8-10-2005

Types of Aggression, Responsiveness to Provocation, and Psychopathic Traits

Luna C. Munoz

University of New Orleans

Follow this and additional works at: https://scholarworks.uno.edu/td

Recommended Citation

Munoz, Luna C., "Types of Aggression, Responsiveness to Provocation, and Psychopathic Traits" (2005). University of New Orleans Theses and Dissertations. 305.

https://scholarworks.uno.edu/td/305

This Dissertation is brought to you for free and open access by the Dissertations and Theses at ScholarWorks@UNO. It has been accepted for inclusion in University of New Orleans Theses and Dissertations by an authorized administrator of ScholarWorks@UNO. The author is solely responsible for ensuring compliance with copyright. For more information, please contact scholarworks@uno.edu.
Dedication

To my father, William (Willie) Muñoz, whose joy for life and for new experiences remains with me. Thank you for instilling in me a will to rise above all my early difficulties and to persist in spite of discouraging circumstances. Despite your educational background, I know you always appreciated learning, particularly the learning that one pursues in the betterment of oneself. I will always try to remember to seek learning opportunities in life and in fancy as well as in academia.
# Table of Contents

Abstract ........................................................................................................................................ iv  
Introduction ................................................................................................................................... 1  
Subtypes of Aggression in Children .............................................................................................. 1  
  Subtypes of Aggression and Their Sequelae ............................................................................... 2  
  Reactive Aggression and Emotional Reactivity .......................................................................... 2  
  Reactive Aggression: Heightened Physiological Reactivity ....................................................... 3  
  Proactive Aggression: A Mixed Subtype of Aggression ............................................................ 4  
  Proactive Aggression and Underreactivity ............................................................................... 5  
  Proactive Aggression: Dissociation Between Physiological and Emotional Reactivity .......... 6  
Psychopathic Traits ...................................................................................................................... 7  
  Psychopathy and Aggression ......................................................................................................... 7  
  Psychopathy and Underreactivity .............................................................................................. 9  
  Psychopathy and Anger ............................................................................................................. 13  
  A Dissociation between Expressed and Experienced Emotion in Psychopaths .................. 15  
The Present Study ......................................................................................................................... 16  
Method .......................................................................................................................................... 18  
  Procedure ..................................................................................................................................... 18  
  Participants ................................................................................................................................... 19  
  Measures ...................................................................................................................................... 21  
Results .......................................................................................................................................... 30  
  Data Inspection ............................................................................................................................ 30  
  Validation of the Provocation Task ............................................................................................ 30  
  Cluster Analysis to Form Aggressive Groups ............................................................................. 32  
  Aggression Clusters and Aggressive Responding on the Provocation Task ............................ 34  
  Aggression Clusters, Callous-Unemotional Traits, and Psychophysiological Indices ............ 36  
  Post-Hoc Analyses .................................................................................................................... 37  
Discussion ...................................................................................................................................... 38  
References ..................................................................................................................................... 50  
Appendix A: Tables and Figures ..................................................................................................... 56  
Appendix B: Internal Review Board Approval Form ................................................................... 70  
Vita.................................................................................................................................................. 72
Abstract

Research on the various subtypes of aggression has documented differences in the experience of anger and the expression of angry aggression. Mixed proactive and reactive aggressive individuals exhibit reactive aggression but, unlike reactive aggressive individuals, fail to exhibit angry expressions or physiological arousal. Similar to the proactive group, individuals with psychopathic traits have been found to exhibit emotional underreactivity, and physiological underarousal, while still exhibiting reactive aggression. The present study examined 85 boys (ages 13 to 18) from a detention center. Three groups of aggressive boys were identified via cluster analysis based on the self-report of types of aggressive behavior: a primarily reactive aggressive group (n=29), a mixed reactive and proactive group (n=16), and a low aggressive group (n=40). The three groups were compared on aggressive responding (during a computerized provocation task with low and high provocation trials), on callous and unemotional traits (CU) and on psychophysiological indices of emotional reactivity. All aggressive groups showed greater aggressive responding to high provocation than to low provocation. The mixed aggressive group showed high aggressive responding across all provocation levels, including the no provocation condition, while the reactive aggressive group only showed high levels similar to the mixed aggressive group during low provocation. Unexpectedly, the reactive and mixed aggressive groups reported higher levels of CU traits than the other group. Although the groups did not differ on psychophysiological activity/reactivity, higher levels of CU traits were related to lower skin conductance responses to provocation. Thus, the contribution of high and low CU traits in the three groups to psychophysiological activity/reactivity was examined. Interestingly, the low and mixed aggressive groups who were high on CU traits had lower sympathetic arousal (indexed by skin conductance) and lower sympathetic reactivity to provocation. Thus, the mixed
aggressive group showed a general disconnect between their angry aggression (on the provocation task) and their sympathetic reactivity to provocation. However, this was true only if they also showed high rates of CU traits. These results suggest that interventions targeted toward individuals who exhibit particular subtypes of aggression may be more beneficial if the presence of CU traits is also considered.
Introduction

Understanding the development of extreme or persistent aggression in children may be of great importance for understanding juvenile violent criminal behavior (Office of Juvenile Justice and Delinquency Prevention, 1995). The cognitive and emotional factors that can lead to aggressive behavior must be understood with reference to the specific subtype of aggressive acts that they produce in order to develop appropriate psychotherapeutic treatments (Dodge & Pettit, 2003; Frick, 2001). Therefore, a review of the extant literature will begin with a description of the subtypes of aggressive acts and their concomitant cognitive, emotional, and physiological correlates.

Subtypes of Aggression in Children

Dodge and Coie (1987) identified two subtypes of aggression: reactive and proactive. Reactive aggression is characterized by impulsive defensive responses to a perceived provocation or threat (Dodge & Coie, 1987; Eisenberg & Fabes, 1992). Reactive (also referred to as impulsive or defensive) aggression is characterized by “hot blooded,” angry, and hostile responses, whereby an overreaction to minor or perceived provocation and intense physiological reactivity are often exhibited (Dodge & Coie, 1987; Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Hubbard et al., 2002). Additionally, reactive aggression has been 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).

Unlike reactive aggression, proactive (otherwise known as instrumental) aggression is not associated with provocation (Dodge et al., 1997). This type of aggression is defined as aggression in pursuit of an instrumental goal. Children who engage in instrumental aggression
tend to value aggression as an effective means of acquiring their desired goals more than do other children and they anticipate positive outcomes for their aggressive behavior (Dodge et al., 1997). These children are overly focused on the end goal and view aggression as an effective problem-solving strategy that will aid in obtaining their goals.

Subtypes of Aggression and Their Sequelae

Proactive aggression also differs from reactive aggression in its prognosis for antisocial outcomes. For boys, proactive aggression rated during preadolescence predicted delinquency, delinquency-related violence, and disruptive behaviors during mid-adolescence (Vitaro, Gendreau, Tremblay, & Oligny, 1998; Vitaro, Brendgen, & Tremblay, 2002; Brendgen, Vitaro, Tremblay, & Lavoie, 2003). In addition, proactive aggression at age 14 predicted criminal behavior in adulthood (Pulkkinen, 1996). In contrast, reactive aggression does not have such predictive utility (Vitaro et al., 1998; Vitaro et al., 2002; Pulkkinen, 1996). Vitaro, Brendgen, and Tremblay (2002) found that individuals who only acted aggressively in response to provocation were less likely to engage in delinquent acts as adolescents. Instead of delinquency-related violence, these children were more likely to engage in dating violence as adolescents (Brendgen et al., 2003). Dating violence may be more likely for reactive aggressive individuals due to the emotional intensity generated in such adolescent relationships. Experiencing high levels of emotional intensity can make responding aggressively in response to provocation more likely for reactive individuals (Lemerise & Arsenio, 2000; Thompson & Calkins, 1996).

Reactive Aggression and Emotional Reactivity

As suggested by these findings, emotion and emotion regulation processes may contribute to both the development and the expression of reactive aggression (see Lemerise & Arsenio, 2000). Differences in the expression of emotion have been found to distinguish the two
subtypes of aggression, whereby a dysregulation of angry or hostile emotions was characteristic of reactive, but not proactive aggression (Hubbard et al., 2002). Individuals who exhibited reactive aggression also showed the sharpest increase in nonverbal angry behaviors (such as throwing materials) throughout a competitive game played with a peer (Hubbard et al., 2002).

It is probable that a child who displays extreme negative emotional responses would evoke hostility from his or her environment, much more than a child who is low in negative emotionality (Schwartz et al., 1998). Moreover, experiencing high negative emotionality or being easily angered may predispose a child to cognitively ‘cue up’ former negative situations that had culminated in hostility (Lemerise & Arsenio, 2000). Importantly, both events could make an aggressive act become more likely (Dodge & Pettit, 2003; Lemerise & Arsenio, 2000).

Reactive Aggression: Heightened Physiological Reactivity

In addition to experiencing strong emotions, individuals who exhibit reactive aggression also show high physiological reactivity (Pitts, 1997; Hubbard et al., 2002). Physiological reactivity is measured as a change in the level of physiological activation to stimuli, indicative of a discrete response, when compared to a baseline period of relative quiescence. Two common indices of physiological reactivity are heart rate and galvanic skin response.

In one study, heart rate was recorded in children who were either primarily reactive or both reactive and proactive aggressive in response to various laboratory tasks (Pitts, 1997). The reactive group showed greater heart rate reactivity across tasks than the mixed group, who exhibited a stable response pattern regardless of the task. Recently, Hubbard et al. (2002) showed that aggression in response to provocation (i.e., reactive aggression) was accompanied by heightened physiological indices of arousal in children during a competitive game with a confederate. Specifically, children rated high in reactive aggression but low in proactive
aggression had the highest heart rates and showed a sharp increase in heart rate reactivity. Those high in reactive aggression showed lower skin conductance levels during baseline but they showed greater reactivity (Hubbard et al., 2002).

Reacting physiologically in response to provocation has also been shown to occur in those children who evidence a hostile attributional bias to social events (Williams, Lochman, & Barry, 2003). Children who responded with aggression to provocation, as compared to non-aggressive children, showed greater increases in their heart rates to the provocation and were more likely to have attributional biases. Therefore, not only was aggression predictive of greater physiological reactivity but attributional bias also showed a positive relationship with physiological reactivity (Williams et al., 2003). It is possible that strong physiological or emotional reactions to stressful situations can impede a reactively aggressive child’s attempts to regulate behavior, as well as emotion (Lemerise & Arsenio, 2000; Thompson & Calkins, 1996). Heightened arousal levels require greater attempts at regulation in order to maintain homeostasis. Consequently, the cognitive activity required to regulate emotional arousal can interfere with the cognitive processing of social stimuli which may result in aggressive responding (Lemerise & Arsenio, 2000).

**Proactive Aggression: A Mixed Subtype of Aggression**

Interestingly, those who engage in proactive aggression often also engage in reactive aggression, although the reverse is not true (Dodge et al., 1997). As a result, Hubbard et al. (2002) found a strong positive relationship ($r = .77$) between proactive and reactive aggression. Other investigators have also found such high correlations (Brendgen et al., 2003; Vitaro et al., 2002; Vitaro et al., 1998).
While some studies have found a small group of children with just proactive aggressive tendencies (Vitaro et al., 2002), other studies have failed to identify a proactive aggressive group who did not also evidence reactive aggressive behavior (Pitts, 1997; Cornell et al., 1996; Kruh, Frick, & Clements, 2005; Frick, Cornell, Barry, Bodin, & Dane, 2003). Thus, for the sake of the present paper, the proactively aggressive and the group who displayed a mix of proactive and reactive aggression will be discussed as a homogenous group, due to their similar personality characteristics and the relative rarity of children who display solely proactive aggressive behavior (Vitaro et al., 2002).

_Proactive Aggression and Underreactivity_

Proactive aggression has been uniquely associated with less emotional responses, as well as minimal physiological reactivity. Using a competitive game, children rated high in proactive aggression actually were less emotionally reactive, thereby displaying less nonverbal angry behaviors than those rated low in proactive aggression (Hubbard et al., 2002). Moreover, the group rated high in proactive aggression had the lowest heart rates throughout the game, and showed little to no heart rate reactivity (Hubbard et al., 2002).

