

## ABSTRACT

Title of dissertation:           SUBTYPING BOYS WITH CONDUCT PROBLEMS:  
  CATEGORICAL AND DIMENSIONAL APPROACHES  
  WITH MULIT-MODAL ASSESSMENT OF  
  PSYCHOPHYSIOLOGY AND BEHAVIOR

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This study examined the physiological and behavioral profile of a group of clinically referred boys (ages 8-12 years) with severe conduct problems. Cerebral EEG asymmetry, fear potentiated startle and cardiac functioning were assessed along with maternal reports of severe antisocial behavior and behavioral measures of reward seeking, reward dominance, and laboratory aggression. Drawing on research seeking to extend the concept of psychopathy to younger populations, this study implemented the Antisocial Process Screening Device (APSD; Frick & Hare, 2001) an assessment instrument designed to assess psychopathic characteristics in children. Two groups of clinically referred children with externalizing problems were screened from an outpatient psychiatry clinic, one with elevated scores on the APSD ( $\geq 25$ ) and a second group with externalizing problems but without elevated scores on the APSD ( $< 20$ ). A third group of comparison boys was recruited from the community.

Findings did not support a fear deficit specific to boys with APSD elevations, but rather suggested under some conditions these children may have exaggerated startle reactivity. High APSD boys sought rewards to a greater extent than other clinically referred externalizing boys on a point-subtraction game, but not more than comparison boys. The point-subtraction game did not differentiate groups of boys on aggressive responding. Boys with elevated APSD scores were rated as displaying greater overt and covert antisocial behavior problems than clinically referred boys without high APSD scores.

A dimensional perspective was explored as an alternative to the categorical (subtyping) approach. When disruptive behavior disorder measures were treated as continuous dimensions, the APSD was not the criterion most strongly accounted for by predictor variables. Broadband externalizing behavior problems were more strongly associated with indicators of approach motivation and fear reactivity, including resting frontal asymmetry and startle change during threat and safety. Similarly these variables were associated with an oppositional defiant symptom dimension. Regression analyses that focused specifically fear reactivity and insensitivity to punishment for predicting callous-unemotional traits indicated that the door-opening task, startle change during safety and harm avoidance each accounted for unique variance.

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by

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## CHAPTER I

### Overview

Conduct problems are a heterogeneous grouping of behaviors, often beginning in childhood, that involve violations rules and the rights of others. Formally within the American diagnostic system they represent a class of behaviors most often referred to under the diagnostic categories of oppositional defiant disorder or conduct disorder. As a class of dysfunction conduct problems represent a significant public health problem with enormous social and economic costs. The negative impact on the quality of life for those classified with “the disorder” and upon those with whom they have contact is pervasive (Knapp, Scott, & Davies, 1999). One of the most frequent reasons for psychological or psychiatric referral in the United States includes some form of conduct problems (Kazdin, 1995). Individuals with childhood conduct problems are at increased risk for negative outcomes in adulthood including psychiatric problems, criminal behavior, incarceration, and increased mortality (Raphael, 2000). The personal cost to victims of youth with conduct problems includes the experience of violence, aggression, and cruelty as well as damage to and loss of personal property. Also, children with conduct problems are often the victims of abuse and violence themselves (Caspi et al., 2002). As parents, these same individuals are likely to perpetuate a cycle of violence, aggression, and antisocial behavior across generations (Fuller et al., 2003; Thornberry, Freeman Gallant, Lizotte, Krohn, & Smith, 2003). Moreover, the monetary cost of treating and/or incarcerating those with conduct disorder and its adult manifestations is in the billions of dollars.

Over the past fifty years, considerable resources have been allocated for the study of antisocial behavior in children. The yield of these efforts has been considerable in terms of descriptive knowledge about the development and maintenance of antisocial behavior (Connor, 2002; Rutter, Giller, & Hagell, 1998). Yet to date, no theory or model has stood out as particularly well supported by extant data or superior to rival models with respect to the prediction or explanation of antisocial behavior. It is generally accepted that children with conduct problems represent a heterogeneous group in terms of behavior, etiology, and developmental trajectory (Hinshaw, Lahey, & Hart, 1993; Rutter et al., 1997). Indeed, there have been many theoretically based attempts to classify or subtype children with disruptive behavior problems. However, these distinctions are rarely translated into empirical research (Craig & Pepler, 1997). Much research in this area, by failing to differentiate causally distinct and qualitatively different subtypes of children, necessarily presupposes conduct problem children are homogeneous with respect to the underlying factors driving their behavior (Richters, 1997). As an initial goal, this project attempted to distinguish among clinically referred boys with externalizing problems. A group of boys with a distinct behavioral / emotional profile was selected with the aim of validating the profile on the basis of psychophysiology, child and parent report and child behavior.

#### Summary and Rationale for the Present Study

The current study was designed to examine the profile of a group of boys whose antisocial behavior patterns are *suggestive* of a qualitatively distinguishable syndrome. The central goal of his study was to characterize a subgroup of conduct problem children

who present with a relatively unique pattern of psychophysiological reactivity and behavior. Specifically, study was undertaken to examine relations of maternal reports of severe antisocial behavior, termed by some investigators as reflecting psychopathic characteristics, and putative indices (ratings, behavior, psychophysiology) of fear, reward seeking, approach-withdrawal related tendencies, and markers of antisocial behavior. A multiple measure approach was adopted as a means of providing converging evidence for a profile of severe conduct problem boys. The project builds upon research in the areas of cerebral asymmetry and emotion; fear potentiated startle, cardiac functioning, and subtyping research in antisocial behavior. The central goal of this study was to provide validity for a subtype of conduct problem child who, as a group, present with relatively unique patterns of emotion and behavior, characterized by shallow emotion, lack of guilt, and a lack of concern for others feelings, and impulsivity as well as chronic and severe conduct problems. Some researchers have addressed the problem of subtyping children with conduct problems by focusing on age of onset rather than patterning of antisocial behavior. This method of categorization is based on the consistent finding that there exists a subgroup of children whose antisocial conduct is more persistent, serious, and severe, emerging in childhood (life-course persistent) rather than in adolescence (adolescence limited) (Loeber, 1988; Moffitt, 1993; Moffitt & Caspi, 2001; Moffitt, Caspi, Harrington, & Milne, 2002). In fact, the influence of this model led to the early-onset late-onset conduct disorder distinction within the current Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994). The present study focuses on boys aged 8-12 years in an attempt to characterize a subgroup of

children within what is presently considered to be this early-onset conduct problem group.

While it is essentially a foregone conclusion that there are multiple subgroups of male children among those termed 'conduct problem', this study sought to identify a subgroup who have been referred as presenting with psychopathic characteristics. The identification and characterization of children who present with chronic, pervasive antisocial behavior patterns is an important research priority, not only for tailoring and targeting early intervention efforts which may hold more promise than intervention in adulthood, but also because it remains an open question as to whether children who present with analogous emotional and behavioral characteristics of adult psychopaths would be characterized as such later in life. The current literature suggests these children may be discerned among the heterogeneous class of conduct problem children. A subtyping strategy that focuses upon motivation and emotion was adopted because current research and theorizing in this area suggests that these characteristics are causally relevant in maintaining these boys antisocial behavior patterns. A decision was made to focus solely on boys because conduct disorder is 3 to 4 times more common in boys than in girls (Zoccolillo, 1993), and it would be unfeasible to recruit enough girls given the screening procedures implemented in this study. In addition, the current assessment devices available are geared toward the male presentation of conduct problems (Keenan, Loeber, & Green, 1999).

### Dimensions and Categories

There has been an ongoing debate as to whether child psychology should be best

viewed from a categorical perspective or a dimensional perspective (Rutter, 2003; Sonuga-Barke, 1998). Either implicitly or explicitly, dimensions presuppose continuity from normality to psychopathology whereas categories assume discontinuity from normality to psychopathology. Current thinking on this issue acknowledges that in most cases, this is a false issue, because neither can be universally correct (Pickles & Angold, 2003; Rutter, 2003).

This thesis, about subtyping boys with conduct problems, straddles both perspectives. Subtyping clearly reflects a categorical approach, as does the focus on boys. On the other hand, the term ‘conduct problems’ reflects language more in the tradition of a dimensional perspective. Statistical analyses examine hypotheses first from a categorical perspective, following other investigators in this area who have either implicitly or explicitly adopted a categorical approach (Blair, Colledge, Murray, & Mitchell, 2001; Christian, Frick, Hill, & Tyler, 1997; Lynam, 1997). Where appropriate, dimensional analyses examine relations between psychopathic characteristics and core domains of interest.

## CHAPTER II

### Literature Review

The following review of the literature contains four general sections. The first section, 'Subtyping Conduct Problems', begins with a brief introduction to general subtyping approaches, followed by a description of conduct problems based on the current diagnostic nomenclature, and then by a discussion of the core affective features associated with these disorders. Next, the general area of subtyping conduct problems is reviewed, first detailing the subtyping of persons and then the subtyping of aggressive behavior as described in the current literature. In the second section, 'The Concept of Psychopathy Applied to Conduct Problem Children', the recent literature on psychopathy in children is reviewed, with focus on pre-adolescent children. The third section, 'Approach and Withdrawal: A Heuristic Framework for Understanding the Motivational Substrates of Conduct Problem Behavior', discusses the Gray's motivational model, with a specific emphasis on the concept of reward dominance as well as a discussion of fear and callous-unemotional traits. The fourth section, 'Psychophysiological Indices for Differentiating Conduct Problem Children', serves to review the literature on frontal EEG asymmetry and approach-withdrawal motivation, the startle reflex and affective modulation, with an emphasis on the startle paradigm and psychopathy. Finally, heart rate and heart rate reactivity among children with conduct problems is discussed, detailing why we might expect to find differences in conduct problem children reflective of differing levels of autonomic arousal.

## Subtyping Conduct Problems

### Approaches to Subtyping

Three general approaches to subtyping conduct problem children have been taken in the literature and applied work. In *clinically based* approaches to conduct problems, clinical observation is relied upon to form categories of behavior that tend to co-occur (Blashfield, 1984). These categories are formed in lieu of a formal theory of etiological and maintenance factors, with the hope that causal processes will be elucidated with further research. The Diagnostic and Statistical Manuals (DSM-III, DSM-III-R, DSM-IV; American Psychiatric association, 1980, 1987, 1994), for the most part, take a clinically based approach to the classification of conduct problems.

*Quantitative approaches*, in contrast, have utilized large data sets and statistical techniques such as inverse factor analysis, cluster analysis, and more recently taxometric analysis to empirically discern distinct subgroups of children with conduct problems (Skilling, Quinsey, & Craig, 2001). One recent example is found in the work of (Christian, Frick, Hill, & Tyler, 1997), who identified four groups of conduct problem children using cluster analysis of conduct disorder and oppositional defiant disorder symptoms as well as callous-unemotional trait items. They identified one group with high levels of both conduct problems and callous-unemotional traits that they believe represent child psychopathy. Other quantitative approaches have focused on subtyping behaviors rather than individuals. For example, Frick and colleagues (Frick, Lahey, Loeber, Tannenbaum, et al., 1993) used multidimensional scaling in a meta-analysis of

60 published factor analyses to identify two dimensions of behavioral co variation, which were termed an overt-covert dimension and a destructive-nondestructive dimension.

Both these approaches have been criticized on several accounts. The clinical perspective, as embodied in the Diagnostic and Statistical Manual (American Psychiatric Association, 1994), has been criticized for an over-reliance on behavioral criteria for the purpose of increasing reliability of diagnoses, at the expense of validity. In addition, the clinical approach tends to be descriptive rather than explanatory. Since the determinants of antisocial behavior are themselves heterogeneous, it is unlikely that classification schemes based primarily on behavior will shed light on the causal mechanisms responsible for the varied manifestations of conduct problems. Quantitative approaches have also been criticized because they depend on the selection of variables that distinguish subgroups. To the extent that critical variables are missing from an analysis, the quantitative approach will fail to detect subgroups. Beyond variable selection, techniques such as cluster analysis are designed to force an arbitrary structure on the data irrespective of whether or not the derived clusters reflect groupings that represent meaningful distinctions in the real world (Beauchaine, 2003).

The *theory-based* approach represents a third, somewhat complementary means of classification of conduct problem children. A theory-based framework requires the proposal of a theoretical description of one or more hypothesized subtype(s) including causes, underlying psychological and biological mechanisms and processes, symptoms, developmental course, and relation to other putative subtypes. A major attraction of the theory-based approach is that it embeds the putative subtype in a theoretical network

linked to basic research (Follette & Houts, 1996; Hempel, 1965). Furthermore, the identification of differential etiological and maintenance factors in subtyping psychopathology is preferable to relying on symptoms alone because it has more direct implications for treatment and prevention efforts (Skinner, 1981).

### Conduct Problems Described

The disruptive behavior disorders include three major DSM-IV (American Psychiatric Association, 1994) diagnostic categories, which are conduct disorder (CD), oppositional defiant disorder (ODD), and attention-deficit hyperactivity disorder (ADHD). Formal diagnosis of conduct disorder requires that the child show antisocial behavior that violates formal rules of conduct and the rights of others (e.g., stealing, physical aggression). Oppositional defiant disorder is defined by defiance and disobedience without clear antisocial behavior. Attention-deficit/hyperactivity disorder is characterized by disruptive behavior that is mainly driven by behavioral disinhibition, distractibility, and impulsivity.

Conduct and oppositional defiant disorders share in common that both include the defiance of authority and noncompliance, which can occur across multiple contexts including the family, the classroom, and the larger society. Conduct disorder is mainly distinguished from ODD by its focus on the violation of the rights and rules of others. However, it is not clear whether the two diagnostic categories represent distinct entities, or classifications along a continuum of severity (Biederman, Newcorn, & Sprich, 1991; Frick et al., 1991). Oppositional defiant disorder is often a precursor to conduct disorder (Loeber, Lahey, & Thomas, 1991). The suggestion of diagnostic overlap is also implied

by the DSM-IV that precludes a diagnosis of ODD if the criteria for CD have been met (American Psychiatric Association, 1994).

### The Affective Qualities of Conduct Problem Children

Traditionally, affective and behavior problems have been segregated in the conceptualization of child psychopathology (Cole & Zahn Waxler, 1992). However, there is considerable comorbidity among the affective and behavior disorders in children (Biederman et al., 1991). This is reflected in the use of the internalizing and externalizing distinction that has been derived from statistical clusters of symptoms. These clusters are often moderately positively correlated in research studies (Achenbach, 1991). In addition, DSM-IV acknowledges that individuals qualifying for diagnosis of a disruptive behavior disorders have emotional difficulties.

Conduct disorder includes a number of affective characteristics among its associated features. Individuals diagnosed with conduct disorder may have diminished empathy and little concern for the feelings of others, they may be callous and lack appropriate feelings of guilt or remorse, try to blame others for their own misdeeds, have low self-esteem while projecting an image of toughness, and show poor frustration tolerance, irritability, and temper outbursts (American Psychiatric Association, 1994).

Oppositional defiant disorder also includes a number of affective characteristics among its associated features. Children diagnosed with oppositional defiant disorder may have problematic temperaments in the preschool years (e.g., high reactivity, difficulty being soothed), and during the school years there may be low self-esteem, mood lability, anger, and low frustration tolerance (American Psychiatric Association, 1994).

### The DSM and Subtypes of Conduct Problems

In the psychiatric nomenclature, several subtypes of Conduct Disorder have been differentiated. They all refer to the persistent display of serious antisocial behavior which is extreme for the child's developmental level, and that leads to the violation of the rights of others (American Psychiatric Association, 1980, 1987, 1994). The DSM-III (American Psychiatric Association, 1980) differentiated between aggressive and nonaggressive CD and also between socialized and undersocialized CD, yielding a taxonomy with four categories: socialized aggressive, socialized nonaggressive, undersocialized aggressive, and undersocialized nonaggressive CD. The next revision, DSM-III-R (American Psychiatric Association, 1987), collapsed the four categories into three, distinguishing among group type, solitary aggressive type, and undifferentiated type CD. The DSM-IV takes another approach by differentiating between childhood onset and adolescent onset conduct disorder on the basis of presence or absence of one at least conduct problem symptom before age ten (American Psychiatric Association, 1994).

### Subtyping Aggressive Behavior

As described above, conduct problems represent a broad class of antisocial behavior that can include disobedience and the violation of the rights of others. Another common characteristic of conduct problem children is that they tend to be aggressive towards others. Vitiello and Stoff (1997) note that among past taxonomies proposed for categorization of aggressive behavior (e.g., overt-covert, Loeber & Schmalung, 1985; reactive-proactive, Dodge & Coie, 1987; hostile-instrumental, Atkins & Stoff, 1993;

predatory-affective, Vitiello, Behar, Hunt, Stoff, et al., 1990) there exists substantial overlap. They suggest that previously proposed taxonomies can be classified into two subtypes with one set of dimensions reflecting a controlled-proactive-instrumental-predatory subtype and another set of dimensions reflecting an impulsive-reactive-hostile-affective subtype. Furthermore, it has been suggested that children classified under these subtypes may be physiologically different, with the former chronically under aroused and the latter over aroused (Frick, 1998b; Vitiello & Stoff, 1997).

In the adult literature, forms of aggressive behavior have been identified which suggest that some individuals who show aggressive and antisocial behavior are characterized by underarousal and others by overarousal (Scarpa & Raine, 1997). In the child literature, Lahey and colleagues have reached a similar conclusion in three published reviews on the biological correlates of CD (Lahey, Hart, Pliszka, Applegate, et al., 1993; Lahey, McBurnett, Loeber, & Hart, 1995; McBurnett & Lahey, 1994). They suggest that the biological literature on conduct disorder points to two groups of early onset conduct problem children, a "psychopathic-undersocialized-aggressive" group and a "neurotic-socialized-nonaggressive" group (Lahey et al., 1995), with the former characterized by lower levels of hypothalamic-pituitary-adrenal (HPA) axis arousal and the latter by elevated sympathetic and HPA axis activity.

Among the theories of aggression proposed, two that have been widely written about suggest different motivational tendencies for aggression. The frustration-aggression model of (Dollard, Doob, Miller, Mowrer, & Sears, 1961), later elaborated by Berkowitz (Berkowitz, 1962, 1993), holds that aggression is a hostile and angry

retaliatory response to perceived frustration or provocation. Drawing on his social learning theory, Bandura (1973) proposes that aggressive behavior is an acquired instrumental behavior maintained by positive environmental contingencies. According to this view, aggressive behavior arises through vicarious learning experiences in which aggression leads to desired outcomes.

Both of these theories have been influential in Dodge and Coie's (1987) conceptualization of reactive and proactive subtypes of aggression. While proactive and reactive aggression are moderately correlated, when more or less pure groups of children with these characteristics are identified, differences emerge in socio-cognitive mechanisms, long-term outcome, and severity of violent behavior. For instance, when Dodge, Lochman, Harnish, Bates, et al. (1997) isolated reactive and proactive groups of children, they found that the reactive aggressive group more often had a history of physical abuse, adjustment problems in peer relations, and inadequate encoding and problem-solving processing patterns. On the other hand, the proactive group was more likely to show a pattern of social information processing suggesting that as a group, these children tend to anticipate their aggression will lead to a positive outcome. Evidence also suggests that these types of individual differences are associated with different outcomes across time. For instance, in another study that applied the reactive-proactive distinction, Pulkkinen (1996) found that males and females classified at age 14 as proactive-aggressive or reactive-aggressive differed at age 27, with proactive aggressive adults having more significant conduct problems during adolescence and manifesting more adult criminality. However, such distinctions are not limited to the literature on reactive

and proactive aggression. For instance, in a group of violent criminal adult offenders, Cornell, Warren, Hawk, Stafford, et al. (1996) examined whether instrumental offenders would score higher than reactive offenders on Hare's Psychopathy Checklist (PCL-R; Hare, 1991). In two studies they found that instrumental offenders were reliably differentiated from reactive offenders, with instrumental offenders showing higher levels of violent crime and psychopathy. Also noteworthy are their findings that when individual items of the PCL-R were examined, differences were most pronounced for affective aspects of the PCL-R, including "lacks remorse", "lacks empathy", and "manipulative".

