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Types of Aggression, Responsiveness to Provocation, and Callous-Unemotional Traits in Detained Adolescents

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Abstract

The present study investigated differences in the behavioral and psychophysiological responses to provocation and in the level of callous-unemotional traits in boys exhibiting different patterns of aggression. Eighty-five boys (ages 13-18) in a juvenile detention center played a competitive computer task against a hypothetical peer who provided low and high levels of provocation. Youth high on both self-reported reactive and proactive aggression showed different behavioral responses to provocation than youth high on only reactive aggression. Specifically, the combined group showed high levels of aggressive responses without any provocation, whereas the group high on reactive aggression showed an increase in aggressive responding to low provocation. Further, results revealed a trend for the combined group to show lower levels of skin conductance reactivity to low provocation if they were also high on callous-unemotional traits.

Keywords: psychopathy, callous-unemotional traits, aggression, autonomic reactivity

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An important focus of research on aggressive behavior in both adults and youth has been to distinguish between reactive/impulsive and proactive/instrumental forms of aggression (Poulin & Boivin, 2000; Dodge & Pettit, 2003). Reactive aggression is characterized by impulsive defensive responses to a perceived provocation or threat (Dodge & Coie, 1987; Eisenberg & Fabes, 1992) usually accompanied by a display of intense physiological reactivity (also see Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Hubbard et al., 2002). It is "hot blooded," angry, and hostile, and can be related to a failure in the cognitive processing of social information at myriad levels of decision-making (Dodge et al., 1997; Lemerise & Arsenio, 2000; Dodge & Pettit, 2003). These cognitive and emotional characteristics are potentially mediated by deficits in the orbital and medial frontal cortex that can lead to a dysregulation in a person's response to perceived threats (Blair, 2005). In contrast, proactive or instrumental aggression is not associated with provocation but is defined as aggression in pursuit of an instrumental goal (Poulin & Boivin, 2000; Dodge & Pettit, 2003). Children who engage in instrumental aggression tend to value aggression as an effective means of acquiring their desired goals more than other children, and they anticipate positive outcomes for their aggressive behavior (Dodge et al., 1997).

Factor analyses have consistently supported that these two types of aggression can be separated in children and adolescents (Poulin & Boivin, 2000; Salmivalli & Nieminen, 2002). Further, there have been a number of studies supporting different correlates to the two types of aggression in samples of youth, with reactive aggression showing stronger correlations with social, academic, and emotional problems (Dodge et al., 1997; Schwartz et al., 1998;

Waschbusch, Willoughby, & Pelham, 1998; Poulin & Boivin, 2000) and proactive aggression showing stronger predictive associations with criminality and substance abuse in adolescence and adulthood (Pulkkinen, 1996; Vitaro, Brendgen, & Tremblay, 2000). Despite the growing evidence for these differential correlates, the utility of this distinction has been questioned (Bushman & Anderson, 2001; Walters, 2005). A primary concern in these critiques is that the dichotomous distinction does not address the fact that both types of aggressive behavior, and many of the emotional and cognitive correlates to these behaviors, are often present in the same individuals. In samples of children and adolescents, the correlation between measures of reactive and proactive aggression range from .40 to .90 with the typical estimate being about .70 (Brendgen, Vitaro, Tremblay, & Lavoie, 2003; Hubbard et al., 2002; Vitaro et al., 2002; Vitaro, Gendreau, Tremblay, & Oligny, 1998). Further, research has indicated that there may be some asymmetry in the high degree of association between the two types of aggression. Specifically, there appears to be a significant number of children who only show reactive forms of aggression, whereas most children who show high levels of proactive aggression also show high rates of reactive aggression (Dodge & Coie, 1987; Brown, Atkins, Osborne, & Milnamow, 1996; Pitts, 1997). Therefore, there appears to be two groups of aggressive children. The first is highly aggressive and shows both types of aggressive behavior. The other group is less aggressive overall and shows only reactive types of aggression (Frick, Cornell, Barry, Bodin, & Dane, 2003).

Thus, if this potentially important body of research is to advance our understanding of aggressive behavior, it must be able to account for both the differential correlates to the two types of aggression, as well as their frequent co-occurrence within the same individuals. To begin to develop such theoretical models, it is important to study both the behavioral and

psychophysiological responses to provocation in youth with different patterns of aggressive behavior. Further, the pattern of overlap between the two types of aggression makes detecting group differences difficult through typical methods of correlational analyses. That is, because both groups of aggressive youth show high rates of reactive aggression, correlates specific to the purely reactive aggressive group may not be apparent or appear weak in simple correlations with measures of reactive aggression (Raine et al., 2006). Also, linear interactions between reactive and proactive aggression measures using multiple regression procedures may not emerge as significant or may be misleading due to the absence of a group high on proactive aggression but low on reactive aggression. If significant interactions emerge, their interpretation is difficult because plots of simple effects of one type of aggression at varying levels of the other will be influenced by the absence of a high proactive but low reactive group. Alternatively, interactions may not be significant and suppressor effects may emerge (e.g., reactive aggression being more strongly related to measures of emotional dysregulation when controlling for proactive aggression). Such effects are difficult to interpret and apply to subgroups of aggressive youth (Lynam, Hoyle, & Newman, 2006). Thus, many researchers have advocated for the use of person-centered approaches to analyses when studying correlates to the different types of aggression (Barker, Tremblay, Nagin, Vitaro, & Lacourse, 2006; Frick, 2006).

