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Throwing Caution to the Wind: Callous-Unemotional Traits
and Risk-Taking in Adolescents

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Abstract

Objective: Developmental research suggests adolescents may be highly influenced by their peers to take risks. Although youths with callous-unemotional (CU) traits engage in high risk behaviors in the form of antisocial behavior and aggression, little is known about their decision making, particularly when their peers are present. Youths high on CU traits may be most susceptible to influence, especially when rewards are involved, or they may be highly rational relative to their low CU peers and less susceptible to social peer pressures. **Method:** The present study used a gambling task with 675 youths (females=348), ages 16 to 20 years ($M=16.9$, $SD=.8$). The majority were White British (64%). We experimentally manipulated whether youths made decisions in groups with peers or individually. All members of the group reported on their CU traits. **Results:** Using multilevel modeling to control for group-level effects, youths with higher levels of CU traits were found to be less sensitive to accruing rewards on the gambling task than youths low on these traits. When in groups, males with higher levels of CU traits made quicker decisions to take risks than males lower on CU traits, particularly after punishment. **Conclusions:** Youths with CU traits are distinct in showing a lack of emotion and this may facilitate heightened rationality in responding to rewards. However, results suggest that adolescent boys who are high on CU traits may react to the possible frustration of losing by attempting to gain back rewards quickly when their peers are watching.

Keywords: Callous-unemotional traits; reward; punishment; risky behavior; peers.

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A significant body of work has established reliable descriptors of psychopathy in adult populations, and studies have demonstrated a clear link between psychopathy and antisocial behavior (e.g., Leistico, Salekin, DeCoster, & Rogers, 2008). More recently, research has examined psychopathy in adolescent populations (e.g., Edens, Skeem, Cruise, & Cauffman, 2001; Vitacco, Neumann, Caldwell, Leistico, & Van Rybroek, 2006), and has categorized youth along affective, interpersonal, and lifestyle dimensions. In particular, within the affective dimension of psychopathy, callous-unemotional (CU) traits have been used to delineate a sub-type of youth who demonstrate low autonomic reactivity and exhibit low levels of fear in response to threatening stimuli (Muñoz, Frick, Kimonis, & Aucoin, 2008; Kimonis, Frick, Muñoz, & Aucoin, 2007). High CU traits in adolescents has also been linked with increased violence (Frick & White, 2008) and aggressive sexual behavior (Lawing, Frick, & Cruise, 2010), so that unpacking decision making patterns in these youths is especially important.

Although youths high on CU traits disproportionately engage in high risk behaviors (see White & Frick, 2010), little research has examined how these youths engage in risky decision making, relative to their same-aged peers. The developmental period of adolescence is also a marked time of risk behavior, and adolescents are disproportionately involved in dangerous behaviors relative to other age groups (CDC, 2009). Yet little is known about the risky decision process in youths with CU traits, and how these youths may potentially differ from developmentally normative youths along different decision making dimensions. The current study uses experimental data to examine the ways in which youths high on CU traits are delineated from normative adolescents in their risky decision making.

Given that individuals high on CU traits are likely to take significant risks in their criminal and antisocial behavior (White & Frick, 2010), a small body of research has begun to investigate a potential link between psychopathic traits, which includes the affective traits associated with the CU dimension, and risk-taking in adults and incarcerated samples. Illustratively, Newman and colleagues (1987) have linked increased risky card playing to psychopathy, suggesting that heightened risk-taking may describe individuals high on CU traits. Yet, other research has found high psychopathy adults within community samples are more successful in card playing relative to low psychopathy adults, but not more risky (Belmore & Quinsey, 1994). Likewise, studies of jailed adults (Swogger, 2010) and adolescents (Marini & Stickle, 2010) failed to find an association between psychopathic traits and behavioral risk-taking. These findings suggest that individuals high on CU may be more successful in their risk-taking, if not more risky overall, relative to other individuals.

However, with the exception of Marini and Stickle, past research has not focused on adolescents, and no research, to our knowledge, has examined CU traits and risky decision making within community samples of adolescents. These represent critical gaps in the literature, given that adolescents, in general, tend to be highly risk-oriented (CDC, 2009), and given the need for psychopathy research that looks beyond the confound of incarceration (Frick et al., 2003). Moreover, a key to understanding differences in adolescent antisocial behavior is identifying how such decisions are made. This study thus examines a number of decision dimensions that might incline youths with CU traits towards risky behavior.

One of the main factors linked with adolescent risk taking is the presence of peers. Both self-report and behavioral measures indicate that adolescents are uniquely driven towards increased risk when in the presence of peers (Gardner & Steinberg, 2005). With psychosocial maturity, adolescents become less susceptible to negative peer influence, which relates to decreases in antisocial behavior (Modecki, 2008; 2009; Monahan, Steinberg, & Cauffman,

2009; Steinberg & Monahan, 2007). Two competing hypotheses predict how youths with CU traits may be affected by the presence of peers. On one hand, youth high on CU traits are marked by a lack of emotion (Blair, Peschardt, Budhani, Mitchell, & Pine, 2006; Kimonis et al., 2008) which may facilitate heightened rationality and decreased risk-taking in the context of peers, relative to individuals low on CU (see Osumi, 2010 for research on decision-making in adults with psychopathy). Indeed, recent research examining the peer network seems to support this assertion (Kerr, Van Zalk, Stattin, 2011). On the other hand, because youths high on CU traits are likely to affiliate with deviant peers (Kimonis, Frick, & Barry, 2004), the presence of antisocial peers might lead to an increase in youth deficits, including increased propensity for risk-taking. Illustratively, dominance and power over others is a key social goal for youths high on CU traits (Pardini, 2011), suggesting that social contexts could affect risk behavior in adolescents high on CU traits. Likewise, in a longitudinal study, youths who were high on psychopathic traits (which included elevated levels on the CU dimension) showed greater stability in delinquency when they associated with peers who were met outside of the prosocial environment of school (Muñoz, Kerr, & Besic, 2008). Muñoz and colleagues' finding indicates that, beyond simply affiliating with other antisocial youths, youths high on CU traits may also be susceptible to both prosocial and antisocial peer influences.