Laboratory research on aggression in adults and children suggests that autonomic arousal facilitates reactive aggression (Dodge & Somberg, 1987; Zillmann & Bryant, 1974). For instance, Dodge and Somberg (1987) found that not only do aggressive boys tend to have a bias to attribute hostile intent to peers; this bias was most intense under conditions of threat. They exposed aggressive and nonaggressive boys to experiences that would lead to benign vs. negative emotional experiences. During the benign experience, the boys experienced relaxed conditions, but under the negative emotional conditions the boys were allowed to overhear that another boy did not like them, and if they met they were sure to fight. Direct observation and self-report indicated that the manipulation led to increased arousal, anxiety, and degree of upset. Following exposure to each type of emotional experience, the boys' attributional biases were assessed using video recorded vignettes of hypothetical provocations in which they were asked to interpret the peer's intentions as being hostile or benign. Under conditions of relaxation,

aggressive boys were slightly more likely than nonaggressive boys to attribute hostile intent, but under conditions of a negative emotional experience, aggressive boys attributed significantly more hostile intent whereas nonaggressive boys showed no discernible changes.

Overall, research and theorizing on subtypes of aggression is consistent with the idea that different patterns of arousal, motivation, and emotion are often associated with different forms of aggression. In turn, these patterns of aggression and arousal appear to be more common to one type of aggressive individual versus another. If children can be identified who present with psychopathic characteristics, we might expect to find patterns of antisocial behavior corresponding to what Cornell, Warren, Hawk, Stafford, et al. (1996) observed among adult psychopaths (instrumental) and analogous to the controlled-proactive-instrumental-predatory subtype referred to by Vitiello and Stoff (1997).

#### The Concept of Psychopathy Applied to Conduct Problem Children

The concept of psychopathy refers to a personality configuration that reflects a constellation of affective/ interpersonal and behavioral characteristics. Among the core affective features are emotional callousness, limited capacity for empathy and guilt and a general lack of concern for the welfare of others (Hare, 1999). The psychopath's behavior includes impulsivity and sensation seeking and reflects a lack of concern about the future and the consequences of their behavior. While the term is widely used in forensic and research settings, the classification "psychopath" is not presently recognized as a diagnosis within the Diagnostic and Statistical Manual (DSM-IV) or the

International Classification of Diseases (ICD-10; World Health Organization, 1992).

Among those who would qualify for an adult diagnosis of antisocial personality disorder (APD) according to the DSM-IV, only a subset would be considered “psychopaths”. The psychopath’s criminal behavior tends to be chronic, sometimes violent, and recalcitrant to intervention efforts (Hare, Hart, & Harpur, 1991). The ASPD diagnosis focuses heavily on behavioral features and does not adequately tap the core affective features of the psychopathy construct (e.g., shallow emotions).

One of the first clinicians to describe cases of what would later be described as psychopathy was Pinel (1802), who coined the term “*manie sans delire*” (mania without delirium) (Maugh, 1941). Later, Prichard (1839) used the term “moral insanity” to capture a form of mental illness which he viewed as based on an absence of morality (cited in Rotenberg & Diamond, 1971) and Koch (1888) proposed the term “psychopathic inferiority” (Gurvitz, 1951). However, the best-known, most comprehensive description of the psychopath was done by Cleckley (1941) in the “*Mask of Sanity*”. Hare (1999) used this treatise as a starting point in his development of the Psychopathy Checklist (PCL), the most widely used psychometric instrument in adult psychopathy research today. Based on a two-factor model of psychopathy, one dimension refers to interpersonal characteristics (lack of empathy, superficial charm, and callous use of others) and emotional style (absence of guilt, shallow emotions, lack of anxiety) and a second dimension includes antisocial acts (multiple arrests, aggression, multiple marriages, poor employment history). The two dimensions are partially independent.

Although a considerable body of research has been directed toward the study of psychopathy in adults, the application of the psychopathy construct to younger populations in a systematic fashion is a relatively endeavor (Blair, 1997; Frick, O'Brien, Wootton, & McBurnett, 1994). Early psychometric studies attempted to identify intellectual, neuropsychological, and free association profiles of psychopathic children (Berrien, 1934; Elonen & Woodrow, 1928). A roundtable discussion entitled "The Psychopathic Delinquent Child" reflected the dearth of research on psychopathic characteristics in children as well as nosological disagreements (Karpman et al., 1950). With the systematic application of the psychopathy concept to children (e.g., Frick et al., 1994) research efforts have begun to document parallels between the adult literature and work with child samples (Blair, 1999; Blair, Colledge, Murray et al., 2001; O'Brien & Frick, 1996).

#### The Antisocial Process Screening Device

In the last ten years, increased efforts to extend the concept of psychopathy to children has led to a small body of literature. The development of the Antisocial Process Screening Device (APSD; Frick & Hare, 2001) has allowed researchers to apply the concept of psychopathy to children. In the published literature, Frick (Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999; Frick et al., 1994) and Blair (Blair, 1997; Colledge & Blair, 2001) have used the Antisocial Process Screening Device to identify children with psychopathic tendencies. Another line of research has been pursued by Lynam (Lynam, 1997, 1998), who applied Cleckley's (1976) criteria to the archival data of the Pittsburgh Youth Study (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen,

1998).

The APSD (Frick & Hare, 2001) is meant to be a downward extension of the PCL-R. However, the two measures are not isomorphic. The item content of the APSD was designed to be developmentally sensitive, such that some items on the APSD do not have a counterpart on the PCL-R (e.g., is concerned about how well he/she does at school or work, and likewise some items on the PCL-R are not represented on the APSD (e.g., many short-term marital relationships). Also, the PCL-R is typically completed by an experienced clinician who uses a clinical interview of the client coupled with a review of the identified person's file in making judgments about PCL-R items. The APSD relies on parent and/or teacher responses to its items.

The initial validity study of the APSD by (Frick et al., 1994) in a relatively small clinical sample (n = 92) suggested a two-factor structure, with one factor that reflects a callous-unemotional (CU) interpersonal style, a second factor that reflects poor impulse control and conduct problems (I/CP). Evidence for validity for the CU and the I/CP factors was supported by correlation analyses that indicated the factors differentially relate to other criterion measures (Frick et al., 1994). The I/CP factor was strongly related to traditional measures of antisocial behavior, whereas the CU scale was associated with a measure of sensation seeking, and inversely related to a measure of anxiety.

Subsequent factor analytic studies of the APSD with larger clinical (n = 155) and community (n = 810) samples suggested a divergence in the factor structure of the APSD across these two samples. While either a two or a three-factor solution fit the clinical

sample, a three-factor solution, including a narcissism factor (NA), clearly emerged for the community sample (Frick, Bodin, & Barry, 2000). Frick and colleagues examined the relations between each of the APSD factors and DSM disruptive behavior symptoms (ODD, CD, ADHD). Simple order correlations revealed that each of the APSD dimensions had moderate to strong association with disruptive behavior symptoms. Associations were somewhat stronger in the community sample, probably due to a greater range of scores within this sample. More revealing were relations observed in partial correlation analyses that examined relations between each of the APSD factors and DSM symptoms (controlling for the other APSD factors). This analysis revealed that the NA and I/CP factors exhibited moderate associations with DSM symptoms whereas the CU dimension was unrelated to DSM symptoms after controlling for the other factors. Within the community sample, the CU dimension was only related to inattentive symptoms. It is unclear whether this finding indicates, to some extent empirical redundancy of the CU dimension, or as Frick (e.g., Barry et al., 2000) argued, the critical importance of the CU dimension because it is not well assessed within the current DSM framework.

In fact, the CU dimension of the APSD has shown some promise in distinguishing subgroups of children with conduct problems. In one study by Christian et al. (1997), cluster analyses identified a group of children elevated on CU traits and conduct symptoms, whose conduct problems were of greater severity and degree, as shown by more police contacts, and whose parents were also more likely to have an antisocial history. In another study, Wootton, Frick, Shelton, and Silverthorn (1997) proposed that

CU traits would be reflective of an uninhibited temperamental style and attenuated fearful inhibitions, leading these children to be less responsive to punishment cues. In support of this hypothesis, these researchers found an interaction between ineffective parenting and CU traits when children were grouped into high and low groups, supporting a moderating role for CU traits. That is, ineffective parenting was unrelated to conduct problems only for children rated with high elevations on CU traits. More recently, Oxford, Cavell and Hughes (2003) replicated this finding. However, they observed this effect for the dimension of CU traits rather than when CU traits were considered as a dichotomous variable. Interestingly, in the only longitudinal study to date to use the APSD, (Frick, Kimonis, Dandreaux, & Farell, 2003) observed that quality of parenting was one of the most stable predictors of the broader construct of psychopathic characteristics in a community sample across 4 years.

Frick (1998a) hypothesizes that CU traits might be related to low levels of behavioral inhibition. Frick (1998) notes that this is consistent with Kochanska's (1991, 1993) contention that behavioral inhibition is critical for the development of the conscience, particularly affective discomfort components such as guilt, remorse, and empathy. Work from Kochanska's lab also supports this model. For instance, Fowles and Kochanska (2000) reasoned that if electrodermal reactivity (EDR) could be used as an index of fearful inhibition, individual differences in EDR should moderate the pathway to internalized conscience. They found that gentle discipline predicted conscience development among electrodermally reactive children but not among electrodermally unreactive children. Among these more unreactive (fearless) children, an

index of child caregiver attachment relationship was important for predicting the development of conscience.

Affect Processing Deficits among Children with Psychopathic Characteristics.

The core affective interpersonal features of psychopathy are considered to be associated with a deficit in the neurophysiology associated with fear (Hare, 1998; Lykken, 1957). The adult literature contains evidence for diminished fear reactivity both in terms of electrodermal responsivity, heart-rate reactivity (Hare, Frazelle, & Cox, 1978) and startle modulation (Patrick, 1994; Patrick, Bradley, & Lang, 1993). Imaging studies indicate amygdala dysfunction in adult psychopathy (Kiehl et al., 2001) but also deficits in the broader functional connectivity of emotion (Mueller et al., 2003). Analogous studies in children with conduct problems and psychopathic characteristics are rare in the research literature. However, a number of studies have investigated deficits in affect-related processes in children with elevated scores on the Antisocial Process Screening Device.

In a sample of children recruited from a school for emotional and behavioral difficulties, Blair (1999) investigated responsiveness to distress cues again among children with elevated APSD scores. Children were presented with slides depicting distress cues (crying face), threatening images (angry face, pointed gun) and neutral objects. Skin conductance responses (SCR) recorded over the course of the slide presentation revealed that children with high APSD scores presented with significantly lower SCRs to distress cues than either a group without extreme APSD elevations or a community sample of children, but the groups were not significantly different in SCRs to

threatening stimuli. Within subject comparisons indicated that children with psychopathic tendencies showed significantly greater response to threat cues than distress cues, but SCRs to distress cues were not significantly different from neutral stimuli.

Again drawing on a sample recruited from schools for children with emotional and behavioral difficulties, Blair, Colledge, Murray (2001) examined differences in the identification of facial affect among children and adolescents ages 9-17 years of age. Children with extreme scores on the APSD (above 28) and children who did not show high elevations (below 20) were compared on their ability to identify facial affects. Across 20 frames of intensity for facial expressions (sadness, happiness, anger, disgust, fear, surprise), Blair et al. observed specific impairments in affect identification. Group comparisons revealed that high APSD children were significantly more likely to categorize fearful affects as one of the other five basic emotions when fearful facial expressions were presented at full intensity, and were more likely to use a greater number of frames to identify sad affects. Stevens, Charman, & Blair, (2001) conducted a similar study that examined recognition of sad, fearful, happy and angry facial expressions and vocal affects among children and adolescents 9-15 years of age. They found specific impairments in the recognition of sad and fearful facial expressions and sad vocal tones among children with APSD scores greater than 25.

Studies examining the ability to distinguish between moral and conventional judgments (Smetana, 1985) also suggest impairments for boys with elevated APSD scores. Moral transgressions are defined by their consequences for others' rights and welfare (e.g., for example hitting another, damaging another's property) and conventional

transgressions systems are defined by violations of behavioral uniformities within social conventions (e.g., dressing in opposite sex clothing, talking in class). The capacity for perceiving moral transgressions is believed to be related to the capacity for moral emotions (e.g., guilt, remorse, sympathy, empathy) (Blair, 1997). Blair (1997; Fisher & Blair, 1998) has conducted a pair of studies finding that children with psychopathic tendencies performed more poorly on a task requiring them to make a moral/conventional distinction. Furthermore, compared to children scoring low on the APSD, they were less likely to attribute the emotions of guilt or remorse to the story protagonists. In general, higher scores on the APSD C/U and I/CP subscales were related to poorer discrimination on the moral-conventional task.

The only published study in the child literature that did not find a reliable difference indicative of an affective processing deficit among children with elevations on callous-unemotional traits and conduct problems was that of Frick et al., (2003), who drew on a community sample. The lexical decision task typically produces response facilitation to negatively valenced emotional words, a phenomenon not observed in psychopathic adults (Williamson, Harpur, & Hare, 1991). Frick et al. (2003) found that third and fourth grade children with elevated callous-unemotional traits failed to show response facilitation for negatively valenced words, consistent with the effect observed in adult psychopaths. But, on the other hand, sixth and seventh grade children, irrespective of their status on CU traits, did show response facilitation to negatively valenced words. These mixed findings may be attributed to the level of dysfunction within the community sample, which was well below that utilized in other research by Frick and colleagues

(e.g., Frick et al., 1994)

Taken as a whole, the body of literature suggests that children with elevated psychopathic characteristics show deficits in processing affect related information, especially emotions that are important for sympathy and empathy. Findings in support of this contention include self-report (Blair, 1997; Fisher & Blair, 1998), behavior (Blair, Colledge, Murray et al., 2001; Stevens et al., 2001), physiological reactivity (Blair, 1999).

Comorbidity as a Subtype: Hyperactivity-Attention-Impulsivity and Conduct Problems and Fledgling Psychopathy.

Researchers have become increasingly aware that when conduct problems and ADHD co-occur, or are comorbid in children, impairment is much more severe than when a single diagnosis is present (Rutter, et al., 1998). The overlap between “aggression” and “hyperactivity” is common and has been estimated to be between 30% and 90% in clinically-referred samples (Hinshaw, 1987) and somewhat less so in nonreferred samples (Angold & Costello, 2001). Children with comorbid conduct problems display patterns of antisocial behavior and aggression that reflects greater severity, versatility, and consistency across social contexts (Lynam, 1996). Even low levels of conduct problems (below diagnostic threshold) among children with a diagnosis of ADHD predict a later diagnosis of conduct disorder (Mannuzza, Klein, Abikoff, & Moulton, 2004).

Drawing on the basic notion, Lynam (1996) has taken a somewhat different approach to the application of the psychopathy concept to children. He has argued that

children who manifest symptoms of hyperactivity-impulsivity-attention problems (HIA) and conduct problems (CP) are at greatest risk for chronic offending, and represent a class of children with the most virulent strain of conduct problems, best conceptualized as fledgling psychopathy. In an attempt to validate the construct of psychopathy in children, Lynam (1997; 1998) conducted a pair of archival studies based on data from the Pittsburgh Youth Study (PYS; Loeber, et al. 1998).

Lynam (1997) developed the Childhood Psychopathy Scale (CPS) based on the PCL-R (Hare, 1991), a reliable and valid index of psychopathy in adults, by drawing on items from the Child Behavior Checklist (Achenbach, 1991) and the California Child Q-set (CCQ; Block & Block, 1980). Thirteen of the 20 PCL-R items were operationalized within a 41-item scale. Factor analysis of these items indicated a two-factor structure although the factors were highly correlated. Within the PYS sample, Lynam identified three groups of male children (10-12 yrs.), stable nondelinquents, stable serious delinquents, and delinquents who did not meet the criteria for stable serious delinquency and compared these groups on variables known to differentiate adult psychopaths. Comparison of the three groups on the CPS indicated that the seriously delinquent boys scored significantly higher on the CPS. Some support for the predictive value of the CPS was shown in that it accounted for significant variance in overall antisocial behavior while controlling for IQ, cognitive and behavioral impulsivity, SES, and delinquency as measured two years prior.

Since adult psychopaths have been described as impulsive, Lynam (1997) predicted that CPS scores would be associated with measures of impulsivity. These

results proved to be a partial replication of the adult literature. Self-reported and teacher-rated behavioral impulsivity all were moderately related to child CPS scores. However, the card-playing task designed to assess reward dominant behavior was unrelated to child CPS scores. Lynam (1997) also found that the CPS was negatively related to child and teacher rated anxiety, but as will be discussed later, this evidence does not necessarily provide evidence for the construct of psychopathy.

In a second study, Lynam (1998) sought to validate the concept of psychopathy by identifying a group of children high on hyperactivity-impulsivity-attention (HIA) problems and high on conduct problems (CP) for comparison with a HIA only, a CP only, and a non-HIA-CP group, based on the Teacher Report Form (TRF) aggressive, delinquent and attention problems scales. As expected he found the HIA-CP group scored higher than the non-HIA-CP group on the Child Psychopathy Scale, self-reported delinquency, as well as measures of reward dominance (card playing task, delay of gratification task) and executive functions (Trail-Making Test, Block Design). The HIA-CP group also scored higher than the HIA-only group on self-reported delinquency as well as the reward dominance measures. The HIA-CP group also scored higher than the CP-only group on self-reported delinquency and on the card playing task and Trail Making Test. However, the Child Psychopathy Scale performed poorly in differentiating the HIA-CP group from the other two clinical groups. While Lynam (1998) considered the difference between HIA-CP group and the HIA only group to be marginally significant ( $p < .10$ ), this was without an alpha correction. The HIA-CP group was not significantly different from the CP only group on the Child Psychopathy Scale.

A recent study by Gresham and colleagues (Gresham, MacMillan, Bocian, Ward, & Forness, 1998) also supported the designation of HIA-CP children, as a high-risk group. The Gresham et al. (1998) sample was comprised youth at-risk for school failure and special education placement and matched controls. Compared to a group of children with elevated internalizing and externalizing problems, the HIA-CP group was twice as likely to be rejected by their peers (66% vs. 33%) and significantly more HIA-CP boys had no friends in 3<sup>rd</sup> and 4<sup>th</sup> grade.

One of the problematic issues for the work of Lynam (1997; 1998) and Gresham et al (1998) in discerning children they term “fledgling psychopaths” is that their cutoff criteria may reflect a broader class of externalizing children than were identified by investigators using the APSD. Lynam (1998), drawing on data from the Pittsburgh Longitudinal Study utilized teacher reports on three narrow band scales (Attention Problems, Aggressive Behavior, Delinquent Behavior) from the Teacher Report Form (Achenbach, 1991). Lynam (1998) opted for cutoff t-scores of 60, which correspond to the 84<sup>th</sup> percentile in the clinical standardization sample (borderline clinical range). Boys who scored at or above this cut point on either the aggressive behavior or delinquent behavior scales were considered positive for conduct problems (CP); Boys who scored at or above this cut point on the attention problems scale were considered positive for a hyperactivity-impulsivity-attention problems dimension (HIA). Boys who scored at or above the borderline clinical range constituted the HIA-CP group, Lynam’s fledgling psychopaths. The work of Frick (Frick et al., 1994) and Blair (Blair, Colledge, & Mitchell, 2001) include samples of children who would meet the clinical range, as

opposed to the borderline clinical range for both the CP and the HIA dimensions.