The importance of how aggressive individuals respond to provocation is evident in most definitions of reactive aggression that focus on behavior that is in response to either real or perceived provocation (Poulin & Boivin, 2000; Dodge & Pettit, 2003). There have been a few studies that have systematically tested the behavioral response to provocation in aggressive youth using computer paradigms in which the individual is "provoked" (e.g., prevented from continuing to play a pinball game) by a hypothetical peer and the child's level of retaliation (e.g.,

delivering aversive noise) is used as a measure of aggressive responding to this provocation (Atkins, Osborne, Bennett, Hess, & Halperin, 2001; Phillips & Lochman, 2003). These studies have generally found that measures of both proactive and reactive aggression are associated with higher rates of aggressive responses. Thus, it is not clear that the behavioral response to provocation differentiates individuals with distinct patterns of aggression. However, these studies have not considered whether there may be differences in the level of provocation needed to elicit a retaliatory response. It is possible that some aggressive children may respond to even very minimal provocation, whereas others may require stronger provocation to elicit an aggressive response (Dodge & Pettit, 2003; Waschbusch et al., 1998; Waschbusch et al., 2002)

Although there have not been consistent findings of behavioral differences within aggressive individuals in response to provocation, there have been more consistent differences reported in terms of psychophyiological responses to provocations across aggressive subgroups (see Lemerise & Arsenio, 2000). Specifically, individuals who exhibit reactive aggression also show heightened physiological reactivity to perceived provocation. For example, Hubbard et al. (2002) reported that second-grade children who were rated as high in reactive aggression but low in proactive aggression exhibited heightened physiological reactivity (i.e., change in skin conductance from baseline) during a competitive game, whereas children rated high on both reactive and proactive aggression showed lower levels of emotional reactivity on psychophysiological indices. Similarly, Pitts (1997) reported that reactively aggressive boys responded with increased autonomic reactivity to a simulated provocation from a peer, whereas boys in a proactive-reactive group did not.

Taken together, the existing research suggests that children who only show reactive aggression respond to provocation with both behavioral and psychophysiological responses.

However, children who also show proactive aggression respond behaviorally to provocation but may not show a concomitant increase in autonomic reactivity. Thus, they may show high rates of impulsivity and reactivity on behavioral indices but they may not show the reactivity on autonomic indices. In support of this disconnect between the behavioral and autonomic response to provocation in children rated high on proactive aggression, Frick and colleagues showed that children scoring high on proactive aggression also scored high on measures of reactive aggression and impulsivity but differed from purely reactively aggressive children by showing deficits on a measure of emotional reactivity (Frick, Cornell, Barry et al., 2003; Frick, Cornell, Bodin, et al., 2003). Similarly, Hubbard et al. (2002) reported that proactively aggressive children showed a sharper increase in their *self-reported* anger throughout a competitive game compared to non-aggressive children, despite showing lower levels of physiological reactivity. These findings are critical because they could provide an explanation for why individuals who show high levels of proactive aggression score high on behavioral indices of reactivity (e.g., measures of reactive aggression and impulsivity) but still show attenuated psychophysiological reactivity to provocation.

This disconnect between behavioral and autonomic responses to provocation is also characteristic of individuals who show the callous and unemotional interpersonal style that is the hallmark of the construct of psychopathy (Cleckley, 1976). Specifically, in samples of incarcerated adults (Williamson, Harpur, & Hare, 1991; Patrick, Bradley, & Lang, 1993; Levenston, Patrick, Bradley, & Lang, 2000), adjudicated adolescents (Loney, Frick, Clements, Ellis, & Kerlin, 2003), clinic-referred children (Blair, 1999; Blair, Colledge, Murray, & Mitchell, 2001) and non-referred children (Kimonis, Frick, Fazekas, & Loney, 2006), individuals high on callous-unemotional traits are less reactive to various types of negative emotional stimuli than

other individuals. However, despite this evidence for low levels of emotional reactivity, individuals with these callous-unemotional traits self-report experiencing high levels of anger to provocation (Blackburn & Lee-Evans, 1985; Steuerwald & Kosson, 2000). Few studies have directly tested this disconnect between the behavioral and psychophysiological responses to provocation in individuals with callous-unemotional traits. One such study by Gottman et al. (1995) observed couples with histories of abusive behavior engage in a heated argument. Those men elevated on psychopathic traits showed a *decrease* in their heart rates during the marital conflict, whereas men low on these traits showed an increase in heart rate (Gottman et al., 1995).

Thus, research has shown a disconnect between the behavioral and psychophysiological response to provocation in individuals high on both reactive and proactive aggression and in individuals high on callous-unemotional traits. Importantly, there is research directly linking these two groups of individuals by showing that individuals with callous-unemotional traits exhibit high rates of aggression that include both reactive and proactive forms of aggression in samples of adults (Cornell et al., 1996; Woodworth & Porter, 2002) and youth (Frick, Cornell, Barry et al., 2003; Kruh, Frick, & Clements, 2005). As result, it is possible that the disconnect between the behavioral and psychophysiological response to provocation found in individuals high on both reactive and proactive aggression is due to the high rates of callous-unemotional traits displayed by this group.

Based on this research, the current study tested the behavioral and psychophysiological responses to provocation in groups of boys differentiated by their level and type of self-reported aggressive behavior. Further, we tested whether differences across groups on their level of callous-unemotional traits could account for differences in their response to provocation. We conducted this study on a sample of detained adolescents in an attempt to oversample individuals

high on aggressive behaviors allowing us to form groups with different patterns of aggressive behaviors of sufficient size to detect group differences on the behavioral, psychophysiological, and personality measures. Further, we chose a person-centered approach as the primary analytic approach to test the different correlates because we had clear hypotheses concerning typologies of aggressive individuals found in past research and because of the difficulties detecting distinct correlates to the two types of aggression using typical correlation methods that were noted previously.

We tested several hypotheses using this methodology. First, consistent with past research, we predicted that three groups of youth that differed on their level and type of aggressive behaviors could be identified in this detained sample: one group being relatively low on self-reported aggression, another showing higher levels of self-reported reactive aggression but not proactive aggression, and the third being higher on both types of aggression (i.e., a mixed aggressive group). Second, we predicted that both aggressive groups would show higher levels of aggressive responding during a competitive computer task involving varying levels of provocation compared to the low aggressive group. However, we hypothesized that the reactive aggressive group would show a more intense reaction on psychophysiological measures of reactivity when minimally provoked and that the mixed aggressive group would show a less intense reaction to provocation than the low aggressive group. Third, we predicted that the mixed aggressive group would show the highest level of callous-unemotional traits and that these traits would account for the mixed group's attenuated autonomic response to provocation.

Method

Procedure

All parents of youth currently housed at a county juvenile detention center who had a valid phone number were contacted by a detention center staff member. The staff member informed parents or legal guardians that a study was being conducted by researchers at a local university and asked permission to forward their phone number to the researchers. They were informed that their child's participation in the project would in no way influence his treatment at the detention center or his legal standing in the adjudication process. Those parents who agreed to be contacted by the researchers were phoned and had the study procedures explained to them. As approved by the host university's Institutional Review Board and the director of the detention center, parents or legal guardians who agreed to have their child participate were asked to have the consent process tape-recorded and were subsequently mailed a copy of the consent form for their records.

