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Can the Fear Recognition Deficits Associated with Callous-Unemotional Traits be Identified in Early Childhood?

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Abstract

Introduction—Callous-unemotional (CU) traits in the presence of conduct problems are associated with increased risk of severe antisocial behavior. Developmentally sensitive methods of assessing CU traits have recently been generated, but their construct validity in relation to neurocognitive underpinnings of CU has not been demonstrated. The current study sought to investigate whether the fear-specific emotion recognition deficits associated with CU traits in older individuals are developmentally expressed in young children as low concern for others and punishment insensitivity.

Methods—A sub-sample of 337 preschoolers (mean age 4.8 years [*SD*=.8]) who completed neurocognitive tasks was taken from a larger project of preschool psychopathology. Children completed an emotional recognition task in which they were asked to identify the emotional face from the neutral faces in an array. CU traits were assessed using the Low Concern (LC) and Punishment Insensitivity (PI) subscales of the Multidimensional Assessment Profile of Disruptive Behavior (MAP-DB), which were specifically designed to differentiate the normative misbehavior of early childhood from atypical patterns.

Results—High LC, but not PI, scores were associated with a fear-specific deficit in emotion recognition. Girls were more accurate than boys in identifying emotional expressions but no significant interaction between LC or PI and sex was observed.

Conclusions—Fear recognition deficits associated with CU traits in older individuals were observed in preschoolers with developmentally-defined patterns of low concern for others. Confirming that the link between CU-related impairments in empathy and distinct neurocognitive deficits is present in very young children suggests that developmentally-specified measurement can detect the substrates of these severe behavioral patterns beginning much earlier than prior work. Exploring the development of CU traits and disruptive behavior disorders at very early ages may provide insights critical to early intervention and prevention of severe antisocial behavior.

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Keywords

disruptive behavior; emotion recognition; developmental; callous-unemotional traits

Callous-unemotional (CU) traits in the presence of conduct problems delineate a group of youth at increased risk of a more severe, chronic and violent pattern of antisocial behavior (Frick, Ray, Thornton, & Kahn, 2014). Accordingly, CU traits have been incorporated into the Diagnostic and Statistical Manual-5th Edition as the "with limited prosocial emotions" specifier for Conduct Disorder (APA, 2013). Although the majority of work examining CU traits has involved adolescents and youth in middle to late childhood, there is increasing evidence that CU traits may be identifiable early in life (Frick & Viding, 2009; Kotler & McMahon, 2005; Nichols et al., 2014; Waller, Hyde, Grabell, Alves, & Olson, 2015). Testing theoretical assumptions regarding developmental trajectories of the behavioral problems associated with CU traits (Blair, 2013; Frick & White, 2008; Wakschlag, Tolan, & Leventhal, 2010) requires tools to assess the expression of these traits in a developmentally sensitive manner.

Recently, multiple independent studies have found that callous behaviors can be identified in early childhood, generally using slightly modified downward extensions of measures designed for older individuals (Ezpeleta, de la Osa, Granero, Penelo, & Domenech, 2013; Hyde et al., 2013; Kimonis et al., 2006; Willoughby, Waschbusch, Moore, & Propper, 2011). Yet many of the items useful in assessing CU traits in older individuals may not optimally capture the developmental phenomenology of CU traits in young children (Wakschlag et al., 2010). However, recent work has linked CU traits in preschoolers to decrements in moral regulation, guilt and empathy similar to those seen in older children (Waller et al., 2015).

In prior work in this sample, we have established the validity of a developmentally sensitive, multi-dimensional measure of disruptive behavior in very young children; the Multidimensional Assessment Profile of Disruptive Behavior (MAP-DB; Nichols et al., 2014; Wakschlag et al., 2014; Wakschlag, Henry, et al., 2012). Two MAP-DB subscales were conceptualized as developmental manifestations of CU traits; the Low Concern (LC) subscale and the Punishment Insensitivity (PI) subscale (Nichols et al., 2014). The LC subscale assesses a child's insensitivity to the feelings of others and includes items such as "Doesn't seem to care about pleasing others" and "Doesn't seem to care when others feel sad" (Wakschlag et al., 2014). On the other hand, the PI subscale assesses a child's failure to demonstrate behavior change following punishment and includes items such as "Blame someone else for something s/he did wrong" and "Keep on misbehaving no matter what you do" (Nichols et al., 2014). Furthermore, we have demonstrated that high PI scores, but not LC scores, are associated with poorer performance on a reinforcement-learning task in very young children (Briggs-Gowan et al., 2014), consistent with passive avoidance learning deficits in older youth with CU traits and adult psychopaths (Blair, 2007). Our recent work in older youth suggests that decision-making, and fear-identification deficits are associated with distinct pathways to antisocial behavior (Blair, Leibenluft, & Pine, 2014). However, the extent to which these differentiated patterns are evident in early childhood has not been tested.

In adolescents and adults, impairment in processing the emotional expressions of others, particularly for distress cues, has been related to CU traits (see Blair et al., 2014). This impairment can be indexed as: (i) impaired facial and vocal distress expression recognition (Dawel, O' Kearney, McKone, & Palermo, 2012; Marsh & Blair, 2008; Stevens, Charman, & Blair, 2001); (ii) reduced psychophysiological responses to distress expressions (Blair, Jones, Clark, & Smith, 1997; Vaidyanathan, Hall, Patrick, & Bernat, 2011); and (iii) reduced amygdala responses (Marsh et al., 2008; Viding et al., 2012; White et al., 2012) to distress expressions. Critically, degree of impairment in response to distress expressions has been shown to be positively associated with level of CU traits (e.g. Blair, Budhani, Colledge, & Scott, 2005; Vaidyanathan et al., 2011; Viding et al., 2012; White et al., 2012).