Gresham's sample was comprised youth at-risk for school failure and special education placement. Gresham also relied on teacher report utilizing the Problem Behavior Scale of the Social Skills Rating System (SSRS-T; Gresham & Elliott, 1990). Gresham et al. (1998) defined a group of HIA + CP having composite raw scores 2 standard deviations above the gender mean of the standardization sample of the SSRS-T. This procedure yielded a sample of children scoring at or above the 98<sup>th</sup> percentile on both the Hyperactivity and Externalizing subscales. While the cutoffs appear to be markedly different from Lynam's, Gresham's were based on a normative sample rather than a clinical sample cutoff. Thus, it is difficult to determine whether Gresham's HIA/CP children have conduct problems as severe as those children studied in the work of Frick and Blair.

After three studies, the "idea that children with HIA-CP constitute a distinct subgroup" (Lynam, 1996, p.226) continues to remain speculative. The finding that Lynam's (1998) study failed to differentiate the HIA-CP group from the other clinical groups on the CPS is at odds with the idea that this group represents fledgling psychopaths, but it also calls into question the adequacy of the CPS. Since the CPS does not represent some of the core affective features of psychopathy, it is unclear whether the fledgling psychopaths Lynam (1997, 1998) sought to identify are analogous to the children high on CU traits and conduct problems identified by Frick, Blair, and their colleagues. In line with this observation, a recent study by Barry et al. (2000) suggests they are not. These authors evaluated the importance of CU traits relative to

hyperactivity, inattention, and conduct problems. They found that only children elevated on CU traits showed features associated with psychopathy such as fearlessness and a reward dominant response style. What can be seen across this review is that callous-unemotional traits appear to be critical for conceptualizing psychopathy in children. This conclusion was also supported by Abramowitz, Kosson, and Seidenberg (2004) who observed that inmates' retrospective reports of conduct problems and ADHD symptoms were not related to the core affective features of psychopathy. Moreover, because the effects of childhood ADHD and conduct problems were additive in predicting adult psychopathy, the ADHD/conduct problem subtype position was not supported. If the ADHD x conduct problem interaction had been significant, then this would have suggested that the presence of both disorders confer unique risk, consistent with an ADHD/CD subtype position.

### Approach and Withdrawal: A Heuristic Framework for

#### Understanding Conduct Problem Behavior

The conceptual framework of approach and withdrawal has served as the basis for considerable theoretical and empirical work on the underpinnings of aggression, antisocial behavior and hyperactivity over the past two decades. This work has drawn heavily on the psychobiological theory of Gray (Gray, 1982a, 1982b; Gray, 1987b; Gray & McNaughton, 2000). Gray (Gray, 1994) posited a model with two motivational systems, a behavioral inhibition system (BIS) and a behavioral approach system (BAS). The BIS is thought to interrupt or inhibit ongoing goal directed behavior by increasing arousal and vigilance and related aversive motivational states such as fear and anxiety.

Signals of punishment, frustrative nonreward, as well as novel and innate fear stimuli are all thought to engage BIS activity (Gray, 1994). The BIS is also proposed to be activated when there exists a conflict between comparably activated mutually incompatible goals (Gray & McNaughton, 2000). Activation of the BIS leads to behavioral inhibition, and increases in physiological arousal, and focused attention (Gray, 1994). The BAS is mediates behavioral approach. Individuals high in BAS activity are thought to be engaged by stimuli signaling reward and omission of punishment (negative reinforcement) (Gray, 1994).

Gray (Gray, 1994) and Fowles (Fowles, 1988) have both noted that the strength and reactivity of the BIS and BAS vary among individuals, and that both the BIS and the BAS are operative in individuals to a greater or lesser extent. Motivational accounts of childhood externalizing behavior propose an imbalance within these two systems (deficient withdrawal, excessive approach). Children thought to have weak BIS activity are more likely to show more persistent reward-seeking behavior in the face of negative consequences. Similarly, Lykken, (1995) proposed that persons with a relatively weak BIS, such as primary psychopaths, are expected to show diminished fear and anxiety, and to be less likely to inhibit previously punished behavior. They approach the forbidden because they do not fear the consequences. By contrast, accounts of aggressive conduct problems have been proposed to arise from reward dominance or excessive BAS activity (Quay, 1988, 1993, 1997). Within Gray's BIS/BAS model, differential behavioral manifestations are accorded to weak BIS alone or weak BIS coupled with excessive BAS activity. Weak BIS was proposed to be associated hyperactivity (Quay, 1997) whereas

the combination of weak BIS with excessive BAS was proposed to be associated with impulsive aggression (Quay, 1993). However, research reviewed in an upcoming section, has not consistently supported this distinction between hyperactive and conduct problem children. Moreover, Gray's model and research that follows from it, implicates fear, anxiety and withdrawal related behavioral tendencies, whereas contemporary models of ADHD implicate deficits in executive functioning (Barkley, 1997). An alternative view suggests some individuals who display antisocial behavior have a normal BIS, but an over-active BAS (Lykken, 1995). They move toward the forbidden because their approach motivation for reward overrides the anxiety they feel. Yet another account, stimulation/novel seeking, (Eysenck & Gudjonsson, 1989; Quay, 1965; Raine, Venables, & Williams, 1990) proposes that stimulation and novelty seeking are aimed at achieving more optimal levels of arousal among individuals who are chronically underaroused physiologically.

#### Reward Seeking and Conduct Problems.

Much of the work on reward seeking and behavioral approach in adult antisocial populations and samples conduct problem children has relied on the concept of reward dominance. Reward dominance refers to the tendency to pursue rewards in the face of increasing losses, or to the predominance of an appetitive drive over the avoidance of punishment. The task most widely used to assess reward dominance is Newman's card playing task. In the original variant of the task (Newman, Patterson, & Kosson, 1987), the individual is presented with a deck of 100 cards and they are told that a face card indicates winning and a numeric card indicates losing on a given trial. They are also told

they may stop the task at any time and collect what they have won. The probability of losing increases by 10% following each block of 10 cards from 10% to 100%. The high rate of reinforcement at the beginning of the game is believed to establish a reward dominant response set (Scerbo et al., 1990). Research with psychopathic adults has shown that once a reward dominant response set is established (by having a high ratio of rewards on early trials of the game) these individuals tend to continue to play the game, even when the ratio of rewarded to punished trials decreases markedly (e.g., Newman et al., 1987). Newman and Wallace (1993) proposed that while the card playing task can discriminate between inhibited and disinhibited participants, these same participants' performance can be accounted for by number of different participant characteristics including (a) the strength of their approach motivation (b) the strength their reaction to intervening stimuli (e.g. Punishment, or frustrative non reward), (c) attentional limitations (such as response modulation; Wallace, Newman, & Bachorowski, 1991) that bound the individual's capacity to attend to and integrate information while they are engaged competing demands of the task. Response modulation includes "suspending a dominant response set in order to accommodate feedback from the environment" (p. 700), and "a brief and relatively automatic shift in attention from the organization and implementation of goal directed action to stimulus evaluation" (p. 700).

In the child literature, seventeen published studies have examined conduct problems and reward dominance using variants of Newman's card playing task. All these tasks operate under the same general principle. Initially responses result in a high win/loss ratio that gradually shifts to a high loss/win ratio across successive blocks of ten

trials. Findings generally support the notion of greater reward dominance among conduct problem children. A number of investigators have relied on Gray's model as conceptual framework to account for participant performance on the CPT and analogous tasks. However, interpretation of research findings varies in terms of emphasis (over active BAS versus under active BIS). For instance, Quay and colleagues (Daugherty & Quay, 1991; Daugherty, Quay, & Ramos, 1993; Shapiro, Quay, Hogan, & Schwartz, 1988) have mainly ascribed to a BAS/BIS interpretation children's performance on their reward dominance task. Specifically, (Quay, 1988) proposed that conduct disorder involves overactive BAS activity, whereas hyperactive/impulsive ADHD involves reduced BIS activity. Shapiro et al. (1988) examined CPT performance in a sample of seriously emotional disturbed public school children, some of whom were classified as having elevated conduct problems. In support of Quay's interpretation, these children played more cards (showed greater reward dominance) than did groups of children with anxiety symptoms or controls. However, children with CD and ADHD did not differ. Given that Quay proposed overactive BAS and weak BIS for CD and ADHD respectively, it is possible that the same behavioral performance for these groups on the reward dominance task could result from either configuration of motivational imbalance. Moreover, because the reward dominance task includes both reward and punishment, it is not possible to simultaneously discern the effects of reward and punishment cues when the outcome measure is persistence in the task. Matthys, van Goozen, de Vries, Cohen Kettenis, and van Engeland (1998) utilized the door-opening task to examine differences among normal controls, boys with conduct disorder and boys with conduct disorder and

comorbid ADHD. They found an increasing linear trend in mean number of doors opened across the groups from controls to boys with ADHD to boys with conduct disorder. In an attempt to partially address BAS/BIS functioning issue in their sample, Matthys et al. examined correlations between numbers of doors opened and CBCL aggressive and attention problems scores, finding both scales to be moderately related to number of doors opened,  $r_s = .35$  and  $.43$  respectively. Addressing the potential mediating relationship between anxiety and number of doors opened, they correlated the CBCL anxious/depressed scale with number of doors opened, finding these variables unrelated  $r = .21$  (ns). More recently, van Goozen, Cohen-Kettenis et al. (2004) and colleagues showed that children with ODD or comorbid ODD/ADHD perseverated more on a door opening task than normal control children, a finding that could not be attributed to cognitive executive deficits assessed with a broad battery of assessments that assessed set shifting, planning, working memory, inhibition and attention. van Goozen et al. (2004) argued that rather than having an executive deficit, children with ODD/CD are impaired when inhibition specifically involves monetary reward.

Frick and colleagues (O'Brien & Frick, 1996; O'Brien, Frick, & Lyman, 1994) have also ascribed to a BIS/BAS interpretation. O'Brien and Frick (1996) examined reward dominance among clinically referred children, finding that children with severe conduct problems and without a comorbid anxiety disorder played more trials than children with conduct problems and comorbid anxiety, ADHD, or normal control children. According to Gray's model (1987, 1994) anxiety is viewed as a marker of BIS functioning. These authors attribute their findings to a relative difference in the strength

of BIS and BAS among conduct problem children with low versus high levels of anxiety. Recent work by Seguin and colleagues (Seguin, Arseneault, Boulerice, Harden, & Tremblay (2002) however, suggests that neuroticism, an anxiety related construct was associated with greater perseveration on the CPT, but only among adolescents with a unstable history of childhood aggression.

Studies using the APSD have generally found that children who score higher on this measure are more likely to show a reward dominant response style (Fisher & Blair, 1998). Differences in findings within these studies may in part be due to the theoretical perspective of the investigator. Frick (e.g., Frick et al., 2003) has directed much of his work at documenting the importance of callous-unemotional traits among conduct problem children, whereas Blair (Blair, 1997, 1999; Colledge & Blair, 2001) has focused on extending the broad construct of psychopathic characteristics to younger samples. O'Brien and Frick (1996) examined the relationship between reward dominance, anxiety, and psychopathic traits in clinically-referred and control children. Children were divided into four groups, those with conduct problems (CD/ODD) or without anxiety (2 groups), ADHD without anxiety, and normal controls. Only the non-anxious CD/ODD children played more trials than the other three groups, which were not significantly different from one another. This study, contrary to Shapiro et al., (1988), suggested that children with CD/ODD do show greater reward dominance than children with ADHD only.

Because psychopathic characteristics have been specifically implicated in a reward dominant response style, O'Brien and Frick (1996) used the APSD to identify children who differed on anxiety and emotional callousness. Low-anxious children with

high levels of callous-unemotional traits played significantly more trials than high-anxious CU children or normal controls, which did not differ from one another. In a later study, Frick and colleagues (Barry et al., 2000) found that children with high levels of CU traits played significantly longer than other clinical groups on a reward dominance task. More recently, Frick et al. (2003) examined callous-unemotional traits and conduct problems in a community sample selected to be extreme on these dimensions. They found children with elevated CU traits displayed a reward dominant response style more often than children low on these traits. Frick et al. did not report whether the presence of conduct problems also accounted for reward dominance. Fisher and Blair (1998) conducted the only study within the literature that used APSD to examine the relation between global psychopathic characteristics and reward dominance. In a sample of children referred from a school for children with emotional and behavioral difficulties, they found that high APSD ratings correlated with playing longer on the CPT. However, this relationship was accounted for by the impulsive conduct problem factor. Only after controlling for child intelligence was the CU trait factor related to reward dominance.

While studies of reward seeking within the child literature have relied heavily on variants of Newman's card playing task, several recent studies have begun to extend this work to other paradigms that involve reward punishment contingencies. In a sample of high-risk adolescents and control adolescents, Lane and Cherek (2001) examined reward-seeking behavior among a sample of high risk adolescents (including conduct disorder, substance abuse, criminal history, and school dropout). They used a two-button task in which button A (risky) required a variable-ratio response of 12 and was reinforced with

probability of .25 (win \$0.50) and punished with probability .75 (loss \$0.20). Button C (non-risky) required 1 press and timed the task out for 2 s. Overall, compared to control participants, high-risk participants were more likely to choose the risky option (button A), earn less money, and make consecutive risky choices after a single monetary gain. Similarly, Lejuez and colleagues (Lejuez et al., 2002) have observed that their Balloon Analogue Risk Task (BART), a task that involves reward seeking, relates to real world risk behavior including substance use and delinquent behavior (stealing) among adolescents.

Recently, Blair, Colledge, and Mitchell (2001) examined orbitofrontal functioning using Bechara's four-pack card playing task. Two of the decks yield greater rewards but also greater losses, such that in the long run, these decks will lead to losing on the task. The other two decks offer smaller rewards, but also smaller losses, such that in the long run, these tasks will lead to winning money on the task. The object of the game is to identify the advantageous decks and to stick with those decks over the course of playing the game. Blair et al. (2001) found that children who scored above 25 on the APSD showed poorer performance on the task compared to other children from a school for boys with emotional and behavioral difficulties.

In summary, the corpus of data to date implicates greater reward dominance and reward seeking behavior among children with conduct problems, psychopathic characteristics and emotional callousness. Some studies suggest a moderating role for anxiety. Findings are inconclusive as to whether or not children with ADHD exhibit comparable levels of reward dominance to children with conduct problems and comorbid

ADHD. The relative importance of appetitive motivation (e.g., BAS activity) versus withdrawal motivation (e.g., BIS activity) has not been directly addressed.

### Anxiety, Low-fear, and Callous-unemotional Traits

The relationship between anxiety and antisocial behavior has been well documented in the child (Russo & Beidel, 1994; Zoccolillo, 1992) and adult literature (Lilienfeld, 1994). In addition, low fear and low anxiety have been described as key features of psychopathy (Cleckley, 1976; Lykken, 1957). For instance, Cleckley observes of the psychopath, "within himself he appears almost as incapable of anxiety as of profound remorse" (Cleckley, 1976, p.340). Yet, individuals with high psychopathic trait scores are often found to score high on self-report measures of anxiety (Lilienfeld, 1994, see Lykken, 1995 for a review). Several authors have proposed that psychopaths, believed to be low in fearfulness, and prone to risk-taking, nonetheless experience high levels of trait anxiety due to a stressful lifestyle (Fowles, 1987; Frick, 1998a; Lilienfeld, 1994).

Lilienfeld (1994) suggests that this confusion may result from researchers' failure to differentiate between fearfulness, which he defines as "sensitivity to cues of impending danger," and anxiety, defined as "distress produced by the perception that danger and related consequences are inevitable" (p. 31). Furthermore, he notes that while fearfulness more often tends to load on constraint, a construct believed to be mediated by behavioral inhibition, anxiety is more strongly associated with negative affect. Fowles (2001) has also raised this issue, citing Barlow's (1988) extensive review of the anxiety literature in which a strong case is made for two types anxiety, one preparatory and the other acute.

Barlow views anxious apprehension as serving to prepare the organism to handle the stresses of everyday life (believed to underlie *generalized anxiety disorder*), and consisting of diffuse cognitive affective structure, perceptions of helplessness or uncontrollability of future events, and worry, whereas fear is seen as an alarm reaction to potentially life-threatening situations (as in panic attacks), leading to behavioral and cardiovascular reaction. Frick et al. (1999) recently by assessing both fearlessness and anxiety in a study of clinically referred children. They found that anxiety and fearlessness were weakly correlated. Furthermore, trait anxiety was positively related to conduct problems, while CU traits tended to be unrelated to trait anxiety. More importantly, they identified a suppressor effect where the correlation between CU traits and conduct problems appears to suppress the divergent relationship between these two constructs and measures of fearlessness and anxiety. Specifically, CU traits positively related to fearlessness after controlling for conduct problems whereas the relation between conduct problems and anxiety rose in magnitude after controlling for CU traits. In addition, the correlations between conduct problems and trait anxiety measures remained significant and positive with CU traits controlled, whereas correlations between CU traits and trait anxiety measures were significant and negative with conduct problems controlled. In practical terms, while increases in CD/ODD symptoms are associated with increased levels of anxiety, children with elevated levels of CU traits will experience less anxiety than children at the same level on CD/ODD but without elevated levels of CU traits.

### Psychophysiological Indices for Differentiating Subtypes of Conduct Problem Children

This section reviews literatures on EEG asymmetry, fear potentiated startle, and resting heart rate / heart rate reactivity with directed at establishing these biological markers as potentially useful indicators of approach/appetitive and withdrawal/aversive motivation and emotional reactivity for studying children with severe conduct problems.

#### Frontal EEG Asymmetry and Approach-Withdrawal Motivation

The spontaneous rhythmic neuronal activity measured with the electroencephalogram (EEG) can be divided into frequency bands that characterize different states of mental activity. When an individual is awake, but not engaged in mental activity, the most prominent synchronized neural activity occurs within the 8-13 Hz frequency band, referred to as alpha. When an individual engages in a cognitive task, such as mental arithmetic, power in the alpha frequency band is reduced and tends to be replaced with higher frequency, lower amplitude beta activity (Stern, Ray, & Quigley, 2001). The inverse relationship between alpha and amount of mental activity has led to the assumption that alpha suppression in a given region reflects greater mental activity (brain activation) in that region.

Frontal EEG asymmetry reflects the relative difference in brain activation across the left and right frontal regions. Frontal EEG asymmetry is a reliable individual difference. Some people show greater relative right frontal alpha activity (implying greater left frontal brain activation) while others show greater relative right frontal activity. A growing body of evidence supports the contention that the left and right hemispheres of the frontal region are differentially specialized for affect and approach

and withdrawal related behavior and related affects (Fox, 1991, 1994). Specifically, the model proposes that the left frontal region is specialized for approach behavior and that activation of this region will be accompanied by the experience or expression of positive affect. The right frontal region is proposed to be specialized for withdrawal related behavior and activation of this region would be accompanied by the experience or expression of negative affect. Support from the model comes from a growing body data from adult clinical and normal samples as well as from child and infant samples. Davidson (1998, 2000a) proposed a diathesis-stress model of anterior activation asymmetry in which asymmetry represents a diathesis that impacts the likelihood that specific affective reactions will follow from required environmental demands (Davidson, 2000a, 2000b). As reviewed below, growing body indicates that individual differences in baseline asymmetric activation are related to differences in affective style.