The following procedures were followed for all participants. First, boys individually met with two examiners in a private room at the detention center and all procedures were reviewed. The youth signed the assent form if he agreed to participate. Second, an investigator placed three Silver-Silver Chloride (Ag-AgCl) electrocardiogram electrodes on the youth's torso. Two Ag-AgCl electrodermal conductance electrodes were attached to the distal phalanges of the two middle fingers of the non-dominant hand to measure skin conductance. Third, each participant was read a standard script about the provocation task and was told that the sensors would record their physiological activity while they played. The youth then played the provocation task. Fourth, the participant completed the Peabody Picture Vocabulary Test-3rd Edition (PPVT-III; Dunn & Dunn, 1997). Fifth, later in the day, and at least half an hour following the initial session, all participants tested that day completed questionnaires as a group (ranging from 1 to

4). The questionnaires were read aloud to all participants with an assistant available to help answer participant questions and to ensure that each participant was working independently and completed every item. Sixth, the group was then given their choice of refreshments (i.e., soft drink and candy bar) as compensation. Seventh, after the participant was released from the detention center, a letter thanking them for their participation and debriefing them about the deception used for the provocation was sent to the participant's home. This debriefing was done following release from the center to avoid the participants sharing this information with other potential participants in the facility.

Participants

One hundred twenty-six parents were contacted by the researchers and 117 (93%) gave consent. Out of those 117, five boys (4%) were released before they could be contacted for assent and 10 (9%) declined to give assent. Two boys were eliminated due to a failure to complete all measures: one because of experimenter error and another because of institutional constraints. Two additional participants were eliminated from subsequent analyses because their aggressive responding on the competitive provocation task was below three standard deviations from the group mean. Finally, 13 youth who had a PPVT-III score below 65 were excluded due to concerns about their ability to understand the questionnaires.

The final sample included 85 boys between the ages of 13 and 18 (M=15.53, SD=1.28). The majority (69%) of the sample self-identified as African American and 22% as Caucasian, which is representative of the ethnic composition of the detention center population on a yearly basis. The most common family structure reported by participants was living with a biological mother alone (45%), followed by living with a biological mother and step-father (25%), living with both biological parents (8%), living with a biological father and step-mother (8%), living

with a biological father alone (5%), and other living arrangements (5%). Participants reported an average of 2.75 (SD=1.38) siblings living in the home with them prior to being detained. Based on self-report, 17% reported taking psychotropic medications, 50% reported placement in special education classes in school, and 69% reported a history of mental health treatment. Based on a review of their offense history from detention center records, 51% had been arrested at least once for a violent crime and they had an average of 6.08 (SD=5.57) previous arrests.

Measures

Peer Conflict Scale (PCS; Kimonis, Marsee, & Frick, 2004). The youth's self-report of aggression was assessed using the Peer Conflict Scale (PCS). The PCS was developed to overcome the limitations of previous measures of reactive and proactive aggression. Specifically, items on the scale were limited to only those involving direct harm to another person. Further, the proactive subscale was broadened to include not only aggression for gain, but also aggression for dominance (e.g., "When I hurt others, I feel like it makes me powerful and respected"), aggression for sadistic reasons (e.g., "I enjoy hurting others"), and unprovoked and premeditated aggression (e.g., "I carefully plan out how to hurt others"). The reactive subscale was also expanded to include not only emotionally provoked, angry aggression (e.g., "When I get angry, I will hurt someone"), but also impulsive aggression (e.g., "Most of the times that I have gotten into arguments or physical fights, I acted without thinking").

The PCS was developed through several steps. First, all items assessing reactive and overt aggression and reactive and proactive relational aggression from existing scales, including the Aggressive Behavior Rating Scale (Brown et al., 1996), the Aggressive Subtypes Scale (Dodge & Coie, 1987), the Direct and Indirect Aggression Scales (Bjorkqvist, Lagerspetz, & Osterman, 1992), and aggression scales created by Little, Jones, Henrich, and Hawley (2003),

Crick and Grotpeter (1995) and Galen and Underwood (1997), were pooled and items that were not clearly related to harm were deleted. Second, a team of faculty, graduate, and undergraduate students reviewed these items to ensure that the wording was clear. Only the ten items for proactive overt aggression ("I carefully plan out how to hurt others") and the ten items for reactive overt aggression ("If others make me mad, I hurt them") were examined in the present study. One proactive overt item ("I like to hit kids smaller than me") was removed from analyses because its variance was 0.

The factor structure of the entire PCS, both relational and overt aggression items, was tested in a sample of juvenile justice involved adolescents (N = 470; age range = 12-18) (Marsee et al., 2006). Exploratory principal components analysis indicated that a four-factor model accounted for 47% of the variance in scoring and that the salient loadings (>.45) on the four factors were conceptually congruent with the four theoretically derived scales. Confirmatory factor analysis (CFA) showed that a hierarchical four-factor model fit the data better than a one factor model (i.e., general aggression factor), a two-factor model (i.e., overt and relational factors), and a four-uncorrelated factor model. In the current sample, Cronbach's alpha for the reactive and proactive overt scales were acceptable (.86 and .77, respectively). Further, the reactive and proactive scales from the PCS were positively correlated with the youth's report of the number of violent delinquent acts (r= .38 and .55, respectively, both $p < .001$). Testing for differences between correlations for dependent samples with Williams's T_2 statistic (see Steiger, 1980), violent delinquency was more strongly related to the proactive overt scales than it was to the reactive overt scales, t (82) = 2.22, $p < .05$, consistent with past findings using other measures of proactive aggression (Vitaro et al., 2002).

Competitive Reaction Time Task (CRTT; Waschbusch et al., 2002). Each participant played a computer game that is similar to provocation tasks used in previous studies with children (Murphy, Pelham, & Lang, 1992; Waschbusch et al., 2002). Participants were seated at a table with a desktop computer that was equipped with audio speakers and a microphone. The researcher read an instructional script to each participant, telling the participant that they would be playing a computer game against a boy from another facility. On each trial, a target appeared on the screen to which the participant was to press the space bar as fast as possible. If they responded faster than their fictitious opponent, they would earn 50 points, and they could take 0 to 100 points in steps of 10 from their opponent. They could also record a 10 second message for their opponent. They were told that they would lose each time the other boy pushed the space bar faster. When this happened, the opponent would win 50 points, could decide to take points, and could record a message. Participants were told that the points taken were not added to the other player's score and that a standard number of trials existed. Thus, taking points from an opponent did not help the person reach their point total goal. This could only be done by pressing the space bar faster then their opponent. The goal, they were told, was to end the game with at least 750 points; then they could choose a candy bar. After completion of the computer game, youth completed a questionnaire to determine whether the deception of the hypothetical peer was successful.