The goal of the current study was to examine emotional expression recognition deficits in very young children with developmentally-defined patterns of callous behavior as measured by the MAP-DB and a developmentally sensitive emotion-processing task. A large community sample of preschoolers, oversampled for disruptive behavior risk, completed a task in which children discriminated between emotional (either fearful, happy or angry) and neutral faces. The current study investigated the extent to which the LC and PI subscales of the MAP-DB were associated with deficits in emotional expression recognition accuracy and response latency. Based on previous work (e.g. Dawel et al., 2012) and theory (e.g. Blair et al., 2014), we predicted that deficits in emotional expression recognition accuracy and response latency would be fear-specific and uniquely associated with LC.

Methods

Participants

The current study's participants were drawn from Phase II of the Multidimensional Assessment of Preschoolers (MAPS) Study, which recruited preschoolers from five Chicago-based pediatric clinic waiting rooms (for details see Figure 1 and Nichols et al., 2014). The MAPS project obtained a sample broadly stratified by child age, sex, race/ethnicity, and poverty. English and Spanish-speaking parents accompanied their 3–5 year old child to the clinic and were invited to participate in a survey study about the MAP-DB if they were the child's legal guardian. The survey had a response rate of approximately 80%, which yielded 1,857 completed surveys. Survey completion was incentivized by the offer of $20 with a $10 bonus for completion of the survey prior to leaving the clinic.

A stratified, random sample was drawn from the Phase II sample to participate in an intensive laboratory-based protocol to assess correlates and mechanisms of emergent psychopathology pathways. The subsample was restricted to children without significant delays or neurodevelopmental conditions and their English-speaking, biological mothers. We oversampled children with (a) disruptive behavior above the 80th percentile on the MAP-DB (Wakschlag et al., 2014) and (b) children of mothers who reported past-year intimate partner violence exposure (for details see Nichols et al., 2014). The analytic sample for this paper includes children who met all eligibility criteria for the intensive sub-study, participated in the first laboratory visit when the emotion identification task was administered (see Figure 1), and had usable data from this task.

Specifically, 425 children participated in the neurocognitive task component of the intensive sub-study. Twenty-eight participants with developmental delays or neurodevelopmental conditions identified at the visit were excluded from the task-based analyses. Of the 397 remaining participants, usable data were acquired for 84.9% (n=337). Task data were subsequently determined to be unusable for 60 children (see Figure 1).

These 337 children did not differ from the children who attended visits but did not have usable data (n=60) in terms of intimate partner violence exposure [χ^2=0.06, p>0.81]. However, they were more likely to be girls [54.9% vs. 36.7%; χ^2=6.78, p<.01], less likely to be living in poverty [46.3% vs. 61.7%; χ^2=4.82, p=.03] less likely to have mothers with low education (high school or less) [21.2% vs. 37.3%; χ^2=7.24, p<.01] and more likely to be Caucasian [22.0% vs. 5.0%; χ^2=4.82–9.37, p<.05]. Additionally, these children tended to be older than children without usable data [mean age in years = 4.8(0.8) vs. 3.8(0.5); t=2.32, p=.02], and had lower levels of total disruptive behavior [67.3(51.5) vs. 89.2(69.5); t=12.47; p<.01]. However, relevant to the aims of this paper, they had similar levels of LC and PI scores [t=1.29–1.56, p>.1].

Average child age in the sample was 4.82 years (SD=0.8, range=3.1–7.2). Ninety-two percent of children were 3–5 years of age but 8% had turned 6 and <1% 7 by the time of their laboratory visit. Consistent with the oversampling strategy, 41.8% had high levels of disruptive behavior on the MAP-DB and 21.4% had mothers who had experienced intimate partner violence. Participant characteristics are presented for the full sample and across the PI and LC groupings in Table 1. High and low PI and LC groups were defined as above and below the 80th percentile on these subscales respectively. Differences in gender and, race/ethnicity breakdown were not observed between high and low PI groups (χ^2=.806–3.920, p>.27). There was no difference in proportion of males and females for LC (χ^2=1.531, p=0.22). However, those with high LC scores were less likely to be of Hispanic ethnicity (25.2% vs. 34.4%, χ^2=8.767, p=0.03) than those with low LC scores (see Table 1).

Procedures

Mothers and children completed a series of observational and behavioral tasks in the course of two three-hour laboratory visits. Informed consent was obtained from mothers. Transportation expenses were reimbursed and participant families were compensated $210 for their time participating in all components of the laboratory visits. Children and mothers were assessed separately. Northwestern University and University of Connecticut Health Center Institutional Review Boards approved all study procedures.

Measures

Emotional Faces Task (LoBue, 2014; Lobue & DeLoache, 2008)—In the Emotional Faces Task, children were presented with an array of images (see Figure 2A). Each array had nine different shapes and the children had to select the target shape. The task was administered using a touchscreen computer and children had to touch the appropriate image to select it and move on to the next trial. If the child's response was correct, an orange border appeared around the image. If the child's response was incorrect, a grey border appeared around the image.

Given the age range of the sample, participants completed a baseline array in the first block of the task. Children were instructed to discriminate between a target shape and distractor shapes (see Figure 2–A1). The target shapes were identical in each trial (see Figure 2–A2). Participants completed three practice trials in a 2 × 2 matrix and twenty-seven task trials in a 3 × 3 matrix. This shapes block was included as a covariate in the model. Children with less than 55% accuracy were excluded.

Following the first block, blocks 2–4 were the task conditions of interest and were randomized between participants. Each block presented 27 trials and contained target faces of one emotion to create a fearful expression block, an angry expression block and a happy expression block. Images were taken from the NimStim stimulus set (Tottenham et al., 2009). Participants were presented with arrays displaying nine faces in a 3 × 3 matrix (see Figure 2B). Each array consisted of eight neutral adult faces and one emotional adult face. Participants were always instructed to identify the emotional face (e.g. "look for the angry face; find the angry face as fast as you can"). The task was administered using a touchscreen computer and children had to touch the appropriate emotion to select it and move to the next trial. Again, after a correct response, an orange border appeared around the image; after an incorrect response, a grey border appeared around the image.