Adolescents' increased propensity towards antisocial behavior has also been linked to youths' decision processes. As one example, emergent research emphasizes adolescents' reward-orientation, such that the rewards of behavior are more salient when making a decision than negative costs (Reyna & Farley, 2006), and this may be especially true of youths with high CU traits since they seem to be aware of punishments yet discount their impact (Pardini & Byrd, 2012). Likewise, in uncertain contexts, adolescents are more responsive to rewards once they are tapped (Van Leijenhorst et al., 2010), so that normative

youths tend to be encouraged by received rewards, as indicated by short latencies to their next decision task. Speculatively, both reward orientation and reward responsivity characterize the developmental timing of adolescent emotional and control systems (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). Adolescents are driven by a strong reward orientation but are not well regulated by their cognitive control system, which may show a developmental lag (Steinberg, 2010).

In comparison to normative youths, youths high on CU traits show deficits in both their emotional and cognitive (executive) systems (see Blair, Peschardt, et al., 2006). Specifically, youths high on CU traits show deficits in their amygdala response to emotional stimuli (Marsh et al., 2008), suggesting potential shortfalls in both reward and punishment responsivity, as is shown for adults with psychopathic traits (Bechara, Damasio, Damasio, & Lee, 1999). Findings from the risk-taking literature reveal youths with psychopathic traits have difficulties in stimulus-reinforcement and reinforcement expectancies, both of which are important for decision-making (Blair, 2008). Blair's (e.g., Blair, Marsh, Finger, Blair, & Luo, 2006) Integrated Emotion Systems (IES) model states that people with psychopathic traits should show deficits in relation to both rewards and punishments, mapping directly onto performance in stimulus-reinforcement tasks. Paradigms such as passive avoidance learning and reversal learning, as often used in risky decision-making research, require such performance, and youths with psychopathic (Budhani & Blair, 2005) and CU (Finger, Marsh, Mitchell, Reid, Sims et al., 2008) traits show difficulties in such tasks. For example, children with psychopathic traits have been found to have difficulties in reversing their responding when there are subtle shifts between reward and punishment contingencies, but seem to perform as well as controls when the contingency shifts (i.e., what was rewarded is now punished) are greater and more salient (Budhani & Blair, 2005). Thus, it appears that environmental cues for punishment are neglected when performing goal-directed behavior in

pursuit of rewards. Indeed, research with youths with CU traits has found support for a reward-dominant response style (O'Brien & Frick, 1996). From this evidence, it appears that youths high on CU traits are over-responsive to rewards, but equally it can be argued that youths high on CU traits have problems in managing their behavior in the face of rewards (see Marini & Stickle, 2010). Such regulation deficits would be evident when changing one's behavior to the task demands, but not when acquiring the knowledge of which responses are rewarded. Indeed, there is evidence that adults with psychopathy are less likely to stay with a previously rewarded response, although they are not deficient in learning which responses are rewarded or punished (Budhani, Richell, & Blair, 2006). Budhani et al. (2006) suggest that brain areas such as the amygdala and the frontal cortices are involved in deficits related to response contingencies.

Recent research demonstrates deficits to areas of the brain that bridge connections between the amygdala and frontal cortices, such as the ventromedial prefrontal cortex (Finger et al., 2008; Marsh et al., 2008) and the orbitofrontal cortex (Finger et al., 2011) for youths high on CU traits. Taken together, the results suggest deficits in morality, decision making, and in processing reward information for these youths (Blair, 2010; Finger et al., 2008; Finger et al., 2011). Further, Finger et al. (2008) argue that learning from reward contingencies relies on communication between the amygdala and the frontal cortices. The fact that higher proportions of grey matter have been shown in frontal regions and in the anterior cingulate gyrus for youths high on CU traits possibly indicates delayed cortical maturation in these regions, which may also negatively affect decision making in youths with these traits (De Brito et al., 2009). Thus, the impaired decision making that is observed in youths with CU traits may result from these combined deficits. Indeed, Mitchell (2010) argues that "emotions play a pivotal role in decoding rewards and punishments" (p. 216).

Youths who are high on CU traits, then, hypothetically should show decreased reward responsivity relative to youths low on CU. In line with this idea, emergent research using the Balloon Analogue Risk Task (BART; Lejuez et al., 2002) suggests that in incarcerated samples, youth high on CU traits demonstrate a decreased reward orientation relative to youths low on CU traits (Marini & Stickle, 2010). Further, the decreased punishment responsivity characteristic of youth high on CU traits is argued to play a minor role in decisions to act out (e.g., Blair, 2010), so that lack of response to punishment is unlikely to fully account for their decidedly antisocial decisions. However, findings of decreased reward responsivity have not been homogeneous (e.g. Kimonis, Frick, Fazekas, & Loney, 2006), so that additional research, particularly with non-incarcerated youths, is needed.

In contrast to few and mixed findings of decreased reward responsivity, a body of research has established decreased punishment responsivity in youth high on CU traits. This is especially the case when punishment cues compete with primed reward cues (Barry et al., 2000; Frick et al., 2003). For instance, Blair (2010) argues that the frustration of not obtaining a reward when one is expected, possibly explained by deficits in vmPFC responding, might lead to a quick, reactive response to the frustration. An exception is Marini and Stickle (2010) who found no evidence of decreased punishment responsivity in incarcerated adolescents high on CU traits.

In their foundational research using the BART risk-taking paradigm, Marini and Stickle (2010) posit that the BART does not provide adequate punishment for individuals high on CU traits to demonstrate decreased responsivity, although another study shows young children with disruptive behavior disorders evidence deficits in punishment responsivity on the BART (Humphreys & Lee, 2011). An alternative explanation is that their operationalization of subsequent punishment behavior might not adequately tap CU-linked deficits. Their research used a behavioral measure – number of balloon pumps on the trial

subsequent to one where the balloon popped – as an indicator of punishment responsivity. However, timing, or a temporal pause after a punishment, may be a more useful indicator of punishment responsivity in youth with CU traits. Reflection is assumed to require a pause, which presumably allows the person to engage in information processing and encoding (Newman, 1987). In non-impulsive people, reflection should follow punishment for the person to process the information and associate the response with punishment. Indeed, prior research suggests timing measures may reveal punishment sensitivity deficits evident in people with callous-unemotional (i.e., psychopathic) traits (Jackson, Trotman, Stephens, & Sellers, 2011).