For each participant, the game was pre-programmed for the same 16 losses out of 48 trials. Two losing trials never occurred in succession. Standard pre-recorded verbal messages by a young African-American male from the local community were played over the computer when a loss occurred. Eight of 16 loss trials were high provocation trials, whereby a highly aversive verbal message was played (e.g., "You wimp! I don't think I'll ever be beaten! Minus 100!") and

80-100 points were subtracted by the opponent. The other eight of the 16 loss trials were low provocation trials, whereby a less-provoking verbal message (e.g., "I won but I'll give you a break. I'll only take 10 points.") was broadcast and 0-20 points were subtracted. The computer indicated a win on the remaining 32 of the 48 trials, resulting in a net win of 780 points, allowing all participants to obtain the candy bar for participation.

Separate aggressive response measures were computed based on the level of provocation. Aggressive responding to no provocation was obtained by examining aggressive responding during the first three win trials before participants experienced any provocation. Aggressive responding also was computed by averaging the points taken during trials immediately following low and high provocation trials. Very few participants chose to record verbalizations for their opponent; thus, coding of taunts could not be performed. Coding of psychophysiological responses was chosen for periods during the game where participants were most likely neither speaking nor moving. Both of these activities increase cardiac output and could have confounded the results. As a result, psychophysiological responses were coded during each of the 16 loss trials, such that the examiner electronically recorded the end of each taunt received by the participant to code offline.

Autonomic Psychophysiology. Skin conductance level (SCL) was measured during a 3-minute baseline period prior to the CRTT and during the 9 to 11 minute CRTT task. Electrodermal activity (EDA) for determining SC was recorded via two electrodes placed on the middle two distal phalanges of the non-dominant hand, and was recorded using Thought Technology's ProComp Infinity encoder connected to a Pentium 4 laptop computer equipped with Biograph Infinity software (version 2.0.1). Sampling for EDA was set at 256 Hz.

After a 10-minute stabilization period, autonomic activity was measured for 3 minutes prior to the CRTT and during the 9- to 11-minute CRTT in order to obtain baseline and phasic measures. According to Stern et al. (2001), because skin conductance is unaffected by initial values, baseline levels are independent from task levels. Thus, change scores were used to detect changes from baseline to the task. Further, separate skin conductance response (SCR) scores were determined for periods following low and high provocation. Consistent with Waschbusch et al. (2002), EDA was measured during "loss message" periods. Thus, after the end of each taunt, the change (0.01 microsiemens or greater) in SCL between the 1-second and 4-second mark was obtained and averaged for skin conductance response (SCR) to low and high provocation (Stern et al., 2001). This allowed us to assess whether youths exhibited a subsequent acceleration in response which would indicate high emotional arousal (see Stadler, Rohrmann, Steuber, & Poustka, 2006; Waschbusch et al., 2002).

The Inventory of Callous-Unemotional Traits (ICU; Frick, 2004). The ICU is a 24-item self-report scale designed to assess callous and unemotional traits in youth. The ICU was derived from the Callous-Unemotional subscale of the Antisocial Process Screening Device (APSD; Frick & Hare, 2001). The CU component of the APSD has emerged as a distinct factor in both clinic and community samples (Frick, Bodin, & Barry, 2000) and has been shown to identify a distinct subgroup of children and adolescents with conduct problems (Frick, 2006; Frick & Marsee, 2006). Most importantly for the current investigation, the CU subscale has designated a group of antisocial adolescents who are more severely aggressive (Frick, Cornell, Bodin et al., 2003; Kruh et al., 2005) and who show deficits in their responding to emotional stimuli (Loney et al., 2003). However, the self-report CU scale has demonstrated only moderate internal consistency in past studies (e.g., Loney et al., 2003), which is likely due to its small number of

items (n = 6) and three-point rating system. Also, 5 out of the 6 items are worded in the same direction, increasing the possibility of response bias.

The ICU was developed to overcome these limitations. It was constructed using the four items that loaded significantly on the CU scale in factor analyses in both clinic-referred and community samples (Frick et al., 2000). These four items ("is concerned about the feelings of others," "feels bad or guilty," "is concerned about schoolwork," and "does not show emotions") were restructured into four positively and four negatively worded items and placed on a four-point scale (0 = "not at all true," 1 = "somewhat true," 3 = "very true," and 4 = "definitely true"). The construct validity of the ICU was supported in a large sample (n = 1443) of non-referred German adolescents in which a model involving three factors (callousness, uncaring, and unemotional) loading on a single higher-order factor fit the data best (Essau, Sasagawa, & Frick, in press). Further, the total scale showed predicted associations with severity of conduct problems and with measures of thrill and adventure seeking. In the current detained sample, two items ("What I think is "right" and "wrong" is different from what other people think," and "I do not let my feelings control me") showed poor relations with the other items on the scale and were removed. The total ICU score was the sum of the remaining 22 items (reverse-scoring 12 of the items), which showed acceptable internal consistency (.72).

Results

Preliminary Data Analyses

Consistent with Pope et al. (2000), participants were judged to have correctly guessed that their opponent was fictitious if they both (1) failed to show any aggressive responding and (2) stated their suspicion on the post-task evaluation. No participant met both criteria; thus, the three participants that expressed doubts about the legitimacy of the task but still showed

aggressive responses were included in analyses. Nonetheless, analyses were performed removing the three participants and the results are similar to those presented here. Moreover, given the possibility that certain medications could have an effect on autonomic nervous system activity, all analyses were repeated removing the 16 participants taking medications. Analyses were again similar to those presented. Finally, outlier psychophysiology scores were defined as values greater than three standard deviations above or below the sample mean and these were treated as missing data (n=7).