Importantly, lower heart rates are characteristic of children with relatively fearless temperaments (Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984). Consistent with this finding, lower levels of fear are common in children who are proactively aggressive (Vitaro et al., 2002). This fearlessness may predispose the individual to act upon his or her whim, while failing to fear the punishment for violating social conventions (see Raine, 2002; Kochanska, 1997). Indeed, fearless children have been shown to be more difficult to socialize (Kochanska, 1997).
Importantly, this link between temperament and socialization may interact with the mode of discipline that a parent uses (Kochanska, 1997; Dadds & Salmon, 2003). A child with low fear may be less reactive to punishment, and therefore require stronger punishment to activate the stress response necessary to imprint the memory of the event in the brain (see Dadds & Salmon, 2003). A consequence of a lack of accompanying negative physiological or emotional response with antisocial behavior may be an inability to self-generate feelings of empathy or guilt the next time one engages in antisocial behavior. Indeed, the “somatic marker” hypothesis supports this theory. It proposes that an individual has a tendency to associate a behavior (i.e., its outcome) with a physiological response (Bechara, Tranel, Damasio, & Damasio, 1996). Therefore, the next time that the individual considers committing the behavior, he or she experiences the physiological response (the “somatic marker”) that originally accompanied the commission of the behavior. This re-experience may act to prevent the person from repeating the behavior (Bechara et al., 1996).

Feelings of guilt may, thus, become internalized when parents label the “marker” for the child. For example, feelings of empathy or guilt can often inhibit a child from stealing another child’s toy. When those feelings are absent, a child may act in accordance with his or her desires (i.e., dominated by a motivation to obtain rewards) without considering its effects on others or even the adverse consequences of his or her behavior.

**Proactive Aggression: Dissociation Between Physiological and Emotional Reactivity**

Based on Hubbard et al. (2002), it’s clear that individuals who evidence instrumentally-motivated aggression experience low physiological reactivity. Thus, they evidence low basal physiological activity, as well as little to no change from their baselines in response to stressful tasks. Yet if the evidence supports underarousal and underreactivity in proactively aggressive
children, then why do they also exhibit reactive aggression? Interestingly, in the Hubbard et al. (2002) study, proactive aggressive children showed a sharper increase in their *self-reported* anger throughout the competitive game when compared to those with a lower rate of proactive aggressive acts. However, their self-report of angry feelings was not commensurate with their display of anger during the game and their physiological reactivity.

Although these proactive aggressive children reported feeling angry during the game, they displayed fewer nonverbal behaviors usually associated with anger (such as handling the game materials roughly) than reactive aggressive children (Hubbard et al., 2002). Thus, the proactive aggressive children examined in Hubbard et al. (2002) appeared to be underreactive to provocation in the competitive game, when only examining their physiological reactivity (which showed little change). On the contrary, when examining their subjective reports of anger, they appear to be highly reactive. A physiological underreactivity and a flat emotional expression both concomitant with a strong subjective feeling of anger suggest a dissociation among the components of emotion for children with proactive aggression.

There is another area of research on individuals that seem to exhibit a flat affect, yet still engage in aggressive behavior and report anger (Cleckley, 1976; Steuerwald & Kosson, 2000; Patrick, Bradley, & Lang, 1993; Loney, Frick, Clements, Ellis, & Kerlin, 2003). This group of individuals has been labeled as showing psychopathy.

**Psychopathic Traits**

*Psychopathy and Aggression*

Psychopathic traits include a constellation of affective, interpersonal, and behavioral characteristics, such as lack of empathy and guilt, callousness, a poverty of emotions, and inadequately motivated and impulsive behavior (Skeem, Mulvey, & Grisso, 2003). One of the
most consistent findings in research on psychopathy is that individuals with psychopathic traits show high rates of aggression and violence (Kruh et al., 2005; Cornell et al., 1996; Serin, 1996; Serin, Peters, & Barbaree, 1990). Importantly, they seem to be particularly at risk for showing a combination of instrumental and reactive aggression. In a juvenile sample, Kruh et al. (2005) identified two subtypes of violent offenders: one group who was high on psychopathic traits committed instrumental violence and reactive violence, and another group who did not show these traits committed only reactive violence. Adult inmates with psychopathy also showed an increased tendency to engage in instrumental aggression (Cornell et al., 1996). This link between psychopathic traits and instrumental aggression is not only found in incarcerated samples. In a school-based sample of children, those children with conduct problems and psychopathic traits showed higher levels of both instrumental and reactive forms of aggression (Frick et al., 2003).

Individuals with psychopathic traits evidence a particular information-processing bias, similar to that associated with proactive aggression (Pardini, Lochman, & Frick, 2003). Specifically, incarcerated youth with psychopathic traits were shown to emphasize the positive outcomes of their aggressive behavior and to pay less attention to the adverse consequences (Pardini et al., 2003). In addition, one of the primary personality features used to characterize individuals with psychopathy is an emotional deficit (Cleckley, 1976). The presumption that individuals with psychopathy lack emotions was supported by Cleckley’s (1976) description of the psychopath’s “semantic dementia” and their superficial experience of emotions. The emotional deficits described by Cleckley included a lack of nervousness, a general poverty of major affective reactions, and a general incapacity for deep affectional bonds. As a result,
persons with psychopathic traits may also share an emotional deficit with persons who show instrumental aggression.

**Psychopathy and Underreactivity**

While there are only a few studies on the association between psychopathy and heart rate, there is a large body of literature that has established a highly reliable association between low resting heart rate and antisocial behavior or conduct problems (Raine, Reynolds, Venables, & Mednick, 1997; Hubbard et al., 2002). A review conducted by Raine (1993) found 14 studies that showed this association. Moreover, a meta-analysis conducted by Ortiz and Raine (2004) confirmed that the association is present in both youths and adults.

Two general theories have been advanced to explain the autonomic underarousal exhibited by antisocial individuals (see Williams et al., 2003): a fearlessness theory (reviewed previously) and a stimulation-seeking theory. The stimulation- or sensation-seeking theory postulates that low levels of arousal signal a physiological state that is similar to boredom (see Williams et al., 2003). The aversive sensation of low arousal then motivates the individual to increase his or her physiological level of arousal to a homeostatic level. This can be accomplished by engaging in stimulation-seeking behaviors or otherwise risky behaviors. In support of this theory, several studies have documented low heart rate levels in individuals who engage in risky professions (e.g., paratroopers; Cox, Hallam, O'Connor, & Rachman, 1983; McMillan & Rachman, 1987; Raine, 2002). A typical response to fear-inducing stimulus in individuals is an increase in heart rate and blood pressure, essentially mobilizing the body to “fight or flee.” However, to an individual with low arousal (and who is thereby stimulation-seeking), fearful stimuli may serve to elevate the stimulation-seeking individual’s arousal levels, thereby reducing the level of discomfort associated with low arousal. Consequently, thrill-
seeking behaviors may act as a negative reinforcer (Raine, 2002). Consistent with this possibility, one study found that preschool-aged children with low basal heart rates and externalizing behavior problems are more likely to prefer watching more intensely angry interactions between adults, as compared to those children with higher basal heart rate levels (El-Sheikh, Ballard, & Cummings, 1994).

Individuals with psychopathy show analogous physiological findings, whereby they not only show low basal levels of arousal, as indexed by either heart rate level or skin conductance levels, they also show little to no phasic activity (see Hare, 1978). Phasic activity is typically defined as a change in basal levels in response to a stimulus. Similar to the autonomic indices of underreactivity uncovered in individuals with instrumental aggression, patterns of physiological and emotional underreactivity have been shown in individuals with psychopathy (Patrick et al., 1993; Levenston, Patrick, Bradley, & Lang, 2000; Williamson, Harpur, & Hare, 1991; Loney et al., 2003). Patrick, Bradley, and Lang (1993) examined the reactions of criminals, with and without psychopathic traits, to unpleasant and pleasant pictures (in respect to neutral pictures). These investigators measured eyeblink startle potentiation (referred to as fear-potentiated startle), which is normally enhanced for unpleasant stimuli and inhibited for pleasant stimuli. Criminals without psychopathic traits showed a potentiated startle response to unpleasant images, presumably due to an elicitation of the “fight or flight” prepotent response. In contrast, pleasant images resulted in startle inhibition; responses to neutral images were linearly placed between the reactions to pleasant and unpleasant stimuli. In contrast, criminals with psychopathic traits showed a quadratic pattern of reactions to the pleasant, neutral, and unpleasant images, where they exhibited startle inhibition to both pleasant and unpleasant stimuli. Importantly, their response to unpleasant images, including images of weapons pointing directly at the viewer, was
the most different (exhibiting inhibition rather than potentiation) from the other criminals (Patrick et al., 1993). Thus, psychopathy was associated with a deficient response to threatening stimuli, but not to pleasant stimuli.

Levenston, Patrick, Bradley, and Lang (2000) sought to clarify which type of unpleasant stimuli would uniquely characterize the deficiency of the startle magnitude in individuals with psychopathy. They reported that directly threatening images potentiated the startle reflex in criminal psychopaths, although this response was not evident at shorter latencies between presentation of the image and the startle probe. However, unlike individuals without psychopathy, who showed potentiation of startle to victim scenes (some of which depicted mutilated bodies), individuals with psychopathy showed inhibition of startle. Moreover, individuals with psychopathy exhibited decreased heart rate in response to all images, regardless of valence, possibly indicating an orienting (i.e., attention) response rather than an expected fear or distress response (Levenston et al., 2000). Thus, criminal psychopaths were underreactive to victim scenes, as well as to threat scenes when initially presented.

A lexical decision task is a task that is designed, using words and non-words, to disguise the intent of examining emotional processing in antisocial individuals. During this task, individuals are asked to respond to whether a set of letters forms a word or not. Reaction times are then examined, whereby the typical response for the average person is to respond to the emotional words more rapidly (i.e., to show facilitation). This is presumably because of the automatic allocation of attention to motivationally significant stimuli (Williamson et al., 1991). Indeed, Williamson et al. (1991) found that adults with psychopathy failed to show a differentiation in reaction times to emotional and neutral words.
Adolescents with psychopathic traits also failed to show facilitation to words of negative valence on the lexical decision task (Loney et al., 2003). In fact, they exhibited slower response times to negatively charged words, suggesting that negative words were processed more extensively than neutral words (Loney et al., 2003). Thus, youths and adults alike did not show an immediate allocation of attention to negatively charged words, relying instead on more upper-level processing mechanisms. These mechanisms might allow for individuals who fail to experience an automatic biological response to be able to cognitively recognize emotional stimuli. Thus, individuals with psychopathic traits do not experience emotions, yet retain the knowledge of emotions. Consistent with this possibility, when adolescents are asked to rate the emotional valence of words, the ratings of those high on psychopathic traits did not differ from those low on these traits.

Another study examined reactions to facial expressions rather than to words. Adults with psychopathy showed a reduced ability to recognize fearful expressions (Blair, Colledge, Murray, & Mitchell, 2001). Additionally, Blair, Colledge, Murray, and Mitchell (2001) found that children with psychopathic traits had difficulty recognizing fearful and sad facial expressions. Children with psychopathic traits also were more impaired in the recognition of sad vocal inflections (Stevens, Charman, & Blair, 2001). However, no differences were evidenced in the recognition of angry facial expressions or vocal inflections (Blair et al., 2001; Stevens et al., 2001). Based on this study and that of Levenston et al. (2000), individuals with psychopathy appear to experience difficulties with the processing of emotional stimuli indicative of others’ distress, but do not have difficulties processing stimuli related to anger.
Psychopathy and Anger

In order to understand the relation between anger and psychopathy, it is necessary first to distinguish it from aggression (Felson, 2000). Anger is the emotion that, when experienced, may spur the individual to action. By contrast, other negative emotions may be associated with withdrawal instead of action (i.e., fear; Christie & Friedman, 2004). Aggression has been defined as the behavior with the intent of harming another person. Although anger can lead to an external expression of that anger, this is not always the case (Felson, 2000; Strayer & Roberts, 2004). That is, most people experience anger without acting aggressively. Also, there are some forms of aggression that may not be accompanied by anger, such as proactive or instrumental aggression.

Due to Cleckley’s (1976) description of psychopathy as lacking genuine expressions of emotion, including anger, it was presumed that the overt expressions of anger (e.g., facial expressions, gestures, verbalizations) were mere dramatic displays lacking affective bases (see Steuerwald & Kosson, 2000). Typically, an expression of anger or threat serves to inhibit agonistic behavior in primates (see Izard, 1991). For example, a child who demands a toy from a peer should elicit resistance and anger from the peer. The child with psychopathic traits would likely show an expression of anger to gain compliance from his or her peer with such a reaction.