Notably, across the range of BART measures, youths who are high on CU may also differ in their susceptibility to peer influence based on gender. A body of past research speculates that the risky decision making in girls high on CU traits is more heavily influenced by social milieus relative to boys with these traits. Illustratively, antisocial behaviors in girls with high levels of CU traits tend to have a “delayed onset” to their antisocial behavior to which social and environmental factors have largely been attributed (Silverthorn & Frick, 1999). In contrast, boys with high levels of CU traits display early antisocial symptoms that are ascribed to temperament (Silverhorn, Frick, & Reynolds, 2001). Indeed, a recent study involving twins suggests that boys may have a stronger genetic effect for CU traits, while girls may have a stronger environmental effect for their stable CU traits (Fontaine, Rijdsdijk, McCrory, & Viding, 2010) and problem behavior (Kroneman, Hipwell, Loeber, Koot, & Pardini, 2011). Accordingly, social factors presumably may affect girls with high levels of CU traits differentially than boys with these traits, and we examine peers effects on adolescents separately for male and female youths. In addition to social factors potentially showing a difference for boys and girls, research suggests engagement in risky behavior may depend less on CU traits for girls than for boys. For example, Wymbs et al. (2012) found that

CU traits uniquely predicted problematic alcohol and marijuana use for boys but not for girls. Thus, there are reasons to believe that CU traits may be less predictive of risk for girls, but that social factors may figure more prominently in girls' decisions to take risks. Together, these gender differences underscore the importance of examining the interaction between CU traits and peer presence separately for boys and girls.

All told, there are notable gaps in understanding the role of callous-unemotional traits in adolescent risk-taking. To address these questions, the current study examined callous-unemotional traits in a large community sample of adolescents, using a functional risk-decision task, the BART. Notably, this study experimentally manipulated the presence versus absence of peers, allowing us to measure and investigate this key component of adolescent risk. Likewise, we operationalized responsivity using both behavioral (amount of money earned) and temporal (timing or temporal pause) constructs, enabling us to systematically measure response processing in youths high on CU traits.

The aims for the present study are four-fold. First, we aim to show that CU traits are related to poor reward responsivity. Second, we will explore the idea that punishment responsivity may be deficient in youths high on CU traits, but with a new measure reported in Jackson et al. (2011). That is, latency to take a risk after having just been punished may indicate a stimulus-response deficit that is more directly related to the punishment stimulus than modulation of goal-directed behavior that takes place long after the punishment. Third, we aim to examine whether the presence of peers relates to greater risk taking, and whether CU traits moderate this relationship. Finally, we aimed to test whether risk taking in girls, as compared to boys, was more related to peer presence and whether this might be moderated by CU traits. Multilevel modeling was used to examine data with a nested structure (i.e., responses embedded in individuals; individuals embedded in peer groups). Of particular interest in this study was the within-level interaction between condition (group vs. individual)

and the slopes (separated by gender) that describe how CU traits were related to risk-taking behavior.

Method

Participants

Participants ($n = 675$) were recruited from sixth-form high schools in the northwest of the UK, which enroll students in 11th and 12th grades. Participants ranged in age from 16 to 20 years ($M=16.9$, $SD=.8$). About half of the participants were female (52%). Participants were mainly White British (64%), and Pakistani (25%) was the largest ethnic minority designation chosen by participants. The most commonly reported highest levels of education for participants' mothers were university (43.4%) and secondary school (39.1%), and for participants' fathers they were secondary school (42.2%) and university (40%). Five percent reported their mother or father had not attended school. The schools recruited were in deprived neighborhoods and the student body reflected these communities, with about half the students receiving maintenance grants. One school was in a community which was ranked the 12th most-deprived in the UK. Indeed, all communities had high levels of unemployment. We selected schools in these areas to oversample youths with high levels of risky behaviours. Study measures did not differ on ethnicity, age, or parent education variables. Gender (males = 0, females = 1), and condition (group = 0, alone = 1) were dummy coded.

Procedure

The research was conducted with the approval of the ethics committee at the University of Central Lancashire, and the methods and materials were reviewed by each Head of School to act *in loco parentis*. Because the youths were ages 16 years and older, in the UK they could legally consent to participate in the study. Groups of three ($N=225$) same-sex participants arrived to an area of the school where the research was conducted. In-line with past experimental research on peer-influence, which has examined individuals of the same

sex (e.g. Gardner & Steinberg, 2005) and in order to decrease extraneous variability between groups, the decision was made to focus only on groups of the same-sex. Thus, all participants were asked to arrive with a same-sex group of friends. Participants were briefed in groups and gave their consent individually. Groups were then assigned to complete some questionnaires (not including the Inventory of Callous-Unemotional Traits) and BART task together (N=110) or independently (N=115). Participants in the group condition were told to make decisions on the tasks together; whereas participants in the individual condition were given noise-reducing headphones and were seated across from or perpendicular to each other to ensure confidentiality. Notably, in order to ensure that the target youth was indeed making a decision around risk in the group condition (as opposed to a non-target youth making the decision for the group), one (target) youth was randomly selected and instructed to be in charge of completing the BART task in the group condition. Tasks and materials were counterbalanced for order, such that the questionnaires and the tasks were counterbalanced to avoid ordering effects. All participants were told they could win money depending on their performance. There were two ways in which we concealed the performance target: we had a moving target between £20-35 on the BART, and another task was added to the study which was counterbalanced with the BART. Specifically, participants were told they could earn £2 depending on their performance on one task and £5 if they performed well on both. Regardless of performance, all participants won £2 at the end of the first task to ensure that all participants were compensated with at least £2 and to ensure adequate motivation on the BART if it happened to be completed second. Participants were debriefed upon completion of the study.