Trials that were less than 100 *ms,* longer than 7 seconds, or more than 4 standard deviations from an individual child's mean latency were removed. Accuracy and latency were calculated only if there were a minimum of 9 usable trials for that emotion condition. Latency was calculated as the mean response time within emotion condition for accurate trials.

Developmental Expression of Callous/Unemotional Traits

Low Concern—Parents were asked to rate behaviors associated with LC over the previous month on a six-point scale [0=Never; 1=Rarely (less than once per week); 2=Some (1–3 days of the week); 3=Most (4–6 days of the week); 4=Every day of the week; and 5=Many times each day]. The LC subscale contains 9 items (see Table 2). The LC subscale has acceptable internal consistency (α=.81) and test-retest reliability (*ICC*=.83 over a mean of 161.2 days, ± 84.9) and has been psychometrically validated for use in early childhood (Wakschlag et al., 2014).

Punishment Insensitivity—The PI subscale includes seven items (see Table 2) that parents rated based on their child's response when punished or disciplined in the previous month, using a six-point scale [0=Never, 1=Hardly Ever, 2=Sometimes, 3=Often, 4=Most of the time, 5=All the time] (Nichols, 2014). The PI subscale has acceptable internal consistency (α= .73) and test-retest reliability (*ICC*=.86 over a mean of 161.2 days, ± 84.9) and has been psychometrically validated for use in early childhood (Nichols et al., 2014).

The correlation between the two scales was .72. For both scales, a two-group categorical variable was calculated to differentiate High (≥80th percentile) and Low (<80^{th} percentile) scores. Thresholds for these categories were defined using the normative distributions from the MAPS Phase II sample (Wakschlag et al., 2014).

Covariates

Other dimensions of disruptive behavior—In order to establish the specificity of the associations between PI, LC and emotion processing, our models also accounted for impulsivity, irritability, aggression and non-verbal reasoning.

Impulsivity—Child impulsivity was assessed via parent ratings of the 10-item Activity/Impulsivity subscale of the preschool version of the Infant-Toddler Social and Emotional Assessment (ITSEA; Carter & Briggs-Gowan, 2006). Internal consistency in the current sample was acceptable (α = .81).

Irritability—Child irritability was assessed with the MAP-DB Temper Loss dimension, which has demonstrated acceptable psychometric properties (α = .97. test-retest reliability = .72, n = 38; Wakschlag, Choi, et al., 2012) and validity in capturing underlying severity of problems with temper tantrums and irritable mood in children (Wakschlag, Choi, et al., 2012; Wakschlag et al., 2015). Temper loss is a defining feature of preschool disruptive behavior and thus was included as a potential covariate.

Aggression—Child aggression was assessed with the MAP-DB Aggression dimension, which has demonstrated acceptable psychometric properties (α = .94, test-retest reliability = .85) (Wakschlag et al., 2014). The aggression dimension has been shown to capture a wide range of aggressive behaviors as expressed in young children including physical, verbal and relational aggression, and to be useful in discriminating between abnormal aggression and aggressive behavioral within the normal range (Wakschlag et al., 2014). Aggression was entered as a covariate to ensure any findings regarding LC or PI were not due to an association with increased aggression.

Child-directed aggression—Eight items from the Conflict Tactics Scales Parent-Child version (CTSPC; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998) were used to measure child-directed physical aggression by the mother (e.g., *You shook your child*). Due to concern for compromising reliability of mother's response, very severe and rare behaviors in the CTSPC were not included. The scale score was calculated, following administration guidelines, by summing the frequency value for each response, using the midpoint (i.e., 0 = *Never*, 1 = *Once*, 2 = *Twice* 4 = *3–5 Times*, 8 = *6–10 Times*, 15 = *11–20 times*, 25 = > *20 Times*). Internal consistency was acceptable (α = .61).

Nonverbal reasoning—Child nonverbal reasoning was directly assessed with the Picture Similarities subscale of the Differential Ability Scales-Second Edition (DAS; Elliott, 1983). The DAS yields scaled ability scores (sample *MN*=99.5, *SD*=19.9). Nonverbal reasoning was assessed as a proxy for IQ. Significant differences between high and low PI and LC groups were not observed on DAS scores (see Table 1).

Analytic Plan

Due to their potential associations with task performance, child age, sex, Temper Loss, Aggression, impulsivity, Shapes block accuracy and response latency, nonverbal reasoning and socio-demographic characteristics were reviewed to determine whether they should be included as covariates in models (Table 3). Variables associated with either task performance or LC/PI were included as covariates. Models also conservatively included CTSPC child-directed aggression due to oversampling based on family violence. The primary analyses consisted of two sets of analyses to test for the effects of LC for others emotions and PI on (i) accuracy of emotion identification and (ii) latency. Within each set, the first analysis was tested as a repeated-measures Analysis of Covariance (ANCOVA) via SAS PROC GLM, which is appropriate for unbalanced designs. The three emotion conditions were the repeated dependent variables (i.e., fear accuracy, angry accuracy and happy accuracy). Independent variables were grouping variables reflecting LC, PI and the interaction between LC and PI. Within subject effects were adjusted for sphericity with the Greenhouse-Geisser (GG) adjustment. All models included relevant covariates. To protect against chance findings due to multiple comparisons, univariate analyses were conducted only when there was a significant main effect. Pairwise comparisons among groups were adjusted for multiple comparisons with the Bonferroni adjustment. A p-value of .05 was used for all analyses.

Analyses employed weights that account for both unequal probabilities of selection and differential non-response rates. Model estimation procedures accounted for the complex stratified sampling design wherever possible. For example, the survey design-based estimator (available in SAS) was employed via PROC SURVEYREG to account for the stratification and unequal probabilities of selection in the sample design.