Some psychological disorders, including psychopathy, were described by Berenbaum et al. (2003) specifically with regard to disturbances either in valence or emotional intensity/regulation. Various disturbances are distinguished by the extent to which unpleasant and pleasant emotions are affected. An emotional valence disturbance is characterized by an unbalanced intensity in the expression of one form of emotion, either unpleasant or pleasant, over the other form. Unpleasant emotions include anger, fear, sadness, anxiety, guilt, and shame,
whereas pleasant emotions include happiness, pride, love, and interest. Berenbaum et al. (2003)
classify antisocial personality disorder as a disturbance in emotional valence, characterized by
normal yet predominant levels of pleasant emotions.

In contrast to an emotional valence disturbance, a disturbance in intensity/regulation is
characterized by excessively high or low intensity pleasant and unpleasant emotions. A
disturbance in intensity is characterized by extremes in both polar ends, and emotion regulation
can either be excessive or inadequate. Thus, disturbances in intensity/regulation can be
categorized as either hyporeactive or hyperreactive. For example, depression and the flat-
affect associated with it are indicative of hyporeactivity (Berenbaum et al., 2003).

However, several investigators assert that individuals with psychopathic traits do
experience anger (Steuerwald & Kosson, 2000). McCord and McCord (1964 as cited in
Steuerwald & Kosson, 2000) argued that, in individuals with psychopathy, anger frequently
results from their ineffective coping strategies to handle everyday frustrations. In spite of this,
the heart rate reactivity literature, which has historically focused on the experience of fear and
anxiety, has left virtually unstudied the physiological experience of anger in individuals with
psychopathic traits.

One notable exception is a study of subjective experiences of anger and of bodily
sensations during anger-evoking scenarios in adults classified as psychopathic(Blackburn & Lee-
Evans, 1985). Aggressive responses to the hypothetical scenarios were also examined.
Individuals with psychopathy, as well as other antisocial individuals, reported more intense
reactions (i.e., more anger and aggressive responses) than controls. However, individuals with
psychopathic traits differed from the other antisocial individuals in their reports of somatic
arousal: individuals with psychopathic traits reported fewer somatic arousal symptoms than antisocial individuals without psychopathy (Blackburn & Lee-Evans, 1985).

Similarly, Gottman et al. (1995) observed couples, who had abusive histories in their relationships, engage in a heated argument. All the men were rated as demonstrating extreme expressions of anger during the argument. However, the wife batterers who showed psychopathic traits exhibited decreased heart rates during the marital conflict, in contrast to the increase in heart rate exhibited by the other men (Gottman et al., 1995). Therefore, a reduction in emotional reactivity characterized those with psychopathic traits, despite the fact that their emotional expression suggested anger.

A Dissociation between Expressed and Experienced Emotion in Psychopaths

As suggested by the results found with proactive aggressive children (Hubbard et al., 2002) and with individuals with psychopathic traits (Gottman et al., 1995; Blackburn & Lee-Evans, 1985), a disconnection seems to exist between the physiological response indicative of emotional experience and the expression of emotion in some individuals. Indeed, Cleckley (1976) proposed that the linguistic and experiential components of emotion are discordant in individuals with psychopathy. Some investigators have suggested that the individual with psychopathy “knows the words but not the music” (see Hare, 1993): he or she may cognitively recognize emotions, though they may not actually experience them. Thus, these individuals may show behaviors suggesting emotional experience that are unaccompanied by any genuine experience of the emotion, such that they may express “vexation, spite, quick and labile flashes of quasi-affection, peevish resentment, shallow moods of self-pity, puerile attitudes of vanity, and absurd and showy poses of indignation” (Cleckley, 1976).
In support of the dissociation between emotional experience and emotional recognition, research has indicated that individuals with psychopathy were able to accurately interpret the emotional significance of slides (Christianson et al., 1996), while still exhibiting reduced physiological responding to those slides (Blair, Jones, Clark, & Smith, 1997; Hare, 1978; Patrick, Cuthbert, & Lang, 1994; also see Lykken, 1995). Additionally, in spite of showing deficits in the emotional processing of words, both adults (Williamson et al., 1991; Patrick et al., 1993; Christianson et al., 1996) and adolescents (Loney et al., 2003) with psychopathic traits were able to effectively identify and rate emotional words. Patrick et al. (1993) also observed a dissociation of self-report and emotional expression from physiological reactivity in individuals with psychopathy, whereby despite showing an abnormality in the physiological processing of emotional stimuli, the people with psychopathic traits were able to recognize the emotional content of such stimuli. Finally, individuals with psychopathy reported emotions similar to individuals without psychopathy, while still reporting less intense bodily sensations in reaction to emotional film clips (Pham, Philippot, & Rime, 2000).

The Present Study

Based on this research, it is proposed that the arousal experienced in proactive aggressive individuals in response to unpleasant stimuli is weak. In contrast, reactive aggression is proposed to be characterized by an emotional valence disturbance that primarily involves unpleasant emotions, whereby they experience greater arousal to unpleasant or undesirable outcomes. As a result, reactive aggressive individuals are prone to experience great increases in arousal concurrent with intense anger to undesirable outcomes, and they may experience difficulty in regulating their arousal. Proactive aggressive individuals who experience an undesirable outcome remain at a low level of arousal and do not experience a spike in unpleasant
emotions. Instead, their aggression results from poor regulatory behaviors. Moreover, based on the literature, both reactive aggression and proactive aggression show low levels of basal arousal though they clearly differ with regard to their reactivity. The low reactivity in those who exhibit proactive aggression is similar to the emotional deficits found in individuals with psychopathic traits. Consistent with this link, individuals with psychopathic traits are more likely to display proactive aggression than are those without psychopathic traits.

Taken together, this research could explain a) why proactive aggressive individuals also show reactive aggression, despite showing low reactivity and b) why persons with psychopathic traits show angry responses despite a deficit in their emotional responsiveness. Both are hypothesized to show a disconnection between their emotional experience and their emotional expression, as indicated by low reactivity and poor regulatory controls of aggressive behaviors. In contrast, individuals who solely engage in reactive aggression typically show anger accompanied by high reactivity, suggesting that their aggression results from a dysregulation of their heightened physiological arousal to unpleasant events. Although research has documented emotional processing deficits in those with psychopathic traits, existing research has failed to examine angry responses in youth high on psychopathic traits.

The present study examined the emotional responses of 85 boys held in a juvenile detention center for committing serious delinquent acts. Participants completed a reaction time computer provocation task. Callous-unemotional (CU) traits were measured as the affective component of psychopathic traits. Physiological responses (heart rate and skin conductance level) to the laboratory computer task were measured.

The current study tested five main hypotheses. The first hypothesis was that youth who self-report high levels of proactive and reactive aggression would display aggressive responding
during the computer task. A low aggressive group was hypothesized to show lower levels of aggression during the computer task. Second, the group high on both forms of aggression was predicted to show high rates of CU traits. Third, both groups of highly aggressive children were predicted to show lower resting levels of arousal. Fourth, children characterized by reactive aggression were predicted to evidence greater physiological reactivity during the computer task, particularly when examining their discrete responses to provocation, than both the other groups. Fifth, the mixed group was hypothesized to exhibit the lowest levels of physiological reactivity in response to provocation.

Method

Procedure

All procedures were approved by the Institutional Review Board of the University of New Orleans. All parents of youth referred to Rivarde Detention Center, who had valid phone numbers or addresses, were contacted by a detention center staff member. The staff member told the parent or legal guardian that a study was being conducted by researchers at the local university, and asked permission to forward their phone number to the researchers. Those parents who agreed to be contacted by the researchers were phoned and had the study procedures explained to them. 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.

Children were individually tested in a designated room at the detention center by two examiners. Prior to the computer provocation task (i.e., CRTT), all procedures were reviewed with the child and an assent form was explained and signed. During the CRTT, heart rate reactivity and skin conductance responses were measured as an index of physiological reactivity.
An investigator placed three Silver-Silver Chloride (Ag-AgCl) electrocardiogram electrodes (measuring heart rate) on the child’s torso. In order to measure skin conductance, two Ag-AgCl electrodermal conductance electrodes were attached to the two middle phalanges of the non-dominant hand.

Each participant was read the script about the “game” (the CRTT) and was told that sensors would record their physiological activity while they played. They were told that they would be competing against another boy of about the same age in another facility.

After completion of the CRTT, each participant completed the CRTT deception-assessment questionnaire and he was told that he won the game and that he would receive a candy bar later in the day. The participant then completed the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) with the experimenter. Later in each day, that day’s group of participants (attendance ranging from one to four) who had completed the CRTT was brought together to complete the Inventory of Callous-Unemotional traits, the Self-Report of Delinquency, and the Peer Conflict Scale. The questionnaires were read aloud to all participants by a researcher, and a different researcher was available to help answer participant questions and to ensure completion of every item. The group was then given soft drinks and their respective candy bars as compensation. After the release of the participant from the Rivarde Detention Center, a letter expressing gratitude for their participation and debriefing the participant about the deception used for the CRTT was sent to the participant’s home.

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. The sample size was reduced to 100 as a result of
missing data: during the lunch break before questionnaires were to be completed, one participant was separated from the other residents in “lock down,” so questionnaires could not be completed with him. The other had data missing due to experimenter error. All youth who had a Peabody Picture Vocabulary score less than 66 (n=13) were eliminated from analyses due to concerns about their ability to understand the questionnaires. Two other participants were eliminated from subsequent analyses because their aggressive responding on the competitive provocation task was below three standard deviations from the group mean, and it was unclear whether they understood the task (Miller & Lynam, 2003).

The final sample included 85 boys between the ages of 13 and 18 (M=15.53, SD=1.28), who were detained at Rivarde Juvenile Detention Center. Typically, after being arrested in Jefferson Parish, children are either released into their parents’ custody to await trial, or they are detained at the Rivarde Juvenile Detention Center. The decision to detain rests on the history of previous arrests and on the severity of the crime. Table 1 notes the characteristics of the sample. The majority (68.6 %) of the sample self-identified as African American and 22.1 % were Caucasian. Only 4.7 % of the sample was Hispanic, 2.3 % Native American, and 2.3 % chose the “other” category. Based on self-report, 17% percent were taking psychotropic medications, 50 % had been in special education classes in school before going to the detention center, and 68.6 % had received mental health services. Also based on self-report, 84% percent of the sample had parents who were divorced or never married, and 70% lived with just their biological mother or with their mother and stepfather. According to participants, at least one of each of the youth’s guardians was employed (82 % of male guardians and 70 % of female guardians). Most (70 %) of the offenses committed by samples of detained boys at this detention center were non-violent. A review of the Office of Youth Development’s (OYD) population revealed that 64 %
of the institutionalized population of juvenile offenders in Louisiana is incarcerated for non-violent offenses. However, 51% had a history of at least one violent offense based on chart review.

Measures

*Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1997).* The PPVT is a brief norm-referenced measure of verbal ability for those ages 2.5 to 90 years. This test assesses a child’s receptive language abilities. The standardized scores of the third revision of the PPVT correlated .90 with the Full-Scale IQ scores from the Wechsler Intelligence Scale for Children, Third Revision in a sample of 41 children ages 7 year, 11 months through 14 years, 4 months (Dunn & Dunn, 1997). The correlation with Verbal Scale IQ was slightly higher than the correlation with Performance Scale IQ (.91 and .82, respectively). The PPVT was also validated using the Kaufman Adolescent and Adult Intelligence Test with 28 adolescents age 13 years through 17 years, 8 months (Dunn & Dunn, 1997). The correlation with crystallized IQ was slightly higher than with fluid IQ (.87 and .76, respectively). It was correlated .85 with the composite IQ score.

*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 (Waschbusch et al., 2002; Murphy, Pelham, & Lang, 1992). Each participant was read a script about the game. The task consisted of a 10 to 15 minute reaction-time game played with a hypothetical opponent. Participants were seated at a table with a desktop computer, equipped with audio speakers and a microphone, to play the game. They were told that they would be playing against a boy of the same age at another facility whose computer was linked to theirs. They were told that the computer compares their button press reaction times with that of the
hypothetical peer and that, when they won, they would be awarded 50 points and they could take away 0-100 points from the other boy. They could also send a short verbal message to the other player. Participants were told that the other boy could take away 0-100 points when he won. Further, pre-recorded verbal messages by a young adult male from the local area were played over the computer when a loss occurred. Two losing trials never occurred in succession. Lastly, participants were told that those youth who scored at least 750 points at the completion of the game would get their choice of candy bar. In actuality, however, all participants received a candy bar.