Table 1 provides the distribution of the primary variables used in analyses. As in past samples (e.g., Dodge et al., 1997), there were higher rates of reactive aggression and greater variability in reactive aggression than proactive aggression. Supporting the validity of the provocation task, paired-samples t-tests revealed that autonomic activity on all indices increased from the baseline period to CRTT. Baseline and phasic skin conductance level (SCL) differed significantly (t (82)= 10.43, $p < .001$, partial Eta^2 = .57). Supporting the validity of low and high provocation levels, the mean skin conductance response (SCR) to high provocation was significantly higher than to low provocation (t (79) = 4.86, $p < .001$, partial Eta^2 = .23).

The zero-order correlations among the main study variables are provided in Table 2. We predicted that responding with aggressive acts to low and high levels of provocation would be related to both reactive and proactive aggression. The relations with reactive aggression were modest but in the expected direction (r(85) = .20 and .19, both low and high $p < .08$, respectively). The proactive aggression scale was significantly related to behavioral aggression prior to provocation (r(85) = .21, $p < .05$), but not to low or high provocation (r(85) = .15 and .14, respectively). ICU scores were negatively related to SCR at high provocation (r(83) = -.23,

$p < .05$). Further, ICU scores were also positively related to both reactive and proactive aggression ($r(85) = .31$, $p < .01$; $r(85) = .27$, $p < .05$, respectively).

As expected, reactive and proactive overt aggression scales were highly correlated ($r(85) = .66$, $p < .001$). Thus, we repeated the correlations among the types of aggression, the behavioral and psychophysiological responses to provocation, and callous-unemotional traits controlling for the correlation between the two types of aggression. Table 2 provides these partial correlations. As indicated by this table, controlling for the correlation between types of aggression did not influence the pattern of correlations substantially, although none of the significant findings remained in these analyses. [1] Although research has shown age-related differences in childhood (see Sohn, Sokhadze, Watanuki, 2001), skin conductance measures were unrelated to age (r= -.02 to 12; all p = n.s.) in this adolescent sample and, therefore, age was not used as a covariate in the main analyses.

Identification of Aggressive Groups

To test whether the hypothesized three groups differing on types of aggression could be identified in this sample, a K-means cluster analysis using the SAS FASCLUS procedure (SAS 8.0; SAS Institute Inc., Cary, NC) was conducted on standardized aggression scores. Fit indices for two, three, four, and five clusters were compared. Based on these indices, a four-cluster solution was chosen because the overall R^2 and the cubic clustering criterion increased significantly from the three (.68 and 2.4) to four (.77 and 4.2) cluster solution, whereas the five-cluster solution resulted in a decrease in the cubic clustering criterion (3.3). The cluster analyses were repeated twice after randomly resorting the data set and identical results were found across these analyses.

In the four cluster solution, the largest group was one that was relatively low on both types of aggression (n=40). The second largest cluster was one that was high on reactive aggression but below the sample mean on proactive aggression (n= 29). Consistent with past research and with our hypotheses, no cluster emerged that was high only on proactive aggression. Instead, the remaining two clusters showed high scores on both dimensions with one being of somewhat less severity on both types of aggression (n = 12) than the other (n = 4). Thus, for analyses, these clusters were combined into a single mixed aggression cluster. The means and standard deviations for the three groups on the self-report measure of aggression are provided in Table 3. Prior to comparing these clusters on variables of theoretical interest, demographic and background characteristics were compared across groups. The three groups did not significantly differ on age, ethnic minority status, PPVT scores, current use of medication, a history of special education placement, or a history of mental health services.

Behavioral Response to Provocation across Aggressive Groups

To compare the clusters on their level of aggressive responding on the provocation task, a 3x3 mixed ANOVA with level of provocation (no provocation, low provocation, and high provocation) as a within-subjects factor and aggressive group membership as a between-subjects factor was performed. Mauchly's test indicated that the sphericity assumption had been violated ($X^2(2)= 16.15$, $p<.05$), thus degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .85$). The main effect of provocation on aggressive responding was significant ($F(1.69,138.89)=35.27$, $p<.001$, partial $Eta^2 = .30$), supporting the validity of the provocation manipulation. Repeated contrasts indicated that there was a significant increase in aggressive responding from low provocation (M = 65.21, SD = 27.80) to high provocation (M = 88.90, SD = 14.34) resulting in a very strong repeated effect for this contrast ($F(1,82)=67.17$,

p<.001; partial Eta² = .45). Contrary to hypotheses, there was no between-subjects main effect for aggressive group membership (F(2,82)=1.20, p=n.s., partial Eta² = .03). However, there was a significant group by provocation interaction (F(3.39,138.89)=2.62, p<.05, partial Eta² = .06).

The form of this interaction is plotted in Figure 1 with error bars showing 95 percent confidence intervals. Repeated contrasts indicated that the group by provocation interaction was evident from no (i.e., no reduction of points and no verbal message from opponent) to low (i.e., a small reduction of points from opponent) provocation (F(2,82)=3.06, p<.05; partial Eta² = .07) but not from low to high (i.e., a high reduction of points from opponent) provocation trials (F(2,82)=1.14, p=n.s., partial Eta² = .03) suggesting low provocation had a different effect on the aggressive reactions across the three groups. As indicated in Figure 1, the significant interaction seemed to be partly a function of the mixed aggressive group's high level of aggression initially, which decreased slightly at low levels of provocation, combined with the increase in aggressive responding following low provocation by the group high on reactive aggression only. To examine whether the reactive aggressive group's increase was significant, post-hoc simple contrasts were performed on the difference between aggressive acts at no and low provocation. The reactive aggressive group increased aggressive acts more than the mixed aggressive group (t(82)= -2.38, p<.05) but not when compared with the low aggressive group (t(82)= -1.67, p=n.s.).

Autonomic Reactivity and Callous-Unemotional Traits in the Aggressive Groups

The next hypotheses predicted that the pure reactive aggressive group would show the highest levels of psychophysiological reactivity and the mixed aggressive group the lowest. The means and standard deviations for the measures of reactivity across the three groups are reported in Table 4. One-way ANOVAs were conducted on the three skin conductance measures (i.e.,

change from baseline; response to low provocation; response to high provocation). The results did not reveal the expected significant group effects with regard to skin conductance.