In the adult literature, greater relative right-frontal activation is associated with depressive symptoms, negative affect, and dysphoria whereas greater relative left frontal activation is associated with positive affect. Henriques and Davidson (1991) found right frontal asymmetry among depressed adults was accounted for by relatively less left frontal activation compared to control participants. A finding that they interpret as a deficit in approach motivation among depressed adults. Also, right-frontal asymmetry was observed among chronically depressed adults in remission from depression, even when current symptoms did not differentiate them from controls (Henriques & Davidson, 1990). Frontal asymmetry is not limited to clinical populations. Among healthy adults, a relative left-frontal bias predicted reports of greater positive affect and less negative

affect compared with participants who showed greater right frontal activation (Tomarken, Davidson, Wheeler, & Doss, 1992). Likewise, among participants who showed stable asymmetry across a two week period, left-frontal bias was associated with reports of greater positive affect in response to a positive film clip and right-frontal bias was associated with reports of greater negative affect in response to negative film clips (Wheeler, Davidson, & Tomarken, 1993). While much of this work has included female samples, Jacobs and Snyder (1996) observed in a sample of normal men that greater relative left-frontal activation was associated with self-reports of increased positive affect and decreased negative affect and depression. Findings not only encompass positive and negative affect, but are more broadly related behavioral traits in the social domain. For instance, Schmidt and Fox (1994) found that adults who self-report low sociability present with greater relative right frontal asymmetry whereas high sociable adults present with greater relative left frontal asymmetry.

Analogous findings are also well-represented in the child literature. Fox et al. (1995) found that four-year-olds who showed social initiative and positive affect during quartet play sessions presented with greater relative left frontal baseline asymmetry whereas those who showed greater reticence (i.e., isolation, onlooking) presented with the opposite pattern of asymmetry. However, patterns of asymmetry and social behavior relations may also need to be qualified. For instance, Fox and colleagues (Fox, Schmidt, Calkins, Rubin, et al., 1996) found that sociable preschoolers who showed right frontal asymmetry had more externalizing behavior problems than their sociable left-frontally activated counterparts. On the other hand, shy children with greater relative right frontal

asymmetry had significantly more internalizing problems than shy left frontal children. Infant studies also find that frontal asymmetry relates to motivation-related constructs in predictable ways. For example, resting frontal asymmetry four-month-old infants who presented with behaviors associated with behavioral inhibition (high motor activity / high negative affect) displayed greater relative right frontal activation at 9 months of age (Calkins, Fox, & Marshall, 1996). Moreover, infants with right frontal asymmetry stability between 9 and 24 months showed greater fearfulness and inhibition in laboratory settings (Fox, Calkins, & Bell, 1994).

Affect eliciting conditions also produce reliable patterns of frontal EEG activity consistent with the notion that state effects are reflected in different patterns frontal asymmetry. Tomarken, Davidson, and Henriques (1990) found that film-induced negative affect was associated with greater right prefrontal activation and anterior temporal activation while film induced positive affect produced the opposite pattern of asymmetric activation (left frontal). Correspondingly, spontaneous facial expressions of emotions in adults are associated with predictable patterns of cortical activation. Positive facial expressions were associated with increases in left cortical activation whereas disgust was associated with activation of the right frontal and temporal regions (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Jones & Fox, 1992). Among social phobics, Davidson, Marshall, Tomarken and Henriques (2000) observed dramatic increases in right frontal activation while these subjects anticipated making a public speech. And, among elderly women, Kline, Blackhart, Woodward, Williams and Schwartz (2000) observed greater left frontal activation to pleasant, relative to neutral or

unpleasant odors. State asymmetry effects are also present in the child literature. For instance, maternal separation and stranger approach were associated with right cortical activation in infants (Fox, Bell, & Jones, 1992; Fox & Davidson, 1987).

#### Frontal EEG Asymmetry and Gray's Motivational Model.

In line with their conceptual similarities, studies have begun to empirically link the approach-withdrawal model of hemispheric specialization to Gray's BIS and BAS model. This is particularly important for the present study given the widespread use of Gray's model as a conceptual framework for understanding youth with conduct problems. Sutton and Davidson (1997) were the first to explore this link when they examined Carver and White's self-report measure of Behavioral Approach and Behavioral Inhibition strength in relation to patterns of frontal activation (Carver & White, 1994). They found that participants with greater relative left prefrontal activation reported greater levels of BAS strength whereas participants with greater relative right prefrontal activation reported greater levels of BIS strength. In addition, frontal EEG asymmetry accounted for more than 25% of the variance in the BAS-BIS self-report measure. Subsequently, two other studies using the BIS/BAS scales found only a relation between greater relative left frontal activation and greater BAS—greater BIS was not associated with asymmetry (Coan & Allen, 2003; Harmon Jones & Allen, 1997). These discrepant findings do not necessarily mean that BIS is unrelated to right frontal asymmetry. The validity of the BIS scale as an index of BIS as well as the participant sampling within the later two studies may have accounted for the null findings.

#### Anger and Frontal EEG Asymmetry as an Approach-Related Motivational Tendency.

Recently, Harmon-Jones and colleagues have made the case for anger as an approach motivational tendency with negative valence (Harmon Jones & Allen, 1998) (Harmon Jones et al., 2002; Harmon Jones & Sigelman, 2001) and have provided support for the conception of greater relative left frontal activation as a biological marker for trait and state anger. In a sample of boys and girls aged 11-17 years (Harmon-Jones & Allen, 1998) found that self-report of trait anger was significantly and positively associated with frontal asymmetry but not with asymmetry in other regions, an effect that was not due to outliers. State effects have also been found with anger. Harmon Jones and Sigelman (2001) found that when college undergraduates received a negative evaluation from a hypothetical peer about an essay they had written (“I can’t believe an educated person would write like this.”), not only did they rate themselves as more angry than participants receiving a neutral evaluation, they subsequently showed greater relative left frontal activation after receiving the feedback. Following EEG collection, they were more likely to assign an unpleasant beverage to their evaluator than were participants receiving neutral feedback. Subsequent analyses indicated that ratings of anger and aggressive behavior were associated with greater relative left frontal activation, but only for those who received the insult.

#### Frontal EEG Asymmetry and Disruptive Behavior Disorders.

Relatively little work has explored EEG asymmetry differences among clinically referred children with externalizing behavior problems. The only two published studies within the literature that explored asymmetry differences among externalizing samples were done by Baving and colleagues (Baving, Laucht, & Schmidt, 1999, 2000). Baving

et al. (1999) examined frontal brain activation among 4 ½ and 8 year-old boys and girls with ADHD, and healthy non-referred children. Four-year-old boys showed greater relative right frontal activation and normal boys were more right frontal than boys with ADHD. Four-year-old girls displayed the opposite pattern of results. Those with ADHD presented with greater relative right frontal activation than control girls, who were slightly more left frontal. At 8 years, ADHD boys showed a bias towards more left frontal activation, which was significantly different from control boys who showed more activation in the right frontal region. Girls with ADHD showed more right frontal activation whereas control girls were more left frontal in their asymmetry pattern. When authors compared ADHD children with those with comorbid ADHD and ODD no laterality differences emerged. However, their sample sizes may have been too small to detect differences (4 ½ 10 boys, 6 girls, 8 yrs 10 boys, 4 girls). Baving, Laucht and Schmidt (2000) examined frontal brain activation among 4 ½ and 8 year-old boys and girls with oppositional defiant disorder, with the exclusion of comorbid diagnoses (conduct disorder, ADHD, or emotional disorder) and healthy non-referred children. Baving et al. found sex, age, and clinical status differences. Preschool and elementary school girls with ODD presented with greater relative right frontal activation, whereas non-referred preschool girls showed no asymmetry patterns and elementary school girls had greater relative left frontal activation. Boys with ODD, irrespective of age, did not show frontal asymmetry. Non-referred boys presented with greater relative right than left frontal activation. These findings clearly demonstrated differences in frontal asymmetry for children with ODD versus healthy comparison children although it is unclear how the

differences fit within the model reviewed above. That Baving et al. (1999, 2000) failed to find asymmetry differences consistent with an approach-withdrawal model could be accounted for by a number of factors. Their strict exclusionary criteria for the ODD study (no comorbid ADHD, CD, or emotional disorder) is likely to have restricted the range of ODD symptoms as well as other affective presentations within the clinical range that we would expect to relate to frontal asymmetry (i.e., anger, greater approach motivation, greater relative left frontal activation). The heterogeneity of approach (e.g., anger) and withdrawal-related emotions (e.g., anxiety) common to the disruptive behavior disorders could also lead to different findings across studies.

#### Cortical Activation and Arousal: The Work of Heller and Colleagues.

The body of research to date suggests that differences in cortical activation in the frontal region can reflect both stable traits as well as shorter-term affective states. However, an alternative approach to the relationship between cortical activation and emotion has been put forth by Heller and colleagues (Heller, 1993; Heller & Nitschke, 1998). They have argued for differentiating between valence and arousal dimensions of emotion. Under this model, activation in anterior regions of the brain is thought to reflect valence (pleasant-unpleasant) and activation in posterior regions is thought to covary with arousal (high-low). In their review of the literature on anxiety and brain activity (Heller & Nitschke, 1998), they note that when the distinction between anxious arousal and anxious apprehension is made, most studies reporting greater right-hemisphere activity involve panic attacks or high stress situations, both of which are characteristic of anxious arousal, whereas most studies reporting greater left-hemisphere activation

(mainly anterior) involve OCD, GAD, or trait anxiety, as most indicated by self-report of anxious apprehension or worry. Heller and colleagues (Heller, Nitschke, Etienne, & Miller, 1997) recently tested this proposition by specifically selecting individuals with self-reported anxious apprehension and then experimentally manipulating anxious arousal. When EEG was measured while the participants were at rest, anxious participants showed a larger asymmetry favoring the left hemisphere than did controls, but during a task designed to manipulate anxiety, anxious participants showed an increase in activity in the right parietal region relative to controls.

Because no published research to date has specifically selected individuals for conduct problems and high levels of psychopathic characteristics for a study of EEG asymmetry, it is difficult to extrapolate what findings might be expected for a group of children believed to be characterized by extreme scores on the APSD. In the adult literature no studies have reported differences in frontal EEG asymmetry among psychopaths. Work from the adult literature that may bear some relevance here suggests that language may be less lateralized among psychopaths than typical adults (Hare & Jutai, 1988; Hare & McPherson, 1984) or that psychopaths may have a deficit in processing nonverbal emotional information when task demands favor right hemisphere functioning (Kosson, Suchy, Mayer, & Libby, 2002). Since externalizing disorders generally reflect approach tendencies, greater relative left frontal activation might be expected. However, as Fox (1994) has underscored, it is important to consider the dynamic interplay between the hemispheres in that an asymmetry can result from either more activation in one hemisphere or less activation in the other, and that these patterns

are related to affective behavior. As such, left frontal asymmetry may be due to relatively greater activation on the left side or relatively less activation on the right side (right frontal hypoactivation). Interestingly, within the literature on disruptive behavior disorders, theorists have argued for “greater approach” or increased BAS functioning (Fowles, 1988) and diminished withdrawal (low BIS functioning; Lykken, 1995).

### The Startle Reflex and Its Affective Modulation

The acoustic startle reflex is a protective behavioral reaction consisting of a rapid extension and flexion of a series of muscles of the eyelid, the neck and extremities. It is assumed that whole-body startle in rats and humans is based on similar neurophysiology although knowledge about the neural organization of the human eyeblink component of the startle response is not completely understood (Berg & Balaban, 1999). The input path for the acoustic startle response begins with auditory nerve fibers that project onto cochlear root neurons within the auditory nerve and then onto the nucleus reticularis pontis caudalis (PnC). Projections from cells in the PnC synapse in the spinal cord and also are believed to project to the facial motor nucleus in the areas critical to the eyeblink component of startle in humans (Berg & Balaban, 1999). Much of what we know about the neural circuitry underlying the startle reflex, and its modulation by fear, comes from the seminal work by Davis (1992). The amygdala is an important component of the system involved in the acquisition, storage, and expression of fear memory (LeDoux, 2000). Davis showed that in the rodent, the central nucleus of the amygdala plays a critical role in the modulation of the startle reflex and that the central nucleus of the amygdala projects to the reticularis pontis caudalis through a descending pathway.

Startle is stronger in the presence of a fear-conditioned cue and the potentiation effect is abolished when the central nucleus is lesioned, leaving baseline startle intact.

Lang and colleagues (Vrana, Spence, & Lang, 1988) were the first to systematically show that an analogous startle modulation effect could be produced in humans. They capitalized on an existing body of work in which instantaneous rise-time white noise was used to elicit the eye-blink portion of the startle response. By placing two electrodes on the obicularis oculi muscle below one eye they measured electromyogram (EMG) activity during the presentation of white noise probes that were presented as participants viewed pleasant, neutral, and unpleasant pictures. Varna et al. (1988) observed that the magnitude of the blink response was greater (potentiated) during unpleasant picture viewing relative to neutral picture viewing. Moreover they observed that startle blink magnitude was attenuated during pleasant picture viewing. A number of investigators subsequently replicated the findings of Varna et al. (1988). As a general model, Lang and colleagues (Lang, Bradley, & Cuthbert, 1990, 1997) account for affective startle modulation findings with pleasant and unpleasant pictures within a motivational framework. The model, conceptually similar to the motivational components of Gray's BIS/BAS model, proposes that emotion is organized around two fundamental systems, one appetitive and the other defensive. Unpleasant pictures are thought to elicit or prime a state of defensive readiness. When a startle probe, fundamentally an aversive stimulus, occurs when a state of defensive readiness has been primed, a stronger eye blink reaction is elicited. Pleasant pictures elicit appetitive readiness, opponent to the startle probe, leading to a weaker eye blink reaction.

Individual differences in startle reflex modulation paradigm have now been well documented in the clinical literature. Studies have used this paradigm to study samples characterized as anxious or fearful, including investigations of clinical anxiety (Cuthbert et al., 2003), phobia (Hamm, Cuthbert, Globisch, & Vaitl, 1997) and trait fearfulness (Cook, Davis, Hawk, Spence, & Gautier, 1992). Overall, studies find that potentiated startle in the presence of unpleasant stimuli tends to be greater for these clinical groups. However, not all individuals show potentiated startle to unpleasant pictures. For instance, a pair of studies by Corr and colleagues (Corr, Kumari, Wilson, Checkley, & Gray, 1997; Corr, Wilson, Fotiadou, Kumari, et al., 1995) showed that individuals low on harm avoidance (trait fearlessness) do not respond to unpleasant slides with potentiated startle reflexes. Patrick (1994; Patrick, Bradley, & Lang, 1993) has applied the startle paradigm to the study of adult psychopaths, also finding diminished startle in the presence of unpleasant pictures. In addition to work in normal adult and clinical populations, emotion modulated startle has been extended to children (McManis et al., 2001) and infants (Balaban, 1995; Schmidt & Fox, 1998).

#### The Startle Response and Psychopathy: Evidence for Abnormal Affective Processing

Patrick et al. (1993) examined startle reflex blink reactions evoked by noise probes among criminal offenders rated low, moderate, or high using the Psychopathy Checklist (PCL-R). Individuals with low or moderate PCL-R ratings showed normal linear startle modulation (i.e., significant linear relationship between slide valence and startle magnitude, with smallest responses during pleasant slides, moderate responses during neutral slides, and largest responses following unpleasant slides). By contrast,

incarcerated men with high ratings on the PCL-R showed a quadratic startle pattern. That is, startle responses were diminished for both pleasant and unpleasant pictures relative to neutral pictures. Group differences in startle modulation were specifically related to the affective features of the PCL-R (Factor 1, emotional detachment), rather than antisocial behavior per se. Supplementary analyses revealed that when subjects high on the antisocial behavior factor of the PCL-R were divided into low and high on emotional detachment groups, only those high on emotional detachment showed the deviant startle pattern. Patrick and colleagues proposed that the deviant startle response pattern observed among psychopaths is consistent with a deficit in aversive responding, perhaps a fear deficit. Moreover, they suggested that the pattern of results for psychopaths might reflect a bias toward foreground attentional engagement over defensive reactivity (Patrick et al., 1993).

Levenston, Patrick, Bradley, and Lang (2000) sought to extend Patrick et al. (1993) by varying probe onset and stimulus content. Their rationale for varying probe onset was based upon recent work and theorizing which suggests a transition from the influence of attention (orienting) to emotion (engagement of a defensive system) on the startle reflex, that is dependent on probe onset and stimulus intensity (Lang, 1997). A shift from attention inhibition to defensive potentiation is apparent over the time course of stimulus processing. During the first few hundred milliseconds post stimulus onset, the blink reflex is generally inhibited. This prepulse inhibition effect is thought to reflect an attenuation of new sensory input (i.e., a startle probe) to ensure adequate processing of the prior stimulus foreground (i.e., an affective picture). The process has been referred to

within the startle literature as sensory gating (Braff, Grillon, & Geyer, 1992; Graham & Hackley, 1991). For instance, Bradley, Cuthbert and Lang (1993) found that at 300 ms after picture onset startle inhibition occurred for both pleasant and unpleasant slides, suggesting that motivationally relevant stimuli are detected relatively early and that processing for these stimuli is protected (see Lang et al., 1997). However, by 800 ms the reflexes elicited were sensitive to the affective valence of the stimulus. Greater startle potentiation was present for unpleasant stimuli, an effect that became stronger at later probe times (1,300 ms and 3,800 ms). The rationale Levenston et al. used for varying stimulus content was based upon Cuthbert, Bradley and Lang (1996) who showed that in normal adults, unpleasant pictures of low to moderate intensity lead to startle inhibition, but pictures of greater intensity along the continuum of unpleasantness lead to startle potentiation. Cuthbert et al. (1996) argued that this finding also reflects a transition from inhibition to potentiation/facilitation and a shift in the relative influence of attention (orienting) to emotion (engagement of a defensive system) on the startle reflex. To examine this possibility with inmates who were classified as psychopaths or nonpsychopaths by the PCL-R, Levenston et al. (2000) again used the affective picture-priming paradigm among inmates who were classified as psychopaths or nonpsychopaths with the PCL-R. They included specific categories of stimuli (pleasant – exotic or thrilling; unpleasant – victim or direct threat) and probe times that were early or late. Early probe times occurred at either 300 or 800 ms and late probe times occurred at 1,800, 3,000 or 4,500 ms post picture onset. Because late probe times did not differentiate the groups (all showed a linear startle pattern), these were combined into a

single “late” category. At 800 ms, nonpsychopaths showed the normal pattern of linear potentiation across affective valence, whereas the psychopathic group showed the quadratic pattern of greater potentiation for neutral relative to both positive and negative affective pictures. Type of negative picture content also contributed to the pattern of startle results. Among the unpleasant picture contents, the victim scenes (mutilation or assault) led to clear startle reflex potentiation (relative to neutral stimuli) for nonpsychopaths and clear startle inhibition (relative to neutral stimuli) for the psychopathic group. During the direct threat scenes, both groups showed relative potentiation, however the effect was only statistically significant for the nonpsychopathic group. Overall, Levenston et al. (2000) interpret their findings to suggest that psychopaths have a higher threshold to transition from orienting to defense.

In a related study, Sutton, Vitale and Newman (2002) used the affective picture system to examine startle reactivity among incarcerated women with and without psychopathy. Building upon Levenston et al. (2000) they also explored the impact of startle probe onset (2.0 vs. 4.5 s) and startle modulation. For the later probe time (4.5 s), nonpsychopaths and psychopaths exhibited the typical pattern of startle potentiation across slide affective valence: positive < neutral < negative. During the earlier probe presentation (2.0 s), nonpsychopaths displayed the typical startle pattern, as did psychopaths with higher levels of anxiety. Psychopaths lower in anxiety exhibited diminished reflex magnitudes while viewing unpleasant pictures. Following Patrick et al. (1993), Sutton et al. (2002) examined the interaction between psychopathy factors 1 (emotional detachment) and 2 (antisocial behavior). Unlike Patrick et al. (1993), who

found that Factor 1 accounted for the deviant startle pattern among psychopaths, (Sutton et al., 2002) found that individuals with elevations on both factors showed smaller reflex magnitudes while viewing unpleasant pictures.

