positively associated with anxiety (Colder & O'Connor, 2004; Goldsmith & Lemery, 2000), CP-only children are expected to score high on measures of fearfulness. Thus, in accord with the dual-pathways hypothesis (Fowles & Dindo, 2006, p. 29), we propose that the same behavioral outcome, CP, may result through different developmental mechanisms, associated with opposite poles of the fearfulness–fearlessness continuum.

Psychophysiology of Antisocial Behavior in Youth

Fear is an evolutionarily significant emotion that is prompted by signals of potential danger and sets forth a cascade of biological reactions (e.g., Bradley, 2009). According to the fearlessness theory, reduced autonomic reactivity when faced with aversive stimuli reflects low levels of fear, which place children at risk for the development of CP (e.g., Lorber, 2004; Raine, 1993; Raine, Venables, & Mednick, 1997). Studies taking into account heterogeneity in antisocial behavior, suggested that among children high on CP only those with elevated CU traits show low autonomic (skin conductance and heart rate) responses to emotionally (i.e., fear) evocative films (Anastassiou & Warden, 2008; de Wied, van Boxtel, Matthys, & Meeus, 2012). However, low heart rate and skin conductance responses are not specific indices of emotion or fear and are related to low arousal levels, which could be supporting of the hypoarousal theory; that is, antisocial children may display poor autonomic responses due to a broader characteristic of being underaroused, which would explain their antisocial behavior as an attempt to increase arousal to optimal levels (Beauchaine, 2012).

Supporting fearlessness as the underlying construct behind antisocial behavior in high CU children, rather than general hypoarousal, requires the use of measures that tap into the defensive system and amygdala function specifically, such as the startle reflex (Patrick, 1994). The eye-blink startle reflex (i.e., the involuntary response to a sudden onset, intense stimulus) has been reliably found to be modulated by different dimensions of affect (Lang, Greenwald, Bradley, & Hamm, 1993; Vrana, Spence, & Lang, 1988). The startle reflex is potentiated when the startling probe is presented in the context of fearful stimuli and is attenuated during the presentation of positive stimuli (e.g., Bradley & Lang, 2000; Patrick, 1994). The reflex provides a direct index of amygdala activation, which is empirically linked to fear and is diminished among children and adults high on psychopathic traits (Blair, 2013; Patrick, 1994). Viding et al. (2012) provided evidence that similar to adults, boys high on both CP and CU traits show lower amygdala activity to fearful faces compared to boys high only on CP.

Diminished fear potentiated startle has been used to support theoretical accounts (Lorber, 2004; Lykken, 1995) that temperamental fearlessness sets the stage for the development of psychopathic traits during adulthood. However, few studies have attempted to extend to younger age groups critical findings from the adult literature that poor fear startle potentiation is an important biomarker of the affective/interpersonal factor of psychopathy, including CU traits (Patrick, 1994; Vaidyanathan, Hall, Patrick, & Bernat, 2011; Vanman, Mejia, Dawson, Schell, & Raine, 2003). Downward extending findings on startle modulation by different emotions may help elucidate the developmental paths leading to adult antisociality. Prior work provided inconsistent findings. First, Fairchild, Stobbe, Van Goozen, Calder, and Goodyer (2010) reported no differences between CP females with or without psychopathic traits on startle reactivity. Second, Syngelaki, Fairchild, Moore, Savage, and van Goozen (2013) found that juvenile offenders with psychopathic traits showed lower startle magnitudes on both positively and negatively valent stimuli compared to those low on these traits, suggesting a general deficit in startle reactivity.

Taking into account the recent DSM-5 specifier of limited prosocial emotions (through the assessment of CU traits) in the current study, rather than general measures of psychopathy (e.g., Fairchild et al., 2010; Syngelaki et al., 2013), is expected to extend to developmentally earlier stages the robust findings of startle deficits specifically to fear found in adults with affective psychopathic traits (Patrick, 2001). Diminished startle potentiation to fear is hypothesized to be a potential biomarker of the subgroup of CP children who meet the CU criteria for the DSM-5 specifier. In contrast, we anticipate CP-only youth to show high startle potentiation to fear due to their hypothesized negative affectivity, difficulty regulating emotions, and heightened sensitivity to social threat (Beauchaine, Gatzke-Kopp, & Mead, 2007; Frick & Morris, 2004; Viding et al., 2012). Established physiological evidence suggests that negative affectivity and the tendency to react to events with high emotional arousal are associated with normal or increased startle potentiation to fear (Patrick, 2001; Vaidyanathan et al., 2011; Vanman et al., 2003).

Current Study

The first aim of the current study was to identify heterogeneous groups of children who vary with respect to CP and CU traits. A longitudinal approach to screening was used in order to identify children who show stability in antisocial behavior, because unstable presentation of CP behaviors may represent a distinct group of individuals (Beauchaine, Hinshaw, & Pang, 2010; Fanti & Henrich, 2010). Among children with high stable levels of CP, we expected to identify groups scoring high or low on CU traits, supporting the concept of equifinality. In accordance with prior work (e.g., Fanti, 2013), we also included a group of children high on CU traits but low on CP to evaluate main effects of CP, CU traits, and possible CP × CU interactions. Nonantisocial children high on CU traits were found to be at low risk for a number of maladaptive outcomes (e.g., Fanti, 2013; Frick et al., 2014), and the current study might offer an explanation of why this group of children does not engage in CP behaviors. Findings might be a good illustration of the developmental psychopathology concept of multifinality, in that CU traits might result in low or high CP based on levels of fearful reactivity.

The second and main aim of the current study was to evaluate the role of the fearfulness– fearlessness continuum as a developmental mechanism that can differentiate heterogeneous CP groups high or low on CU traits. We tested the hypothesis that reduced fearfulness, as assessed both behaviorally and through the startle reflex, insensitivity to punishment, and low behavioral inhibition are core characteristics of children with high/stable CP symptoms and high CU traits. To the contrary, children high on CP symptoms but low on CU traits may display exaggerated degrees of fearfulness, demonstrating potentiated startle response to fear. To our knowledge, this is the first attempt to use the startle reflex, an established index of defensive motivation, to study heterogeneity in CP and CU traits. We also examined whether startle reactivity deficits are specific to fear and not to other negative (i.e., anger) or positive (i.e., joy) emotions to further provide support for fearlessness as a specific mechanism involved in high CP/high CU profiles. The study's findings are anticipated to corroborate the new DSM-5 limited prosocial emotions specifier and contribute to efforts aiming to identify distinct emotional deficits and biological markers to explain heterogeneity in CP.