The results of a one-way ANOVA comparing the groups on their ICU scores also are provided in Table 4. As predicted, the ANOVA using ICU scores as the dependent variable revealed significant groups differences ($F(2,84)=5.01$, $p<.01$; partial $Eta^2 = .11$). Also, consistent with predictions, pairwise comparisons revealed that the mixed aggressive group had higher scores on the ICU than the low aggressive group. However, contrary to predictions, the reactive aggression group also differed from the low aggressive group and the two high aggression groups did not differ significantly from each other.

Post-Hoc Analyses

As noted in Table 2, callous-unemotional traits were negatively related to indicators of autonomic reactivity as predicted from past research. However, the three aggressive groups did not differ on the level of these traits in the expected manner. Therefore, several post-hoc analyses were conducted to explore whether varying levels of callous-unemotional traits could explain different patterns of autonomic reactivity within aggressive youth. First, a series of 2 x 3 ANOVAs were conducted with two levels of ICU (median split of ICU variable) and the three aggression groups as the predictors and the three skin conductance indices as the dependent variables. The only ANOVA to reach significance was for the main effect of ICU on the skin conductance response elicited by low provocation messages (F (1,75) =4.61, $p < .05$; partial $Eta^2 = .06$), although the main effect of ICU on high provocation was in the same direction (F (1,77)= 1.85, $p = .18$; partial $Eta^2 = .02$). The means and standard deviations across the aggressive subgroups split by level of CU traits are provided in Table 5. As evident from these means, youth

high on CU traits were consistently lower on these measures of autonomic reactivity, especially for the low aggression and mixed aggression groups.

Discussion

The current study adds to the growing body of literature investigating the distinction between reactive and proactive forms of aggression in several respects. First, three clusters were hypothesized to emerge, consistent with past research in adjudicated (Kruh et al., 2005), clinic-referred (Dodge et al., 1997) and community (Dodge & Coie, 1987; Brown et al., 1996; Frick, Cornell, Barry et al., 2003) samples. As predicted, boys in our detained sample could be classified into three groups based on the severity and type of aggression: a reactively aggressive only group, a proactively and reactively aggressive mixed group, and a relatively low aggressive group. Thus, research has consistently shown that it is not unusual to find youth who show elevated levels of solely reactive aggression. However, finding youth who show solely proactive forms of aggression is relatively rare (see Cornell et al., 1996 for similar findings in adults).

Second, we compared the reaction to provocation on a competitive computer task across the different aggression subgroups. Past research has used similar provocation tasks have not consistently documented differences in response to provocation for children with different patterns of aggressive behavior (Atkins et al., 2001; Phillips & Lochman, 2003). Our findings are consistent with Waschbusch et al. (2002) to suggest that these past findings may have been due to a failure to consider the level of provocation. That is, we documented an aggressive group by level of provocation interaction on our computer task. Specifically, all three groups showed increases in aggressive responses to high levels of provocation. However, youth showing strictly reactive aggression showed an increase in retaliatory aggression to a fictitious peer at the low provocation level (see Figure 1), whereas youth in the mixed aggressive cluster

showed high rates of aggression prior to provocation and remained relatively high during the low provocation condition. This pattern suggests that the mixed group may be predisposed to act aggressively even in the absence of provocation, whereas the purely reactive group may be uniquely susceptible to responding in an aggressive manner to even minimal perceived provocations from others. Such susceptibility could be due to the deficits in social cognition (e.g., a hostile attributional bias) that are often present in this group (Dodge & Pettit, 2003) or due to the problems in emotional regulation they often experience (Frick & Morris, 2004). Correspondingly, Waschbusch et al. (2002) found that children with clinical diagnoses characterized by impulsivity and antisocial behavior exhibited the greatest reactive aggression, particularly to low provocation.

Third, the current study also investigated potential differences in how the three study groups reacted to provocation by examining their autonomic reactivity to the task. Thus, we examined not only their behavioral responses, but also their physiological responses to provocation. On the psychophysiological indices, the differences between groups were not significant. Also, divergent from hypotheses, the two aggressive groups did not differ in their level of callous-unemotional traits. These two findings could be related. Past research has consistently linked the presence of callous-unemotional traits to deficits in emotional reactivity in children and adolescents (Blair, 1999; Kimonis et al., 2006; Loney et al., 2003). This was supported in our sample, such that our measure of callous-unemotional traits was negatively associated with autonomic reactivity to provocation. Further, we separated youth within the groups based on their level of callous-unemotional traits. The result revealed an interesting trend: low aggressive youth and youth with a mixed pattern of aggression who also showed high levels of callous-unemotional traits exhibited lower autonomic reactivity in response to low

provocation. These findings support previous research suggesting that it may be the presence of callous-unemotional traits, not the level or the type of aggression, which is most strongly predictive of low levels of psychophysiological reactivity (Kimonis et al., 2006; Lorber, 2004).

However, this interpretation needs to be made with possible explanations for why the mixed aggressive group did not show higher rates of callous-unemotional traits as would be predicted from past studies (Cornell et al., 1996; Frick et al., 2003; Kruh et al., 2005). It is possible that the cluster analysis may not have been the optimal way of differentiating subtypes of aggressive groups to detect differences on callous-unemotional traits. As noted in Table 3, the purely reactive group showed higher rates of proactive aggression than the non-aggressive group, albeit below the sample mean and significantly lower than what was displayed by the mixed group. However, some past studies have suggested that the presence of any level of proactive and instrumental aggression, in combination with reactive aggression, designates a group who is high on callous-unemotional traits (Cornell et al., 1996).

Regarding the aggressive clusters, not only did the reactive aggressive group report substantial levels of proactive aggression, their level of reactive aggression was not as high as that of the mixed group. Thus, the mixed aggressive group was higher in aggression in general. This pattern could suggest that this mixed aggressive group should be considered distinct based on severity, rather than type, of aggression (Bushman & Anderson, 2001; Walters, 2005). However, the mixed aggressive group did not show the most deviance on many measures. Specifically, the mixed aggressive group was not higher than the reactive aggressive group in behavioral responses to provocation at either low or high provocation. It was only distinct in showing higher rates of aggressive acts without provocation.