Measures

Callous-unemotional traits. Independently, each participant completed the 24 item Inventory of Callous-Unemotional traits (ICU; Frick, 2004). This rating scale is rated on a

four-point Likert scale indicating 0 'not at all true' to 3 'very true'. The ICU has been validated in a community sample of German adolescents (Essau, Sasagawa, & Frick, 2006), school-based samples of Greek Cypriot (Fanti, Frick, & Georgiou, 2009) and Belgian (Roose, Bijttebier, Decoene, Claes, & Frick, 2010) adolescents, and juvenile offenders in the United States (Kimonis et al., 2008). In all four samples, a similar factor structure emerged with three factors (e.g., Uncaring, Callousness, Unemotional) loading on a higher-order CU dimension. The total scores were internally consistent in the samples (coefficient alpha .77 to .89) and were related to antisocial behavior, aggression, delinquency, various personality dimensions, and psychophysiological measures of emotional reactivity in ways consistent with past research on CU traits. The internal consistency was good in the present study (Cronbach's alpha=.79), and mean total ICU (M=21.62, SD=7.85) was comparable to that found in prior research. For example, the mean for males (M=23.90, SD=8.14) and females (M=19.49, SD=6.93) was similar to prior research in the UK (males: 25.25 (7.90); females: 21.76 (9.4); Muñoz, Qualter, & Padgett, 2011).

Balloon Analogue Risk Task (BART, Lejuez et al., 2002). Either alone or in groups, participants completed a virtual balloon pumping task. Participants clicked on the mouse to 'blow up' a total of 30 balloons, but were not given their track record of balloons completed. Participants accumulated money by pumping the balloons as large as they could, and then 'banking' the money earned. The money earned on each balloon was made visible once it was banked. Balloons were set to burst on a random schedule of balloon pumps, and if the balloon burst before the participant was able to bank, then no money was earned. Previous research indicates that the BART is associated with drug use, psychopathy, and other risky behaviors (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Crowley, Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006; Lejuez et al., 2002).

Past research has typically indexed risk taking in terms of adjusted average number of pumps (only averaging the pumps on balloons which are banked since a ceiling effect occurs on balloons that burst). We also examined the total money earned, not average money earned, given that total money earned was used to gauge participant payment. Further, in line with Marini and Stickle (2010), we operationalized reward responsivity as the difference in the number of pumps before and after a successful bank, and punishment responsivity as the difference in the number of pumps before and after experiencing a burst (see also Humphreys & Lee, 2011). In addition, we also considered the latency after a burst balloon as a potentially stronger indicator of punishment sensitivity than punishment responsivity as measured by Marini and Stickle. Indeed, this is a new measure noted by Jackson et al. (2011). In their study, Jackson et al. found neither reward nor punishment responsivity deficits in adults with psychopathic traits, yet latency measures seemed better able to designate periods of risk taking. Specifically, in their study, the first part of the BART, which was called the “reactive” period, discriminated better than the “stable” period those who were high and low on psychopathic traits (Jackson et al., 2011). Thus, the present study divided the latency periods by early (i.e., first 15 balloons) and late (i.e., last 15 balloons). Moreover, the latency to pump after a pop was a measure that we took very close in time to the failure itself, and in this way, was taken as a sensitivity to punishment; that is, after the pop sensitive participants should show greater latencies.

Results

Pairwise correlations which account for the peer clustering effect are noted in Table 1. The BART measures were intercorrelated, but measured distinct constructs. Illustratively, money earned was associated with higher reward responsivity and decreased sensitivity to punishment. That is, people who earned more money pumped more after a successful bank and were quick to begin pumping after punishment. Reward responsivity was positively

correlated with punishment responsivity and punishment responsivity was positively correlated with latency to event (i.e., latency to begin pumping the balloon) for the last 15 balloons. Thus, those who were more punishment responsive were also slower to begin pumping during the late period. Average adjusted pumps were related to greater reward responsivity and lesser punishment responsivity as well as decreased sensitivity to punishment.

The data were analyzed with restricted maximum likelihood estimation (RML) using hierarchical linear modeling (HLM) analyses in ML Win version 2.24 to account for the nested structure of the data (i.e., responses embedded in individuals; individuals embedded in peer groups). All variables were centered prior to analyses.

Following Raudenbush and Bryk (2002), we began by running a fully unconditional (null) model (akin to a one-way random effects ANOVA), to partition within- and between group variance in each outcome (Model 1). In our data, significant design effects indicated whether peer groups differed on their mean scores of the dependent variable, and therefore needed to be accounted for in subsequent analyses. Separate within group models were run for BART money, adjusted average pumps, event latency, and sensitivity to punishment. However peer groups did not exhibit similarity in punishment and reward responsivity outcomes, and these dependent variables were examined using standard OLS regression. Our data had only 1.7% missing, all of which was on out dependent variables, for which ML WIN uses list-wise deletion. This rendered our analyses on each dependent variable nested. Thus, predictor variables were added independently and robust overall model chi-square difference tests were used to evaluate improvement of fit between models (Bartholomew, Steele, Moustaki, & Galbraith, 2008).¹

As shown in Table 2, the mean group average amount of BART money earned adjusted for peer-group risk taking was £34.09 (range: £2.65 to £51). Gender and condition

each predicted significant amounts of variance in BART money. The final model (M3), indicated that females earned less money than males ($\beta = -3.12$, $SE = .89$, $CI = -4.86 - -1.38$) and youths earned more money alone than in groups ($\beta = 2.88$, $SE = .99$, $CI = .94 - 4.82$). Similar findings were found for average pumps, such that callous-unemotional traits were not significant for either model, once gender and condition were entered.