Results

Correlations among study variables are presented in Table 3. Child-directed aggression was not significantly associated with accuracy or response latency. The patterns observed indicate increased response accuracy and faster latencies for shapes and faces with increases in child age. Further, the observed data indicate increased faces accuracy for girls, but not faster response latencies. Children's accuracy and latency in the Shapes block were positively correlated with accuracy and latency in the Emotion blocks (r=.57 & .49 respectively, p<.01). Nonverbal reasoning, age, sex, Temper Loss, Aggression and Impulsivity (but not race/ ethnicity) were significantly correlated with accuracy and/or latency, supporting their inclusion as covariates in the models. As such, these variables were included as covariates in the model.

Response Accuracy

A repeated-measures ANCOVA was conducted to examine the influence on response accuracy to emotional facial expressions (fear relative to anger relative to happy) of PI (below 80th percentile, above 80th percentile) and LC (below 80th percentile, above 80th percentile) while accounting for variance due to the continuous covariates of age, child-directed aggression, Temper Loss, Aggression, Activity/Impulsivity and Shapes block response accuracy and a dichotomous covariate of sex. Significant main effects were observed for sex [F(1,325)=7.12, p=.008] and Shapes block response accuracy [F(1,325)=79.98, p<.001]. That is, Shapes block accuracy was associated with increased accuracy and females were more accurate than males.

A significant interaction effect was observed for the emotional facial expression-by-LC interaction [$F(2,650)=7.84$, *GG Epsilon*=.961, $p<.001$], but not for the emotional facial expression-by-PI interaction [$F(2,650)=1.11$, $p=.328$]. Review of the univariate ANCOVAs, which included the PI and LC groups, indicated that a significant difference between low and high LC groups was observed for fearful faces [*difference*=−.046, 95% CI=−.087 to −.005; $F(1, 327)=4.95$, $p=.027$], but not angry [*difference*=−.025, 95% CI=−.001 to .050; $F(1, 327)=3.56$, *p*=..060] or happy faces [*difference*=−.027, 95% CI=−.063 to .009; $F(1, 327)=2.16$, $p=.143$]. The high LC group was less accurate in identifying fearful faces than the low LC group, while accuracy rates for the high and low LC groups did not significantly differ for angry or happy faces (see Figure 3). Results of models that tested for interactions between LC and PI and child sex revealed no significant effect on accuracy, [*Between Subjects* $F(1,324)=.00$ to .65, $p>.41$; *Within Subjects* $F(2,648)=1.19$ to 1.39, *GG Epsilon*=.960 to .965, p>.24].

Response Latency

A parallel repeated-measures ANCOVA was conducted to examine the influence on response latency to emotional facial expressions of PI and LC while accounting for variance due to the continuous covariates of age, child-directed aggression, temper loss, aggression, impulsivity, nonverbal reasoning and Shapes block response latency and a dichotomous covariate of sex. Significant main effects were observed for age [$F(1,325)=24.68$, $p<.001$], temper loss [$F(1,325)=12.19$, $p<.001$] and Shapes block response latency [$F(1,325)=35.30$, $p<.001$]. Greater age was associated with quicker response latencies, whereas increased levels of Temper Loss and slower response latencies on Shapes block were associated with slower response latencies.

Significant interaction effects were observed for the emotional facial expression-by-age [$F(2,650)=3.44$, *GG Epsilon*=.976, $p=.034$] and emotional facial expression-by-nonverbal reasoning score interactions [$F(2,650)=4.80$, $p=.009$]. Significant effects for the emotional facial expression-by-PI or emotional facial expression-by-LC interactions were not observed [$F_{PI}(2,650)=2.17$, $p=.117$; $F_{LC}(2,650)=1.64$, $p=.195$]. These patterns held when tests for moderation by sex were evaluated in a second model, with no significant emotional facial expression-by-sex-by-PI or emotional-facial-expression-by-sex-by-LC interactions [*Within Subjects* $F(2,648)<1.22$, *Greenhouse-Geisser Epsilon*=.975, $p>.298$] and no significant sex-by-LC interactions [$F_{Between}(1, 324)=.64$, $p=.425$). There was a significant sex-by-PI interaction [$F_{Between}(1, 324)=4.19$, $p=.042$]; however, these differences did not hold up when examined within boys and girls separately [$F(1,174=1.45$, $p=.231$ and $F(1,141)=2.91$, $p=.090$].

The magnitude of the inverse relationship between age and response latency was observed to be greater for angry expressions [$r=-.471$] relative to happy expressions [$r=-.404$, Steiger's $Z=2.01$, $p=.04$]. The relationship between age and response latency to fearful expressions [$r= -.428$] did not significantly differ from the relationship between age and response latency to happy [Steiger's $Z=0.68$, $p=.50$] or angry expressions [Steiger's $Z=1.21$, $p=.23$]. The magnitude of the inverse relationship between nonverbal reasoning scores and response latency was observed to be greater for fearful expressions [$r=-.277$] relative to happy expressions [$r=-.179$, Steiger's $Z=2.30$, $p=.02$] and relative to angry expressions [$r=-.186$, Steiger's $Z=2.56$, $p=.01$]. The magnitude of the relationship between nonverbal reasoning scores and response latency did not significantly for angry relative to happy faces [Steiger's $Z=.19$, $p=.85$].

Discussion

The goal of the current study was to employ developmentally-sensitive methods to examine the extent to which a distinct pattern of fear recognition deficits associated with empathic features of CU traits in older individuals is also evident in early childhood. A fear-specific deficit in emotion recognition was observed in preschoolers with high LC scores, similar to older individuals with high CU traits. This relationship was significant when accounting for the contributions of child-directed aggression, sex, age, shape discrimination, nonverbal reasoning, and other behavioral correlates. No significant interactions between LC or PI and sex were observed.