Method

Participants

The current study is divided in two phases: a screening phase and an experimental phase. During the *screening phase*, 1,311 families (*M* age at study commencement = 9.38, *SD* = 1.04; 53.4% female) participated in the initial data collection. From this sample, families who participated at two (*n* = 152 mothers and 133 fathers) or three (*n* = 1,048 mothers and 961 fathers) waves of longitudinal data collection, 6 months apart, were included in the sample used for further analysis. A missing value analysis using all available variables was performed to impute missing values for fathers,

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because the expectation maximization algorithm procedure in SPSS 19.0 suggested that father reports ($n = 106$; 9.1%) were missing completely at random. Attrition analysis did not reveal any differences on demographic or main variables (i.e., CP or CU) between families included in the final sample ($n = 1{,}200$) and families excluded from further analysis due to incomplete assessments ($n = 111$). Children completed the screening questionnaires only after the age of 9.5, with all children completing the questionnaires at least once ($n = 1{,}200$). From this sample, selected extreme groups (see Results section for screening information) differentiated on levels of CP and CU traits, and controls were invited to participate in the *experimental phase* of the study. The sample participating in the experimental phase was composed of 73 children (M age = 11.21, $SD = 1.06$; 45.2% female). From the 73 participants, 15 children scored high on CP and low on CU traits (8 boys), 16 scored high on both CP and CU traits (9 boys), 20 scored high on CU traits but low on CP (11 boys), and the remaining 22 scored low on both CP and CU traits (12 boys).

Following approval of the study by the Cyprus Ministry of Education, 26 schools in four school districts (Larnaca, Lemeso, Papho, and Lefkosia) in Cyprus were randomly selected to ensure that the sample is representative of the country's population. School administrators and personnel were provided with a description of the study, and the study was approved by the school boards of all participating schools. Before data collection, signed parental consent and youth assent were obtained from all participating families (85% of parents and children agreed to participate). Families were also informed about the longitudinal and experimental nature of the study and their rights as participants. In return for their participation in the experimental assessment, families received a reimbursement of €15–€20.

Screening phase: Procedure and questionnaires

During school hours, children were given a sealed envelope that included the questionnaires to be completed by parents. Parents were instructed to place the completed questionnaires in the sealed envelope and return them to the child's school. Participants were also instructed that responses from *both* parents were required. In the case that one or both parents were unable or failed to complete the questionnaires, we scheduled an appointment with the family. By doing so, we managed to ensure small longitudinal attrition and to collect longitudinal mother and father reports from the majority of participating families. Children completed the questionnaires in their familiar school setting.

CP. CP symptoms were measured with the Checkmate Plus Child Symptom Inventory for Parents—4 (Gadow & Sprafkin, 2002) and the self-report Checkmate Plus Youth's Inventory—4 (Gadow & Sprafkin, 1999). Children and their parents indicated the frequency that the participating child engaged in CD relevant behaviors (15 items; e.g., "Stolen things from others using physical force") on a 4-point scale (0 = *never*, 3 = *very often*). The Cronbach α for the CD variable ranged from 0.86 to 0.87 across time and based on both parent and child reports. Previous research has provided evidence for the validity of the CD symptom scale measured with the parent and self-report instruments in community and clinical samples in Cyprus and the United States (Fanti & Muñoz Centifanti, 2013; Gadow & Sprafkin, 2002). For the purposes of the growth analysis, average scores were computed based on mother and father reports, which were highly correlated at each time point of measurement (rs = .57–.68). Children reports were averaged across time (rs = .44–.49) and were used to validate the identified groups differentiated on levels of parent-reported CD symptoms.

CU traits. CU traits were assessed with the ICU (Frick, 2004). The ICU is a parent- and self-report scale that comprises 12 positively and 12 negatively worded items that are rated on a 4-point Likert scale (0 = *not at all*, 3 = *definitely true*). Previous research has verified the validity of the ICU in community and incarcerated samples of youth (Fanti, 2013; Kimonis et al., 2013). The workgroup proposal to add the limited prosocial emotions specifier to DSM-5 used a four-item criterion set based on the ICU, "Is concerned about the feelings of others" (reverse scored), "Feels bad or guilty when he/she has done something wrong" (reverse scored), "Is concerned about schoolwork" (reverse scored), and "Does not show emotions," to select four specific indicators of CU traits related with the limited prosocial emotions specifier (i.e., lack of remorse or guilt, callous–lack of empathy, unconcerned about performance, and shallow or deficient affect). The four-item criteria set was generated by identifying the items that consistently loaded on the CU dimension of the ICU.

Following Frick and Moffitt's (2010) suggestions, to determine if a symptom is present or absent, as required by the DSM-5 criteria, ICU items were dichotomously coded to be indicative of the limited prosocial emotions specifier (coded as absent if rated 0 or 1 and present if rated either 2 or 3). Scores were calculated by summing the four dichotomous items to obtain a total score. Ratings from mothers and fathers were combined by using the higher score from either informant for each item, as done in prior work with this instrument, because informants tend to underreport a child's level of psychopathic traits (Frick et al., 2003). Child reports on the four-item set averaged across time were also used as screening criteria, in that children with self-report scores below the cutoff score were excluded. Using data from four samples each from a different country, including Cyprus, Frick and Moffitt (2010) provided evidence that youth meeting the diagnostic threshold of two or more CU symptoms, based on the four-item criteria, showed significantly greater impairment on various antisocial behaviors (i.e., CP, aggression, delinquency, and bullying) compared to youth with only one or no symptoms (see Kimonis et al., 2014). To validate the selection of groups, a total score based on all the ICU original items was also computed using the higher score reported by mothers and fathers. Mother and father reports were highly correlated at each time point of measurement (rs = .66–.69). Finally, child reports averaged across time (rs = .42–.60) were used to verify the identified groups. The total ICU score demonstrated adequate internal consistency in the present study based on parent and child reports across time (Cronbach $\alpha = 0.80$–0.83).