Also in Table 2, the mean group average reward response was 3.60 additional pumps following a successful bank (range: -6.88 to 22), and condition and callous-unemotional traits contributed significantly to the model. The final model (M 4) shows that youths completing the task individually had a stronger reward response relative to youths completing the task in groups ($\beta = .88$, $SE = .40$, $CI = .10 - 1.66$) and CU traits was related to less reward responding ($\beta = -.05$, $SE = .02$, $CI = -.09 - -.01$). For punishment, the average response was 5.92 reduction of pumps following a pop (range: -14.67 to 31.67), and only gender contributed to the model (M2). Female adolescents demonstrated a stronger punishment response than male adolescents ($\beta = 1.89$, $SE = .59$, $CI = .73 - 3.05$).

Table 3 shows results predicting latency to begin pumping and latency to begin pumping after punishment. These variables were transformed using square-root in order to reduce their skewness. Squaring the intercept, the mean group average event latency adjusted for peer-group effects was 2.62 seconds (untransformed range: .51 to 18.50; $M=2.57$) in the early period and 3.84 seconds (untransformed range: .27 to 11.26; $M=1.45$) in the late period. Only for the early period, the final model (M 6) indicated a significant interaction between gender, condition, and callous-unemotional traits ($\beta = -.05$, $SE = .02$, $CI = -.09 - -.01$). The form of the interaction was plotted for the group condition, which is where the significant interaction was found ($\beta = .05$, $SE = .02$, $CI = .01 - .09$). The interaction was probed by solving the regression at high (+1SD) and low (-1SD) levels of callous-unemotional traits (Aiken & West, 1991). Plotting of the interaction (Figure 1) showed that in the group

condition for males, those high on CU traits were faster to begin pumping after a trial than those low on CU, and for females, those high on CU traits were slower to pump after a trial relative to those low on CU traits. Probing of the interaction showed that for males ($\beta = -.03$, $SE = .01$, $CI = -.05 - -.01$) in the group condition the confidence interval did not include zero, yet this simple-slope effect was small. Similarly, the mean group average sensitivity to punishment adjusted for peer-group risk taking was 1.54 seconds (untransformed range: .23 to 11.48; $M=1.55$) for the early period and 1.10 seconds (untransformed range: .09 to 9.51; $M=1.11$) for the late period. A significant interaction was found between gender and condition, but the final model revealed CU traits as a moderator. Thus, the final models (M6) for the early and late periods indicated a significant interaction between gender, condition, and callous-unemotional traits ($\beta = -.03$, $SE = .01$, $CI = -.05 - -.01$; $\beta = -.04$, $SE = .01$, $CI = -.06 - -.02$, respectively). The form of the interaction was plotted for the group condition, where the significant interactions were found for early ($\beta = .03$, $SE = .01$, $CI = .01 - .05$) and late periods ($\beta = .03$, $SE = .01$, $CI = .01 - .05$). Again, post-hoc probing was done following Aiken and West (1991) and Figure 2 plots the interaction between gender and CU and early sensitivity to punishment in the group condition. The form of the interaction was similar for late sensitivity to punishment. Females high on CU traits took longer to pump after a pop, relative to females low on CU; whereas males high on CU traits were quicker to pump after a pop relative to males low on CU. After probing the interactions for both females ($\beta = .02$, $SE = .01$, $CI = .00 - .04$) and males ($\beta = -.01$, $SE = .01$, $CI = -.03 - -.01$), the confidence intervals indicated the effects for the simple slopes were very small, and zero was included in the female confidence intervals.

Discussion

The experimental findings regarding peer influence are novel and have not been shown in prior research, to our knowledge: when in groups, males with higher levels of CU

traits make quicker decisions to take risks than those lower on CU traits, particularly when their goals are blocked. As expected, findings also suggest that youths with CU traits are less sensitive to accruing rewards, such that they do not increase their pumps following a success in banking their money. Recently, the latency measures on the BART have garnered attention as indications of punishment responsivity (Jackson et al., 2011). Consistent with a lack of reflection after a punishment (Newman, 1987), when in the company of friends, males high on CU traits had a shorter delay between their decision to pump and beginning to pump, relative to males low on CU traits. Moreover, when in groups, males high on CU also demonstrated a lack of reflection after losing an undefined amount of money.

Because we found differences in males' and females' risky decision making in groups with regard to the latency measures, we discuss them separately. In our study, male youths who were high on CU were affected by their peers; males high on CU traits in the group condition were quicker to take risks than males low on CU traits, and this was evident during the early (reactive) period of the BART where participants were learning how the task worked (Jackson et al., 2011). Thus, males in groups with their peers were significantly quicker to take risks during a time when most were still becoming familiar with the game. Past research has emphasized a need for dominance and endorsement of power-oriented social goals in youths high on CU traits (Pardini, 2011). Speculatively, then, youths high on CU traits may be quick to take risks in an effort to exert their power or authority over their peers, as opposed to facilitating their social popularity or group cohesion. Seemingly, youths with psychopathic traits are cognitively able to take other perspectives into account, and simply do not care about the implications of their actions on others (Jones, Happé, Gilbert, Burnett, & Viding, 2010). It could be that males high on CU understand that a show of dominance must be displayed as early as possible in the task to show who is "boss". Moreover, given that youths high on CU traits tend to have delinquent friends (Muñoz, Kerr

et al., 2008), it is feasible that males high on CU traits selected antisocial peers with whom to participate. Thus, the presence of antisocial peers may have exacerbated the need for dominance vis-à-vis risky decision making in males high on CU traits. Moreover, while we cannot completely disentangle questions of peer selection versus socialization, we did experimentally manipulate the effect of peers on youths' risky decision making. If youths high on CU traits simply selected highly antisocial peers and their presence had no effect, we would expect to see effects for youths high on CU traits in both the individual and group condition. Hence, males with high levels of CU traits seem to be less cautious in their decision making and influenced by their male peers, who themselves may be prone to risk-taking. Notably, this is different from Kerr et al.'s (2011) findings, where youths high on CU traits showed less change in their delinquency when their friends changed. Although social network analyses may parse effects into peer socialization effects, they merely reflect the changes that occur organically in social networks. The present study is the first we are aware of that uses experimental manipulation to examine peer influence with regard to CU traits. Experimental manipulation remains the best way to show peer influence, although there are limitations to this methodology which we note below. Nevertheless, further research is needed to see if these findings replicate across different areas of risky decision making, since antisocial behavior may be exempt from socialization effects in youths high on CU traits but risk taking may not.