The game was pre-programmed for the same 16 losses out of 48 trials for each participant. Eight of 16 loss trials were high provocation trials, whereby a highly aversive verbal message (e.g., “I beat you again, dork! You lose another 80 points”) was broadcast and between 80-100 points were subtracted by the hypothetical 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 just take 10 points”) was broadcast and between 0-20 points were subtracted by the hypothetical opponent. For each participant, the computer indicated a win on the remaining 32 of the 48 trials, resulting in a net win of 780 points. Immediately after the win signal, the participant was allowed to record a verbal message via the computer for his “opponent” and was allowed to take between 0 and 100 points from the other boy. However, only 10 percent recorded a message for their opponent. Total aggressive responding was measured by the number of points taken away from the hypothetical peer on the win trials. These separate aggression measures were also computed based on the level of provocation. A measure of aggressive responding to no provocation was obtained by examining aggressive responding during the first three trials, which only included win trials. In addition, two measures of
aggressive responding to provocation resulted from examining aggressive responding during low provocation and during high provocation trials. As another measure of reactivity, during each of the 16 loss trials, the examiner electronically placed a mark on the psychophysiological record, as the data scrolled across the screen, to indicate the end of each taunt received by the participant to later calculate their emotional responding offline.

This task was chosen because it has been validated with adults and children alike (Taylor & Gammon, 1975; Zeichner & Pihl, 1979; Hubbard et al., 2002; Murphy et al., 1992; Pelham et al., 1991). Differences have been shown in boys with and without disruptive behavior disorders in their level of aggressive responding to both high and low provocation trials (Waschbusch et al., 2002). Giancola and Chermack (1998) have argued for the construct validity of competitive tasks such as this, and Anderson, Lindsay, and Bushman (1999) have found support for laboratory tasks on aggression by performing meta-analyses and finding that the results are comparable to results in field studies on aggression. Consistent with the definition of aggression as intent of harming another person, the intentional removal of points from one’s opponent ostensibly harms the opponent’s aim to win and gain a prize (Giancola & Chermack, 1998).

Participants were read the following instructions:

“You will be playing a computer game with another boy who is in another facility. In the game, both of you can win and lose points. The game is set up to see how fast you can respond to a command from the computer. You place your hand here and after you see “Ready” “Set” “Go,” a target will appear on the computer screen. When you see the target, you press the space bar as fast as you can. When you push the space bar faster than the other boy, you win that time. You get 50 points every time you win, and you can record a 10 second message.
that will be played for the other boy. In the message, you can tell him whether you are taking away any points from him, and if so, how many. You can take anywhere from 0 to 100 points from the other boy, in steps of 10. So on the times you win you can decide to take away 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 points from the other boy. After you win a trial, you decide how many points you want to take away from the other boy, and I will put it into the computer. Each time the other boy pushes the space bar faster than you do, he wins 50 points, and he will get to take away points from you. How many points he decides to take away from you each time he wins will show up on the counter in the top right hand corner of the screen. If you score at least 750 points, you will get your choice of candy bar that you’ll get this afternoon, where you will also fill out some questionnaires.”

The ultimate goal of measuring aggressive responding was never mentioned to the participants. In order to aid deception, the examiner carried a cellular phone, which was connected to the computer and simulated an Internet connection with the other computer at the hypothetical other facility to start the game. The simulation included a scripted problem with the connection with the other facility, which was subsequently resolved in front of the participant. After completion of the computer game, children completed a questionnaire to determine whether the deception was successful.

*Evaluation of instructional deception.* After completion of the session, participants were given a questionnaire where they were asked 1) to describe the other person with whom they were paired, 2) to estimate whether they had subtracted more or less money than the other person, and 3) to speculate as to the purpose of the study. This questionnaire is used routinely to
assess whether the participant maintained a belief in the existence of another person with whom they played (Pope, Kouri, & Hudson, 2000).

Peer Conflict Scale (PCS; Marsee, Kimonis, & Frick, 2004). The Peer Conflict Scale (PCS) was developed to overcome the limitations of previous measures of reactive and proactive aggression (Little, Jones, Henrich, & Hawley, 2003). Specifically, 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, but also impulsive, thoughtless 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, proactive, overt, and relational aggression from existing scales, including the Aggressive Behavior Rating Scale (Brown, Atkins, Osborne, & Milnamow, 1996), the Aggressive Subtypes Scale (Dodge & Coie, 1987), the Direct and Indirect Aggression Scales (Bjorkqvist, Lagerspetz, & Osterman, 1992), and aggression scales created by Little et al. (2003), Crick and Grotpeter (1995) and Galen and Underwood (1997), were pooled and items that were not clearly related to harm were deleted. Second, items were reworded to ensure that there was direct correspondence between overt and relational items, such that for each reactive overt item there was an analogous reactive relational item, and for each proactive overt item, there was an analogous proactive relational item. A team of faculty, graduate, and undergraduate students then reviewed these items to ensure that the wording was simplified and developmentally appropriate. This process
led to the creation of the PCS that includes ten items in each of the four categories: proactive overt (“I carefully plan out how to hurt others”), proactive relational (“I gossip about others to become popular”), reactive overt (“If others make me mad, I hurt them”), and reactive relational (“If others make me mad, I tell their secrets”). Only the overt scales were examined in the present study. One item (“I like to hit kids smaller than me”) was removed from analyses because its variance was 0. Cronbach’s alpha was examined and both the proactive and reactive overt scales showed good internal consistency (α’s = .77 and .86, respectively).

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 CU scale 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 with conduct problems that are more severe than other children with conduct disorder (Christian, Frick, Hill, Tyler, & Frazer, 1997).

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 based on a factor analysis of parent and teacher ratings on the APSD, using the four items that loaded significantly on the CU scale 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”). 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 (corrected item total correlations were -.04 and -.27, respectively), and thus were removed. The ICU score was the sum of the remaining 22 items (reverse-scoring 12 of the items), which showed acceptable internal consistency (α = .72).

Self-Report of Delinquency (SRD; Elliott & Ageton, 1980). The SRD was developed from a list of all offenses reported in the Uniform Crime Report with a juvenile base rate of greater than 1% (Elliott & Huizinga, 1984) and it lists 36 questions about illegal juvenile acts. The youth reports whether or not a specific act has ever occurred, the number of times the act has occurred, and the age at which the act first occurred. The general delinquency scale totals the number of delinquent acts across all items (Krueger et al., 1994). This scale assesses for the frequency of specific types of delinquent acts, including drug offenses (9 items), violent offenses (8 items), property offenses (10 items), status offenses (4 items), and sexual deviance (3 items). Drug offenses, property offenses, status offenses, and sexual deviance items were combined to create a non-violent offenses variable. However, the one sexual deviance item (“Have you ever had sexual intercourse with someone against their will”) relating to the use of violence was eliminated due to a variance of 0. Thus, summing the respective items created a total general delinquency scale, a violent delinquency scale, and a non-violent delinquency scale. The violent delinquency scale showed moderate internal consistency (α = .62), while the total and non-violent scales showed good internal consistency (α’s = .87 and .84, respectively).

Autonomic Psychophysiology. The electrocardiogram (ECG) was recorded via three electrodes placed in a modified Lead II configuration over the distal right collarbone, lower
left rib, and lower right rib (ground). Electrodermal activity (EDA) was recorded via two electrodes placed on two fingers of the non-dominant hand.

The ECG and EDA were recorded using Thought Technology’s ProComp Infinity encoder connected to a laptop computer (Pentium 4, 256MB RAM) equipped with Biograph Infinity software (versions 1.0.2 and 2.0.1). Sampling for ECG was set at 2048 Hz for data processing and EDA was set at 256 Hz. Editing the ECG files consisted of scanning the data for outlier points with respect to adjacent data and marking the points for exclusion in any analyses. Heart rate (HR) means were derived from the ensemble-averaged ECG for the entire task duration. Skin conductance level (SCL) means were derived from EDA for the entire task duration.

Phasic activity, also referred to as physiological reactivity, is usually measured as a deviation, either a decrease or an increase, from a control value often derived from a resting state, and is presumed to reflect an individual’s response to an environmental stimulus (Stern, Ray, & Quigley, 2001). Reactivity has been regarded as a stable pattern of an individual’s response tendencies that reflects temperamental characteristics (Porges, 1996; Kagan, Reznick, & Snidman, 1990; Calkins & Dedmon, 2000). Given that autonomic measures, such as heart rate and skin conductance, are noninvasive, they have been the most widely studied indices of physiological reactivity. When in a resting state, the parasympathetic branch of the autonomic nervous system is more engaged than the sympathetic branch. Since the parasympathetic nervous system regulates heart rhythm via the 10th cranial nerve (the vagus nerve), this serves to decrease heart rate. However, when exposed to stress, there is a surge of sympathetic activation, which increases cardiovascular output and skin conductance (Stern et al., 2001).
After a 10-minute stabilization period, autonomic activity (i.e., heart rate and skin conductance) 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. Heart rate (number of beats during the 3-minute period divided by the number of minutes) and SCL (average level during the 3-minute period) provided baseline HR and baseline (i.e., tonic) SCL. Heart rate and SCL during the CRTT provided phasic HR and phasic SCL. The changes (0.01 microsiemens or greater) in level after 1 second but before 4 seconds of the end of low-provocation and high-provocation taunts, was obtained and averaged as the dependent measures of skin conductance response (SCR) to low provocation and SCR to high provocation (Stern et al., 2001). Measuring SCR allows for more discrete responses to specific provocation levels that may provide a better index of emotional reactivity.

Stern et al. (2001) suggest two ways in which to analyze phasic HR activity, which can be influenced by initial values (baseline values). Analyses involving change scores, where baseline values are subtracted from phasic values, assume independence of these measured values. However, high levels are less likely to increase further and low levels are less likely to decrease further as a result of homeostatic mechanisms. For example, a change in HR from 50 to 65 may require less metabolic energy than a change from 100 to 105. In order to compare individuals who may begin with varying initial levels, Stern et al. suggested that baseline levels be entered as covariates in an Analysis of Covariance instead of using change scores (Stern et al., 2001). According to Stern et al. (2001), because skin conductance is unaffected by initial values, baseline levels are independent from task levels. Thus, a change from baseline to the CRTT in mean SCL was calculated as the SCL reactivity to the game (called phasic SCL).
Results

Data Inspection

Only 10 percent of the participants chose to record a message for their “opponent.” There was some evidence that 8 participants might have suspected that they were playing against a computer and not a real person. On the deception evaluation questionnaire, one participant stated that he was playing against a computer when asked to describe his opponent. Two others expressed that it might be a computer. The other 5 participants characterized their opponent as a real person, but had made comments during the game that they thought it might be a computer. Consistent with Pope et al. (2000), participants were judged to have correctly guessed that their opponent was a computer 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, all eight participants were included in analyses. Nevertheless, all main analyses were repeated eliminating these eight participants and the results were similar to those presented (e.g., number of prior arrests was still positively related to aggressive responding during no provocation trials, $r(77) = .25$ from $r(85) = .27$). Outliers were identified by examining values that were greater than three standard deviations above or below the sample mean. Using these criteria, a few were identified with respect to the psychophysiological indices: one phasic HR, two baseline SCL, one SCR to high provocation, and three SCR to low provocation scores. These scores were not included in analyses.

Validation of the Provocation Task

Table 2 provides the distribution of the primary variables used in analyses. As a group, the participants were expected to increase their psychophysiological activity as well as their aggressive responding to the CRTT, in response to increasing levels of provocation. Paired-
samples t-tests revealed that physiological activity increased from the baseline period immediately before the CRTT to the time during the CRTT. Baseline and phasic heart rate (HR) were significantly different ($t(83)=3.79, p < .001$) and baseline and phasic skin conductance level (SCL) also differed significantly ($t(82)=10.43, p < .001$). Mean skin conductance response (SCR) to high provocation (hi prov) were significantly higher than to low provocation (lo prov) ($t(79)=4.86, p < .001$).

Table 2 also lists the results of paired-samples t-tests that served as manipulation checks for the effects of the level of provocation on aggressive responding. Mean aggressive responding differed across all pairwise comparisons. Aggressive responding was greater after low provocation trials as compared to no provocation trials ($t(84)=2.17, p < .05$), was greater after high as compared to low provocation trials ($t(84)=9.20, p < .001$), and greater after high as compared to no provocation trials ($t(84)=8.36, p < .001$).