More recently, Vanman and colleagues (Vanman, Mejia, Dawson, Schell, & Raine, 2003) examined startle modification with affective pictures in a community sample. They observed that elevations in antisocial behavior (Factor 2) were accompanied by lack of startle modulation across positive and negative pictures, at 4.5 s during slide presentation, but only if participants also showed elevations in emotional detachment (Factor 1). When Vanman et al. examined the PCL-R factors as dimensions in relation to startle modulation, both factors were important for understanding individual differences in a startle modulation difference score. Specifically, they observed a suppression effect whereby emotional detachment was negatively related to startle modulation whereas antisocial behavior was positively associated with startle modulation. The findings point to the importance of both PCL-R factors for understanding startle modulation effects in psychopathy.

On the whole, the work of Patrick and colleagues has reliably documented a pattern of deviant startle responsivity for adult psychopathic individuals in the presence of unpleasant stimuli. Specifically, psychopaths show diminished startle in the presence of unpleasant stimuli, whereas these same stimuli typically potentiate startle in other groups of adults. Stimulus intensity and timing of the startle probe appear to moderate these effects. Patrick and colleagues have ascribed to an interpretation that presupposes a higher threshold to transition from orienting to defense among adult psychopaths.

Another possibility relates to the concept of affective chronometry (Davidson, 1998). Affective chronometry refers to temporal features of affect including how rapidly affect increases (enhancement rate) and decreases (decay rate). Individual differences in affective chronometry mediated by physiological dimensions such as arousal could also account for the deviant startle pattern among adult psychopaths and would not necessitate the mechanism (higher threshold from orienting to defense) as proposed by Patrick and colleagues. Indeed, the findings of Sutton et al. (2002) are more in line with an interpretation that incorporates affective chronometry because they found differences relatively late in stimulus processing (2 s) which was moderated by trait anxiety, an arousal related construct. However, the affective picture startle paradigm typically uses pictures in a static fashion, which may not be optimal for studying affective chronometry. Studies that utilize more active paradigms to elicit dynamic changes in emotion related process are now being perfected in normal populations (Jackson, Malmstadt, Larson, & Davidson, 2000; Skolnick & Davidson, 2002).

#### Affective Startle Modulation in Children

To date, few published studies have used the affective picture paradigm to examine startle modulation in normally developing children (McManis, Bradley, Berg, Cuthbert, & Lang, 2001; Waters, Lipp, & Spence, in press, 2004). McManis and colleagues (McManis et al., 2001) were the first to conduct this work. They found the typical pattern of linear startle potentiation across affective valence from positive to negative, among 7-10-year-old girls. Boys of the same age range showed a statistical trend in the opposite direction (less startle for unpleasant pictures). While these data

clearly indicate a gender difference, it remains an open question as to why boys in this study did not show the expected linear pattern of startle modulation. McManis et al. (2001) suggested that the boys in their study might have responded to the unpleasant pictures with more interest and attention than girls who appeared to respond more defensively. Increasing the intensity of the pictures shown to children is one means of exploring this gender difference further. However, there are ethical concerns with presenting the types of stimuli that have been used in studies with adults (nudity, mutilation, threat with a weapon).

Responding to the concern that the affective pictures used in adult studies may not be appropriate for use with younger participants, Grillon and colleagues (Grillon et al., 1999) explored the use of an airpuff threat paradigm for use with children. In this experimental situation the participant wore a collar that delivered an airpuff to the larynx. The participant was told that when a given light bulb was lit (e.g., green = threat) they might get an airpuff, but when another light bulb is lit (e.g., blue = safe), they could be sure that no airpuff would happen. At varying points throughout the experiment startle probes (white noise bursts) were delivered. Grillon et al. (1999) and colleagues found that the paradigm reliably potentiated startle from the safety to the threat conditions. However, unlike the affective picture paradigm, the airpuff paradigm presents the child with an ongoing context in which stimuli, safe and threat, are intimately tied to one another across time. This type of paradigm could be important for examining individual differences in affective chronometry as discussed above.

More recently, van Goozen, Snoek, Matthys, van Rossum and van Engeland

(2004) published the first study to examine startle modulation in behaviorally disordered and comparison children, 7-12 years of age. Clinically referred participants (n = 21, 19 boys) were assessed with the DISC-P 2.3 (Fisher, Wicks, Shaffer, Piacentini, & Lapkin, 1992). Fifteen of these children met DSM-IV criteria for ODD and six met criteria for CD based on parent report. Normal control children (n = 33, 14 boys) were recruited from an elementary school. Ten of the clinically referred children were taking methylphenidate, and normal control children were medication free. Overall, van Goozen et al. (2004) observed that both groups showed a linear relationship across slide valence and startle magnitude, with disruptive behavior disordered children showing lower levels of startle magnitude across all slide categories. Correlation analyses within the clinically referred group revealed that CBCL delinquency scores were negatively associated with startle magnitude, but only for unpleasant slides. This finding provides evidence for increased fearlessness among children with disruptive behavior disorders. The fact that van Goozen et al. (2004) had only two girls in their clinical group, but 19 girls in their control group could be used as evidence to suggest that the differences between their clinical and control groups were due unbalance samples with respect to girls. In fact, McManis et al. (2001) observed that girls startled more than boys. However, that the control boys and girls were not significantly different, suggests that the group differences observed across the clinical and control group cannot be attributed to the presence of more girls in the control group.

The body of literature reviewed thus far indicates that the affective modulation of startle is a reliable phenomenon that has been shown to differentiate individuals who

show differences in trait anxiety and fear. Adult antisocial populations with elevated scores on the PCL-R exhibit an abnormal pattern of startle modulation (Levenston et al., 1999, Patrick et al., 1993, Sutton et al., 2002). In addition, timing of startle probes appears to be important for detecting the abnormal pattern of affect modulation of startle among psychopaths (Levenston, et al., 1999, Sutton, et al., 2002). Evidence also suggests that modulation of startle in children is a reliable phenomenon (McManis et al. 2001; Schmidt & Fox, 1998). Among children with disruptive behavior problems (van Goozen, et al. 2004), severity of delinquency is associated with decreased startle responsivity in the presence of unpleasant stimuli, consistent with increased fearlessness among these children. Based on these findings we might expect to find that boys who show elevated characteristics on the APSD, a measure purported to be a downward extension of the PCL-R, might also show a deviant pattern of startle responsivity.

#### Heart Rate and Heart Rate Reactivity Among Children with Conduct Problems

Heart rate reflects activity in both the sympathetic and parasympathetic branches of the autonomic nervous system (Hugdahl, 1995). Nonetheless, heart rate has been used in a number of studies as an index autonomic nervous system arousal and reactivity. Low resting heart rate has been shown to be a marker of antisocial and aggressive behavior in child and adolescent samples (Eisenberg, Fabes, Guthrie, Murphy, et al., 1996; Raine, 1993; van Goozen et al., 1998). In general, low resting heart rate is thought to be associated with underarousal and psychological characteristics such as sensation seeking and fearlessness, whereas elevated heart rate has been linked with anxiety and a fearful temperament (Kagan, 1989b; Scarpa & Raine, 1997).

A review of 10 studies by (Raine, 1993) consistently found lower resting heart in antisocial groups of children between the ages of seven and fifteen, with an average effect size of 0.84. Raine, Venables, and Mednick (1997) extended this work by showing that groups of three-year-olds with high or low resting heart rate differed on aggression at age 11. Low resting heart rate in children has also been associated with a diminished empathy (Zahn Waxler, Cole, Welsh, & Fox, 1995). On the other hand, childhood anxiety and behavioral inhibition have been associated with elevated resting heart rate (Rogeness, Cepeda, Macedo, Fischer, & Harris, 1990; Scarpa, Raine, Venables, & Mednick, 1997). Mezzacappa et al. (1997) examined levels of anxiety, antisocial behavior and heart rate regulation in a sample of adolescent boys, a third of whom were identified as having early-onset stable aggression. They found increased levels antisocial behavior were associated with lower levels of mean heart rate while increased levels of anxiety were associated with enhanced levels of resting heart rate. However, not all studies find a relationship between lower resting heart rate and disruptive behavior. For instance, Beauchaine (2002) did not find a difference in resting heart rate among adolescent males carrying diagnoses of CD, ADHD, and comparison boys.

Two recently published meta-analyses provide strong support for heart rate and heart rate reactivity as neurobiological markers of antisocial behavior in youth. Lorber (2004) found that across 13 studies, low resting heart rate was associated with conduct problems with small effect size of  $d = -0.33$ . No differences were noted across child and adolescent samples. Similarly, for aggression, 16 studies indicated an effect size of  $d = -0.38$ . When age was examined as a moderator, significant effect sizes were observed for

children  $\underline{d} = -0.51$  and adults,  $\underline{d} = -0.30$ , but not for adolescents,  $\underline{d} = -0.15$ . In the same year, Ortiz and Raine (2004) examined the relation between heart rate and antisocial behavior across 40 studies, many of which overlapped with those of Lorber (2004). They observed an average effect size of  $\underline{d} = -0.44$ , which was not moderated by other variables (i.e., gender, age, method of recording, informant, and use of a clinical comparison group). These findings led Ortiz and Raine (2004) to conclude that low resting heart rate is “the best-replicated biological correlate to date of antisocial behavior in children and adolescents” (p. 154). No published study to date has examined resting heart rate among children with psychopathic characteristics. However, Raine (1993) concluded there was no evidence for a relation between low resting heart rate and psychopathy among adults. Lorber (2004) reached the same conclusion when he looked at 16 studies of psychopathy/sociopathy in which the average effect size was not statistically significant,  $\underline{d} = 0.06$ .

Compared to work on resting heart rate, far fewer studies have examined the relation between heart rate reactivity and disruptive behavior. Studies have found group differences as well as potential moderating variables. For instance, van Goozen et al. (1998) found that a group of children diagnosed with ODD or CD had higher HR levels in response to frustration (unsolvable problem) and provocation (verbal provocation by a competitor) than did controls. Moving toward specifying differences among subgroups of aggressive children, Dodge & Schwartz (1997) proposed that proactive and reactively aggressive children might differ physiologically. Pitts (1997) examined this possibility by selecting a reactive aggressive only group and a mixed proactive-reactive aggressive

group. The reactive aggressive group exhibited significantly greater heart rate level in response to a reactive challenge than did the mixed proactive-reactive group. In a related vein, some work suggests that heart rate reactivity among children with disruptive behavior problems is moderated by anxiety. For instance, in a non-referred sample, Harden and Pihl (1995) observed greater heart rate reactivity among boys with elevated disruptive behavior problems and anxiety compared to boys only elevated on disruptive behavior problems and comparison boys. Lorber (2004) also examined heart rate reactivity in his meta-analysis. Conduct problems were associated with greater levels of heart rate reactivity in a sample of seven studies that included children and adolescents, ( $d = .20$ , small effect). Lorber (2004) observed that heart rate reactivity was related to aggression in adults ( $d = .27$ ) but not adolescents. However, the presence of Psychopathy/sociopathy in adult samples was not related to heart rate reactivity in a sample of 13 studies ( $d = 0.07$ ).

### Overview of the Current Study

#### Purpose

The current study was designed to examine the profile of a group of boys whose antisocial behavior patterns are *suggestive* of a distinguishable syndrome.

The central goal of his study is to characterize a subtype of conduct problem children who present with a relatively unique pattern of psychophysiological reactivity and behavior. Specifically, study was undertaken to examine relations of maternal reports of severe antisocial behavior, termed by some investigators as reflecting psychopathic characteristics, and putative indices (ratings, behavior, psychophysiology) of fear and

anxiety, approach-withdrawal related tendencies, and markers of severe antisocial behavior. A multiple measure approach was adopted as a means of providing converging evidence for the profile of severe conduct problem boys. The project builds upon research in the areas of cerebral asymmetry and emotion; fear potentiated startle, cardiac functioning, and subtyping research in antisocial behavior.

#### Overview of the Study Design

The research project included screening of boys referred for psychiatric care with elevated externalizing problems and non-referred comparison boys who did not present with elevated externalizing or internalizing problems. The clinically referred group was parsed into two groups based on maternal responses to the Antisocial Process Screening Device (Frick & Hare, 2001), an instrument designed to be a downward extension of the Psychopathy Checklist-Revised (Hare, 1991). Overall, the screening procedures were designed to yield three groups of children: 1) clinically referred boys with extreme elevations on the Antisocial Process Screening Device (High APSD group, APSD total score  $\geq 25$ ); 2) clinically referred boys without high elevations on the APSD, but with significant externalizing problems (Externalizing group, APSD total score  $\leq 20$ ); 3) non-referred community boys (Comparison group). In this way, boys with high elevations of the APSD could be contrasted with other clinically referred externalizing boys as well as with boys who were not presenting with significant internalizing or externalizing symptoms.

In this study, 8-12-year-old boys sat for a psychophysiological recording session that included active and passive tasks designed to elicit motivational and emotional

responding. Concurrently, each child's mother or primary caregiver completed a computer assisted diagnostic interview that assessed diagnostic criteria for conduct disorder, oppositional defiant disorder, and attention deficit hyperactivity disorder according to DSM-IV diagnostic criteria. Fear reactivity was operationalized with psychophysiological responses and rating scales. The psychophysiological markers included heart rate collected at rest and during film clip viewing and the eye blink startle response elicited during conditions of safety or threat. Each child and their primary caregiver completed rating scales designed to assess fear and anxiety. Approach and withdrawal related behavioral tendencies were operationalized with psychophysiological responses and behavioral tasks. Brain electrical activity (EEG) was collected at rest and during film clip viewing. Boys also completed a task that varies reward to punishment ratio over time, and a task that pits each boy against a hypothetical peer in the context of a competitive game that allows for reward seeking, aggressive responding and self-protective behavior. Markers of Antisocial Behavior and Related Processes included ratings of covert antisocial behavior, hostile attributional bias and aggressive responding during a competitive task. As statistical control variables, family socioeconomic status and global intellectual functioning were assessed.

### Summary of Hypotheses

Fear and the "Low Fear" hypothesis. On the whole, the hypothesis that underlies the multi-method assessment of fearful reactivity was that boys with extreme ratings on the Antisocial Process Screening Device (High APSD group) would present with low levels of fearful reactivity compared to other children. Specifically, concerning to

psychophysiological reactivity, the High APSD group was expected to present with relatively lower resting heart rate levels than the externalizing group. Under conditions of threat of an airpuff, it was expected that High APSD boys would show less startle reactivity during threat (an airpuff directed at the larynx) than either Externalizing boys or Comparison boys. Moreover, in the presence of a threatening stimulus, this effect was expected to be most pronounced when startle reactivity was assessed earlier, rather than later, during stimulus presentation. Along the continuum of fear, High APSD boys were expected to self-report less fearfulness and more fearlessness than either the Externalizing group or the Comparison group.

Reward Seeking and Approach-withdrawal. The guiding hypothesis regarding reward seeking and behavioral approach was that High APSD boys would present with a pattern suggestive of greater approach related tendencies, both in terms of their reward seeking behavior and their resting frontal EEG asymmetry pattern. The tasks used within the current study consist of reward seeking in the context of other competing demands. Within the first task (Door Opening Task) boys received more rewards initially and then more punishments as they choose to persist longer in the task. It was expected that the High APSD group would play the game longer (open more doors) than externalizing or comparison boys. Within the second task (Point Subtraction Game) boys chose between seeking rewards, aggressive behavior and self-protective behavior. Within this context, it was predicted that High APSD boys would show more reward seeking behavior than the other groups of boys. With respect to frontal EEG asymmetry, it was expected that High APSD boys would show a psychophysiological brain activity pattern suggestive of a

tendency toward approach. That is, High APSD boys would show greater relative activation on the left frontal side, consistent with a greater tendency towards approach.

Psychophysiological Reactivity to Affective Films. One of the defining characteristics of boys with elevated APSD scores is emotional callousness. Indeed some work has shown that boys with elevated APSD scores are relatively unresponsive to other's distress (Blair, 1999). In response to affective films it was predicted that boys with extreme APSD scores would, on average, have lower heart rate levels (mean IBI). Moreover, it was expected that the Externalizing group would show greater changes in heart rate across film clip viewing than High APSD boys. Thus in the present study, High APSD boys are not expected to not show significant changes in frontal EEG asymmetry in response to affect eliciting films compared to baseline films. Conversely, boys without extreme elevations on the APSD and comparison boys are expected to show increased right frontal activation (change from baseline) in response to viewing a sympathy film and increased left frontal activation (change from baseline) in response to viewing two anger films.

Markers of Antisocial Behavior and Related Processes. With the aim of providing converging evidence for High APSD boys as a distinct subgroup among clinically referred externalizing boys, several measures were selected with the aim of characterizing the patterning of their antisocial behavior. First, it was predicted that High APSD boys would present with greater levels of covert but not overt antisocial behavior than externalizing boys, per maternal report. Second, it was expected that High APSD boys would present with greater levels of aggressive behavior during a competitive point-

subtraction game than other clinically referred boys or comparison boys. Third, drawing on the work and theorizing of Frick and colleagues (Frick et al., 2003; Frick & Ellis, 1999) it was predicted that High APSD boys would show less hostile attributional bias than other clinically referred externalizing boys when responding to hypothetical vignettes depicting conflict with peers.

Categorical vs. Dimensional Approach. For this study, a distinct subgroup of children with severe conduct problems was identified. However, it is not necessarily the case that these children represent a qualitatively distinct subgroup. Alternatively, they may be thought of as at the extremity along the continuum of conduct problems. Indeed the categorical vs. continuous discussion continues in the psychopathology research literature (Krueger & Piasecki, 2002; Pickles & Angold, 2003). As such, the behavioral and physiological markers collected may also be thought of as varying along continua. Consequently, within the results section, we take an agnostic perspective with regard to the categorical versus dimensional distinction. Hypotheses were stated in the form of categorical subgroup analysis. Nonetheless, in several sections of the results we take a dimensional perspective for comparative purposes. This approach allows for use of the full sample of clinically referred boys ( $N = 78$ ) along with the comparison sample, for addressing the relations among variables of interest.

## CHAPTER III

### Method

#### Clinical and Comparison Group Formation

Children with a known neurological deficit, diagnosis of mental retardation, or pervasive developmental disorder were excluded. Children taking psychiatric medications were excluded except those on short acting stimulant medications such as Ritalin. Families from the clinically referred sample whose child met the behavioral cutoffs and agreed to withhold short-acting stimulant medication for a period of at least 24 hours prior to their attendance at the laboratory portion of the study were invited to participate. All families contacted agreed to withhold medication. None of the comparison children invited to participate indicated they were taking any psychiatric medications.

The initial screening was from a recruited sample of 155 clinically-referred boys, ages 8-12 years. Within this sample, 110 boys were at the borderline clinical range for externalizing behavior problems ( $t$  score  $\geq 60$ ). One hundred and two families of boys were contacted for participation in the assessment phase of the study. The final clinical sample included 78 boys who also met the exclusionary criteria described earlier. Families that did not participate did so for a variety of reasons including: medication, hospitalization, child age greater than 12.99 years, scheduling difficulties, and choosing not to participate further. The clinically referred sample was then divided into two groups based on caregiver responses to the Antisocial Process Screening Device. One group consisted of children with scores of 25 or greater on the APSD. This cutoff was meant to

be comparable to that used by Blair and colleagues who used a cutoff of greater than 25 in their research. This group was designated the *High APSD group*. A second group consisted of the children who scored 20 or below on the APSD. This group was designated the *Externalizing Group*.