Similarly, and consistent with findings by O'Brien and Frick (1996), youths high on CU traits appear to have problems considering the negative outcomes of their behavior, and the present findings extend this lack of consideration to scenarios where males are together with their male peers. Jackson et al. (2011) found that people high on psychopathic traits showed deficits in punishment sensitivity only during the early (reactive) period; however, we found that males high on CU traits who were in groups with other males showed deficits

in punishment sensitivity during both early and late periods of the task. Thus, punishment sensitivity deficits were not influenced by the learning curve, and were similarly evident at the most stable period of the task. Because deficits in processing punishment cues have been found for males with psychopathic traits (Arnett, Smith, & Newman, 1997; Baskin-Sommers, Wallace, MacCoon, Curtin, & Newman, 2010; Newman et al., 1987), the presence of peers may have been distracting for males high on CU traits. In prior research, high demands on attention have been found to exacerbate the emotional deficits that males with psychopathic traits already evince (Baskin-Sommers, Curtin, & Newman, 2011). In the current study, these demands for attention may augment deficits in punishment sensitivity. Moreover, the presence of friends may actually increase the value of immediate rewards (O'Brien, Albert, Chein, & Steinberg, 2011). If this is also true for males high on CU traits, peers may induce risk-taking by enhancing the enjoyment of risk-taking, given findings of increased activation of brain reward centers when adolescents take risks with peers (Chein et al., 2011). Thus, male youths who are high on CU traits may be particularly vulnerable to the attention of their peers, and fail to take the time to consider the negative consequences of their actions.

When in the group condition, females with elevated levels of CU traits responded differently to males on the latency measures. We expected females to show greater risk taking in groups with peers and for CU traits to moderate this. However, we found females high on CU traits were slower to take risks (i.e., to begin pumping) in groups with girls than females low on CU traits. Also, females high on CU traits, again within groups, were slower after punishment than females low on CU. Thus, in groups of girls, CU traits acted as an inhibitor. Of note, these positive simple slopes were small and nonsignificant. There are possible reasons for these results. It could be that CU traits do not motivate risky decision making in girls as they do in boys (Wymbs et al., 2012). The punishment deficits that we noted for boys were not present in girls, and this could reflect the difference in reactions to

harm that may characterize boys and girls with CU traits. For example, boys with CU traits appear to discount the impairment that accompanies substance use (Wymbs et al., 2012). However, research is needed to determine if these findings replicate across different areas of risk beyond antisocial behavior where males and females with elevated CU traits may be similar. There is also a need for further research across different samples. In non-referred samples of girls, the construct of CU traits seems to operate differently than for boys, but in adjudicated or clinic-referred samples, CU traits seem to relate to problem behaviors as much for girls as for boys (Verona, Sadeh, & Javdani, 2010). Therefore, CU may be a better predictor of risk for girls with severe behavior problems.

For both males and females, following success in accumulating money, CU traits were also related to less disinhibition, possibly reflecting less responsivity to reward, and this is consistent with prior research (Marini & Stickle, 2010). Also consistent with prior research, youths high on CU traits were not encouraged by rewards such that they did not replicate the response that had just been rewarded on the previous trial (Budhani, Richell, & Blair, 2006). Indeed, this response is consistent with findings of deficits across the amygdala (which responds to stimulus-reinforcement) and the frontal cortices (which regulate stimulus-responding; see Budhani, Richell, & Blair, 2006 for a discussion) which have been shown to affect response learning tasks in youths with CU traits (e.g., Finger et al., 2008). It also could be that those with high levels of CU were making a rational decision, since the size of the balloon when it popped on the previous trial has nothing to do with the size it will possibly achieve on the next trial. Viewed in this way, participants who responded by taking more chances in pumping the balloon after experiencing a successful bank may have been responding irrationally. Indeed, prior research shows that people with psychopathic traits remain rational when making economic decisions on an ultimatum task (Osumi & Ohira, 2010). Further, from a temperament perspective, youths high on CU traits (unlike other

aspects of psychopathy such as narcissism) are unlikely to be motivated by appetitive rewards; they report reduced experience of positive emotions after a reward (Roose, Bijttebier, Decoene, Claes, & Frick, 2010). This lack of positive emotion derived from rewards could explain the reduced reward responsivity observed for youths high on CU traits. Instead, Roose et al. (2010) found that CU traits are associated with a lack of fear and anxiety, which may disrupt risk appraisals by youths high on these traits.

However, as found by Marini and Stickle (2010), the punishment responsivity measure was unrelated to CU traits. Lorenz and Newman (2002) suggest the deficits that people with psychopathic traits show in processing reward versus punishment cues is due to response modulation difficulties. Response modulation is defined as “a brief and highly automatic shift of attention that enables individuals to monitor and, if relevant, use information that is peripheral to their dominant response set, i.e., deliberate focus of attention” (Lorenz & Newman, 2002, p.92). Rewards may be sought out with little delay when a response set for reward has been established (Arnett et al., 1997; Newman et al., 1987). This seems to be true of people with psychopathic traits who, unlike those with high levels of CU traits, are high in anxiety such that they attend to reward to the detriment of their responsivity to punishment cues (Baskin-Sommers et al., 2010). The present findings are consistent with recent research that shows little evidence for deficits in responding to punishment in people with primary psychopathic traits (i.e., low-anxious psychopathy; Baskin-Sommers et al., 2010). The present findings, along with those by Marini and Stickle (2010), show that youths with CU traits may experience deficits in their reward-responsivity, but experience little to no deficit in the modulation of behavior (i.e., pumping the balloon to earn money) in response to punishment.

Contrary to our expectations, decisions made in groups were more cautious in pumping the balloons (i.e., the money they earned) and there were bigger delays overall to

make decisions. However, given that one youth in each group was selected to be ‘in charge’ and ostensibly was responsible for the economic gain (or loss) of him/herself and that of his/her friends, there may have been a ‘cautious-shift’ as reported in other studies where people make economic decisions on behalf of a group (Ertac & Gurdal, 2011). It is also worth noting that risk-taking, across the board, is not entirely undesirable. For instance, Moffitt (1993) argues that some degree of risk taking is adaptive in adolescence. To this end, some risk taking on the BART may enhance goal achievement, and youth acting alone may be reflecting a reasonable objective to earn money on the BART.