The CRTT’s construct validity was examined by correlating task performance with physiological indices, measures of violent and antisocial behavior, and callous-unemotional traits. All correlational analyses with phasic HR were performed while controlling for baseline HR. As shown in Table 3, only one of the psychophysiological indices was related to aggressive responding on the task. Low baseline heart rates characterized those who exhibited high aggressive responding to low provocation ($r(85)=-.23, p<.05$). ICU scores were unrelated to aggressive responding. Non-violent delinquency scores were negatively related to aggressive responding at low provocation ($r(85)=-.22, p<.05$). More non-violent delinquent acts were

1 Baseline HR was significantly and negatively correlated with age ($r(85)=-.27, p<.05$). All analyses with the psychophysiological indices were repeated controlling for age and the results were similar to those presented.
associated with less aggressive responding on the CRTT. Number of prior arrests was positively related to total aggressive responding \( r (85) = .30, p < .01 \), aggressive responding to low provocation \( r (85) = .33, p < .01 \) and to no provocation \( r (85) = .27, p < .05 \).

Cluster Analysis to Form Aggressive Groups

Prior to conducting a cluster analyses on the two subscales (proactive overt and reactive overt aggressive subscales) of the PCS, the subscale scores for the 85 participants were first converted into standard \( (z) \) scores. A two-stage approach that is described below was then used to ascertain whether distinct types of aggressive groups could be identified based on these standard scores.

First, the results of four K-means cluster analyses were examined. The K-means cluster analysis is a non-hierarchical iterative-partitioning procedure conducted with the SAS FASTCLUS procedure (SAS 8.0). In the k-means method, the approximate expected overall \( R^2 \), and the cubic clustering criterion were calculated for sets of two, three, four, and five clusters. The change in \( R^2 \) and cubic clustering criterion are shown in Figure 1 and Figure 2 for all four k-means cluster analyses. The cubic clustering criterion is an index that is based on the amount of variance explained by a cluster relative to the amount of variance that would be expected if the clusters were drawn from a random, uniform hyper-rectangular distribution. Based on these indices, the four-cluster solution was chosen because the overall \( R^2 \) (Figure 1) and the cubic clustering criterion (Figure 2) increased significantly from the specified three- (.68 and 2.4) to four- (.77 and 4.2) cluster result. Additionally, in this cluster solution, the cluster centers for the primarily reactive group failed to show a distinct separation between the means for reactive and proactive scores. Specifying the four-cluster solution resulted in some of the cases from the reactive group to be separated into a combined proactive and reactive aggression group (n=12),
which also resulted in a more distinct primarily reactive group (n=29). Of importance, the five-cluster solution resulted in a decrease in the cubic clustering criterion.

The four-cluster solution revealed a primarily reactive cluster (n=29), a low aggressive cluster (n=40), and two mixed clusters differing largely in the severity of their aggression: one lower (n=12) and one greater (n=4) in severity. The four-cluster solution resulted in a pseudo $F$ statistic and approximate expected overall $R^2$ of 135.02 and .77, indicating that the k-means procedure had produced distinct PCS types that adequately explained large proportion of the covariation among the scores of the four subscales. To prevent the possibility that the first few cases selected influenced the cluster iterations and cluster centers, the cluster analyses were repeated twice after resorting the data set and identical results were found across these analyses

Based on cluster analyses involving clinical and community samples (Kochenderfer-Ladd, 2003; Vitiello et al., 1990), three groups were expected to emerge (i.e., reactive aggressive, mixed aggressive group, and non-aggressive). However, two groups emerged in the four-cluster solution that had mixed elevations that differed in severity. Thus, the two mixed proactive/reactive clusters were combined, resulting in a group labeled mixed aggressive (n=16). The group with low scores on both was labeled low aggressive (n=40), and the group with elevated scores on the reactive subscale was labeled reactive only (n=29). Means and standard deviations of the three groups are noted in Table 4. A one-way analysis of variance (ANOVA) revealed that the three groups in fact differed on reactive and proactive overt aggression scores $(F (2,84) = 121.80, p < .001$, and $F (2,84) = 108.59, p < .001$, respectively). Post hoc paired comparisons were made using Tukey's Honestly Significant Difference (Tukey’s HSD). These post hoc comparisons demonstrated that the mixed group had significantly higher means on both
proactive and reactive aggression than the reactive aggressive only groups, who had significantly higher means on both proactive and reactive aggression than the low aggressive group.

Demographic and background characteristics were compared across groups. As shown in Table 5, the groups did not significantly differ on age, ethnic minority status, PPVT, income, number of prior arrests, current use of medication, or a history of special education or mental health services.

In order to validate the three groups, a one-way ANOVA was performed on the self-report of delinquency scores (see Table 6). Total delinquency, violent delinquency, and non-violent delinquency scores all differed across aggressive groups \(F(2,84)=15.50, p<.001;\) \(F(2,84)=19.81, p<.001;\) \(F(2,84)=9.61, p<.001\). Paired comparisons revealed that for all delinquency variables, the two high aggressive groups differed from the low aggressive group. However, only for violent delinquency were the means for the two high aggression groups significantly different from each other, with the mixed aggressive group reporting a higher level of violence.

**Aggression Clusters and Aggressive Responding on the Provocation Task**

The first hypothesis predicted that the three aggressive groups would differ on aggressive responding on the provocation task, such that both the mixed and reactive aggressive groups would show higher levels of aggressive responding than the low aggressive group, yet would not differ significantly from each other. Aggressive responding was analyzed in 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. The results are noted in Table 7. The sphericity assumption was not met so the Greenhouse-Geisser correction was applied. The main effect of level of provocation on aggressive responding was
significant \((F(1.69,138.89)=35.27, p<.001, \text{Eta}^2 = .30)\). The significant main effect for level of provocation was analyzed by repeated contrasts. Effect sizes were computed as partial Eta squared values. The contrasts indicated that there was a significant increase in aggressive responding from low provocation \((M = 65.21, SD = 27.80)\) to high provocation \((M = 88.90, SD = 14.34); F(1,82)=67.17, p<.001\). This effect of level of provocation accounted for 45% of the variability in aggressive responding. Aggressive responding at no provocation \((M = 56.94, SD = 38.36)\) was lower than that at low provocation, but they did not differ significantly from each other \((F(1,82)=2.64, p=n.s., \text{Eta}^2 = .03)\). The between-subjects main effect also did not reach significance \((F(2,82)=1.20, p=n.s., \text{Eta}^2 = .03)\).

Of importance, the interaction examining the effects of level of provocation across the three aggressive groups was significant \((F(3.39,138.89)=2.62, p<.05, \text{Eta}^2 = .06)\). The interaction is plotted in Figure 3. The significant interaction was also analyzed by repeated contrasts. Effect sizes were computed as partial Eta squared values. The contrasts indicated that there was a difference in aggressive responding across the groups from no provocation (low aggressive: \(M = 54.08, SD = 37.33\); reactive only: \(M = 51.38, SD = 41.00\); mixed aggressive: \(M = 74.17, SD = 32.94\) to low provocation (low aggressive: \(M = 59.72, SD = 28.96\); reactive only: \(M = 71.03, SD = 24.13\); mixed aggressive: \(M = 68.36, SD = 30.05\); \(F(2,82)=3.06, p<.05\)). This interaction effect accounted for 7% of the variability in aggressive responding. However, there was no significant interaction across groups from low to high provocation trials \((F(2,82)=1.14, p>.05, \text{Eta}^2 = .03)\); thus, the effect of the change in provocation from low to high had a similar effect across the groups. As illustrated in Figure 3, the reactive aggressive only group was initially low in aggressive responding during no provocation trials, but the group showed a steady increase in aggressive responding to each increase in provocation. The low aggressive
and mixed aggressive groups showed a similar profile across the three levels of provocation. They both changed very little from no to low provocation trials, yet increased their aggressive responding to high provocation. Thus, all three aggressive groups increased their aggressive responding to a high level of provocation. However, the mixed aggressive group was high initially in aggressive responding, even when there was no provocation.

*Aggression Clusters, Callous-Unemotional Traits, and Psychophysiological Indices*

The second hypothesis predicted that the mixed aggressive group would report higher scores on the ICU than the other two groups. A one-way ANOVA performed on the ICU scores revealed that the groups differed on their report of callous-unemotional traits ($F(2,84)=5.01$, $p<.01$). However, as noted in Table 6, pairwise comparisons revealed that both the reactive only and the mixed aggressive groups had higher scores than the low aggressive group. However, contrary to predictions, the two high aggression groups did not differ significantly from each other.

The third hypothesis predicted that both groups of highly aggressive children would show lower baseline HR and SCL. Children characterized by reactive aggression were predicted to evidence greater physiological reactivity (i.e., greater phasic HR and change SCL) during the computer task. They were also predicted to show greater skin conductance responses to provocation than both the other groups. The mixed group was hypothesized to exhibit the lowest levels of physiological reactivity to provocation. All analyses with phasic HR were performed using analyses of covariance (ANCOVAs), covarying baseline HR. As shown in Table 6, there were no significant differences across aggression clusters for any of the physiological indices, either at baseline or during the provocation task.
Post-Hoc Analyses

An attempt was made to understand the lack of any significant differences across the aggressive groups on physiological reactivity. Given the high ICU scores for both reactive only and mixed aggressive groups and the theoretical relation between callous-unemotional traits and physiological arousal, the relation between ICU scores and the psychophysiological indices were explored. The zero-order correlations are noted in Table 8. These correlations revealed a significant and negative correlation between the ICU scores and the averaged event-related skin conductance responses in response to high provocation ($r(83) = -.23, p < .05$). Higher ICU scores were related to lower average skin conductance reactivity when exposed to high provocation messages. Although nonsignificant, all other relations with psychophysiological indices, with the exception of the phasic HR partial correlation, were negative, supporting a lower physiological activity/reactivity level for those with high ICU scores.

To further investigate if the level of CU traits could help to clarify the psychophysiological responses of clusters, a 2x3 between subjects ANOVA was performed on the psychophysiological indices with two levels of ICU (median split of ICU variable) and the three aggressive groups as the two factors. Again, an ANCOVA was performed on phasic HR, controlling for baseline HR. The results of these analyses are provided in Table 9. Two significant main effects were revealed for ICU on baseline SCL ($F (1,82) = 5.47, p < .05$) and on the averaged skin conductance response elicited by low provocation messages ($F (1,80) = 4.61, p < .05$). As evident from the means provided in Table 9, all groups high on ICU exhibited lower resting SCL. However, although the interaction between ICU and aggressive group membership was not significant, the means provided in Table 9 indicate that only the low aggressive and the
mixed aggressive groups showed lower SCR in response to low provocation if they were high on ICU traits.

Discussion

It was expected that boys in a high-risk detained sample could be classified into three groups based on the type of their aggression: a low aggressive group, a reactively aggressive only group, and a proactively and reactively aggressive group. Based on a series of k-means cluster analysis, four groups were identified: a two mixed proactively proactively and reactively aggressive groups, one of lower severity (5%) and one of greater severity (14%); a reactively aggressive only group (34%); and a low aggressive group (47%). The two mixed aggressive groups were combined to create a single mixed aggressive group. The three-group classification is consistent with (Dodge et al., 1997), who found a low aggressive, a reactive aggressive only, and a group who showed both reactive and proactive aggression but not a group high on proactive aggression only. Also consistent with Dodge et al. (1997), more participants classified their aggression as reactive (64%) than as mixed (36%).

In validating the aggressive groups, group membership was related to self-reported delinquent behavior. Both highly aggressive groups (reactive and mixed) reported more delinquency, both violent and non-violent, than the low aggressive group. Moreover, violent delinquency differentiated the two highly aggressive groups, with the mixed aggressive group reporting the greatest level of violent delinquency. This is consistent with research showing that youth classified as proactive-reactive exhibit more severe delinquency (Vitaro et al., 2002; Pulkkinen, 1996).

A primary focus of the current study was on whether the three groups, formed based on self-reports on types of aggression, would respond differently to a competitive provocation task.
Although past research has used the paradigm to differentiate children with behavior problems from control children (Pelham et al., 1991), little research has compared groups of aggressive youth that differ on their type of aggressive behavior. These analyses revealed no overall group effect of aggressive responding; however, as in prior research (Pelham et al., 1991; Santor, Ingram, & Kusumakar, 2003; Taylor, 1967), a difference in responding across levels of provocation was revealed. All groups increased their aggressive responding from low provocation to high provocation. However, the groups differed in their responding from no provocation to low provocation. The mixed aggressive group showed a high level of aggression to no provocation and their aggressive responding remained high to low provocation. The low aggressive group showed low aggressive responding for both no and low provocation. Interestingly, the reactive aggressive group increased their aggressive responding from a level similar to the low aggressive group at no provocation to a rate similar to the mixed group at low provocation.