The comparison sample consisted of male children who scored at or below the borderline clinical range for caregiver reported externalizing behavior problems (T score  $\leq 60$ ) and internalizing problems (T score  $\leq 60$ ). These children had no known psychiatric disorder or developmental disability based on a parental report screening measure. Community boys who met the behavioral criteria above and their primary caregiver were invited to participate such that they were proportionally representative of the ages and ethnic backgrounds of the boys in the clinically referred sample. This group was designated the *Comparison group*.

### Participants

**Clinically referred sample.** Seventy-seven clinically referred male children, ranging in age from 8.01 to 12.91 years ( $M=10.45$ ,  $SD=1.34$ ), took part in the study. Recruitment occurred at three regional outpatient psychiatry clinics of Children's Hospital, Washington, D.C. Families of 8-12-year-old children seeking mental health services at the clinics were initially screened based on behavioral ratings completed by their caregiver (see Appendix B for recruitment procedures). The racial/ethnic background of the children was as follows: 21% Caucasian, 71% African-American, 4% Hispanic, 4% Other. The socioeconomic status (Hollingshead, 1975) of families by classification from highest to lowest was as follows: 1=10%, 2=42%, 3=23%, 4=16%,

5=9%.

**Comparison sample.** Twenty-four nonreferred male children, ranging in age from 8.23 to 12.99 years ( $M=10.69$ ,  $SD=1.31$ ) also took part in the study. Families of 8-12-year-old children living in the areas surrounding College Park, Maryland were initially contacted by mail using a list of names and mailing addresses obtained from a commercial mailing list company. The racial/ethnic background of the children was as follows: 29 % Caucasian, 63% African-American, 4 % Hispanic, 4% other. The socioeconomic status (Hollingshead, 1975) of families by classification from highest to lowest was as follows: 1=21%, 2=67%, 3=8%, 4=4%.

### Procedure

The study consisted of 2 phases: a Screening Phase, and an Assessment Phase, with procedures differing slightly for the clinical and comparison groups. Recruitment of the *clinically referred sample* occurred through Children's National Medical Center, Washington D.C. Participants were recruited from the main outpatient psychiatry service, and two satellite clinics. Recruitment of the *comparison sample* began through solicitation of participation via a commercially available mailing list that targeted households likely to have boys in the 8-12-year old range. The mass mailing included two thousand letters and yielded a 6% return rate. Through the mass mailing parents received a letter briefly describing the study along with a screening form that included questions concerning family demographics, child behavioral and emotional functioning, health history and contact information (see Appendix C for recruitment letter and Appendix D for Screening Survey). Caregivers who returned the brief screening form

were contacted by phone and invited to participate in the second screening procedure that utilized the Child Behavior Checklist.

#### General Screening Procedure

Upon initial contact for the screening, each child's parent or guardian was given a general description of the study's purpose over the phone. Interested parents were told they would be receiving a consent form along with a packet of questionnaires through the mail. After fully explaining the purpose of the screening portion of the study and the details of the consent form, parents were asked to sign and return an informed consent form for participation in the screening portion of the study. Families were told at that time that they might be contacted again and asked to participate in an additional laboratory visit at the University of Maryland, College Park at a later date. The screening consent form and questionnaires were returned through the mail. Families received 10 dollars compensation for completing and returning the screening packet. Measures completed at screening included the Child Behavior Checklist and a General Information Sheet. Families of boys who met the screening criteria (described later) were invited to participate in the Assessment phase of the study that included a laboratory visit.

#### Assessment Phase

Parents of children who qualified for the assessment portion of the study, either as clinically referred, or comparison children, were contacted by phone. At this time, details of the assessment portion of the study were discussed. Those families wishing to participate were scheduled for a 2-hour, fifteen-minute visit at a time convenient for them. The assessment phase was conducted at the Child Development Laboratory within

the Department of Human Development at the University of Maryland. Each child and a primary caregiver participated in the laboratory visit. Assessment instruments and laboratory tasks completed during the laboratory visit were identical across the clinically referred and comparison samples.

Following arrival for the assessment portion of the study, the parent or guardian and child were given a general description of the tasks and the purpose of the assessment phase of the study. After a full description of the consent form, each parent or guardian signed and dated an informed consent form for participation in the assessment phase. Clinically referred children recruited from Children's National Medical Center signed and dated an informed assent. Non-referred children recruited from the community were asked to give their verbal assent (see Appendix A for Informed consent and assent forms).

The primary caregiver was administered a computer assisted diagnostic psychiatric interview (DISC-4.0; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) for disruptive behavior disorders by a trained undergraduate lay interviewer. Next, the caregiver completed Antisocial Process Screening Device, and the Interview for Antisocial Behavior.

The child and the experimenter began the visit in a psychophysiology acquisition room. Each child was administered the Multidimensional Anxiety Scale for Children (MASC; March, Parker, Sullivan, Stallings, & Connors, 1997) and the Thrill and Adventure Seeking scale for Children (SSSC; Russo, 1991; Russo, Lahey, Christ, Frick, et al., 1991; Russo, Stokes, Lahey, Christ, et al., 1993). Next, psychophysiological

measures of heart rate activity (ECG), electromyogram activity (EMG) and brain electrical activity (EEG) were collected during the following conditions: a baseline condition, emotionally evocative films, an air-puff threat paradigm and during two computerized games which assessed reward sensitivity and aggressive behavior. Collection of psychophysiological measurements lasted approximately 1 hour. Subsequently, electrodes and EEG cap were removed from the child, followed by a 5-minute break. Next, the child and an examiner sat at a table in the same room. Eight social problem solving vignettes depicting situations common to middle childhood were administered over the course of approximately 15 minutes. Next, a brief assessment of intellectual functioning was administered.

Upon conclusion of the visit, the child was asked if they had any questions about any of the things they had done during the visit. The child was then given a wrapped prize (disposable camera) and allowed to select two prizes from a box for completing each of the two computer games. The child's mother or guardian was asked if they had any questions about the visit and received \$40.00 for their participation in the study.

## Measures

### Screening Phase

Child Behavior Checklist (CBCL). The CBCL (Achenbach, 1991) is a 118-item measure that comprises multiple behavior problem scales, including an externalizing subscale and an internalizing subscale. Each item is rated on a 0- to 2-point scale. The psychometric properties of the CBCL have been well established (Achenbach, 1991). The CBCL broad band internalizing and externalizing scales have shown adequate

internal consistency reliability with clinical and normative samples and the predictive validity of the instrument has been well established (Achenbach, 1991). An anxiety scale rationally and empirically derived by Lengua and colleagues (Lengua, Sadowski, Friedrich, & Fisher, 2001) was also used. This scale has been shown to have adequate internal consistency reliability ( $\alpha = .75$ ) within a clinical sample.

#### Assessment Phase

General Information Sheet. This measure assessed contact information and participant demographic variables, including, occupation and education of primary caretaker(s), ethnic background, age, marital status and number of siblings of the child.

Antisocial Process Screening Device (APSD). The APSD (Frick & Hare, 2001) is a 20-item rating scale designed to assess the construct of psychopathy in children analogous to the way it has been assessed in the adult literature (Hare, 1991). The APSD assesses a callous unemotional domain (CU) and an impulsivity/conduct problem domain (I/P). Each item is rated on a 0- to 2-point scale. The APSD includes items like: “Can be charming at times, but in ways that seem insincere or superficial,” “Feels bad or guilty when he/she does something wrong.” Parent and teacher forms have identical content.

Frick and colleagues (Christian, Frick, Hill, Tyler, & Frazer, 1997; Frick et al., 1994) have conducted a number of studies examining the psychometric properties of the APSD with clinical samples, as reviewed previously. The APSD has shown adequate internal consistency reliability: I/CP,  $\alpha = .83$ , CU,  $\alpha = .70$ . Findings from the community sample collected by Frick and colleagues (Frick et al., 2003) indicate adequate stability for the APSD total score  $r_s = .88, .87, .80$  across 2, 3, and 4 years respectively. Frick

(Frick et al., 1994) examined the factor structure of the measure with principal components analysis, yielding the two factors mentioned above. Factor loadings for the CU items ranged from .48-.74, and from .45-.71 on the I/CP items. The I/CP scale showed a moderate to strong relations with DISC parent reported symptoms (CD, CD/ODD) and CBCL delinquency and aggression scales,  $r = .53-.68$ . The CU scale was also correlated with these same measures to a lesser extent  $r = .30-.45$ . Convergent and discriminant validity of the CU and I/CP scales have also been investigated. The CU scale was found to be positively related to sensation seeking ( $r = .27$ ), negatively related to anxiety ( $r = -.47$ ) and unrelated to Performance IQ ( $r = .04$ , n.s.). In another study, Christian (Christian, Frick, Hill, Tyler et al., 1997) demonstrated the utility of the APSD for identifying a subgroup of children with CU traits and severe conduct problems. Using cluster analysis, they identified a subgroup of children with elevated CU traits and severe conduct problems. These children presented with conduct problems that were greater in number, had a greater history of police contacts, and had a stronger parental history of antisocial personality disorder.

Interview for Antisocial Behavior (IAB). The IAB (Kazdin & Esveldt-Dawson, 1986) is a parent report measure that contains 30 items designed to assess antisocial behavior for degree and severity. Each item is rated on a 5-point scale for severity of dysfunction, ranging from not a problem at all (1) to very much a problem (5), and on a 3-point scale for duration from recent or new problem ( $\leq 6$  months) (1) to always (3). The IAB yields scores on two factors that reflect overt (Arguing/Fighting; 17 items) and covert antisocial behaviors (10 items). It contains items like “stealing from stores,”

“getting into fights.” In a clinical standardization sample, internal consistency for the total score was  $\alpha = .91$ . Factor loadings for the Overt scale ranged from .43 to .72, and from .27 to .67 for the Covert scale. There is support for the validity of the IAB as detailed earlier.

NIMH Diagnostic Interview Schedule for Children, Version IV (DISC-IV, parent version). The DISC (Shaffer et al., 2000), a highly structured psychiatric interview was chosen because it is known to reliably assess the presence of oppositional defiant disorder (ODD), conduct disorder (CD), and attention-deficit hyperactivity disorder symptoms contained in the DSM-IV criteria (American Psychiatric Association, 1994). Each parent or guardian reported on their child’s behavior (DISC-P). The computer assisted version of this instrument was chosen because it has a number of advantages over the paper and pencil version of the DISC, including that it is designed to be administered by a lay interviewer, presents each item one at a time on the screen, allows for direct response entry, and immediately incorporates timing-relevant information into each question. Interviewers consisted of senior undergraduates and post baccalaureate each interviewer received a minimum of 6 hours training on interview administration in addition to an actual administration of the instrument to at least one clinical pilot participant. The interviewer-assisted version was chosen over the self-administered version to allow for clarification of item content, pace of administration, and to engage interviewees in their best effort at addressing interview questions. Each interviewer and interviewee sat before a 19-inch monitor on which individual items were presented.

The Home Interview With Child (HIWC). The HIWC (Dodge, Pettit, Bates, &

Valente, 1995; Dodge, Pettit, McClaskey, & Brown, 1986) is designed to assess hostile attributional biases through eight cartoon stories depicting a hypothetical negative outcome. Following presentation of the story, the child is asked to indicate how and why the peer might have acted the way that he or she did. Responses are recorded immediately by the interviewer as 0 (benign intent) or 1 (hostile intent). Dodge et al. (1986) report high interrater agreement in past studies. Scores are averaged across the eight stimuli and standardized to yield an index of hostile attributional bias ( $\alpha = .72$ ).

Next, in response to the same eight cartoons, the child is asked what he or she would do if they were the story protagonist. The interviewer immediately records the child's response and scores it as 1 (nothing), 2 (ask why it happened or ask again), 3 (command the peer), 4 (ask an adult to punish the peer), 5 (directly retaliate aggressively). In past research, these responses have been considered to vary along a continuum of increasing aggressiveness, with high interrater agreement (see Pettit, Dodge, & Brown, 1988). Each response is summed across the eight cartoons yielding a component score for increasing aggressiveness ( $\alpha = .72$ ). The hostile attributional bias measure has been found to predict teacher reported externalizing problems in 3<sup>rd</sup> and 4<sup>th</sup> grade (Dodge, Pettit, Bates, & Valente, 1995).

Fearfulness (Harm Avoidance). The Multidimensional Anxiety Scale for Children (MASC; March et al., 1997) is a child measure containing 39 items of self-reported anxiety including four subscales (physical symptom scale, social anxiety scale, separation/panic scale, harm avoidance scale) and a total score. Each item is rated on a four-point scale from never to often. It contains items like "My hands feel sweaty or

cold”, “ I worry about getting called on in class”. March (March et al., 1997) report that the item total correlations range from .4 to .8 and show a negligible reduction in  $\alpha$  reliability with the serial removal of items at the factor level. Validity for the MASC includes that the four scales were born out in a robust four-factor solution. Convergent and divergent validity information includes that the MASC was strongly related to the Children's Manifest Anxiety Scale,  $r = .63$ , but was unrelated to the Children's Depression Inventory and the Abbreviated Symptom Questionnaire. Only the Harm Avoidance scale was used for the present study.

Thrill and Adventure Seeking Fearlessness. The self-report (TAS) scale from the Sensation Seeking Scale for Children (SSSC; Russo, 1991; Russo et al., 1993) is a measure of fearlessness analogous to the TAS subscale of the Sensation Seeking Scale (SSS), adult version, in content and format (Zuckerman, Kolin, Price, & Zoob, 1964). The SSSC items are in a forced choice format in which respondents are to choose which is most like them. One alternative indicates a preference for sensation-seeking behavior (e.g., I'd never touch a bug or a snake) while the other indicates a preference against sensation seeking behavior (e.g., Bugs or snakes are fun to hold and play with). In a second validation study, Russo et al., (1993) identified three reliable factors in a large sample of middle school children. The first factor, Thrill and Adventure Seeking accounted for 17% of the variance in the overall scale and the TAS scale had adequate internal consistency reliability,  $\alpha = .77$ . As detailed earlier, this scale has been operationalized as the opposite of a measure of fearfulness.

Intellectual Functioning. Level of intelligence was assessed from individual

administration of two subscales of the Wechsler Intelligence Scale for Children - III (WISC -III; Wechsler, 1991). Information and Block Design subtests were used to estimate full-scale IQ. These two subtests relate highly ( $r = .85$ ) with Full Scale IQ (Sattler, 1992). While Vocabulary is often chosen as the best single indicator of VIQ, Information was chosen to represent the verbal domain because it is shorter, more reliably scored, and is only marginally less predictive of Full Scale IQ than is Vocabulary.

Socioeconomic Status. Socio-economic status of families was evaluated by way of the method proposed by (Hollingshead, 1975) from data included within the general information sheet described earlier. This method assigns a unit weighting of three to the educational level (1-7) and a unit weighting of five to the occupational level (1-5). These scores are then added to produce a single score for each parental caregiver. Where two parents are present, the final SES index represents the average scores of both parental caregivers. Where one parent is present, this single score is used. Greater scores reflect high socio-economic status.

#### Psychophysiological Collection and Measures

Acoustic Startle Probe Recording. The air-puff startle paradigm allows for the assessment of fear reactivity as indexed by startle potentiation under conditions of threat. The startle response is believed to be mediated by the central nucleus of the amygdala. Assessment of potentiated startle was accomplished through threat of an air puff directed at the larynx (Grillon, et al., 1999). This procedure was developed specifically for younger populations (Grillon, et al., 1999).

In this protocol, the child sat in a comfortable chair facing a color monitor at a distance of 50 cm and a visual angle of approximately 4 degrees. On the screen, the child viewed a 15 cm x 22 cm colored square of either bright green or bright blue against a black background. One of the squares (e.g. green), signaled the possible administration of an aversive stimulus (threat signal – possible air puff); the other (e.g. blue) signaled that the aversive stimulus would not be administered (safe signal – no air-puff will occur). The aversive stimulus (air puff) consisted of a 50 ms 100 psi burst of breathable air directed at the larynx through 4 mm DOT tubing. A terry cloth Velcro protective hockey collar (the Easton company) held the tube in place with the opening of the tubing affixed at the front center portion of the collar. Acoustic startle probes consisted of 50 ms, 100 dB white noise bursts, with instantaneous rise time, presented binaurally through ear-canal conforming earplugs.

After a startle adaptation period, during which four startle probes were presented, a threat portion of the task was presented. The threat portion consisted of four blocks of two safe and two threat signals randomly presented (for a total of eight safe and eight threat signals). During the inter-trial interval, a black screen was presented. The duration of each threat and safe signal was 12 s. The inter-trial interval (ITI) between the onset of two successive safe/threat signals varied from 17 to 42 s. In each block, six startle probes were delivered: one during each threat and each safe signal, and two during the inter-trial intervals (ITI). For each signal type (safe and threat), half the startle stimuli were delivered 4 s following signal onset and the other half were presented 7 s following signal onset. The color of the safe and the threat signals were counterbalanced

across participants. Air puffs were administered randomly on three of the 8 threat signals (2 s before signal offset), excluding the first block.

Method for EMG acquisition. Blink responses to the startle probes were recorded from two Ag-Ag/Cl miniature electrodes (Rochester Electro-Medical, Tampa FL), were attached above the orbital portion of the orbicularis oculi muscle beneath the left eye. One electrode was placed at the margin of the bony orbit centered on the iris, with the second electrode placed 10 mm lateral to the first. Before electrode placement, the sites were lightly cleaned with isopropyl alcohol, and a small amount of Synapse conducting gel (Med-Tek Corporation, Northbrook IL) was placed in the cup of each electrode. The raw EMG signal was amplified using a Model NAF-30/72 BA bioamplifier from SA Instrumentation (San Diego, CA), with filter settings at 1 Hz (high pass) and 250 Hz (low pass). Bioamplifier gain was set at 1000 for the EMG channel. The EMG data was digitized online to the hard drive of a Pentium III PC using a Daqbook 112 12-bit external A/D system (working range +/-2.5 V; Iotech, Inc., Cleveland OH) and Snap-Master acquisition software (HEM Data Corp, Southfield MI). The EMG data was digitized online using a sampling rate of 512 Hz and stored on CDROM for later analysis.

Method for EMG Quantification and Analysis. Prior to analysis, the EMG signal was digitally filtered between 28 and 250 Hz, then rectified and integrated using a time constant of 32 ms. Peak amplitude was determined in the 20-150 ms time frame relative to a baseline value (50 ms pre-startle to 20 ms post-startle). Eyeblink responses were scored visually. To be scored as a response, the peak must have occurred within the 130

ms window from 20 ms post startle probe onset to 150 ms post startle probe onset. If two peaks occurred, the larger of the two was scored. When no eyeblink response was detectable for a given probe, for a given participant, startle amplitude was scored as missing data.

Artifact occurring in the baseline epochs was detected using EMGART software (EMG Analysis Program, Caroga Lake, NY). This software creates an ipsitive/derived threshold. This threshold scalar is compared with each trial's baseline and any baselines that exceed the threshold are rejected. The artifact detection algorithm has an amplitude threshold for trial rejection of +2 standard deviations above the mean amplitude for the baseline.

As participants commonly vary greatly in overall blink magnitude, outliers were defined within participants across all trials of the experiment. Scores were considered extreme if they exceeded 3 SDs above the mean. Extreme scores were reined in to the raw score value for that individual that corresponded to the  $\pm 3$  SD point in the across-participant distribution.

Trials in which an artifact were detected were not included. Due to the considerable variability in startle reactivity across individuals, researchers in this area typically standardize startle responses within participants before analyses. This practice maximizes changes across conditions, within individuals, and conversely reduces disproportionate contribution by individuals with greater overall reactivity to group means. Individual z-scores were then converted to t-scores ( $\underline{M} = 50$ ,  $\underline{SD} = 10$ ) to establish a common metric for all individuals. In the literature on EMG startle, the two most

common measures are mean startle amplitude and mean startle magnitude. Mean startle amplitude refers to the practice of averaging only those startle responses which were actually determined to have occurred. Mean startle magnitude refers to the practice of including non-responses, set to zero, within the average. Thus, mean startle magnitude refers not only the degree of average response, but also the probability of response.