The limitations in the resulting aggression clusters are related to a broader limitation concerning the sample used in this study. A detained sample was used to increase the rate of aggressive behavior that would be reported, so that aggressive subgroups would be large enough to detect hypothesized differences. However, this methodology makes it unclear if the low aggression group was actually "normative" on their levels of aggression or just lower than other detained adolescents. There was no normal control group used in the study and the self-report of aggression measure did not have normative data to which to compare the level of aggression found in the current sample. However, the fact that 47% of our sample fell into this low aggressive cluster is not inconsistent with typical characteristics of detained samples. For example, 2003 arrest statistics of the United States indicated that about 31% of detained youth are held for an offense against persons (e.g., homicide, robbery, assault; Office of Juvenile Justice and Delinquency Prevention, 2006). Similarly, Potter and Jensen (2003) reported that 48% of a detained sample of juveniles responded positively to questions about lifetime histories of aggression and violence towards others. Nevertheless, differences between groups may have been even stronger if a non-detained and truly low aggressive group had been included.

Another limitation of the current study concerns the difficulty in establishing reliably a person's motivations for an aggressive act on the computer task. Specifically, one cannot conclusively assume strictly hostile (i.e., reactive) motivations for retaliations following provocation. Reactive motivations probably play a large role, since the points removed from the opponent did not enhance the player's points or chances of receiving the prize. Also, there have been legitimate concerns raised as to how well retaliations on such a computer task relate to actual physical aggressive behaviors displayed outside of a laboratory situation (Tedeschi & Quigley, 1996; also see Anderson, Lindsay, & Bushman, 1999). Further, as in past studies

(Stadler, Rohrmann, Steuber, & Poustka, 2006; Waschbusch et al., 2002), we measured psychophysiological reactivity following provocation and not during the aggressive responses. As a result, all interpretations need to be limited to differences in response to various levels of provocation and not as an indicator of the level of emotional arousal during the aggressive act.

Within the context of these limitations, these results support both the importance of distinguishing among youth who show different types of aggression, as well as the importance of developing explanations for why the different forms of aggression may co-occur within the same individuals. Further, they support the importance of studying both the behavioral and psychophysiological responses to provocation in developing these explanations. Specifically, our results suggest that adolescents who show only reactive aggression show high levels of retaliatory responses to relatively lower levels of provocation. In contrast, adolescents with both reactive and proactive aggression are distinct in showing high rates of aggressive responses, even in the absence of provocation, and do not show the same increase in aggressive responses to relatively low levels of provocation. This finding would be consistent with theories that the aggressive behavior of this group may be more strongly related to expectations that their behavior will result in positive outcomes, rather than to specific cognitive or emotional deficits or in response to provocation (Dodge & Pettit, 2003; Frick & Morris, 2004; Pardini, Lochman, & Frick, 2003). Further, children within this mixed aggressive group who are also high on callous-unemotional traits appear to show low levels of reactivity on physiological measures, despite their behavioral responses to provocation. Thus, these findings support the importance of considering the presence or absence of callous-unemotional traits for understanding the emotional correlates to aggressive behavior (Frick, 2006; Frick & Marsee, 2006).

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Footnotes

[1] We also examined the interaction between the two types of aggression in predicting the variables of interest by performing a series of hierarchical regressions with the two aggression variables entered on the first step and examining the change in R^2 when the interaction was added on the second step. The only interaction to reach significance was in the prediction of callous-unemotional traits (ΔR^2=.05, F (1,81) = 4.85, $p < .05$). Using the post-hoc probing techniques suggested by Holmbeck (2002), the interaction appeared to be due to the fact that reactive aggression had a positive relation with callous-unemotional traits ($\beta = .40$, $t = 2.51$, $p < .05$) at low levels of proactive aggression but not at high levels proactive aggression ($\beta = -.02$, $t = -.11$, p = ns). However, as noted in the introduction, this interaction needs to be interpreted cautiously due to the fact that the few youth high on proactive aggression but low on reactive aggression could have influenced the simple slopes.

Table 1.

Distribution of Primary Study Variables.

Measures	*MIN*	*MAX*	*M*	*SD*	*N*
SELF-REPORTED AGGRESSION					
Proactive Overt Aggression	0	15	2.44	3.15	85
Reactive Overt Aggression	0	29	10.20	6.47	85
INVENTORY OF CALLOUS-UNEMOTIONAL TRAITS					
ICU	1	39	23.02	7.70	85
PSYCHOPHYSIOLOGICAL MEASURES					
Baseline Skin Conductance Level[a]	0.16	11.05	3.81	2.15	83
Phasic Skin Conductance Level	0.17	14.58	5.80	2.97	85
Change Skin Conductance Level	-1.57	7.60	1.78	1.56	83
SCR to Low Provocation[b]	0.00	0.31	0.07	0.08	81
SCR to High Provocation	0.00	0.45	0.13	0.11	83
AGGRESSIVE RESPONDING ON THE CRTT					
No Provocation	0	100	56.94	38.63	85
Low Provocation	1	100	65.21	27.80	85
High Provocation	35	100	88.87	14.34	85

Note: Proactive Overt Aggression, Reactive Overt Aggression (Peer Conflict Scale; PCS); Change Skin Conductance Level (SCL)=change in SCL from baseline to CRTT (Competitive Reaction Time Task); SCR= skin conductance response.

[a]Baseline and CRTT skin conductance level (Phasic SCL) were significantly different (t (82)= 10.43, p < .001); [b]Mean skin conductance response (SCR) to low provocation and to high provocation were significantly different (t (79)= 4.86, p < .001);

Table 2.

Correlations among Study Variables.