Previous use of this paradigm tended to only examine aggressive responding after low and high provocation levels (Waschbusch et al., 2002). Importantly, the mixed group was the only group to evidence a high rate of aggressive responding during no provocation trials. The motivation for taking points when no provocation had been experienced is difficult to interpret. However, it is possible that this group may have used high initial aggressive responding in an attempt to intimidate their opponent. Thus, the aggressive behavior of the mixed aggressive group may have been more instrumental (i.e., in pursuit of a goal), such that they may have tried to control the aggressive behavior of their opponent through intimidation (Dodge et al., 1997). In a related way, this type of responding may reflect a tendency for this group to consider aggression as an appropriate means to obtain goals (Pardini et al., 2003; Orobio de Castro, Merk,
The initial high rate of aggressive responding found in the mixed aggressive group is consistent with Gottman et al.’s (1995) research with type 1 abusive husbands. Gottman et al. (1995) found that the type 1 group, who like the mixed aggressive group were the most violent across situations, evidenced a high initial rate of aggression which remained high across the session. Gottman et al.’s (1995) type 1 group were also found to be violent, not only with their wives, but with others as well.

For the reactive aggressive group, only the increase in aggressive responding to low provocation trials was remarkable; they increased their aggressive responding from no provocation more than the other groups. 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. Reactive aggressive individuals may experience such high emotional arousal levels that their anger inhibits cognitive processing of social information, possibly leading to a hostile attribution bias (Dodge et al., 1997; Lemerise & Arsenio, 2000; Dodge & Pettit, 2003; also see Williams et al., 2003).

Based on past research, callous-unemotional (CU) traits were expected to differ across aggressive grouping, such that youth in the mixed group were expected to exhibit significantly higher rates of CU traits than both the other groups (Frick et al., 2003; Miller & Lynam, 2003; Pardini et al., 2003). However, both of the highly aggressive groups reported higher levels of callous-unemotional traits than the low aggressive group, and both the mixed aggressive and the reactive aggressive groups did not differ from each other on these traits. The finding of high CU traits in both aggressive groups may have been due to the presence of some mild level of proactive aggression in the purely reactive group. The reactive aggressive group had a higher level of reactive aggression, yet their level of proactive aggression was still not as low as the
level reported by the low aggressive group. The way in which the groups were designated in the present study may be important, because prior research has designated a mixed group using the presence as any proactive aggression to designate this group (Cornell et al., 1996). Thus, the reactive aggressive group may not have been a “pure reactive”, as designated in past studies that have found low rates of callous-unemotional traits in this reactive group (Cornell et al., 1996). It is also possible that the reactive aggressive group has a history of maltreatment and harsh physical punishment (Dodge et al., 1997), which can result in emotional numbing and passivity (Saltzman, Holden, & Holahan, 2005; Weems, Saltzman, Reiss, & Carrion, 2003; Perry & Pollard, 1998). Therefore, the reactive aggressive group may have callous-unemotional traits as a result of early trauma and thus experience both high responsivity to provocation and emotional desensitization due to past trauma.

Based on past research, the three aggressive groups were expected to differ in psychophysiological activity and reactivity during the provocation task (Hubbard et al., 2002; Waschbusch et al., 2002). Heart rate and skin conductance were measured at rest prior to their performance on the CRTT. Lower heart rates and skin conductance levels were expected for the two highly aggressive groups, given their low arousal levels and prior research showing lower heart rates for aggressive participants (Hubbard et al., 2002; Raine et al., 1997). No significant differences were found in the present study. The hypothesized greatest physiological reactivity in the reactive aggressive only group also was not supported. One possibility for these null findings may be the influence of personality traits on psychophysiological responses. In past research, psychophysiological reactivity was related to information processing biases (Williams et al., 2003). Additionally, Pelham et al. (1991) found that only their low aggressive group with attention-deficit hyperactivity disorder showed an increase in HR to provocation, which the
authors tentatively attributed to heightened anxiety in the low aggressive group. Another possibility for these null findings may be that a clear distinction between the aggressive groups was not achieved in this high-risk detained sample based on the type of their aggression but was largely due to differences in the severity of aggression. Specifically, the reactive aggressive group was moderate in severity, being more severe than the low aggressive group but less severe than the mixed aggressive group. Thus, the importance of the distinction between these forms of aggression needs to be tested further to determine whether it contributes to the understanding of groups of detained youth.

Given that the reactive aggressive only group showed the expected aggressive responsiveness to the change in provocation from no to low, the important question was why did their psychophysiological response fail to show similar changes? Also, why did the mixed group fail to show the expected lower levels of reactivity on psychophysiological indices? The failure to find the expected results may be due to the differences among the groups on callous-unemotional traits (CU). Of importance, CU traits were related to lower skin conductance responses. In exploring CU traits and group membership in predicting psychophysiological activity and reactivity, differences in baseline SCL and in skin conductance reactivity to low provocation were found. Youth high on CU traits were more sympathetically underaroused at rest than youth low on CU traits across all three groups. They also were more underreactive to provocation, but only to low provocation and this was largely in the low aggressive and mixed aggressive groups. These results are consistent with patterns of physiological and emotional underreactivity that have been shown in individuals with psychopathy (Patrick et al., 1993; Levenston et al., 2000; Williamson et al., 1991; Loney et al., 2003), if limited to the mixed aggression group. Specifically, it is this group who exhibited a high initial rate aggressive
responding on the CRTT and had lower psychophysiological reactivity if they also showed high levels of CU traits.

Also, the hypothesized disconnection between the expression of anger and the experience of anger was supported but only for this small group of children. That is, the mixed aggressive group showed angry aggression and those with CU traits showed sympathetic psychophysiological underreactivity. The disconnection found in the present study for those in the mixed aggressive group with CU traits is consistent with prior research showing reduced emotional responses to emotional stimuli in psychopaths (Verona, Patrick, Curtin, Bradley, & Lang, 2004; Blair et al., 1997; Hare, 1978; Patrick et al., 1994; Williamson et al., 1991; Patrick et al., 1993; Christianson et al., 1996; Loney et al., 2003). It is also consistent with theories suggesting a low level of fear as being an important factor related to their antisocial behavior (Frick & Morris, 2004). Their low fear or anxiety is in accord with their aggressive responding across provocation conditions. In order to take a high rate of points away from one’s opponent, one must be free of apprehension regarding possible retribution from the opponent.

Regarding the reactive aggressive group with and without CU traits, no pattern in psychophysiological arousal/reactivity was evident. However, the reactive aggressive group with CU traits showed lower baseline SCL than the group without these traits, which is consistent with Hubbard et al.’s (2002) finding that those high in reactive aggression showed lower skin conductance levels during baseline. Unlike Hubbard et al. (2002), the reactive aggressive group did not show increased reactivity on psychophysiological measures, despite showing increases in aggressive responding to low provocation. Again, this group may be more likely to have experienced child maltreatment and childhood trauma (Dodge et al., 1997). Additionally, rates of child maltreatment are related to levels of community violence (Lynch & Cicchetti, 1998).
Two different sequelae have been found for the experience of exposure to violence. In addition to emotional numbing, past research on the experience of trauma in childhood have found hyperarousal in the form of higher autonomic activity (Saltzman et al., 2005; Weems et al., 2003; Perry & Pollard, 1998). However, underarousal has also been found for children exposed to community violence (Perry & Pollard, 1998; Krenichyn, Saegert, & Evans, 2001). Perry and Pollard (1998) theorized that a “defeat” reaction state sets in both for children when repeated fight-or-flight cardiovascular activation fails to elicit assistance or to remove the individual from harm. After repeated exposures to violence, this defeat reaction can be characterized by very low autonomic arousal levels and externalizing behaviors. To complicate matters, it may be possible to increase activity in one area of the nervous system while there is decreased activity in another (Perry & Pollard, 1998). Thus, the psychophysiological responses of the reactive aggressive group may be indistinct given the heterogeneous nature of this group with regard to experienced trauma.

Interpretation of the results of the present study might have also benefited from having a measure of emotion regulation. The review by Perry and Pollard (1998) included a study where increased levels of epinephrine and other stress hormones were concurrent with a decreased heart rate. This decrease in heart rate can be caused by an activation of the vagus nerve. The vagus nerve carries parasympathetic nervous system (PNS) signals to the heart and, when activated, slows the heart rate. A distinct psychophysiological response pattern for the reactive aggressive group high and low on CU traits may have been found had respiratory sinus arrhythmia (an index of PNS activity) been measured as a proxy of emotional regulation. Both branches of the autonomic nervous system dually innervate the heart; therefore, measuring one or both branches (e.g., respiratory sinus arrhythmia) may have elucidated the pattern of reactivity for those high
on CU traits and in the reactive aggressive group. Past research has indicated that both types of aggressive groups were emotionally dysregulated (Orobio de Castro et al., 2005). Future studies should include a measure of parasympathetic as well as sympathetic activity.

There are several additional limitations to the present study that need to be noted. A number of participants were lost due to low scores on a measure of verbal abilities and this may have resulted in a loss of power to detect differences on the psychophysiological indices, including heart rate. Moreover, in their study, Waschbusch et al. (2002) formed heart rate responses into discrete epochs during the provocation task, indicating anticipatory reactions and reactions following loss. Phasic heart rate, in the present study, covered the duration of the CRTT, which varied from 9 to 11 minutes. Similar to the collection of SCR variables, an examination of the heart rate reactivity during each minute of the 9- to 11-minute task may have been more useful to discretely analyze change across the task. Consistent with this possibility, Hubbard et al. (2002) found that children rated high in reactive aggression showed a sharp increase in heart rate reactivity during the task. Thus, examining the linear trend in heart rate across the task for each aggressive group would be a fruitful direction for future research.

Although the current use of prescription medications was assessed through self-report in the present study, the current use of other drugs, such as illicit drug use and use of commercial stimulants was not assessed. Drug use, however, can have cardiovascular effects (Jennings et al., 1981). Thus, it is indeterminable if heart rate in this study was affected by tobacco or the use of other stimulants.

Another limitation of the present study concerns the formation of the aggressive groups. Three groups were formed based on a self-report of aggression scale that does not have normative data. Further, there was no normal control group to which to compare the level of
aggression in the group labeled “Low Aggression”. Therefore, low aggression in this high-risk detained sample may be different from what would be found in a normal sample. Similarly, the level of aggression displayed by this group on the aggression task may still have exceeded the level of aggression that would have been displayed by non-detained youth.

Anderson et al. (1999) examined the construct validity of laboratory aggression tasks, and they determined that laboratory aggression tasks showed acceptable relations with field studies on aggression. However, they expressed concerns about the fact that experimentally studying aggression has its limitations, paramount of which is the practical inability of researchers to observe under controlled circumstances physical aggression, such as punching and kicking. Thus, Anderson et al. argue that laboratory aggression tasks must rely on provoking the individual to determine whether they will react aggressively, usually by taking points or money from an opponent and the external validity of this as a proxy of aggression is open to question. Related to the use of provocation, laboratory aggression tasks have been criticized for their exclusive assessment of reactive aggression (Giancola & Chermack, 1998). The present study found differences across the three aggressive groups when levels of provocation changed from no to low provocation. Thus, future research should seek to replicate and expand upon the results of the present study. Of importance, in developing a proactive laboratory aggression measure, motivations for responding aggressively when no provocation has been presented should be assessed. Additionally, the design of proactive laboratory aggression measures must consider Waschbusch et al.’s (2002) finding that reactive aggressive children were slow to return to low levels of aggression even two to three trials after provocation. This finding suggests that proactive aggression must be measured prior to any level of provocation, as angry aggression
tends to dissipate very slowly over trials for reactive aggressive individuals who experience provocation (Waschbusch et al., 2002).

Additionally, information processing biases in proactive aggressive groups and their relation to laboratory tasks on aggression should be explored. Williams et al. (2003) found that children who responded with aggression to provocation, as compared to non-aggressive children, were more likely to have hostile attributional biases. Future research should examine other social information processing biases, such as the belief that aggression can obtain benefits for the aggressor (Pardini et al., 2003) and their relation to performance on laboratory aggression tasks.

In summary, several distinct aggressive groups of individuals could be identified in this detained sample. A reactive aggressive only group was identified based on self-report that was more reactive to provocation, as shown by their aggressive responding on a computerized provocation task. They also showed a high rate of aggressive responding in proportion to the level of provocation experienced. Additionally, the mixed aggressive group showed a general disconnect between their angry aggression (on the provocation task) and their sympathetic physiological reactivity to provocation. However, this was true only if they also showed high rates of callous and unemotional traits.