Experimental phase: Stimulus materials

Stimulus materials were 12 affective imagery scripts (3 for each of 4 emotions: fear, joy, anger, and pleasant relaxation) normed on an independent, age-matched sample of youth ($N = 61$; 39 females, 22 males; Mage = 12.2) on content, valence, and arousal (Russell & Merhabian, 1977). Scripts were adapted for use with children based on a well-validated tone-cued affective imagery paradigm (e.g., Panayiotou, Witvliet, Robinson, & Vrana, 2011; Vrana, 1994), and their standardization in the Greek language is described elsewhere (Panayiotou, 2008). All scripts consisted of one sentence and an average of 22 words, and they contained references to physiological and behavioral responses meant to elicit emotional processing and associated efferent activation of emotion response systems (Panayiotou, 2008). Three high arousal emotions, including two negative valence emotions: fear (e.g., *Alone in the alley, your heart starts beating fast, your stomach tightens while a group of older children are surrounding you laughing and being threatening*) and anger (e.g., *While returning home from school, some children on bikes pass by your side fast, throwing down your bag and books*), and a positive valence emotion: joy (e.g., *You jump with joy as your dad is giving you a gift for Christmas, a brand new mobile phone of the latest technology!*), were selected. A low arousal emotion, pleasant relaxation (e.g., *You had just finished your homework and you are relaxing on your living room sofa, watching your favorite TV program*), was included for control purposes.

Experimental phase: Physiological measures

Apparatus and data reduction. The timing of events and the presentation of auditory stimuli were controlled by an E-Prime script (E-Prime 2.0; Schneider, Eschman, & Zuccolotto, 2002). Auditory stimuli (i.e., cuing tones and the startle probe) were presented binaurally via headphones in order to mask ambient noise. All physiological signals were collected using BIOPAC MP150 for Windows bioamplifiers and transducers and the Acq3.9 data acquisition software (Biopac Systems Inc., Santa Barbara, CA). Electromyography (EMG) signals were sampled at 1000 Hz using miniature Ag/AgCl electrodes filled with electrode gel at the orbicularis occuli muscle under the right eye, using the guidelines of Fridlund and Cacioppo (1986). Raw EMG was rectified and integrated using a 10-s time constant. Startle amplitude was scored offline by identifying peak microvolts within a 100-ms window following each startle probe. Mean baseline orbicularis occuli EMG was calculated for the 2 s prior to each startle probe and was subtracted from the peak amplitude. These difference scores were then converted to T scores for each participant (using all startle responses) to account for individual differences in startle responding. For each participant, nonmissing startle responses were averaged across all scenaria to obtain a mean startle response for each emotion. Participants had between 0 and 2 zero or unidentifiable (i.e., could not be visually detected) startle responses, which were scored as missing. Extreme outliers, at the level of each segment, were detected using a boxplot function (three interquartile ranges from the median; Ashare, Hawk, & Mazzullo, 2007) and were excluded from the analyses.

Startle probes were created using Audacity software and constituted 50-ms bursts of 95 dB white noise with near-instantaneous rise time. Cuing tones were high (2150 Hz), medium (1898 Hz), and low (1735 Hz) frequency. All were at 80 dB (A) and 500 ms in duration with a 25-ms fade in and out period.

Procedure. When children arrived in the lab, they were seated in a padded, reclining chair and were given detailed information about the experiment. After mothers signed the informed consent, children completed a short questionnaire package. Next, children were fitted with physiological monitors and were instructed to relax for a few minutes in order to check the accuracy of recordings. Earphones were placed on participants, and a practice block was run. Each script was randomly assigned to a tone (either high or low) that cued children to start imagery, which lasted for 8 s until they heard the next tone. Then, a medium tone signaled a relaxation period; that is, participants were instructed to "clear their minds," relax, and silently repeat the word "one" until the next (high or low) tone. These intertrial intervals were of variable duration and served as control/neutral conditions. High and low tones were presented in a quasi-random order. Material presentation occurred in six blocks of two scripts. At the beginning of each block, participants were given two index cards, one with a positive emotion (e.g., joy) and one with a negative emotion (e.g., fear). Participants were then asked to describe the scripts to the experimenter and memorize the emotional (or neutral) situation. When cued, participants had to retrieve the situation from memory and create a vivid personal image as if it actually happened to him/her. During imagery periods, startle probes occurred at 3.5, 5, or 7 s after tone onset, for two of three of the trials. During "relaxation, count-one" periods, startle probes were distributed between 2 and 37 s in a fully balanced design, so that all types of emotion had the same number of probe presentation times, evenly distributed throughout the experiment, as were the probe times during the intertrial intervals. Once the experiment was completed, all electrodes were removed and participants were debriefed about the purposes of the study. Parents completed a set of questionnaire measures (described below) at the same time as children participated in the physiological experiment.

Experimental phase: Child- and parent-report questionnaire measures

Behavioral inhibition/activation systems. The Behavioral Inhibition System and Behavioral Activation System Scales for Children (BIS/BAS; Muris et al., 2005) is a 20-item self-reported measure of the child version of Carver and White's (1994) BIS/BAS scales. Items are scored on a 4-point scale (0 = *not true*, 3 = *very true*). Seven items make up the BIS scale (α = 0.70; e.g., "I have very few fears compared to my friends" (reversed), and 13 items make up the BAS scale (α = 0.85; e.g., "When I want something, I usually go all the way to get it"). The scales have been used in community samples, and have been associated with personality traits and psychopathology symptoms (e.g., Muris et al., 2005). Although both the adult and the child versions of this instrument are widely used as measures of individual differences in BIS and BAS activity, the BIS scale has received criticism in that it reflects mostly punishment sensitivity and fear rather than anxiety and inhibitory behavior (Brenner, Beauchaine, & Sylvers, 2005). Based on factor analytic findings, other authors suggest that the BIS subscale measures both fear and anxiety (e.g., Poythress et al., 2008). In the present study, the tool was used as a measure of individual differences in broad traits relevant to fearfulness, anxiety, and behavioral inhibition.

Sensitivity to punishment. In this study, we used a modified version of the Punishment and Sensitivity to Reward Questionnaire (Colder & O'Connor, 2004; Torrubia et al., 2001) for children. This questionnaire consists of two main subscales completed by mothers: sensitivity to punishment (α = 0.83; 15 items; e.g., "Your child could do more things if it were not for their fear") and sensitivity to reward (α = 0.85; 18 items; e.g., "When your child gets something they want, they feel excited and energized"). As Colder and O' Connor (2004) report, sensitivity to reward is associated with externalizing problems, whereas sensitivity to punishment is associated with internalizing problems.