The current data indicate that the fear-specific accuracy deficits in the identification of distress facial expressions associated with high levels of CU related empathic deficits in older youth (Dawel et al., 2012; Marsh & Blair, 2008) can be observed in preschoolers. This is a strong indication of the validity of the LC subscale of the MAP-DB as a measure of early expression of CU traits in preschoolers. A developmentally appropriate measure of CU traits will allow researchers to test theoretical assumptions about the development of CU traits and antisocial behavior in younger children than is currently possible (Wakschlag, Henry, et al., 2012).

One such theoretical assumption is that the neural deficits associated with CU traits observed in older children and adults are present in very young children. The fear-specific emotion recognition deficits associated with CU traits are argued to be the product of amygdala *hypo*-responsivity to fear/distress cues (Blair et al., 2014). Indeed, the level of dysfunction during emotion recognition (Blair et al., 2005) and during viewing of emotional expressions (Viding et al., 2012; White et al., 2012) has been related to level of CU traits. The common neurobehavioral deficits seen across development suggest that, consistent with theoretical positions (e.g., Blair et al., 2014), the amygdala dysfunction during emotion recognition observed in older youth and adults with high levels of CU traits are present early in development. This is consistent with the developmental processes theorized to be associated with deficits in the development of conscience. Specifically, multiple theorists (e.g., Blair, 2007; Kochanska & Aksan, 2006) have suggested that children with impaired conscience development and moral regulation have difficulty recognizing emotional distress in others and therefore have reduced responsiveness to socialization. Given that substrates of conscience can be measured as early as toddlerhood (Kochanska & Aksan, 2006), the present findings suggest that the early emergence of the atypicalities that mark callous patterns may be detectable (and preventable) well before severe antisocial behavior is developmentally possible.

Additionally, girls were more accurate, but not faster, than boys in identifying emotional expressions. Female adults (Hoffmann, Kessler, Eppel, Rukavina, & Traue, 2010) and youth

(McClure, 2000) have consistently shown better expression recognition than males. Importantly, however, no significant interactions with sex were found in this sample. This is consistent with other work failing to find significant interactions between sex and CU traits (e.g., Dadds et al., 2014; Horan, Brown, Jones, & Aber, 2014; Stickle, Marini, & Thomas, 2012).

It is worth noting that high levels of PI did not significantly predict the fear-specific emotion deficits in the current study despite the fact that PI and LC were correlated. In previous work using the current sample, PI was associated with reinforcement-learning deficits, although LC was not (Briggs-Gowan et al., 2014). This differentiated pattern of LC to fear identification deficits reported here and our prior reports of PI's association to decision-making deficits in early childhood (Briggs-Gowan et al., 2014) is strikingly similar to differentiated patterns found in older youth (Dawel et al., 2012; Marsh & Blair, 2008; Viding et al., 2012; White, Clanton, et al., 2014; White, Fowler, et al., 2014; White et al., 2013).

It is also worth noting that the environmental variable, child-directed aggression, did not show a relationship with task performance. Clearly, environmental variables have a significant role in developmental pathways for externalizing behavior (Moffitt, 2003). Adverse environmental experiences, such as child-directed aggression, increase the risk for externalizing behavior (Wilson, Stover, & Berkowitz, 2009). However, this appears to particularly occur through increasing threat sensitivity (Dodge, 1980; Dodge et al., 2015). This has been indexed as *increased* sensitivity to angry expressions (Pollak & Tolley-Schell, 2003; Pollak et al., 2005; Shackman & Pollak, 2014) rather than decreased sensitivity to fearful expressions that here related to LC and in work with older youth has related to callous-unemotional traits (Dawel et al., 2012; Marsh & Blair, 2008). Of course, there may be other environmental variables that are associated with decreased sensitivity to the fearful expressions of others (Blair, Leibenluft, & Pine, 2014). While beyond the scope of the current paper, a more thorough investigation of the role of environmental processes in this and other developmental pathways for externalizing behavior will be addressed in other analyses involving this sample.

Although our hypotheses regarding response accuracy were supported, it is notable that our hypotheses with respect to response latencies were not supported. High LC/PI scores were unrelated to fear-specific increases in response latency. There are several possible explanations for this null finding. This finding may reflect type II error. Alternatively, the wide range of response latencies associated with age within the sample may have obscured any response latency findings. However, it is also possible that the relationship between LC and emotion recognition is limited to accuracy.

These data have potentially important clinical implications. Preventing or intervening early in cases of disruptive behavior is more effective during this period of heightened plasticity rather than when the disruptive behaviors have become entrenched (Dodge, Bierman, et al., 2015). By demonstrating that the neurocognitive substrates of developmentally-defined deficits in concern for others parallel those found in older youth with CU traits, these findings suggest that low concern for others is an early manifestation of CU traits. Combined with a burgeoning body of evidence demonstrating callous patterns in early childhood using developmentally-based methods (Nichols et al., 2014; Waller et al., 2015), the current data suggest that early identification of young children predisposed to this severe developmental pathway may be efficacious. Importantly, a promising intervention targeting empathic emotion deficits in young children with callous traits is currently being tested (Hawes, Price, & Dadds, 2014).

Linking developmental expressions of early callousness and specific neurobehavioral deficits in very young children when using developmentally sensitive methods further supports the notion that developmental specification may elucidate prodromal patterns well in advance of serious antisocial behavior. Of course, longitudinal prediction to callous behavior at ages where the validity of the construct of CU traits is well established and examination of the continuity of these patterns of behavior across developmental periods (as well as factors that buffer against CU risk in young children) will be important next steps. We are currently conducting a longitudinal follow-up of the MAPS sample for this purpose. It is our hope that these next steps will provide insights critical to neuroscience-based targeted early intervention and prevention of severe and chronic antisocial syndromes.