However, the presence of CU traits in the reactive aggressive group failed to reveal any consistent pattern in their physiological activity/reactivity, aside from a lower baseline SCL. Thus, future research should examine prospectively the effect of trauma – from both the experience of abuse in the home and the exposure to violence in the home or community – on reactive aggression, facial affect, and emotional responding.

It’s difficult even to predict what type of social information processing biases the reactive group who were high on CU traits might exhibit, as hostile attributional biases are not typical of
individuals with psychopathic traits (Miller & Lynam, 2003). Therefore, future research should attempt to replicate finding a reactive aggressive group with CU traits and attempt to characterize these individuals and their social information processing.

The results of the present study provide further support for targeting subtypes of aggressive youth in intervention programs. Reactive aggressive children, specifically, may require interventions that target their information-processing errors; this group is hypervigilant to hostile cues and quick to respond to perceived threats. Promoting the use of self-control mechanisms in this group could interrupt an automatic manner of responding and may reduce minor delinquency (Cauffman, Steinberg, & Piquero, 2005). These children could be taught decision-response delay techniques, such as counting to 10 before responding. If this group of children can be taught how to deal with their intense anger to even low provocation, these self-regulation measures may have a greater probability of success. The mixed aggressive group evidenced the highest rate of aggression and delinquent violence. This detained group appears to choose aggressive acts much more readily than the other groups when confronted with at competitive situations involving provocation (Miller & Lynam, 2003; also see Anderson & Bushman, 2002). Additionally, the members of this group who were high on CU traits may lack the fearfulness which might deter them from using violence to obtain their goal (Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999). Since individuals who are high on CU traits appear to be focused on rewards (O'Brien & Frick, 1996), the high CU subgroup of the mixed aggressive participants may respond to interventions that target ways in which they can obtain rewards that do not violate the rights of others (see Frick, 2001). Interventions should, instead, emphasize the positive consequences of competing behaviors, such as affiliative tendencies and prosocial behavior, by offering incentives for prosocial behavior. For example, it may be
possible to influence individuals in this group by giving them the privilege to participate in a particular interest or hobby as a reward for prosocial behaviors (Frick, 2001).
References


Bechara, A., Tranel, D., Damasio, H., & Damasio, A. R. (1996). Failure to respond autonomically to anticipated future outcomes following damage to prefrontal cortex. Cerebral Cortex, 6, 215-225.


Appendix A:

Tables and Figures
Table 1.  
*Distribution of Demographic and Background Characteristics.*

<table>
<thead>
<tr>
<th>Measures</th>
<th>MIN</th>
<th>MAX</th>
<th>M</th>
<th>SD</th>
<th>PERCENT</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>13</td>
<td>18</td>
<td>15.53</td>
<td>1.28</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>African American</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>68.20%</td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.40%</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.70%</td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.40%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.40%</td>
<td></td>
</tr>
<tr>
<td>Current Medications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20.00%</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.00%</td>
<td></td>
</tr>
<tr>
<td>Special Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50.60%</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>49.40%</td>
<td></td>
</tr>
<tr>
<td>Mental Health Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>69.40%</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30.60%</td>
<td></td>
</tr>
<tr>
<td>Living Arrangements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Biological Mother Alone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44.70%</td>
<td></td>
</tr>
<tr>
<td>Biological Mother and Stepfather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.70%</td>
<td></td>
</tr>
<tr>
<td>Biological Mother and Father</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.20%</td>
<td></td>
</tr>
<tr>
<td>Biological Father and Stepmother</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.20%</td>
<td></td>
</tr>
<tr>
<td>Biological Father Alone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.70%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.40%</td>
<td></td>
</tr>
<tr>
<td>Number of Siblings</td>
<td>0</td>
<td>7</td>
<td>2.75</td>
<td>1.38</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>PPVT</td>
<td>66</td>
<td>123</td>
<td>85.47</td>
<td>13.57</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Neighborhood Income</td>
<td>19,768</td>
<td>80,895</td>
<td>37,914</td>
<td>13,070</td>
<td></td>
<td>83</td>
</tr>
<tr>
<td>No. Prior Arrests</td>
<td>0</td>
<td>28</td>
<td>6.08</td>
<td>5.57</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>History of Violent Offenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>51.80%</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48.20%</td>
<td></td>
</tr>
</tbody>
</table>

Note: PPVT=Peabody Picture Vocabulary Test.
Table 2.  
Distribution of Primary Study Variables.

<table>
<thead>
<tr>
<th>Measures</th>
<th>MIN</th>
<th>MAX</th>
<th>M</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTISOCIAL BEHAVIORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proactive Overt</td>
<td>0</td>
<td>15</td>
<td>2.44</td>
<td>3.15</td>
<td>85</td>
</tr>
<tr>
<td>Reactive Overt</td>
<td>0</td>
<td>29</td>
<td>10.20</td>
<td>6.47</td>
<td>85</td>
</tr>
<tr>
<td>SRD Total</td>
<td>3</td>
<td>27</td>
<td>12.91</td>
<td>6.53</td>
<td>85</td>
</tr>
<tr>
<td>SRD Violent</td>
<td>1</td>
<td>20</td>
<td>9.84</td>
<td>5.24</td>
<td>85</td>
</tr>
<tr>
<td>SRD Non-Violent</td>
<td>0</td>
<td>7</td>
<td>2.45</td>
<td>1.61</td>
<td>85</td>
</tr>
<tr>
<td><strong>CALLOUS-UNEMOTIONAL TRAITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td>1</td>
<td>39</td>
<td>23.02</td>
<td>7.70</td>
<td>85</td>
</tr>
<tr>
<td><strong>PSYCHOPHYSIOLOGICAL MEASURES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline HR&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.34</td>
<td>100.28</td>
<td>78.13</td>
<td>10.77</td>
<td>85</td>
</tr>
<tr>
<td>Phasic HR</td>
<td>51.10</td>
<td>107.80</td>
<td>80.07</td>
<td>11.83</td>
<td>84</td>
</tr>
<tr>
<td>Baseline SCL&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.16</td>
<td>11.05</td>
<td>3.81</td>
<td>2.15</td>
<td>83</td>
</tr>
<tr>
<td>Phasic SCL</td>
<td>0.17</td>
<td>14.58</td>
<td>5.80</td>
<td>2.97</td>
<td>85</td>
</tr>
<tr>
<td>Change SCL</td>
<td>-1.57</td>
<td>7.60</td>
<td>1.78</td>
<td>1.56</td>
<td>83</td>
</tr>
<tr>
<td>SCR hi prov&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.00</td>
<td>0.45</td>
<td>0.13</td>
<td>0.11</td>
<td>83</td>
</tr>
<tr>
<td>SCR lo prov</td>
<td>0.00</td>
<td>0.31</td>
<td>0.07</td>
<td>0.08</td>
<td>81</td>
</tr>
<tr>
<td><strong>AGGRESSIVE RESPONDING ON THE CRTT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRTT Total</td>
<td>11</td>
<td>100</td>
<td>74.64</td>
<td>21.23</td>
<td>85</td>
</tr>
<tr>
<td>CRTT High&lt;sup&gt;d&lt;/sup&gt;</td>
<td>35</td>
<td>100</td>
<td>88.87</td>
<td>14.34</td>
<td>85</td>
</tr>
<tr>
<td>CRTT Low</td>
<td>1</td>
<td>100</td>
<td>65.21</td>
<td>27.80</td>
<td>85</td>
</tr>
<tr>
<td>CRTT No</td>
<td>0</td>
<td>100</td>
<td>56.94</td>
<td>38.63</td>
<td>85</td>
</tr>
</tbody>
</table>

Note: Proactive Overt = Proactive Overt Aggression (Peer Conflict Scale; PCS); SRD Total = Total Delinquency, SRD Violent = Violent Delinquency, SRD Non-Violent = Non-violent Delinquency (Self-Report of Delinquency; SRD); ICU=Inventory of Callous-Unemotional traits; Change SCL=change in SCL from baseline to CRTT (Competitive Reaction Time Task); CRTT Total=Mean aggressive responding, CRTT High=Mean aggressive responding after high provocation, CRTT Low= Mean aggressive responding after low provocation, CRTT No=Mean aggressive responding during no provocation.

<sup>a</sup>Baseline and phasic heart rate (HR) were significantly different ($t(83)= 3.79, p < .001$);  
<sup>b</sup>Baseline and CRTT skin conductance level (Phasic SCL) were significantly different ($t(82)= 10.43, p < .001$);  
<sup>c</sup>Mean skin conductance response (SCR) to high provocation (hi prov) and to low provocation (lo prov) were significantly different ($t(79)= 4.86, p < .001$);  
<sup>d</sup>Mean aggressive responding differed across all pairwise comparisons. Points taken after high and low provocation trials ($t(84)= 9.20, p < .001$), after high provocation trials and during no provocation trials ($t(84)= 8.36, p < .001$), and during no and low provocation trials ($t(84)= 2.17, p < .05$) were significantly different.
### Table 3.
**Provocation Task Performance Associations with Psychophysiological Indices, Antisocial Behaviors, and Callous-Unemotional Traits.**

<table>
<thead>
<tr>
<th></th>
<th>CRTT-Total</th>
<th>CRTT-High prov</th>
<th>CRTT-Low prov</th>
<th>CRTT-No prov</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSYCHOPHYSIOLOGICAL INDICES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline HR</td>
<td>-.14</td>
<td>-.06</td>
<td>-.23*</td>
<td>.14</td>
</tr>
<tr>
<td>Phasic HR (partial corr)</td>
<td>-.16</td>
<td>-.16</td>
<td>-.18+</td>
<td>-.06</td>
</tr>
<tr>
<td>Baseline SCL</td>
<td>.04</td>
<td>.12</td>
<td>.01</td>
<td>.08</td>
</tr>
<tr>
<td>Change SCL</td>
<td>-.05</td>
<td>-.01</td>
<td>-.11</td>
<td>-.13</td>
</tr>
<tr>
<td>SCR hi prov</td>
<td>-.01</td>
<td>.04</td>
<td>-.04</td>
<td>.01</td>
</tr>
<tr>
<td>SCR lo prov</td>
<td>.02</td>
<td>-.01</td>
<td>-.03</td>
<td>-.01</td>
</tr>
<tr>
<td><strong>ANTISOCIAL BEHAVIORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proactive Overt</td>
<td>.15</td>
<td>.05</td>
<td>.14</td>
<td>.19+</td>
</tr>
<tr>
<td>Reactive Overt</td>
<td>.17</td>
<td>.13</td>
<td>.17</td>
<td>.12</td>
</tr>
<tr>
<td>SRD Total</td>
<td>-.18+</td>
<td>-.19+</td>
<td>-.20+</td>
<td>.04</td>
</tr>
<tr>
<td>SRD Violent</td>
<td>.02</td>
<td>-.08</td>
<td>-.01</td>
<td>.17</td>
</tr>
<tr>
<td>SRD Non-Violent</td>
<td>-.20+</td>
<td>-.19+</td>
<td>-.22*</td>
<td>.00</td>
</tr>
<tr>
<td>No. Prior Arrests</td>
<td>.30**</td>
<td>.14</td>
<td>.33**</td>
<td>.27*</td>
</tr>
<tr>
<td><strong>CALLOUS-UNEMOTIONAL TRAITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td>-.07</td>
<td>-.20+</td>
<td>.01</td>
<td>-.04</td>
</tr>
</tbody>
</table>

Note: HR=Heart rate; SCL=Skin conductance level; SCR hi prov=Mean skin conductance response to high provocation; Change SCL=change in SCL from baseline to CRTT; SCR lo prov=Mean skin conductance response to low provocation; Proactive Overt = Proactive Overt Aggression, Reactive Overt = Reactive Overt Aggression (Peer Conflict Scale; PCS); SRD Total = Total Delinquency, SRD Violent = Violent Delinquency, SRD Non-Violent = Non-violent Delinquency (Self-Report of Delinquency; SRD); ICU=Inventory of Callous-Unemotional traits; CRTT Total=Mean aggressive responding, 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).
Table 4.  
*Characteristics of the Three Aggressive Groups based on the Cluster Analysis.*