Fearfulness. Fearfulness was assessed with two measures: the first measure was the parent version of the Early Adolescent Temperament Questionnaire—Revised (EATQ-R), which was developed based on Rothbart's temperament model (Ellis & Rothbart, 2001). The fearfulness subscale, which comprises six items (α = 0.76; e.g., "Your child worries about getting into trouble" and "Your child is nervous being home alone"), measures how worried and negatively affected are youth in the case of anticipated distress. A 5-point rating scale (1 = *hardly ever true*, 5 = *almost always true*) was used. The second measure was the anxious–fearful subscale of the Child Behavior Scale (CBS; Ladd & Profilet, 1996). Mothers rated their children on four items (α = 0.70; e.g., "Appears miserable, unhappy, tearful, or distressed" and "Tends to be fearful or afraid of new things or new situations") on a 3-point scale (0 = *not true*, 3 = *often true*). Both questionnaires were associated with behavioral problems, including delinquency and externalizing problems (Fanti & Henrich, 2010; Pardini, 2006).

Plan of analysis

Screening phase. Latent class growth analysis (LCGA) in Mplus 6.1 (Muthén & Muthén, 2010) was initially used to identify distinct groups of individual trajectories for CD symptoms based on parent reports. LCGA identifies heterogeneous classes by modeling the relationship between an attribute, in this case CD symptoms, and age (Muthén & Muthén, 2010), which allows for cross-class differences in the shape of developmental trajectories. In order to retain children with incomplete assessments in the analysis, full information maximum likelihood fitting was used in the Mplus software. The model fit statistics used are the Bayesian information criterion (BIC) and the Lo–Mendel–Rubin (LMR) statistic. The BIC is based on a maximization of a log likelihood function, and the model with a lower BIC is preferred (Lo, Mendell, & Rubin, 2001). The LMR statistic tests k – 1 classes against k classes, and a nonsignificant χ^2 value ($p > .05$) suggests that a model with one fewer class is preferred (Lo et al., 2001). In addition, average posterior probabilities greater than 0.70 imply satisfactory fit, and entropy values greater than 0.70 indicate clear classification and greater power to predict class membership (Muthén & Muthén, 2010; Nagin, 2005). The identified CD trajectories were verified based on child reports using an analysis of variance (ANOVA). Further, the identified CD groups were categorized by the number of CU criteria endorsed based on longitudinal parent reports and average child reports. The following three groups were formed: those receiving or endorsing no symptoms, those with one symptom, and those with two or more symptoms (i.e., meeting CU specifier criteria) reflecting the DSM-5 symptom threshold (American Psychiatric Association, 2013). These groups were also compared on total ICU scores using ANOVA.

Experimental phase. Separate ANOVAs were conducted to examine the effect of CP and CU traits on the different dependent variables related to fearfulness in IBM SPSS 19.0. For *startle potentiation by fear*, 2 (low and high CP) × 2 (low and high CU) between subjects ANOVA were conducted investigating main and interactive effects of CP and CU traits. The same analysis was repeated with startle modulation by joy and anger as outcomes to verify that startle response differences between groups are specific to fear. Because we included two measures of *fearfulness*, we conducted a 2 × 2 multivariate ANOVA with EATQ-R fearfulness and CBS anxious/fearfulness as the outcomes. To compare the CP and CU groups on the *sensitivity to punishment* scale, a 2 × 2 analysis of covariance was used to control for sensitivity to reward because the two variables are statistically related ($r = .50$, $p < .001$). A 2 × 2 analysis of covariance was also used to compare CP and CU groups on BIS, in order to control for the covariation between BIS and BAS

($r = .44$, $p < .001$). Partial η^2 ($\eta^2 = 0.01$–0.06 small effect, $\eta^2 = 0.06$–0.14 medium effect, and $\eta^2 > 0.14$ large effect; Cohen, 1988) and standardized mean difference effect sizes (Cohen *d*: $d = 0.20$ small effect, $d = 0.50$ medium effect, and $d = 0.80$ large effect; Cohen, 1992) are reported for main effect comparisons. Significant interactions are depicted in figures along with 95% confidence intervals.

Results

Aim 1: Trajectories of CD symptoms and CU heterogeneity

To identify the optimal number of CP trajectories, models with one to four classes were estimated using LCGA. The BIC statistic increased from Class 3 (BIC = 10,383.95) to Class 4 (BIC = 10,480.35) and decreased from Class 2 (BIC = 10,919.13) to Class 3, indicating that the three-class model better fit the data. In addition, the LMR statistic fell out of significance for the four-class model ($p = .39$), suggesting that the three-class model better represented the data. The mean probability score for the three CP classes ranged from 0.92 to 0.99 and the entropy value was 0.95, indicating that the classes were well separated. The final trajectory groups are shown in Figure 1. Children assigned to the low-risk group (434 males and 539 females) exhibited low CD symptoms across time, intercept (i) = 0.66, $p < .001$; slope (s) = –0.08, $p < .01$, and children in the moderate group (84 males and 70 females) scored at average levels of CD symptoms ($i = 3.04$, $p < .001$; $s = 0.25$, $p = .10$). Children in the high-risk group (42 males and 31 females) showed a linear increase in CD ($i = 7.33$, $p < .001$; $s = 1.85$, $p < .01$) and exhibited higher levels of CP relative to the low and moderate groups. Findings from the ANOVA comparing the identified groups on child-reported CD symptoms, F (2, 1,197) = 18.44, $p < .001$, $\eta^2 = 0.05$, indicated that children in the high/stable group ($M = 8.50$, $SE = 1.01$) scored higher compared to children in the moderate-risk ($M = 3.19$, $SE = 0.36$; $p < .001$) and low-risk ($M = 2.31$, $SE = 0.13$; $p < .001$) groups, which were not significantly differentiated.

Table 1 demonstrates the screening procedure we followed to identify the experimental groups. To be consistent with the proposed DSM-5 criteria, children with a parent-reported symptom score of 2 or greater during at least two assessment periods received the CU (limited prosocial emotions) specifier. As seen in Table 1, a higher percentage of participants in the high/stable CP group received the CU specifier compared to low- and moderate-risk groups across the three time periods. The percentage of children showing the CU specifier remained relatively similar across time, with those low and high on CU traits showing high longitudinal stability (see parent reports across time). The child-reported percentages were similar to those reported by parents, although the percentages in the four groups of interest decreased after talking child reports into account (see agreement between parent and child reports).