Although this study offers novel insight into the relations between CU traits, gender, and risk-taking in adolescents, there were several limitations. One limitation of the present study is our inability to relate risk taking to different forms of group gender composition. It may be that peer gender composition may affect females with CU traits, given that research shows greater antisocial behavior for females in male-dominated groups (Cauffman, Farruggia, & Goldweber, 2008). Further research is needed to directly test the role of peers for girls high on CU traits (Silverthorn & Frick, 1999). Also, because the BART is not a game of speed, we were not able to show any negative consequences, such as more risk-taking (i.e., greater pops or pumps), that the rash decisions noted for males grouped with friends might result in. Finally, because we did not include a measure of impulsivity, we cannot be sure that the results are not due to other factors that are related to CU traits. However, Marini and Stickle (2010) included a measure of impulsivity and it neither related to risk taking on the BART nor did it reduce the significance of the effects of CU traits. Additionally, based on Roose et al.’s (2011) findings, reward responsivity deficits were unique to CU traits and CU traits showed the strongest negative relation with behavioral inhibition.

This study still offers a number of important strengths. Notably, this study is based on a fairly large, representative sample of normative adolescents. Participants were recruited from diverse areas (and six different schools) and the sample was well-represented in terms of ethnic and socio-economic diversity. While prior research (Marini & Stickle, 2010) used an adjudicated sample, we were able to extend the findings to a community sample of adolescents. Thus, these traits, rather than the antisocial behaviors that may be associated with them, relate to risk-taking. Further, instead of relying on self-reported measures this study uses experimental data to unpack specific dimensions of behavioral risk-taking. Moreover, research to date has not yet examined the effects of peers on CU and risk-taking. This study fills this gap in previous research by manipulating and examining the effects of peers on behavioral risk.

In sum, youths with CU traits remain fairly rational in the face of successive wins. However, adolescent boys who are high on CU traits seem to have an immediate need for gaining rewards when other boys are watching, especially when they have just failed to win money. Thus, interventions that target reward-motivations may work best for youths high on CU traits, instead of interventions that are solely punishment-oriented (see Muñoz & Frick, 2012 for a review). Moreover, findings like ours and those reported in Marini and Stickle (2010) suggest it may be worthwhile to find what is most rewarding for these youths. The intensive treatment program used by Caldwell and colleagues (2012) for youths high on psychopathic traits targets the interests of these youths in order to motivate them to change their behaviors, and includes reward-oriented approaches that are reliable, readily available, and concrete. Additionally, interventions for boys with high CU traits that limit opportunities to engage with risk-taking friends may be needed, since the presence of friends seemed to further increase the likelihood that punishment cues would be ignored. Although youths high on CU traits pay little attention to social cues, they appear to be swayed by their peers in risk-

taking situations. Thus, as a time of critical developmental change, adolescence represents a unique and important period for intervention (Lejuez, Aklin, Daughters, Zvolensky, Kahler, & Gwadz, 2007), so that understanding adolescent risk taking in relation to known predictor variables is especially important.

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Notes

1. Numbers or estimates that appear to be zero are due to rounding.

Table 1. Pairwise Correlations for Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Gender	---	.01	-.32***	-.16***	-.06	.16***	-.18***	.00	-.00	.19***	.11*
2. Condition	---	---	-.06	.18***	.11*	-.01	.22***	-.40***	-.32***	-.43***	-.42***
3. Callous-Unemotional Traits	---	---	---	.10*	-.09	-.06	.03	-.06	-.06	-.07	-.06
4. Bart Money	---	---	---	---	.37***	.05	.89***	-.04	-.05	-.16***	-.17***
5. Reward Response	---	---	---	---	---	.34***	.51***	-.03	-.05	-.07	-.07
6. Punishment Response	---	---	---	---	---	---	-.11*	.01	.10*	.04	.07
7. Average Pumps	---	---	---	---	---	---	---	-.06	-.09	-.16***	-.17***
8. Early Latency	---	---	---	---	---	---	---	---	.54***	.51***	.42***
9. Late Latency	---	---	---	---	---	---	---	---	---	.57***	.66***
10. Early Punishment	---	---	---	---	---	---	---	---	---	---	.67***
11. Late Punishment	---	---	---	---	---	---	---	---	---	---	---

Note. Correlations accounting for peer clustering effect; Gender (males = 0, females = 1) and condition (group = 0, alone = 1);

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2.

Variance in gender, condition, and CU predicting variance in observed risk-taking.

Model	M1: Null	M2	M3	M4
<i>Predicting Bart Money</i>				
Intercept	34.09(.47)	35.69 (.65)	33.65 (.95)	
Gender (female=1)		-3.08 (.90)	-3.12(.89)	
Condition (alone=1)			2.88(.99)	
CU				
Δ -2Log		11.21***	8.39**	1.18
<i>Predicting Average Pumps</i>				
Intercept	30.69(.60)	32.80(.84)	29.35(1.19)	
Gender (female=1)		-4.04(1.17)	-4.12(1.14)	
Condition (alone=1)			4.98 (1.25)	
CU				
Δ -2Log		11.43***	15.62***	0.07
<i>Predicting Reward Response</i>				

Intercept	3.6(.17)	3.86(.24)	3.19(.39)	3.34(.39)
Gender (female=1)		-.51(.34)	-.52(.34)	-.75(.35)
Condition (alone=1)			.88(.40)	.84(.40)
CU				-.05(.02)
Δ -2Log		2.27	4.94*	4.27*
<i>Predicting Punishment Response</i>				
Intercept	5.92(.30)	4.96(.42)		
Gender (female=1)		1.89(.59)		
Condition (alone=1)				
CU				
Δ -2Log		10.15**	.03	0.00

Note. Coefficient (SE); CU=callous-unemotional traits; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3.