<table>
<thead>
<tr>
<th></th>
<th>Low Aggressive (n=40)</th>
<th>Reactive Only (n=29)</th>
<th>Mixed Aggressive (n=16)</th>
<th>F (2,84)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-Score Proactive Overt</td>
<td>-0.54 (0.34)${}^a$</td>
<td>-0.18 (0.38)${}^b$</td>
<td>1.74 (0.99)${}^c$</td>
<td>108.59***</td>
</tr>
<tr>
<td>Z-Score Reactive Overt</td>
<td>-0.88 (0.30)${}^a$</td>
<td>0.52 (0.44)${}^b$</td>
<td>1.23 (0.87)${}^c$</td>
<td>121.80***</td>
</tr>
<tr>
<td>Absolute Proactive Overt</td>
<td>0.70 (1.07)</td>
<td>1.83 (1.20)</td>
<td>7.88 (3.10)</td>
<td></td>
</tr>
<tr>
<td>Absolute Reactive Overt</td>
<td>4.55 (2.17)</td>
<td>13.59 (2.86)</td>
<td>18.19 (5.61)</td>
<td></td>
</tr>
</tbody>
</table>

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

$^+ p < .10; * p < .05; ** p < .01; *** p < .001$
Table 5. 
*Demographic and Background Characteristics of the Three Aggressive Groups.*

<table>
<thead>
<tr>
<th></th>
<th>Low Aggressive (n=40)</th>
<th>Reactive Only (n=29)</th>
<th>Mixed Aggressive (n=16)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>15.65 (1.33)</td>
<td>15.24 (1.22)</td>
<td>15.75 (1.24)</td>
<td>1.16 (2.84)</td>
</tr>
<tr>
<td>PPVT</td>
<td>85.70 (15.20)</td>
<td>85.07 (11.94)</td>
<td>85.63 (12.80)</td>
<td>0.02 (2.84)</td>
</tr>
<tr>
<td>Neighborhood Income</td>
<td>37625(15128.18)</td>
<td>39484(11027.24)</td>
<td>35631(11188.33)</td>
<td>0.44 (2.82)</td>
</tr>
<tr>
<td>No. Prior Arrests</td>
<td>5.88 (5.04)</td>
<td>6.00 (5.22)</td>
<td>6.75 (7.48)</td>
<td>0.14 (2.84)</td>
</tr>
</tbody>
</table>

Likelihood ratio, $\chi^2$

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Majority Member</td>
<td>17.50%</td>
</tr>
<tr>
<td>Minority Member</td>
<td>82.50%</td>
</tr>
<tr>
<td></td>
<td>24.10%</td>
</tr>
<tr>
<td></td>
<td>75.90%</td>
</tr>
<tr>
<td></td>
<td>31.30%</td>
</tr>
<tr>
<td></td>
<td>68.80%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Medications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>17.50%</td>
</tr>
<tr>
<td>No</td>
<td>82.50%</td>
</tr>
<tr>
<td></td>
<td>31.00%</td>
</tr>
<tr>
<td></td>
<td>69.00%</td>
</tr>
<tr>
<td></td>
<td>6.30%</td>
</tr>
<tr>
<td></td>
<td>93.80%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Education</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>45.00%</td>
</tr>
<tr>
<td>No</td>
<td>55.00%</td>
</tr>
<tr>
<td></td>
<td>51.70%</td>
</tr>
<tr>
<td></td>
<td>48.30%</td>
</tr>
<tr>
<td></td>
<td>62.50%</td>
</tr>
<tr>
<td></td>
<td>37.50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mental Health Services</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>70.00%</td>
</tr>
<tr>
<td>No</td>
<td>30.00%</td>
</tr>
<tr>
<td></td>
<td>69.00%</td>
</tr>
<tr>
<td></td>
<td>31.00%</td>
</tr>
<tr>
<td></td>
<td>68.80%</td>
</tr>
<tr>
<td></td>
<td>31.30%</td>
</tr>
</tbody>
</table>

Note: PPVT=Peabody Picture Vocabulary Test.
Table 6. 
Comparison of the Three Aggressive Groups on Delinquent Behavior, Provocation Task Performance, Psychophysiology, and Callous-Unemotional Traits.

<table>
<thead>
<tr>
<th></th>
<th>Low Aggressive (n=40)</th>
<th>Reactive Only (n=29)</th>
<th>Mixed Aggressive (n=16)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>SRD Total</td>
<td>9.55a</td>
<td>(5.15)</td>
<td>14.62b</td>
<td>(5.45)</td>
</tr>
<tr>
<td>SRD Violent</td>
<td>1.65a</td>
<td>(0.98)</td>
<td>2.62b</td>
<td>(1.70)</td>
</tr>
<tr>
<td>SRD Non-Violent</td>
<td>7.50a</td>
<td>(4.60)</td>
<td>11.34b</td>
<td>(4.38)</td>
</tr>
<tr>
<td>ICU</td>
<td>20.35a</td>
<td>(7.33)</td>
<td>25.28b</td>
<td>(7.42)</td>
</tr>
<tr>
<td>Baseline HR</td>
<td>79.09</td>
<td>(11.25)</td>
<td>77.64</td>
<td>(10.21)</td>
</tr>
<tr>
<td>Phasic HR (w/baseline)</td>
<td>80.05</td>
<td>(12.70)</td>
<td>78.93</td>
<td>(9.71)</td>
</tr>
<tr>
<td>Baseline SCL</td>
<td>3.55</td>
<td>(2.08)</td>
<td>3.99</td>
<td>(2.41)</td>
</tr>
<tr>
<td>Change SCL</td>
<td>1.80</td>
<td>(1.56)</td>
<td>1.78</td>
<td>(1.68)</td>
</tr>
<tr>
<td>SCR hi prov</td>
<td>0.14</td>
<td>(0.13)</td>
<td>0.11</td>
<td>(0.09)</td>
</tr>
<tr>
<td>SCR lo prov</td>
<td>0.07</td>
<td>(0.08)</td>
<td>0.07</td>
<td>(0.07)</td>
</tr>
</tbody>
</table>

*p < .10; *p < .05; ** p < .01; ***p < .001

Note: Superscripts are the results of Tukey HSD pairwise comparisons, such that means with different letters are significantly different at p < .05.
SRD Total = Total Delinquency, SRD Violent = Violent Delinquency, SRD Non-Violent = Non-violent Delinquency (Self-Report of Delinquency; SRD); ICU=Inventory of Callous-Unemotional traits; CRTT Total=Mean aggressive responding, 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); HR=Heart rate; SCL=Skin conductance level; Change SCL=change in SCL from baseline to CRTT; SCR hi prov=Mean skin conductance response to high provocation; SCR lo prov=Mean skin conductance response to low provocation.
Table 7.
Post-Hoc Contrasts Examining the Within-Subjects Simple and Interaction Effects.

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df</th>
<th>Contrasts</th>
<th>Partial Eta sq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-Subjects Effects</td>
<td>35.27***</td>
<td>(1.69,138.89)</td>
<td>2 vs. 3***</td>
<td>.30</td>
</tr>
<tr>
<td>1. CRTT No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CRTT Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. CRTT High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between-Subjects Effects</td>
<td>1.20</td>
<td>(2,82)</td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>1. Low Aggressive (n=40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Reactive Only (n=29)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Mixed Aggressive (n=16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provocation*Aggressive groups</td>
<td>2.62*</td>
<td>(3.39,138.89)</td>
<td>1 vs. 2*</td>
<td>.06</td>
</tr>
<tr>
<td>1. CRTT No across Groups 1, 2, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CRTT Low across Groups 1, 2, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. CRTT High across Groups 1, 2, 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .10; *p < .05; ** p < .01; ***p < .001

Note: 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).
Table 8. 
*Relations Between Callous-Unemotional Traits and Psychophysiological Indices.*

<table>
<thead>
<tr>
<th></th>
<th>ICU</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline HR</td>
<td>-.06</td>
<td>85</td>
</tr>
<tr>
<td>Phasic HR (partial corr.)</td>
<td>.05</td>
<td>81</td>
</tr>
<tr>
<td>Baseline SCL</td>
<td>-.14</td>
<td>83</td>
</tr>
<tr>
<td>Change SCL</td>
<td>-.08</td>
<td>83</td>
</tr>
<tr>
<td>SCR – Hi Prov</td>
<td>-.23*</td>
<td>83</td>
</tr>
<tr>
<td>SCR – Lo Prov</td>
<td>-.09</td>
<td>81</td>
</tr>
</tbody>
</table>

\* p < .10; \* p < .05; ** p < .01; ***p < .001 

Note: ICU=Inventory of Callous-Unemotional traits; HR=Heart rate; SCL=Skin conductance level; Change SCL=change in SCL from baseline to CRTT; SCR hi prov=Mean skin conductance response to high provocation; SCR lo prov=Mean skin conductance response to low provocation.
### Table 9.
**Analyses of Variance Performed with Callous-Unemotional Traits and Aggressive Group Membership on Psychophysiological Measures.**

<table>
<thead>
<tr>
<th></th>
<th>Low Aggressive</th>
<th>Reactive Only</th>
<th>Mixed Aggressive</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hi CU (n=13)</td>
<td>Lo CU (n=27)</td>
<td>Hi CU (n=19)</td>
<td>Lo CU (n=10)</td>
</tr>
<tr>
<td><strong>Baseline HR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(12.09)</td>
<td>(11.04)</td>
<td>(9.13)</td>
<td>(11.70)</td>
</tr>
<tr>
<td><strong>Phasic HR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(13.91)</td>
<td>(12.31)</td>
<td>(8.18)</td>
<td>(11.74)</td>
</tr>
<tr>
<td><strong>Baseline SCL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(1.73)</td>
<td>(2.24)</td>
<td>(1.90)</td>
<td>(2.82)</td>
</tr>
<tr>
<td><strong>Change SCL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(1.07)</td>
<td>(1.63)</td>
<td>(1.83)</td>
<td>(1.17)</td>
</tr>
<tr>
<td><strong>SCR hi prov</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(0.10)</td>
<td>(0.14)</td>
<td>(0.08)</td>
<td>(0.10)</td>
</tr>
<tr>
<td><strong>SCR lo prov</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>SD</em></td>
<td>(0.06)</td>
<td>(0.08)</td>
<td>(0.07)</td>
<td>(0.07)</td>
</tr>
</tbody>
</table>

Note: CU=Callous-Unemotional Traits; HR=Heart rate; SCL=Skin conductance level; Change SCL=change in SCL from baseline to CRTT; SCR hi prov=Mean skin conductance response to high provocation; SCR lo prov=Mean skin conductance response to low provocation.

*a* $F (1,82) = 5.47, p < .05; \quad b \quad F (1,80) = 4.61, p < .05
Figure Captions

Figure 1. Results of K-means cluster analysis; R-square statistic for two, three, four, and five clusters.

Figure 2. Results of K-means cluster analysis; Cubic clustering criterion statistic for two, three, four, and five clusters.

Figure 3. Plot of the within- and between-subjects interaction between level of provocation and aggressive group membership in the number of points taken from the “opponent” on the provocation task.
Level of Provocation

Points Removed

3 group cluster
- Mixed
- Reactive
- Low
Appendix B:

Internal Review Board Approval Form
University Committee for the Protection of Human Subjects in Research
University of New Orleans

Form Number: 04oct04-r
(please refer to this number in all future correspondence concerning this protocol)

Principal Investigator: Kimonis, Munoz, Aucoin
Title: Graduate Student

Faculty Supervisor: Paul Frick
(if PI is a student)

Department: Psychology
College: Science

Project Title: Emotional adjustment in adjudicated boys

Date Reviewed:

Dates of Proposed Project Period From 10/01/04 to 08/31/05

*Approval is for one year from approval date only and may be renewed yearly.

Note: Consent forms and related materials are to be kept by the PI for a period of three years following the completion of the study.

Approval Status

☑ Full Committee Approval
☐ Expedited Approval
☐ Continuation
☐ Rejected

☐ The protocol will be approved following receipt of satisfactory response(s) to the following question(s) within 15 days:

Committee Signatures:
Laura Scaramella, Ph.D. (Chair)
Pamela Jenkins, Ph.D.
Anthony Kontos, Ph.D.
Richard B. Speaker, Ph.D.
Gary Talarchek, Ph.D.
Karl Walsh
L. Allen Wist, Ph.D.

Kathleen Whalen, LCSW
Vita

Luna Muñoz was born in Colebrook, New Hampshire, although she never lived in New Hampshire. Instead, she was raised in such diverse areas of America as California, Puerto Rico, Ohio, and New York. In 1996, she received her B.A. from SUNY at Stony Brook. She worked in the music industry and with children of celebrity actors as a teacher’s assistant in Beverly Hills before pursuing graduate study in “Happy Valley” at The Pennsylvania State University. Working with Cynthia Stifter (Human Development and Family Studies) and Karen Quigley in the psychobiology area there, she earned her M.S. degree before entering the Ph.D. program at the University of New Orleans.