From the 73 participants with high/stable CP, 19 had high CU and 18 had low CU after taking longitudinal and multireporter agreement into account. These children were invited to participate in the experimental phase of the study, and 31 accepted the invitation, resulting in the CP-only ($n = 15$; 8 boys) and CP-CU ($n = 16$; 9 boys) groups. Next, 60 randomly selected participants with low CD symptoms differentiated on their levels of CU traits were invited to participate, resulting in 20 participants (11 boys) who scored high on CU traits, but low on CP, and 22 (12 boys) participants who scored low in both CP and CU traits. To verify the selection of groups, identified groups were compared on longitudinal parent and child reports on the total ICU measure. Findings from the ANOVAs comparing the identified groups on CU traits suggested main effects for CU groups based on parent reports at Time 1, F (1, 69) = 6.07, $p < .01$, $\eta^2 = 0.18$, Time 2, F (1, 69) = 21.34, $p < .001$, $\eta^2 = 0.44$, and Time 3, F (1, 69) = 6.78, $p < .01$, $\eta^2 = 0.20$, and average child reports, F (1, 69) = 13.11, $p < .01$, $\eta^2 = 0.46$ (see Table 1). No other main or interactive effects were identified. Average CU scores are reported in Table 1.

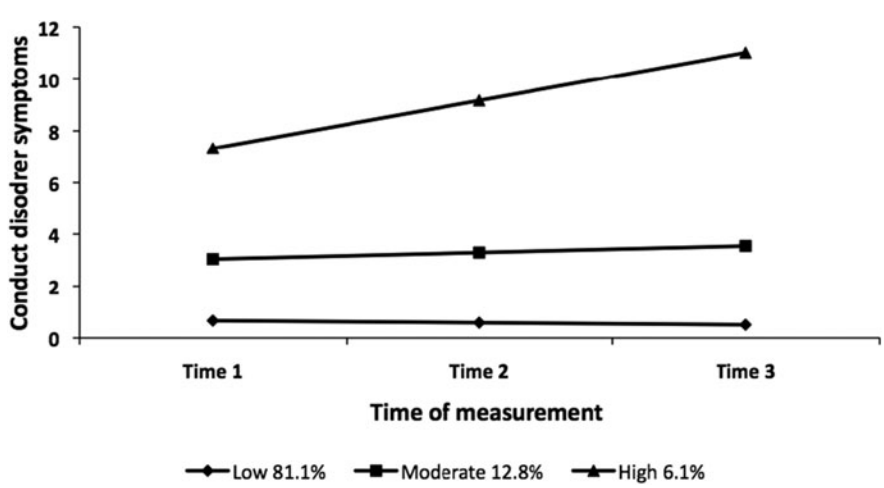

Figure 1. Subgroups of conduct disorder symptoms based on latent class growth analysis.

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Table 1. *Screening: Identification of heterogeneous CP/CU groups*

	Parent Report Time 1		
	No CU Symptoms	One CU Symptom	CU Specifier
Low CD symptoms	58.2%	32.6%	9.2%
Moderate CD symptoms	46.3%	38.5%	15.2%
High CD symptoms	34.7%	27.8%	37.5%
	Parent Report Time 2		
	No CU Symptoms	One CU Symptom	CU Specifier
Low CD symptoms	65.8%	24.8%	9.4%
Moderate CD symptoms	51.3%	33.2%	15.5%
High CD symptoms	33.8%	29.8%	36.4%
	Parent Report Time 3		
	No CU Symptoms	One CU Symptom	CU Specifier
Low CD symptoms	67.1%	23.8%	9.1%
Moderate CD symptoms	51.9%	25%	23.1%
High CD symptoms	35.2%	27.5%	37.3%
	Parent Report Across Time[a]		
	No CU Symptoms		CU Specifier
Low CD symptoms ($n = 973$)	57% ($n = 555$)		7.4% ($n = 72$)
High CD symptoms ($n = 73$)	32.8% ($n = 24$)		34.4% ($n = 25$)
	Child Report (M Age = 10)		
	No CU Symptoms	One CU Symptom	CU Specifier
Low CD symptoms	57.1%	31.3%	9.6%
Moderate CD symptoms	58.5%	23.8%	12.8%
High CD symptoms	31.3%	30.4%	38.3%
	Agreement Between Parent and Child Reports		
	No CU Symptoms		CU Specifier
Low CD symptoms ($n = 973$)	43.9% ($n = 427$)		3.5% ($n = 34$)
High CD symptoms ($n = 73$)	24.7% ($n = 18$)		26% ($n = 19$)
	Agreement Between Specifier and Total ICU Scale		
	Low CU M (SE)	Mean Scores (Total Sample)	CU Specifier M (SE)
Parent report ICU			
Time 1	9.27 (2.15)	18.42	29.22 (2.48)
Time 2	8.62 (2.82)	17.97	31.17 (2.82)
Time 3	8.36 (2.26)	16.02	31.55 (1.82)
Child report ICU	8.26 (2.85)	15.51	32.34 (2.60)

Note: The percentages represent the value for each identified conduct disorder (CD) group differentiated on callous–unemotional (CU) criteria. CP, Conduct problems; ICU, Inventory of Callous–Unemotional traits.
[a]At least two time points.

Table 2. *Descriptive statistics and correlations among the main study outcomes*

	Fear Startle	Anxious/ Fearfulness	EATQ Fearfulness	Sensitivity– Punishment	BIS
Anxious/fearfulness	.31†				
EATQ fearfulness	.35†	.61**			
Sensitivity–punishment	.21	.65**	.49**		
BIS	.19	.04	.08	.08	
Descriptives					
Mean	0.77	2.20	1.58	1.61	1.54
SD	8.94	1.88	0.74	0.67	0.61

Note: EATQ, Early Adolescent Temperament Questionnaire; BIS, behavioral inhibition system.
†$p < .10$. **$p < .01$.