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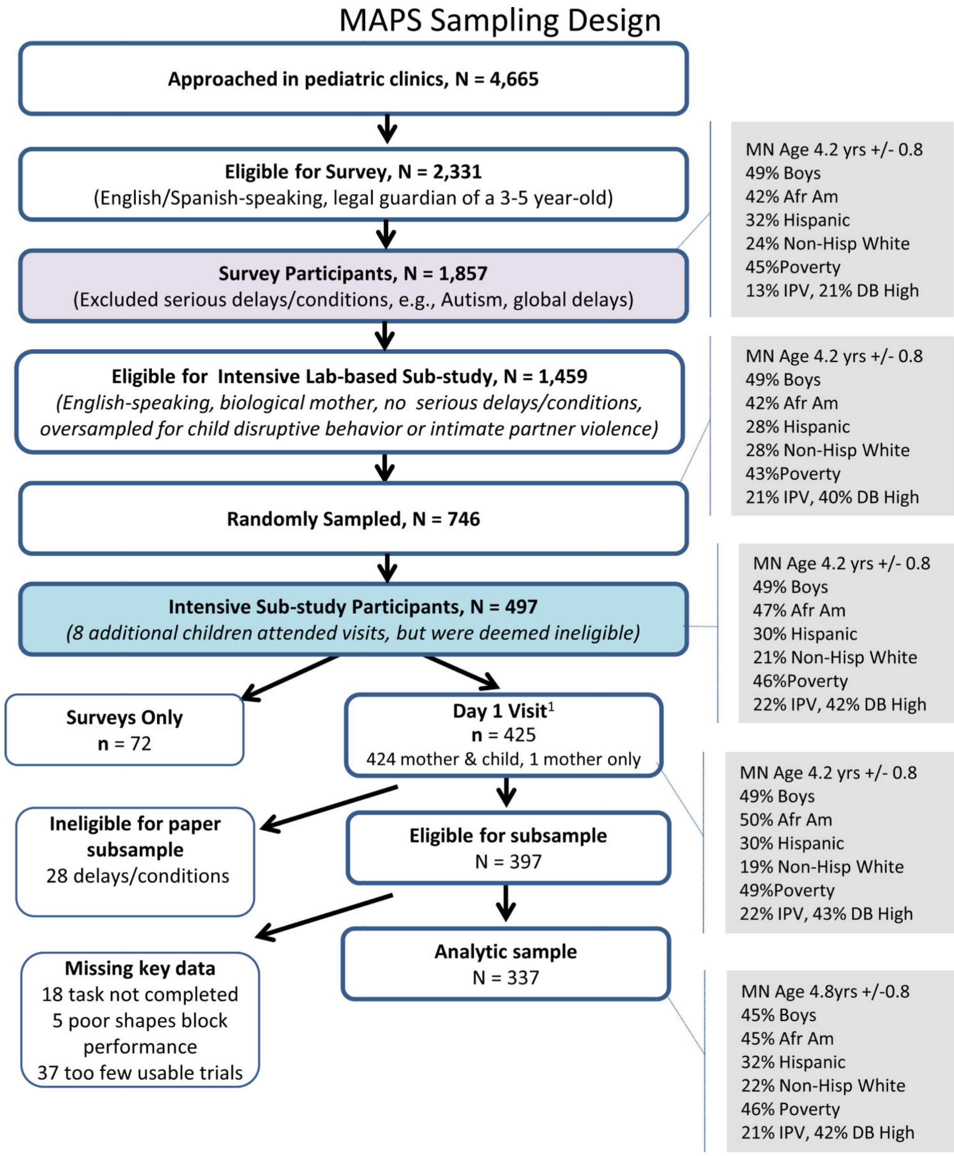

[1] 28 of the 425 children who participated in visits had delays or neurodevelopmental conditions that make them ineligible for some analyses: mixed language delay (n=13), non-verbal reasoning delay (n=7), epilepsy (n=4), ADHD medication (n=2), other (n=2)

[2] 14 Children did not attend Day 2 Visit: illness (n = 1), difficulty comprehending tasks (n = 5), behavioral/emotional issues (n = 5), child refusal of tasks (n = 2), and mother decline (n=1)

Figure 1. MAPS Sampling Design

The analytic sample for the current study was drawn from the larger Multidimensional Assessment of Preschoolers (MAPS) study. A total of 337 usable data sets were drawn from the 1,459 children eligible for the intensive lab-based study.