Variance in gender, condition, and CU predicting variance in observed risk-taking.

Model	M1: Null	M2	M3	M4	M5	M6
<i>Predicting Early Latency to Event</i>						
Intercept	1.62(.04)	1.58(.06)	1.88(.07)			1.88(.08)
Gender (female=1)		.08(.08)	.08(.01)			.20(.12)
Condition (alone=1)			-.55(.08)			-.49(.11)
CU						-.03(.01)
2-way interactions						
Gender x Condition x CU						-.05(.02)
Δ -2Log		.82	48.19***	1.96	4.78	9.71**
<i>Predicting Late Latency to Event</i>						
Intercept	1.96(.02)	1.19(.03)	1.34(.04)			1.37(.05)
Gender (female=1)		.02(.04)	.02(.04)			.00(.07)
Condition (alone=1)			-.24(.04)			-.27(.06)
CU						-.01(.01)

2-way interactions						
Gender x Condition x CU						-0.02(.01)
Δ -2Log	.18	35.91***	2.65	2.36		3.08
<i>Predicting Early Sensitivity to Punishment</i>						
Intercept	1.24(.03)	1.14(.04)	1.40(.04)			1.38(.06)
Gender (female=1)		.20(.06)	.20(.05)			.31(.08)
Condition (alone=1)			-.43(.05)			-.38(.07)
CU						-.01(.01)
2-way interactions						
Gender x Condition x CU						-.03(.01)
Δ -2Log		12.26***	67.59***	1.97	4.30	8.35**
<i>Predicting Late Sensitivity to Punishment</i>						
Intercept	1.05(.03)	.98(.03)	1.22(.04)		1.16(.05)	1.38(.06)
Gender (female=1)		.13(.05)	.12(.04)		.26(.07)	.31(.08)

Condition (alone=1)		-0.39(.04)								
CU										
2-way interactions										
Gender x Condition x CU										
Δ -2Log										

Note. Coefficient (SE); CU=callous-unemotional traits; * $p < .05$; ** $p < .01$; *** $p < .001$.

Figure 1. Interaction for group condition between gender x callous-unemotional traits predicting latency to event (i.e., latency to begin pumping balloons) during the early (reactive) period.

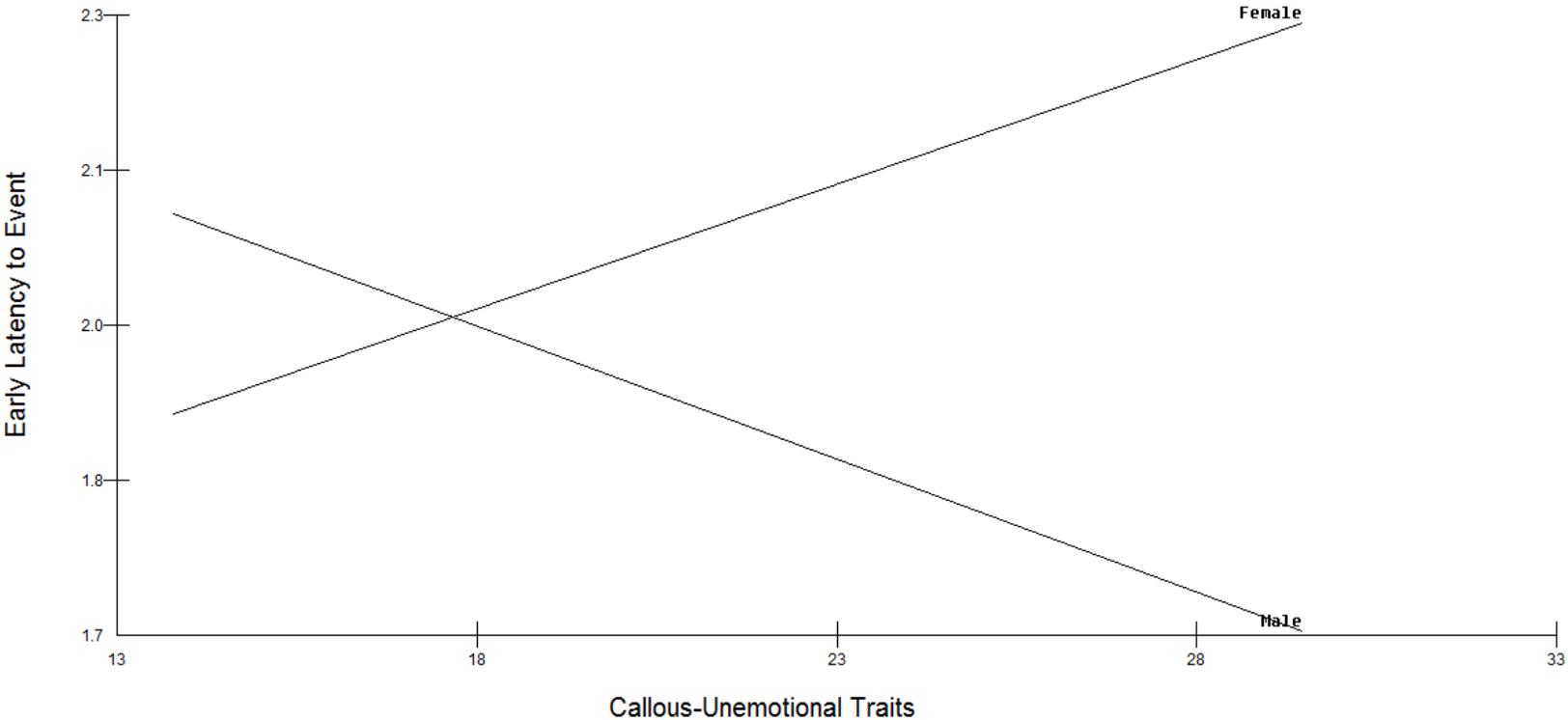


Figure 2. Interaction for group condition between gender x callous-unemotional traits predicting sensitivity to punishment (i.e., latency to begin pumping balloons after a prior pop) during the early (reactive) period.