	2	3	4	5	6	7	8	9
PSYCHOPHYSIOLOGICAL INDICES								
1 Change SCL	**.37****	**.47*****	-.10 (-.16)	.03 (.13)	-.13	-.11	-.01	-.08
2 SCR lo prov	-	**.59*****	-.06 (-.06)	-.03 (.02)	-.01	-.03	-.01	-.09
3 SCR hi prov	-	-	.05 (.03)	.03 (.00)	.01	-.04	.04	-.23*
SELF-REPORTED AGGRESSION								
4 Proactive Overt	-	-	-	**.66*****	.21* (.15)	.15 (.03)	.14 (-.05)	.27* (.10)
5 Reactive Overt	-	-	-	-	.11 (-.01)	.20^{+} (.11)	.19^{+} (.13)	.31** (.17)
AGGRESSIVE BEHAVIORS								
6 CRTT-No prov	-	-	-	-	-	**.47*****	**.40*****	-.09
7 CRTT-Low prov	-	-	-	-	-	-	**.52*****	.02
8 CRTT-High prov	-	-	-	-	-	-	-	-.11
CALLOUS-UNEMOTIONAL TRAITS								
9 ICU								

Note: Change SCL=change in skin conductance level from baseline to CRTT; SCR lo prov=Skin conductance response to low provocation; SCR hi prov=Skin conductance response to high provocation; Proactive Overt = Proactive Overt Aggression, Reactive Overt = Reactive Overt Aggression (Peer Conflict Scale; PCS); CRTT High=Mean aggressive responding after high provocation, CRTT Low= Mean aggressive responding after low provocation, CRTT No=Mean aggressive responding during no provocation (Competitive Reaction Time Task); ICU=Inventory of Callous-Unemotional traits; Correlations in parentheses are partial correlations, controlling for the other form of aggression. $^{+}p < .10$; $*p < .05$; $**p < .01$; $***p < .001$.

Table 3.

Characteristics of the Three Aggressive Groups based on the Cluster Analysis.

	Low Aggressive (n=40)	Reactive Only (n=29)	Mixed Aggressive (n=16)	*F* (2,84)
Z-Score Proactive Overt	-0.54 (0.34)[a]	-0.18 (0.38)[b]	1.74 (0.99)[c]	108.59***
Z-Score Reactive Overt	-0.88 (0.30)[a]	0.52 (0.44)[b]	1.23 (0.87)[c]	121.80***

Note: Superscripts are the results of Tukey HSD pairwise comparisons, such that means with different letters are significantly different at $p < .05$; *** $p<.001$.

Table 4.

Comparison of the Three Aggressive Groups on Psychophysiological Indices of Reactivity and Callous-Unemotional Traits.

	Low Aggressive (n=40)		Reactive Only (n=29)		Mixed Aggressive (n=16)		
	M	SD	M	SD	M	SD	*F*
Change SCL	1.80	(1.56)	1.78	(1.68)	1.76	(1.65)	0.01 (2,82)
SCR lo prov	0.07	(0.08)	0.07	(0.07)	0.07	(0.08)	0.04 (2,80)
SCR hi prov	0.14	(0.13)	0.11	(0.09)	0.14	(0.08)	0.71 (2,82)
ICU	20.35^{a}	(7.33)	25.28^{b}	(7.42)	25.63^{b}	(7.29)	5.01** (2,84)

Note: Superscripts are the results of Tukey HSD pairwise comparisons, such that means with different letters are significantly different at $p < .05$; Change SCL=change in skin conductance level from baseline to CRTT; SCR lo prov=Skin conductance response to low provocation; SCR hi prov=Skin conductance response to high provocation; ICU=Inventory of Callous-Unemotional traits; *$p<.05$; ** $p<.01$.

Table 5.

Psychophysiological Reactivity of Aggressive Groups based on Level of Callous-Unemotional Traits.

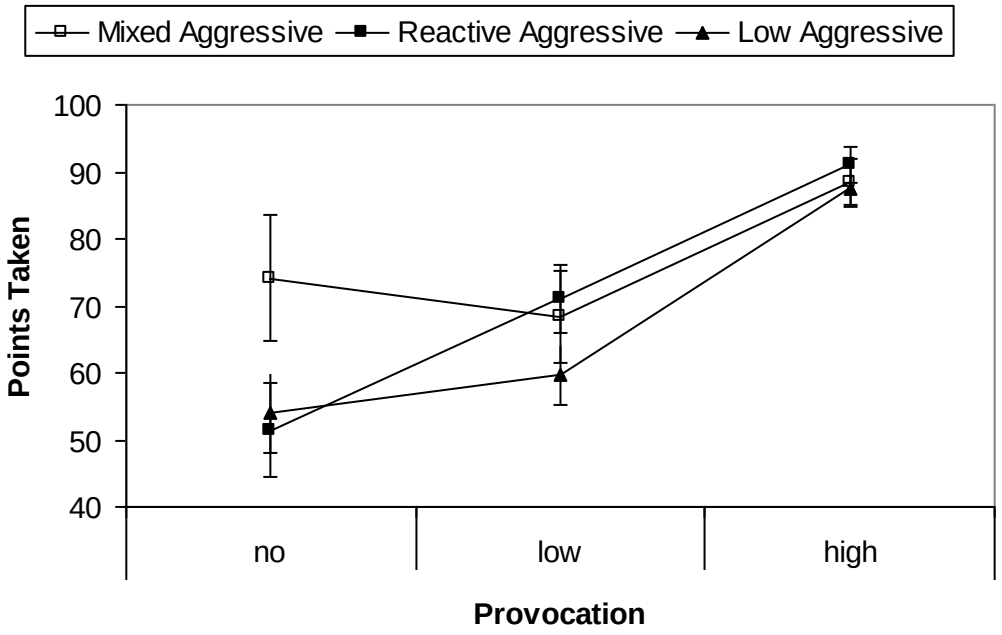
	Low Aggressive		Reactive Only		Mixed Aggressive		
	Hi CU (n=13)	Lo CU (n=27)	Hi CU (n=19)	Lo CU (n=10)	Hi CU (n=11)	Lo CU (n=5)	Effects
Change SCL	1.47	1.97	2.15	1.11	1.56	2.18	
SD	(1.07)	(1.63)	(1.83)	(1.17)	(1.52)	(2.03)	
SCR lo prov	0.04	0.09	0.07	0.07	0.05	0.13	CU[a]
SD	(0.06)	(0.08)	(0.07)	(0.07)	(0.05)	(0.11)	
SCR hi prov	0.11	0.15	0.10	0.13	0.13	0.16	
SD	(0.10)	(0.14)	(0.08)	(0.10)	(0.09)	(0.06)	

Note: Change SCL=change in skin conductance level from baseline to CRTT; SCR lo prov=Skin conductance response to low provocation; SCR hi prov=Skin conductance response to high provocation.

[a]F (1,80) =4.61, $p < .05$; partial Eta² = .06;.

Figure Captions

Figure 1. Interaction between level of provocation and aggressive group membership on aggressive responses on the provocation task.


Mixed Aggressive
Reactive Aggressive
Low Aggressive
100
90
80
70
60
50
40
Points Taken
no
low
high
Provocation