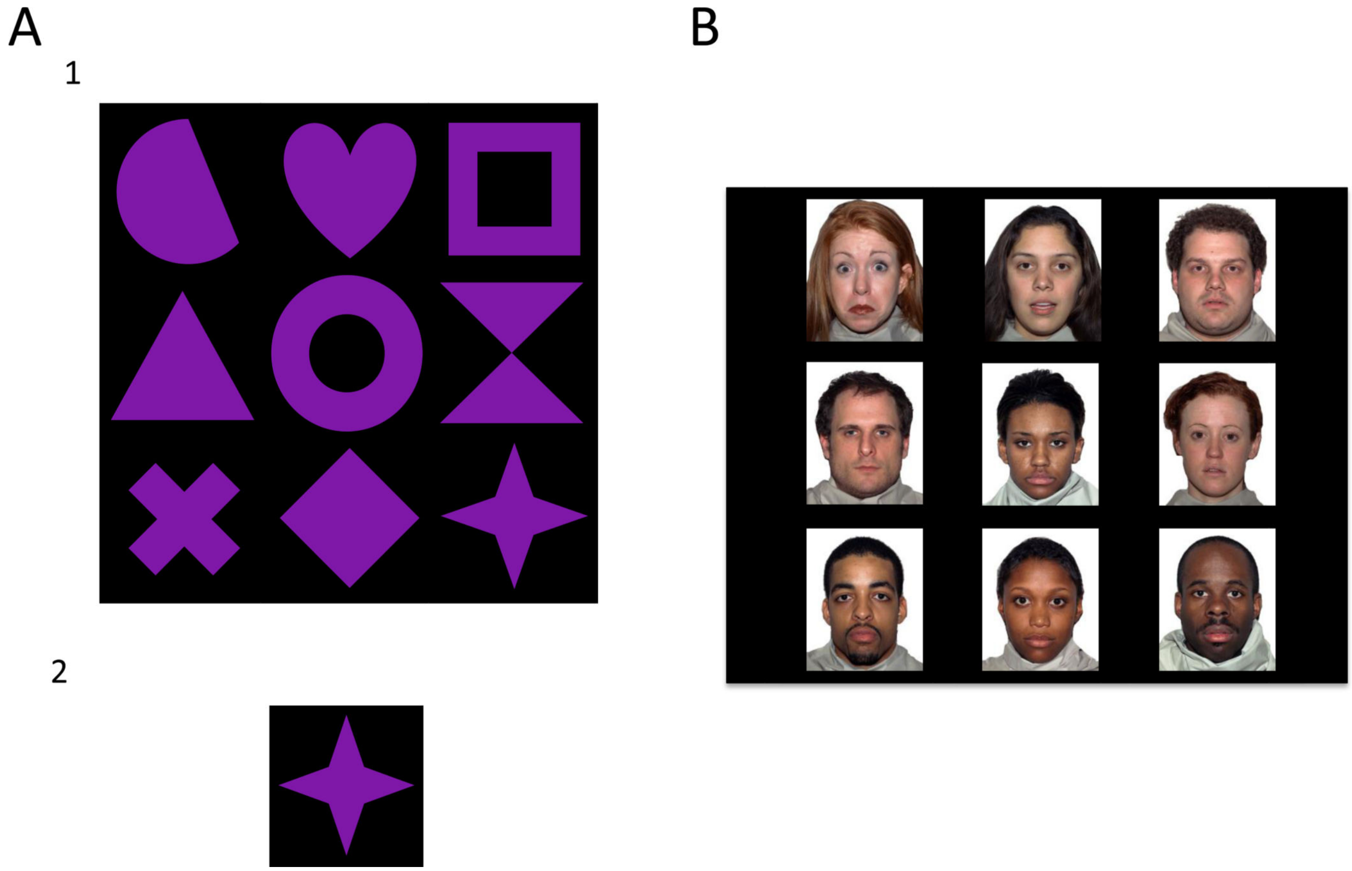

Figure 2. The Emotional Faces Task

The Emotional Faces Task is a developmentally sensitive emotion recognition task. In the first block, children are presented with an array of shapes (A1) and asked to select the target shape (A2). The blocks 2–4, children are asked to select the emotional face from an array of adult faces (B). The task was performed using a touchscreen computer.