As a part of the consent procedure for this task, the parent or guardian of the child participating in the study was provide with a document from the NIH National Institute on Deafness and Other Communication Disorders (NIDCD) to assist in evaluating the risk (URL: [http://www.nidcd.nih.gov/health/pubs\\_hb/ruler.htm](http://www.nidcd.nih.gov/health/pubs_hb/ruler.htm) [100 Decibels No more than 15 minutes unprotected exposure recommended]). The parent or guardian of the child was also given the opportunity to listen to the startle probes before providing consent for their child to participate.

#### Brain Electrical Activity (EEG) Collection and Recording

EEG Collection and Recording Prior to each psychophysiology acquisition session, a calibration signal (50 uV peak-to-peak, 10 Hz sine wave) was input into each of the EEG channels from an internal signal generator within the bioamplifier. The calibration signal was digitized for 30 seconds and stored with the EEG files for later analysis. All EEG was recorded using an electrode cap manufactured by Electro-Cap Corporation (Eaton, OH) that has tin electrodes affixed to correspond to 10-20 electrode system. The Lycra caps stretch to accommodate a range of head sizes. The appropriate cap size was selected for each child based on the measured head circumference.

Recordings were made from 17 scalp locations: F3, F4, F7, F8, T7, T8, C3, C4, P3, P4,

O1, O2, A1, A2, Fz, Pz, Cz. The reference site was Cz. The EEG from each site was referenced to Cz, with a ground electrode at AFz. One channel of electrooculogram (EOG) was recorded from the right eye using two miniature biopotential electrodes. Placement of the first electrode was in line with the pupil of the right eye, at the supraorbital position, while placement of the second was at the outer canthus of the same eye. After the cap was properly placed on the child's head, impedances for collection of EEG signal from each site were prepared in the following manner. First, a small amount of Omni-Prep abrasive gel was inserted into each of the 17 active electrode sites. Then the wooden end of a Q-tip was inserted into each electrode site and gently twirled to abrade the scalp. Next, a small amount of EEG conducting gel was applied at each site. Finally, impedances for each electrode site were measured. Any site with impedances above 5 kilohms was re-prepared with more gel and mild abrasion. Each of the 17 EEG channels and the EOG channel were amplified by a 30-channel Model NAF-30/72 BA bioamplifier from SA Instrumentation (San Diego, CA). All EEG signals were amplified by a factor of 5000 and EOG signal was amplified by a factor of 1000, with filter settings at 0.1 Hz (high pass) and 100 Hz (low pass). Data was digitized online and stored on the hard drive of a Pentium III PC using a Daqbook 112 12-bit external A/D system (working range +/-2.5 V; Iotech, Inc., Cleveland OH) with Snap-Master acquisition software (HEM Data Corp). Concurrently, a channel containing event markers was digitized. All channels were digitized using a sampling rate of 512 Hz per channel. After acquisition, the acquired data files were transferred to the laboratory server and were backed up onto CD-R discs for later analysis.

EEG Acquisition. Initially the child was asked to sit quietly with eyes open for one minute and then to close his eyes gently for one minute. This was repeated for a total of 6 minutes of baseline EEG. Next, the child viewed three consecutive emotion-eliciting film clips. After viewing each film clip, the child rated their feelings on a 6-point Likert scale. The first clip was selected to induce sympathy and the second two films depicted angry interactions. The sympathy-inducing film (“I’ll Find a Way”), showing a child with spina bifida, was used to evoke sympathy and personal distress. The film has been shown to elicit sympathy in prior research (Eisenberg, et al. 1991). The film clip is 88 seconds long and it is clear from the beginning of the clip that the child has a handicap. The child speaks about her condition, and is depicted doing exercises and struggling to walk during therapy. The last 6 seconds are particularly evocative, with the child almost falling as she attempts to walk. Prior to the film clip, 10 seconds of black screen was shown. The angry interaction film (El Sheikh, Ballard, & Cummings, 1994) contains two angry interactions between a male and female adult. The first angry interaction lasted 63 seconds and depicted an argument about time with friends. The second angry interaction, which depicted an argument about finances, lasted 64 seconds and depicted arguing and mild pushing. Prior to the film clip, 10 seconds of black screen was shown.

EEG Asymmetry Quantification and Analyses. The EEG data were re-referenced to an average reference configuration. Initially, data were scored for artifact due to eye blinks, eye movements, and other motor movements using software developed by James Long Company which implements an automated algorithm (EEG Analysis Program,

Caroga Lake, NY). The program scans the data for excessive EOG activity and movement-related EEG artifact and deletes (rejects) a segment of EEG data from all channels where artifact is present in any one channel. A given epoch was rejected if vertical EOG changes were of  $\pm 50$   $\mu\text{V}$  or more in a 100 ms time period. Also rejected were epochs in which the EEG exceeded  $\pm 200$   $\mu\text{V}$ . The automated artifact rejection procedure was followed by visual inspection of the EEG and EOG data for further artifacts (e.g., muscle twitches, electrode pops). Epochs containing such artifact were also excluded from further analysis. Analysis of artifact free EEG data implemented discrete Fourier transform (DFT), with a Hanning window of 1 sec width and 50% overlap between consecutive windows. Before DFT computation, the mean voltage was subtracted from each data point to eliminate DC offset. Spectral power in single-Hz bins was computed for frequencies between 1 and 20 Hz, with power being expressed in mean square microvolts. The 7-12 Hz band for alpha power was utilized for each electrode site. Selection of this power band was based on previous studies that have used a comparable bandwidth for children in the 8-12-year-old age range (e.g., Clarke, Barry, McCarthy, & Selikowitz, 2001). In addition, the alpha band was empirically derived for the children in the study by examining differences in the distribution of power between the eyes open and eyes closed conditions. This procedure was carried out in the present study confirming that the 7-12 Hz band captured peak alpha activity for 100% of participants. The frontal EEG asymmetry index was computed as the natural logarithm of alpha power from F4 minus the natural logarithm of alpha power from F3 during the eyes closed condition. A laterality difference score was computed to examine

hemispheric asymmetry in the frontal and parietal regions respectively, for each of the EEG acquisition conditions (eyes closed, sympathy film, anger/argue film, anger/push film). Asymmetry scores were calculated as follows:  $[\ln \text{ power (right hemisphere)}] - [\ln \text{ power (left hemisphere)}]$ . Positive values on this metric represent greater relative left hemisphere activation whereas negative values denote greater relative right hemisphere activation (Davidson & Tomarken, 1989).

#### Electrocardiogram (ECG) Recording

An electrocardiogram (ECG) recording was recorded by placing two disposable pediatric electrodes on the child's back, one on the lower part of the right trapezoidal muscle and the other on the left side of the lower back. A 30-channel Model NAF-30/72 BA bioamplifier from SA Instrumentation (San Diego, CA) amplified the ECG signal, with filter setting at 1 Hz (high pass) and 1250 Hz (low pass). ECG data were analyzed using software from the James Long Company (IBI Analysis Program, Caroga Lake, NY).

Interbeat Interval (IBI) Following identification of artifact-free ECG data, inter-beat interval was quantified from beat-to-beat heart period data collected during four acquisition periods (six minutes resting baseline and during the three film clips). Bioamplifier gain was set at 1000 for the ECG channel. The ECG data was digitized online to the hard drive of a Pentium III PC using a Daqbook 112 12-bit external A/D system (working range +/-2.5 V; Iotech, Inc., Cleveland OH) and Snap-Master acquisition software (HEM Data Corp, Southfield MI). The ECG data was digitized online using a sampling rate of 512 Hz and stored on CDROM for later analysis.

### Laboratory Tasks

Reward Dominance Paradigm (Door Opening Task). The reward dominance paradigm consists of a game with competing rewards and punishments in which the probability of reward diminishes over time (Daugherty & Quay, 1991; O'Brien & Frick, 1996). Over 100 trials, the rate of reward per 10 trials drops from 90% to 0%. Evidence for the validity of the reward dominance paradigm comes from a number of studies as reviewed earlier. The Door-opening task was presented on a computer monitor. In this task, the child was presented with a door labeled with a question mark. An open door followed by a smile face indicated winning on a given trial, whereas an open door followed by a frown indicated losing on a given trial. Doors were presented in a single order and each door could only be opened in the sequence it was presented. Prior to beginning the task, to maximize motivation for points, the child viewed a box of potential prizes of varying value including chocolate bars, toy cars, rubber balls, Nerf basketball hoops, and small models. Participants were told they could stop at any time and redeem their winnings in for prizes, but that they must open the doors in the order in which they were presented. Each child verbally indicated that they wished to stop. Pressing a button on a hand held button box opened doors. Each child began with 12 coins (nickels) depicted on the screen. A coin was added or subtracted from the screen based on the outcome of a particular trial. Each child was told they would be allowed to choose from the prize box based on their winnings during the game. All children, regardless of their performance on the task, received their choice of prize (see Appendix L for instructions and images).

Point Subtraction Game. The Point Subtraction Game (PSG) is a computerized game similar to that used by Cherek (Cherek & Dougherty, 1997) with adult samples. The PSG was developed for use with younger children. Each child played the game for a total of 6 minutes. On the PSG, the child is given 3 response options: (1) nonaggressive responding that earns money (Button A), (2) aggressive responding that ostensibly subtracts money from another (fictitious) person (Button B), and (3) escape, which protects the child's earnings from subtractions initiated by the other person (Button C). The child is given 3 response options on separate buttons labeled "A" and "B." Pressing Button A was maintained by a fixed ratio of 30 presses for each coin earned on the screen. With each coin earned, a counter was incremented on the screen. The child was also told that 10 presses on Button B subtracted a coin from a second (fictitious) child also responding to accumulate winnings. Button B responses were operationalized as aggressive because they present an aggressive stimulus to another person. Winnings were subtracted from the child's point counter at quasi-random intervals to provoke the child into Button B responses. These constituted provocations. During the first half of the game (3 min.) 8 provocations were scheduled to occur (low provocation). During the second half of the game (3 min.), 20 provocations were scheduled to occur (high provocation). The child was told that subtractions from their counter were due to Button B responses made by another child (fictitious) and that the other child was able to keep what was subtracted. The child could protect their winnings for a brief duration (15 seconds) by pressing Button C. Following completion of this task, each child was allowed to choose a prize (see Appendix M for example screens). All children,

regardless of their performance on the task, received their choice of a prize. In a comprehensive review, (Giancola & Chermack, 1998) provided substantial evidence for the construct validity of the PASAP. In a study of male violent and nonviolent parolees, (Cherek, Moeller, Schnapp, & Dougherty, 1997) found that violent participants emitted significantly more aggressive responses, and the number of aggressive responses was significantly correlated with a questionnaire measure of aggression. In a study of ADHD boys, Pelham (Pelham, Milich, Cummings, Murphy, et al., 1991) found that high aggressive ADHD boys were more likely to respond with aggression to provocation than were low aggressive ADHD boys on a similar game that involved provocation.

## CHAPTER IV

### Results

Analyses within this section were designed to address formally stated hypotheses from a categorical perspective. A dimensional perspective was adopted within the results sections examining fear reactivity and reward seeking and approach-withdrawal related tendencies. Two sets of supplementary analyses are contained in the appendices. Appendix M contains analyses of EMG startle amplitude data for safety and threat within the air puff paradigm. Appendix N contains a final section that examines the predictive power of variables from these domains in accounting for variability psychopathic characteristics, externalizing symptoms, oppositional defiant symptoms, and callous-unemotional traits. All a priori pairwise comparisons within the results section were evaluated at an overall alpha level of .05 based on a family-wise error rate rather than across all the dependent measures collected within this study.

#### Preliminary Descriptive Analyses

Table 1 presents the descriptive statistics for child age, ethnic background, IQ, SES, and for the screening measures (CBCL and APSD) by group. The broadband internalizing and externalizing factors of the CBCL are presented along with the factors of the APSD. Analyses of variance revealed that there were differences among the groups with respect to child IQ and family SES, but not child age (child IQ,  $F(2, 98) = 9.30, p < .001$ ); family SES,  $F(2, 85) = 10.88, p < .001$ ; child age,  $F(2, 85) = .23, ns$ ). Consequently, before proceeding with omnibus tests of group differences for dependent measures of interest, correlation analyses were conducted to determine if dependent

measures were significantly related to child IQ or family SES. Where this was the case, either or both of these variables were entered into the model as appropriate. Tables 2, 3, and 4 present data on sample family characteristics by group. Table 2 presents information on number of adults and children in the home, who has custody of the child. Table 3 presents data on the child's mother and/or father figure (e.g., biological, adoptive, grandparent). Table 4 presents data on the child's mother's marital status and her relationship to the child's biological father. Table 5 presents descriptive statistics for the factor scores of the Antisocial Process Screening Device by group. Table 6 presents DSM-IV disruptive behavior disorder diagnoses (ODD, CD, ADHD) met in the past month, along with descriptive statistics of symptom counts. Table 7 presents the relations between child IQ, family SES and questionnaire measures used as dependent measures within the study.

#### Dependent Measures Assessing Fear Related Processes

Resting Heart Rate. The primary aim of the analysis of resting IBI was to examine whether clinical group status was associated with mean heart rate (IBI) while at rest. Five children did not have useable IBI data due to technical problems during acquisition of the heart rate data (Externalizing = 4, Comparison = 1). Preliminary analysis revealed that IBI acquired at rest was significantly correlated with child IQ,  $r(96) = -.22$ ,  $p < .05$ , but not with family SES,  $r(96) = -.03$ , ns. Thus child IQ was included as a covariate in the analyses of the IBI data.

Group differences in mean IBI were examined within an ANCOVA in which mean IBI collected during a rest condition served as the dependent measure, group (High

APSD, Externalizing, Comparison) served as the between subjects factor and child IQ served as the covariate. This analysis indicated that there were no significant differences among group means with respect to IBI collected at rest,  $F(2, 82) = .13, \eta^2 = .003, ns$ . However, the covariate, child IQ did account for significant variance within the model,  $F(1, 82) = 2.97, \eta^2 = .04, p = .09$ . As a follow-up analysis, child IQ was removed from the model to determine whether or not inclusion of the covariate masked group differences in mean IBI. This analysis indicated there were no significant differences among group means with respect to IBI collected at rest,  $F(2, 82) = .31, \eta^2 = .01, ns$ . A post hoc analysis of IBI indicated that High APSD group and the Externalizing group were not significantly different ( $t(60) = .51, ns$ ). Means and standard deviations for the groups are presented graphically in Figure 1. In summary, clinical group status was not associated with differences in mean IBI during a period of rest. Because mean IBI was unrelated to the APSD total score ( $r(96) = .10, ns$ ), regression analyses and a dimensional approach were not pursued further.

Fear Potentiated EMG Startle. The focus of startle data analyses was to examine relations between clinical group status and patterns of startle magnitude across safety and threat. Preliminary analyses of the air-puff startle magnitude data revealed that neither child IQ nor family SES were significantly associated with any of the mean startle magnitude dependent measures ( $r_s(89)$  from  $-.11$  to  $.15, ns$ ), thus child IQ and family SES were not included in the overall model as covariates. Eleven children were excluded from the analysis of the startle data because they either did not display any startle response or did not display a sufficient number of startle responses for statistical analysis. One child

opted not to participate in the air-puff task (Externalizing group). Children excluded from the analysis by subgroup were as follows (High APSD = 5, Externalizing = 5, Comparison = 1). In line with the bulk of adult literature on psychopathy and startle modulation (Carmen, Moltó, Vila, & Lang, 2003; Patrick et al., 1993; Sutton et al., 2002), the analyses that follow relied on the startle magnitude measure as defined earlier (an analogous set of group comparisons were conducted with startle amplitude as the dependent measure, these appear in Appendix N). Next, the air puff threat paradigm is examined from a dimensional perspective, first examining startle modulation in relation to the APSD factors, second, comparing predictive power of APSD factors to other measures of disruptive behavior problems, and finally exploring the data in way that incorporates startle non-responders.

The data analytic approach for the startle magnitude data consisted of an omnibus repeated measures MANOVA with condition (safe, threat) and probe time (4.0 vs. 7.0 s) as repeated factors. The means and standard deviations for the startle magnitude data are presented in Table 8. This analysis revealed a significant main effect for Condition (Roy's Largest Root  $F(1, 77) = 127.93, p < .001, \eta^2 = .62$ ). Across participants, startle magnitude tended to be greater under the threat condition than the safe condition. The interaction of condition x probe time was significant ( $F(1,77) = 24.74, p < .001, \eta^2 = .24$ ), supporting the a priori plan to assess the safe and threat conditions separately. Figure 2 depicts this interaction. The means for the startle magnitude data during safe (4.0 s and 7.0 s) and threat (4.0 s and 7.0 s) are presented graphically in Figure 3.

The Affective Chronometry of Startle Magnitude for Safety and Threat within the

Air Puff Paradigm. For the safe condition, a repeated measures MANOVA with probe time (4.0 vs. 7.0 s) as the repeated factor, group (High APSD, Externalizing, Comparison) as the between subjects factor, and mean startle magnitude as the dependent measure revealed a significant main effect for probe time (Roy's Largest Root  $F(2, 75) = 23.46$ ,  $p < .001$ ,  $\eta^2 = .24$ ). Across participants, startle magnitude tended to decrease from the early to the late probe time during safety. The probe time x group interaction was also significant (Roy's Largest Root  $F(2, 75) = 3.26$ ,  $p < .05$ ,  $\eta^2 = .08$ ), indicating that the groups showed differential changes in startle magnitude across 4 s and 7 s during the safe condition (Figure 3). The time x group interaction was further examined with two one-way ANOVAs for early (4 s) and late (7 s) respectively. At 4 s there was a significant difference among group means ( $F(2, 75) = 3.22$ ,  $p < .05$ ,  $\eta^2 = .08$ ). Planned comparisons indicated that at 4 s during safety, High APSD boys startled less than Comparison boys ( $t(75) = -2.31$ ,  $p < .02$ ) but not less than Externalizing boys ( $t(75) = -.74$ , ns). A post hoc analysis suggested a trend whereby Externalizing boys startled less than Comparison boys ( $t(75) = -2.07$ ,  $p < .05$ ). At 7 s during safety there were no significant differences among group means ( $F(2, 75) = .55$ , ns).

Startle magnitude change over time during safety was examined through pairwise comparisons within a repeated measures ANOVA. These analyses revealed that the High APSD group did not significantly change from 4 s to 7 s probes (difference  $M = 1.23$ ,  $SD = 3.99$ ,  $F(1, 14) = 1.41$ , ns,  $\eta^2 = .09$ ), whereas the Externalizing group did show significantly decreased startle magnitude (difference  $M = 2.61$ ,  $SD = .85$ ,  $F(1, 39) = 9.42$ ,  $p < .01$ ,  $\eta^2 = .19$ ) as did the comparison group (difference  $M = 5.27$ ,  $SD = 5.26$ ,  $F(1, 22)$

= 23.12,  $p < .001$ ,  $\eta^2 = .51$ ).

For the threat condition, a repeated measures MANOVA with probe time (4.0 vs. 7.0 s) as repeated factors, group (High APSD, Externalizing, Comparison) as the between subjects factor, and mean startle magnitude as the dependent measure revealed a significant main effect for probe time (Roy's Largest Root  $F(2, 75) = 3.97$ ,  $p < .05$ ,  $\eta^2 = .05$ ). Across participants, startle magnitude tended to increase from the early to the late probe time during threat. The probe time  $\times$  group interaction was also significant (Roy's Largest Root  $F(2, 75) = 4.52$ ,  $p < .05$ ,  $\eta^2 = .11$ ), indicating that the groups showed differential changes in startle magnitude across 4 s and 7 s (Figure 3).