Aim 2: Identifying individual differences indicative of a fear–fearless continuum

Descriptive statistics and correlations between different measures of fear are depicted in Table 2. Although nonsignificant, the measure of startle reflex was correlated in the expected direction with all other measures. The correlations between fear startle potentiation and the two measures of fearfulness approached significance, and were of moderate effect size (Cohen, 1992). Fearfulness and sensitivity to punishment measures were moderately correlated, although the BIS measure was not significantly correlated with any of the other measures. Before proceeding with the ANOVA comparisons, we tested the distribution of the standardized residuals of each variable under investigation against the grouping variables. The assumption of normal distribution of residuals was adequately met, because the skewness of the standardized residuals for the behavioral and physiological variables was small and below 1, ranging from 0.01 (anxious/fearful) to 0.67 (anger startle).

Fear startle potentiation. The fear startle potentiation index was defined as the startle responses to fear minus startle responses to the pleasant relaxation scenaria, representing neutral affect (i.e., low arousal, close to the midpoint of the valence scale). Findings from the ANOVA comparing the identified groups suggested that youth high on CU traits showed diminished startle potentiation compared to youth low on CU traits (Table 3). A significant interaction between the effects of CP and CU traits, $F(1, 69) = 10.02$, $p < .01$, $\eta^2 = 0.14$, was also identified. As indicated by 95% confidence intervals, youth high on both CP and CU traits had the lowest scores on fear startle potentiation, while youth high on CP only showed the highest levels of startle potentiation (Figure 2). Youth with low levels of CP and high CU traits scored similarly as the low-risk group and at average levels of fear startle potentiation.

Joy startle index. Joy startle index was defined as the startle responses to joy minus the startle responses to the pleasant relaxation stimuli. Findings from the ANOVA comparing the identified groups on joy startle only suggested a main effect for CP (Table 3). Youth high on CP scored higher on startle reactivity to joy compared to youth low on CP. No other main or interactive effects, $F(1, 69) = 1.08$, $p = .30$, $\eta^2 = 0.02$, were identified.

Anger startle index. Similar to prior startle measures, the anger startle index was defined as the startle responses to anger minus the startle responses to the pleasant relaxation stimuli. Findings from the ANOVA comparing the identified groups on anger startle did not suggest any main or interactive effects, $F(1, 69) = 1.63$, $p = .21$, $\eta^2 = 0.03$, and the effect sizes reported in Table 3 were of small magnitude.

Table 3. *Analysis of variance results*

	Low CP	High CP	*F*	η^2	*d*	Low CU	High CU	*F*	η^2	*d*
Fear startle	−0.70 (1.31)	2.41 (2.10)	1.57	0.01	0.37	6.39 (1.51)	−2.69 (1.58)	5.61**	0.09	0.99
Joy startle	1.31 (1.59)	7.57 (2.53)	4.38*	0.04	0.53	4.58 (1.97)	4.30 (2.24)	0.01	0.00	0.02
Anger startle	−0.58 (1.94)	−3.07 (3.06)	0.47	0.01	0.17	−1.47 (2.38)	−2.18 (2.73)	0.04	0.00	0.05
Anxious/fearfulness	1.88 (0.29)	3.60 (0.48)	9.26**	0.19	0.78	2.96 (0.37)	2.32 (0.42)	0.59	0.02	0.20
EATQ fearfulness	1.50 (0.12)	2.06 (0.20)	5.37*	0.12	0.61	1.93 (0.16)	1.62 (0.17)	1.70	0.04	0.32
Sensitivity–punishment	1.65 (0.11)	1.88 (0.17)	1.18	0.03	0.27	1.87 (0.14)	1.64 (0.15)	1.22	0.03	0.24
BIS	1.50 (0.08)	1.45 (0.14)	0.12	0.01	0.08	1.78 (0.11)	1.17 (0.12)	13.61**	0.18	0.89

Note: The values are estimated marginal means (standard errors), and all $df = 1$. Only main effect findings from the 2×2 analysis of variance (analysis of covariance for sensitivity to punishment and BIS) are reported. Interaction effects are reported in the text, with significant interactions related to fear startle, anxious/fearfulness, sensitivity to punishment, and BIS graphed in Figures 2–5.
*$p \leq .05$. **$p \leq .01$.

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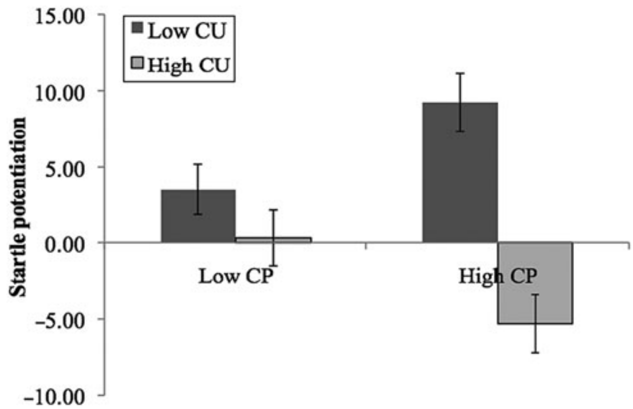

Figure 2. The interaction between conduct problems and callous–unemotional traits predicting fear startle potentiation.

Fearfulness. Findings from the multivariate ANOVA comparing the identified groups on the two different measures of fearfulness suggested main effects for CP, Wilks $\lambda = 0.81$, F (2, 68) = 4.54, $p < .05$, $\eta^2 = 0.19$, and significant CP by CU interactions, Wilks $\lambda = 0.85$, F (2, 68) = 3.28, $p < .05$, $\eta^2 = 0.15$. Post hoc ANOVA suggested that youth high on CP scored higher on CBS anxious/fearfulness compared to youth low on CP (Table 3). The interaction between CP and CU traits, F (1, 69) = 4.40, $p < .05$, $\eta^2 = 0.10$, indicated that youth high on CP but low on CU traits were the ones with the highest scores on anxious fearfulness (Figure 3). The post hoc ANOVA for EATQ-R fearfulness showed that youth high on CP scored higher on temperamental fear compared to low CP youth (Table 3). No interaction effects were identified, F (1, 69) = 0.01, $p = .93$, $\eta^2 = 0.001$. As shown in Table 3, differences between low and high CU groups on both measures of fear were in the expected direction with small effect sizes.