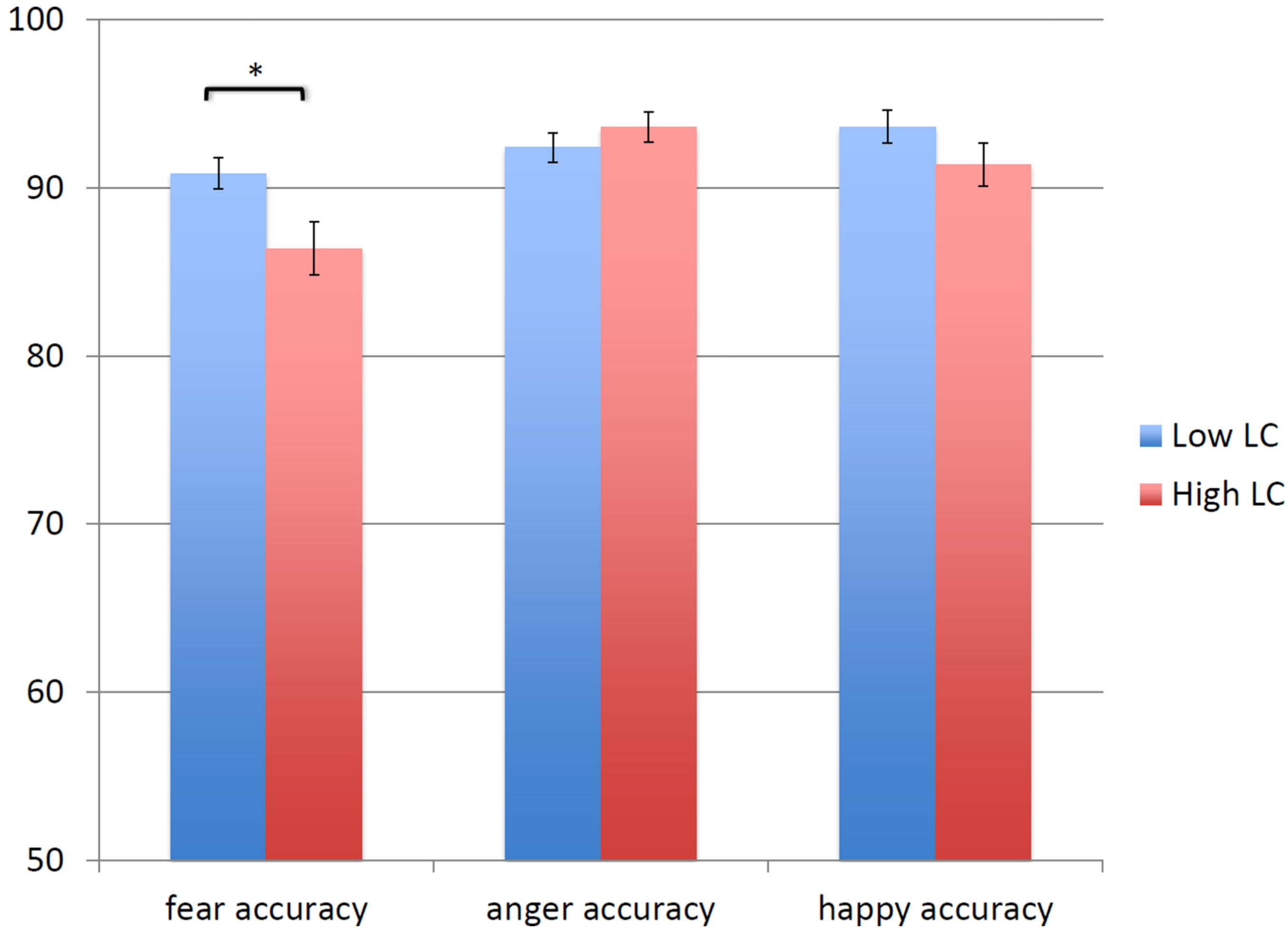

Figure 3. Accuracy rates for identification of emotional faces in youth with high levels of Low Concern relative to youth with low levels of Low Concern

Youth with high levels of Low Concern (LC), relative to youth with low levels of LC, showed significantly poorer accuracy in identifying fear faces, but not angry or happy faces.

Table 1

Sample Characteristics

	Analyzed sample	Low Concern Disregard			Punishment Insensitivity		
	(*N*=337)	Low (*N*=230)	High (*N*=107)		Low (*N*=241)	High (*N*=96)	
	N(%)	*N*(%)	*N*(%)	χ^2	*N*(%)	*N*(%)	χ^2
Gender							
Males	152 (45.1%)	109 (47.4%)	43 (40.2%)		105 (43.6%)	47 (49.0%)	
Females	185 (54.9%)	121 (52.6%)	64 (59.8%)	1.53	136 (54.6%)	49 (51.0%)	0.81
	N(%)	*N*(%)	*N*(%)	χ^2	*N*(%)	*N*(%)	χ^2
Ethnicity/Race							
African-American	152 (45.1%)	104 (45.2%)	48 (44.9%)		107 (44.4%)	45 (46.9%)	
European-American	74 (31.5%)	42 (18.3%)	32 (29.9%)		49 (20.3%)	25 (26.0%)	
Hispanic	106 (22.0%)	79 (34.3%)	27 (25.2%)		80 (33.2%)	26 (27.1%)	
Other	5 (1.5%)	5 (2.2%)	0 (0%)	**8.77***	5 (2.1%)	0 (0%)	3.92
	N(%)	*N*(%)	*N*(%)	χ^2	*N*(%)	*N*(%)	χ^2
Socio-economic factors							
Employed mother	181 (53.9%)	124 (45.2%)	57 (53.8%)	<.01	129 (53.8%)	52 (46.9%)	<.01
Mother Ed <= HS	70 (21.2%)	48 (45.2%)	22 (20.8%)	0.02	50 (21.2%)	20 (46.9%)	<.01
Living in poverty	156 (46.3%)	107 (45.2%)	49 (45.8%)	0.02	105 (43.6%)	51 (46.9%)	2.52
Married/cohabitating	221 (65.6%)	149 (64.8%)	72 (67.3%)	0.20	164 (68.1%)	57 (59.4%)	2.23
	M (*SE*)	*M* (*SE*)	*M* (*SE*)	*F*	*M* (*SE*)	*M* (*SE*)	*F*
Differential Ability Scales	99.47 (0.98)	99.31 (1.05)	95.57 (1.98)	2.79	99.33 (1.04)	95.34 (2.02)	3.08
Child-Directed Aggression	7.98 (0.66)	7.30 (0.81)	9.43 (1.17)	2.24	6.58 (0.64)	11.47 (1.65)	**11.35***

* $p<.05$,

SE=standard error

Table 2

Punishment Insensitivity and Low Concern Items

Punishment Insensitivity Items	Low Concern Items
1. Act like s/he didn't hear you when you said "no"	1. Not care about other's feelings when frustrated, angry, or upset
2. Deny he or she did something that was not allowed	2. Not seem to care about parent's feelings
3. Act like rules didn't matter	3. Keep on doing something that was scaring or upsetting someone
4. Keep on misbehaving "no matter what you do"	4. Not seem to care about other adults' feelings
5. Act like s/he did not know "right from wrong"	5. Act like s/he did not care about pleasing other people
6. Not care when punished	6. Act like s/he did not care when someone was mad or upset
7. Refuse to apologize	7. Enjoy making others mad
	8. Do things to humiliate or embarrass others
	9. Act like s/he did not care when someone felt bad or sad

Table 3

Correlation of Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. LC	1	.688**	−.088	.053	−.051	.083	.028	.044	−.023	.734**	.785**	.415**	−.056	.121*
2. PI		1	−.137*	.121*	−.102a	.174**	.003	−.047	−.100a	.681**	.668**	.512**	−.167**	.211**
3. Response Accuracy			1	−.305**	.573**	−.364**	.151**	.085	.351**	−.069	−.143**	−.140*	.401**	−.049
4. Response Latency				1	−.354**	.488**	−.038	.095a	−.477**	.137*	.058	.061	−.238**	−.010
5. Shapes Accuracy					1	−.398**	.078	.123*	.407**	−.018	−.132*	−.047	.457**	.047
6. Shapes Latency						1	−.057	.001	−.597**	.065	.118*	.157**	−.464**	.002
7. Sex							1	−.024	−.097a	.010	−.016	−.039	.058	−.014
8. Race								1	−.136*	.090a	−.024	−.154**	.064	−.060
9. Age									1	−.088	−.042	−.090	.561**	.005
10. Temper Loss										1	.788**	.501**	−.045	.137*
11. Aggression											1	.485**	−.132*	.169**
12. Impulsivity												1	−.062	.226**
13. DAS													1	−.037
14. Child-Directed Aggression														1

** $p<.01$,

* $p<.05$,

a $p<.1$;

LC=Low Concern; PI=Punishment Insensitivity; DAS=Differential Ability Scales