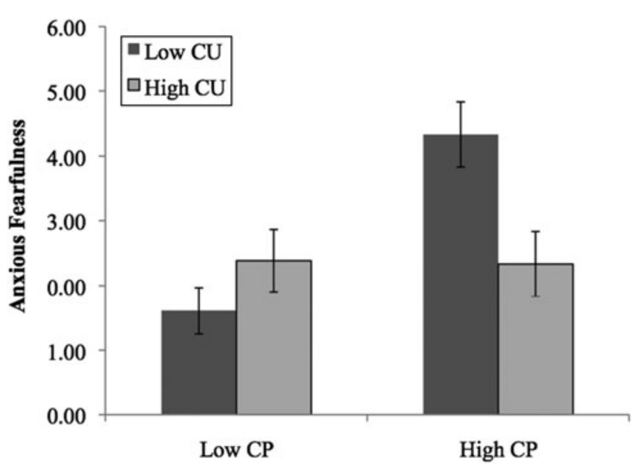

Figure 3. The interaction between conduct problems and callous–unemotional traits predicting anxious/fearfulness as measured with the Child Behavior Scale.

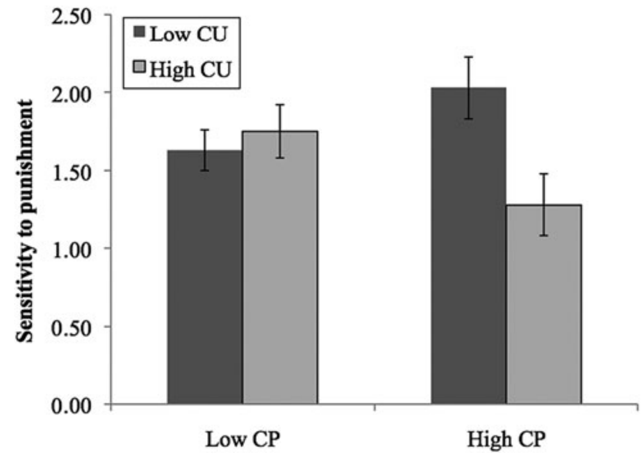

Figure 4. The interaction between conduct problems and callous–unemotional traits predicting sensitivity to punishment as measured with the Punishment and Sensitivity to Reward Questionnaire.

Sensitivity to punishment. The findings suggested a significant interaction between CP and CU traits, F (1, 69) = 6.60, $p < .01$, $\eta^2 = 0.14$, and no main effects predicting sensitivity to punishment. The interaction effect, which is depicted in Figure 4, shows that CP-only children demonstrated higher sensitivity to punishment compared to CP youth high on CU traits, with CU only and low-risk children scoring in between these two groups. Sensitivity to reward was a significant covariate for sensitivity to punishment, F (1, 69) = 11.88, $p < .001$, $\eta^2 = 0.23$.

BIS. A main effect for CU groups indicated that high-CU youth scored lower on BIS compared to low-CU youth (Table 3). Further, a significant interaction, F (1, 69) = 9.21, $p < .001$, $\eta^2 = 0.20$, demonstrated that youth high on both CP and CU traits reported the lowest levels of BIS, although

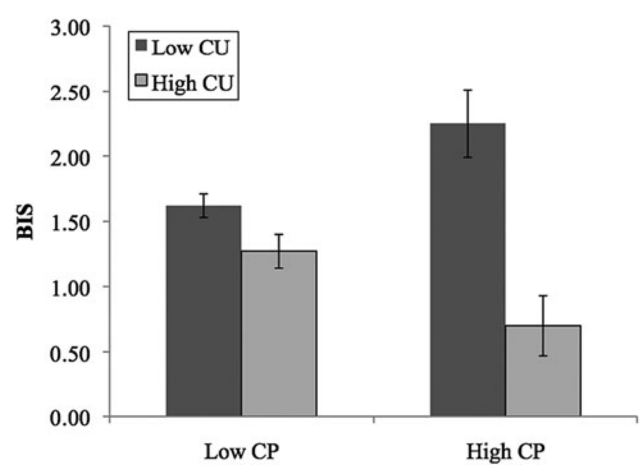

Figure 5. The interaction between conduct problems and callous–unemotional traits predicting the behavioral inhibition system as measured with the Behavioral Inhibition System and Behavioral Activation System Scales for Children.

youth high on CP only reported the highest levels of BIS (Figure 5). CU-only and low-risk youth scored in between the CP-only and CP + CU groups. BAS was a significant covariate for BIS, F (1, 69) = 5.26, $p < .05$, $\eta^2 = 0.12$.

Discussion

By identifying two groups exhibiting continuous CP scoring on opposite extremes on fear startle reactivity and reported fearfulness, the present study contributes to the further validation of the new DSM-5 limited prosocial emotions CD specifier. In particular, evidence for a fear–fearless continuum explaining CP heterogeneity is provided: children with continuous high levels of CP and CU traits showed attenuated fear startle potentiation, low BIS activity, and low sensitivity to punishment. To the contrary, children high in CP and low on CU traits demonstrated high physiological and behavioral responsiveness to fear, high BIS, and high sensitivity to punishment. Novel evidence that CU-only children score similarly (intermediate levels) as low-risk children on fear startle potentiation, fearfulness, and punishment sensitivity are also provided. Taken together, these findings offer a theoretical framework for understanding how normal development can digress into the appearance of antisocial behavior, when a fundamental aspect of temperament, normal fear, deviates from the typical midrange to either very high or very low levels, resulting in equifinal phenotypic outcomes of CP.

First, the study's findings replicate prior work conducted during adulthood documenting that the affective/interpersonal features of psychopathy, including CU traits, are related to physiological measures of fearlessness, providing evidence for the downward extension of psychopathic traits to children (Blair, 2013; Vaidyanathan et al., 2011). Among youth high on CU traits, only those exhibiting continuous CP showed the pattern of diminished eye-blink startle reactivity to fearful stimuli compared to neutral stimuli. These findings suggest that abnormal activation of the defensive system and amygdala dysfunction, revealed through deficits in fear startle potentiation, are risk factors associated with the combination of CP and CU traits (Viding et al., 2012). Agreeing with these findings, children high on CP and CU traits were found to show the strongest fear recognition deficits, hypothesized to be associated with failure to develop consciousness (Sylvers, Brennan, & Lilienfeld, 2011). The identified characteristics of children high on CP and CU traits might be related to a genotype of a dysfunctional defensive motivation system, manifested as absence of fear responses (Vaidyanathan, Patrick, & Bernat, 2009) during risky, aggressive, and antisocial acts.

In addition to defensive system dysfunction, children high on CP and CU traits scored low on behavioral inhibition and sensitivity to punishment, which are considered early appearing temperamental traits. Frick and Morris (2004) proposed a developmental pathway model in which temperamental fearlessness and punishment insensitivity lead to abnormal development of guilt, empathy, and conscience, which set the stage for the development of CP in combination with CU traits. Our findings are overall supportive of this assertion in that children high on CP and CU traits were less likely to experience emotional distress when exposed to fearful situations, as verified by both behavioral and physiological measures. The reason that the interaction between CP and CU traits did not predict parent-reported fearlessness may be that the CBS and EATQ-R measures in addition to fear also measured anxiety and negative affect. Recent evidence indicates that focal, circumscribed fear is associated with appropriate defensive system recruitment, apparent in amygdala activation and startle reactivity, while anxiety or negative affect are not associated with startle potentiation and the fear circuitry (McTeague & Lang, 2012). Despite concerns that the BIS measure may assess a mixture of sensitivity to punishment and broad anxiety or negative affect (Poythress et al., 2008), individual differences in BIS between groups followed the expected pattern of results verifying that the scale captures traits related broadly to fearfulness. However, one concern is the poor correlation of this measure with other indices of fear; perhaps, as others have suggested, the construct validity of the BIS scale needs to be revisited (Brenner et al., 2005).

Second, the findings provide novel evidence that children high on CP only show the greater startle potentiation in response to fearful stimuli, which may be due to their high fearfulness/anxiety, high BIS, and high sensitivity to punishment. Prior work provided evidence that CP-only children do not show poor response to punishment (Fisher & Blair, 1998; Frick et al., 2003), and our findings add to this work by suggesting that CP-only children actually show exaggerated response to punishment cues or a general high emotional reactivity to fear cues. According to Frick and Viding (2009), deficits in emotional regulation of behavior in combination with hostile parenting and inadequate socializing experiences, seen among CP-only youth, could lead to strong reactivity to negative stimuli, which might be specific to fear. These problems lead to antisocial behaviors but through a different pathway than high CP-high CU children, who engage in similar behaviors due to an absence of concern for negative consequences and their lack of empathy to others distress. These findings are important for intervention purposes, in that CP-only children may be more likely to be benefitted from and be responsive to parenting interventions focusing on discipline strategies than would children high on both CP and CU traits.

The current results point to the importance of taking heterogeneity into account, because youth high on CP differentiated on CU traits display opposite patterns of response to fear, which might have been masked or canceled out into an absence of effects had they been grouped into the same category. It should be noted that the identified hyperreactivity of CP-only children and the hyporeactivity of CP-CU children in terms of the startle reflex was only apparent in the fear condition, and not in the anger or joy conditions, indicating a specific deficit in fear reactivity. Similarly, Viding et al. (2012) found that children with CP and CU traits exhibited lower amygdala activity during a fearful faces task, although those high on CP only show increased amygdala activity. The study's physiological findings along with evidence suggesting differences in amygdala activation can inform current research efforts toward research domain criteria based on biomarkers of psychological disorders (Insel et al., 2010). Specifically, low and high startle reactivity to fear might be considered as potential biomarkers for identifying groups of children who do or do not meet the DSM-5 CD specifier.

Third, in contrast to youth high on both CP and CU traits, nonantisocial youth high on CU traits were similar to controls in terms of behavioral and physiological responses to fear. Thus, fearlessness and problems in processing fear-related information might be required for the emotional "coldness" of high CU children to be expressed phenotypically into antisocial and aggressive acts. This finding is supportive of recent conceptualizations of antisocial behavior, where a combination of inherited vulnerabilities (CU traits in this case; Frick et al., 2014) do not produce externalizing disorder profiles possibly because of low emotion regulation difficulties and normative levels of fearful reactions (Beauchaine et al., 2010). Based on this evidence, future research should address the issue of whether CU traits should be solely used as a diagnostic criterion or only in combination with CP (Frick et al., 2014), or whether children high in CU traits can be further subdivided into those high and low in fear in order to best predict their future behavioral outcomes.

Strengths, limitations, and conclusions

The selection of CP youth high and low on CU traits from a large sample of children, based on longitudinal measures, and using information from multiple informants is a strength of the current study. However, future research should also investigate how physiological and behavioral measures of fear relate to interview assessments of CU traits and CP. Additional strengths of the current study are the multiple-method and multiple-informant assessments of different measures of fear, including physiological, child-report, and parent-report measures. Findings are also important for startle modulation research because the results add to the scarce previous evidence that startle potentiation by negative affect can be measured effectively during childhood. This is the first study examining this topic using the tone-cued imagery paradigm with children, demonstrating that these effects are robust in a variety of affective contexts and using a wide range of materials. The experimental task employed in the current study is a useful and sensitive tool to identify differences between CP groups with and without CU traits. Furthermore, although the study extends prior findings suggesting that CU traits can lead to the typical absence of startle potentiation by negative valent stimuli even among a community sample of children, this work needs to be replicated in clinical or adjudicated samples of youth. A possible limitation is that the small sample size of the experimental groups did not allow for testing gender differences, which should be investigated by future research. Future studies should also incorporate separate and purer measures of fear and anxiety to delineate the role of these two emotions in antisocial behavior.

In conclusion, current findings have implications for the fearlessness theory (Raine, 1993) by providing evidence for a fear–fearless continuum. On one extreme, children with CP and CU traits show physiological and behavioral responses associated with fearlessness and low distress. At the middle of the continuum are nonantisocial children with or without CU traits. At the opposite extreme, are children high on CP only, demonstrating high levels of fearfulness and negative affectivity. The findings are in accord with the equifinality principle, by showing that two different potential mechanisms (i.e., extremes of high and low fear) may have the same behavioral outcome manifested as phenotypic antisocial behavior. Although evidence is still limited, current results indicate that both extreme fearlessness and fearfulness may represent distinct etiological underpinnings that possibly disrupt normal development, leading to CP with or without the limited prosocial emotions specifier. In addition to linking abnormal patterns of behavior to typical developmental processes of appropriate emotional responses, evidence that can aid the formulation of appropriate interventions is provided. Specifically, given the low overall success rates of remediating antisocial behavior (e.g., Frick et al., 2014), it is important to develop programs that explicitly address the emotional profile of distinct antisocial subgroups to increase treatment efficacy and prevent future impairment. Thus, current evidence indicates that the limited prosocial emotions specifier can aid in treatment planning and the identification of more homogeneous CP subtypes.

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