Planned comparisons at 4 s during threat, did not detect differences in startle reactivity between the High APSD boys and either the Comparison boys ( $t(75) = -1.24$ , ns), or the Externalizing boys ( $t(75) = .10$ , ns). A post hoc analysis suggested a trend whereby clinically referred boys (High APSD and Externalizing) startled less than Comparison boys ( $t(75) = 1.68$ ,  $p < .10$ ) at 4 s during threat. At 7 s during threat there was a significant difference among group means ( $F(2, 75) = 4.13$ ,  $p < .05$ ,  $\eta^2 = .10$ ). Planned comparisons at 7 s during threat detected differences in startle reactivity between the High APSD boys and both the Comparison boys ( $t(75) = 2.87$ ,  $p < .01$ ), and the Externalizing boys ( $t(75) = 1.98$ ,  $p < .05$ ). A post hoc analysis indicated that the Externalizing boys and the comparison boys were not significantly different from one another ( $t(75) = 1.46$ , ns).

Pairwise comparisons for startle probe magnitude from 4 s to 7 s during threat revealed that the High APSD group showed a significant increase in startle reactivity

(difference  $\underline{M} = -4.70$ ,  $\underline{SD} = 5.75$ ,  $\underline{F} (1, 14) = 10.02$ ,  $\underline{p} < .01$ ,  $\underline{\eta}^2 = .42$ ). The Externalizing group showed a much smaller increase in startle magnitude (difference  $\underline{M} = -2.08$ ,  $\underline{SD} = 1.13$ ,  $\underline{F} (1,39) = 3.38$ ,  $\underline{p} < .07$ ,  $\underline{\eta}^2 = .08$ ) and the Comparison group showed a decrease in startle magnitude that was not significantly different over the times assessed (difference  $\underline{M} = 1.80$ ,  $\underline{SD} = 6.79$ ,  $\underline{F} (1, 22) = 1.62$ ,  $\underline{ns}$ ,  $\underline{\eta}^2 = .07$ ). Figure 4 displays a plot of startle responses during the threat condition at 7.0 s. This plot indicated that the pattern of greater startle responsivity for the High APSD group was not due to the influence extreme scores.

#### A Dimensional Approach to Startle Modulation

##### Early and Late Threat Startle Magnitude and Conduct Problem Variables.

Building on past research with adult samples (i.e., Patrick, et al. 1993) startle magnitude was correlated with the APSD factors, callous-unemotional traits and impulsive conduct problems. These analyses revealed that the APSD factors were negatively associated with startle magnitudes that occurred at 4.0 s during threat, but neither reached statistical significance (impulsive conduct problem factor ( $\underline{r} (89) = -.19$ ,  $\underline{p} = .08$ ; callous-unemotional traits:  $\underline{r} (89) = -.09$ ,  $\underline{ns}$ ), narcissistic traits ( $\underline{r} (89) = -.12$ ,  $\underline{ns}$ ). Startle magnitude that occurred at 7.0 s during threat was correlated with impulsive conduct problems ( $\underline{r} (89) = .23$ ,  $\underline{p} < .03$ ). A statistical trend suggested a similar relation with callous-unemotional traits ( $\underline{r} (89) = .20$ ,  $\underline{p} = .06$ ), but not with narcissistic traits ( $\underline{r} (89) = .06$ ,  $\underline{ns}$ ).

Startle Modulation Change During Safety and Threat. This section examines the relations among startle reactivity, Antisocial Process Screening Device factors, and disruptive behavior problems (CD, ODD, ADHD) as measured by the DISC. Analyses

proceeded with three sets of regressions. First, change scores for safety and threat were used to predict the APSD total score. This was done in order to understand which aspects of startle modulation relate to the APSD. Second, separate models were computed regressing change threat and then change safe onto the three APSD subfactors and their interaction terms. This was done to examine the relative importance of the different aspects of the APSD in relation to startle modulation. Third, regression analyses were conducted in which the change threat and change safe scores were individually regressed on ADHD symptoms, ODD symptoms, and CD symptoms. This was done to contrast the strength and patterning of the APSD with dimensional measures representing the traditional DSM-IV nomenclature.

Time Dependent Changes in Startle Modulation and APSD Scores. Two change scores were created within condition by subtracting the 7.0 s startle probe from the 4.0 s startle probe (i.e., threat 4.0 s – threat 7.0 s). The first set of analyses applied multiple regression to examine the predictive relations between startle change across safety, across threat and severity of conduct problems as indicated by the APSD total score. The results of the regression analysis predicting APSD total are presented in Table 10. Both change-threat and change-safe entered as significant main effects within the model, each contributing unique variance. The full model accounted for 13% of the variance in APSD score ( $F(3, 85) = 4.36, p < .01$ ). The interaction of safety and threat change did not contribute significant variance to the model ( $\Delta F(1, 85) = .39, ns$ ).

The next set of analyses examined change in startle modulation over time separately for safety and threat and relations with the APSD factors (I/CP, CU, NA).

Multiple regression analyses of these predictive relations allowed for examination of the relative contribution of APSD factors in accounting for startle modulation. The results were generally consistent across two separate models. For safety change, regression analyses with backward elimination (Table 11) indicated that only the I/CP factor remained in the model ( $F(1, 88) = 5.04, p < .03, R^2 = .06, \Delta R^2 = .01$  from the full model). The first order interactions (Table 11, Model 4) did not enter into the model (all  $t_s < 1.74, ns$ ). For threat change, regression analyses with backward elimination (Table 12) indicated that only the I/CP factor remained in the model ( $F(1, 88) = 8.90, p < .01, R^2 = .10, \Delta R^2 = .01$  from the full model). The first order interactions (Table 8, Model 4) did not enter into the model (all  $t_s < 1.03, ns$ ).

DSM-IV Disruptive Behavior Problem Symptoms and Startle Modulation During Safety and Threat. This set of analyses examined startle modulation over time separately for safety and threat and relations with disruptive behavior problems (CD, ODD, ADHD). Multiple regression analyses of these predictive relations allowed for the examination of the relative contributions of DSM-IV symptoms in accounting for startle modulation. The results of these prediction models diverged across safety change and threat change. For safety change, regression analyses (Table 13) indicated that only ADHD symptoms remained in the full model ( $F(1, 88) = 11.50, p < .001, R^2 = .12, \Delta R^2 = .00$  from the full model). The first order interactions (Table 13, Model 4) did not enter into the model (all  $t_s < 1.17, ns$ ). For threat change, regression analyses with backward elimination (Table 14) indicated that only oppositional defiant symptoms remained in the model ( $F(1, 88) = 11.50, p < .001, R^2 = .34, \Delta R^2 = .00$  from the full model). First order interactions tested

within a second block (Table 14, Model 4) did not contribute significant variance to the model (all  $t_s < 1.00$ , ns).

Exploring Data for Startle Non-responders. Ten of the clinically referred children were excluded because of no startle response, or because they showed an insufficient number of startle responses. Following Herpertz et al. (2001) who observed that adult criminal offenders categorized as psychopathic were significantly more likely to be non-responders, we examined total number of startle responses as a dependent measure. The total number of responses was included as a continuous variable ranging from 0 to 24, the range of total startle responses possible within the airpuff task. Correlation analyses were conducted with the APSD factors, callous-unemotional traits and impulsive conduct problems. These analyses revealed that the APSD factors were negatively associated with number of startle responses (impulsive conduct problem factor ( $r(101) = -.19$ ,  $p \leq .06$ ; callous-unemotional traits:  $r(101) = -.24$ ,  $p < .02$ ; narcissistic traits ( $r(101) = -.20$ ,  $p < .05$ ). A second set of correlation analyses indicated that number of startle responses was not associated with conduct disorder symptoms ( $r(101) = .01$ , ns), or oppositional defiant symptoms ( $r(101) = -.17$ , ns) but was associated with ADHD symptoms ( $r(101) = -.29$ ,  $p < .01$ ).

In summary, threat of an air-puff lead to significant startle potentiation from the safe to the threat condition across the sample of children, replicating past work with this paradigm (Grillon, et al., 1999). Also consistent with past research (i.e., Levenston et al., 1999, Sutton et al., 2002), startle probe time interacted with condition. In the presence of a safety signal, startle probe magnitude was reduced from the early (4.0 s) to late (7.0)

probe presentation. By contrast, startle probe magnitudes increased from early to late startle probe presentation in the presence of a threat signal. Clinically referred boys as a group showed a trend toward diminished startle reactivity during threat for the 4.0 s probe time compared to the Comparison boys. Contrary to predictions, a marked increase in startle potentiation was observed for the High APSD group during threat compared to the Externalizing group or the comparison group. Also, startle magnitude changed differentially for the groups across the early and late probe times within the safe and the threat conditions. During the safety condition, the comparison group showed a marked decrease in startle magnitude from 4.0 s to 7.0s ( $\eta^2 = .51$ ), whereas the High APSD group and the Externalizing group showed comparably smaller decreases in startle magnitude ( $\eta^2 = .09$  and  $\eta^2 = .19$ , respectively). During the threat condition, the High APSD group showed a marked increase in startle magnitude from 4.0 s to 7.0s ( $\eta^2 = .42$ ), whereas the Externalizing group and showed a comparable but smaller increase in startle magnitude ( $\eta^2 = .08$ ), which was not statistically significant. The Comparison group showed a non-significant change in startle modulation that was opposite that of the clinically referred groups. An analogous set of analyses performed with startle amplitude instead of startle magnitude (Appendix N) yielded comparable findings, with the exception of the time x group interaction for safety was not statistically significant.

Dimensional analysis of the startle data revealed a somewhat different picture. During threat, late startle magnitude was associated with impulsive conduct problems and callous-unemotional traits. Early startle magnitude (4 s) during threat was not significantly related to the APSD subfactors. When startle was examined as a change

variable (change safe, change threat), each of these change scores accounted for significant variability in the APSD total score. Examination of the relative contribution of the APSD subfactors indicated that the impulsive conduct problem factor was the only APSD factor associated with startle change during threat or change during safety. Regression analyses indicated that DSM-IV symptom scales related differently to change threat and change safe. Among CD, ODD, and ADHD symptoms, only ODD symptoms remained in a model predicting a startle magnitude change score during threat. On the other hand, for the same set of predictors, only ADHD symptoms remained in a model predicting a startle magnitude change score during safety. Lastly, much of the work on startle modulation excludes individuals who do not show sufficient numbers of startle responses, in an attempt to include these participants, total number of startle responses across the task was treated as a continuous variable. Each of the APSD factors were similarly and negatively related to total number of startle responses ( $r_s$  -.19 to -.24). By contrast, among the DSM-IV disruptive behavior symptom categories, only ADHD was significantly negatively related to total number of startle responses ( $r =$  -.29).

Self-report Measures of Fearlessness and Fearfulness. In order to test the hypothesis that high APSD boys would self-report more fearlessness and less fearfulness, the relation between each of these measures and clinical group status was examined. Preliminary analyses revealed that neither child IQ nor SES were significantly correlated with fearlessness (thrill and adventure seeking) ( $r$  (101) = .09, ns and  $r$  (101) = .19, ns) or fearfulness (harm avoidance) ( $r$  (101) = .10, ns and  $r$  (101) = .11, ns), respectively (Table 3). Although in the right direction, the non-significant correlation between the two

measures of fear suggested that their combination in a multivariate analysis was unwarranted, ( $r(101) = -.18, ns$ ).

Trait Fearlessness. Group means and standard deviations are presented in Table 15 for Thrill and Adventure Seeking (trait fearlessness). The relation between clinical group status and self-report of trait fearlessness was examined within a one-way ANOVA. There were no statistically significant differences among the group means ( $F(2, 85) = .41, ns$ ).

Trait Fearfulness. Group means and standard deviations are presented in Table 15 for Harm Avoidance (trait fearfulness). The relation between clinical group status and self-report of trait fearfulness was examined within a one-way ANOVA. A statistical trend suggested differences among group means ( $F(2, 85) = 1.80, p = .16$ ). A priori contrasts revealed that the high APSD group did not endorse significantly more harm avoidance than the externalizing group ( $F(1, 85) = -.83, ns$ ), whereas the difference between the high APSD group and the comparison group suggested a statistical trend ( $F(1, 85) = 1.86, p = .07$ ). Similarly, a post hoc analysis suggested that clinically referred boys endorsed significantly less harm avoidance than did the comparison group ( $F(1, 85) = -1.83, p < .07, \eta^2 = .05$ ).

#### A Dimensional Approach to Fearlessness and Fearfulness.

This set of analyses applied multiple regression to evaluate the predictive relations between measures of fearlessness and fearfulness and severity of conduct problems as indicated by the APSD total score. The interaction between fearlessness and fearfulness was also examined in the prediction model. The results of the regression analysis

predicting APSD total are presented in Table 16. The interaction term was not a significant predictor in the model ( $t = .13$ , ns,  $\Delta R^2 = .00$ ). The model with harm avoidance and thrill and adventure seeking accounted for 6% of the variance in APSD score ( $F(3, 85) = 3.41$ ,  $p < .04$ ). However, consistent with the group comparisons, harm avoidance entered significantly into the model ( $t = -2.59$ ,  $p < .01$ ), but thrill and adventure seeking did not enter significantly into the model ( $t = -.78$ , ns).

In summary, trait fearlessness did not differentiate the High APSD group from the Externalizing group. On the other hand, High APSD boys self-reported less trait fearfulness than the Comparison group although this difference manifested as a statistical trend. Indeed, both clinically referred groups presented with comparable levels of fearfulness, which tended to be less than the Comparison group. These data suggest that the characteristic of being less fearful may be representative of clinically referred externalizing boys as a whole rather than a trait specific to High APSD boys. This interpretation is further supported by regression analysis that indicated that harm avoidance was negatively associated with the APSD total score. Moreover, regression analysis suggested that harm avoidance related to the APSD in a dimensional fashion.

#### Dependent Measures Assessing Reward Seeking and Resting Frontal EEG Asymmetry

Group Status and Behavior on the Door-Opening Task and the Point-Subtraction Game. Of particular interest were boys' behavioral choices in reward-related contexts. Reward seeking was assessed in two different types of tasks, the Door Opening Task and the Point-Subtraction Game. Results are presented for the Door Opening Task first, followed by the Point-Subtraction Game. Results for the Point-Subtraction Game

aggressive and self-protective behaviors are presented in the section entitled “Markers and Correlates of Antisocial Behavior”. Lastly, measures of reward seeking are examined from a dimensional perspective.

Door Opening Task. The Door Opening Task is thought to assess reward dominance, or the degree to which an individual pursues rewards (open doors) in the face of increasing losses (response cost). Preliminary analyses revealed that neither IQ nor SES were significantly correlated with number of doors opened ( $r(101) = -.17$ , ns and  $r(101) = .12$ , ns) on the Door Opening Task. The relation between number of doors opened and clinical group status were examined within a one-way ANOVA, with clinical group status serving as the between subjects factor and number of doors opened as the dependent measure. There were no significant differences among group means with regard to number of doors opened ( $F(2,95) = .38$ ,  $\eta^2 = .01$ , ns). Group means and standard deviations for the Door Opening Task are presented in Table 17.

Point-Subtraction Game. The Point-Subtraction Game presents the child with the option of choosing to seek rewards with in the context of a game that also allows for aggressive behavior (subtracting points from a hypothetical peer) or self-protective behavior (protect your winnings) amidst provocations from a hypothetical peer. Provocations were set to occur twice as frequently during the second half of the game as during the first half of the game. Seven children (High APSD = 1, Externalizing = 6) did not have data for the Point-Subtraction Game due to experimenter error ( $N = 5$ ) or equipment failure ( $N = 2$ ). Preliminary analyses revealed that neither IQ nor SES were significantly correlated with number of rewards sought during the first half of the task ( $r$

(94) = .18, ns and  $r$  (94) = .02, ns) or the second half of the task ( $r$  (94) = .16, ns and  $r$  (94) = -.05, ns). Group means and standard deviations for the Point-Subtraction Game are presented in Table 17.

The relations between clinical status and reward seeking behavior on the Point-Subtraction game were examined using an omnibus repeated measures MANOVA with provocation level (first half of task—low, second half of task—high) as the repeated factor, group (High APSD, Externalizing, Comparison) as the between subjects factor and number of rewards (Button “A” choice) as the dependent measure. This analysis revealed a significant repeated effect for provocation level (Roy’s Largest Root  $F(1, 78) = 10.25$ ,  $\eta^2 = .12$ ,  $p < .01$ ), such that reward seeking tended to decrease from the first half (low provocation) to the second half of the task (high provocation) (first half:  $M = 12.84$ ,  $SD = 4.26$ , second half:  $M = 11.96$ ,  $SD = 3.56$ ). The half x group interaction was also statistically significant ( $F(2, 78) = 3.25$ ,  $\eta^2 = .08$ ,  $p < .05$ ), indicating that the groups different in terms of their rate of reward seeking across the first and second halves of the task. Figure 6 graphically depicts group means by provocation level for rewards earned.

Next, two one-way ANOVAs were conducted separately for rewards earned during the first half of the task (low provocation) and the second half of the task (high provocation). The first one-way ANOVA revealed a main effect of group ( $F(2, 78) = 4.34$ ,  $\eta^2 = .10$ ,  $p < .01$ ). Pairwise comparisons revealed that under conditions of low provocation, during the first half of the Point-Subtraction Game, High APSD boys sought rewards significantly more often than Externalizing boys (High APSD:  $M = 14.37$ ,  $SD = 4.32$ , Externalizing:  $M = 11.33$ ,  $SD = 4.53$ ,  $t(57) = 2.45$ ,  $p < .02$ ), although not more

than Comparison boys ( $M = 13.79$ ,  $SD = 3.50$ ,  $t(41) = .48$ , *ns*). Comparison boys also sought rewards more often than Externalizing boys ( $t(62) = -2.29$ ,  $p < .03$ ). The one-way ANOVA, conducted for reward-seeking data from the second half of the task (high provocation) did not reveal any significant differences among the group means ( $F(2, 78) = 1.01$ , *ns*). A second set of post hoc analyses examined changes in reward seeking across the task within each group by way of paired-sample t-tests. High APSD boys showed a significant decrease in reward seeking from the first half to the second half of the task (difference  $M = 1.47$ ,  $SD = 2.25$ ,  $t(18) = 2.86$ ,  $p < .05$ ), as did Comparison boys (difference:  $M = 1.79$ ,  $SD = 3.10$ ,  $t(23) = 2.85$ ,  $p < .01$ ). Externalizing boys did not show a significant change in reward seeking across the task (difference:  $M = .01$ ,  $SD = 3.14$ ,  $t(38) = .01$ , *ns*).

As a follow-up analysis, child IQ was included in the model. The effect of the child IQ covariate by provocation level interaction was not statistically significant, ( $F(1, 11) = .31$ , *ns*)). The provocation level by group interaction remained as a statistical trend with the IQ covariate entered into the model,  $F(2, 77) = 2.56$ ,  $p = .08$ .

#### A Dimensional Approach to Reward Seeking

Following the analytic plan of the previous section, analyses were conducted examining the relations between the APSD factors (callous-unemotional traits, impulsive conduct problems, and narcissistic traits) and reward seeking (Door Opening Task, Point Subtraction Game) drawing on the entire sample of boys. First, analyses were conducted examining the relations between the APSD factors, callous-unemotional traits, impulsive conduct problems, and narcissistic traits and number of doors opened. This analysis

revealed that callous-unemotional traits were significantly correlated with number of doors opened ( $r(101) = .25, p < .01$ ), whereas impulsive conduct problems and narcissistic traits were not associated with number of doors opened ( $r_s(101) = .06$  and  $.03, ns$ ), respectively. Second, relations between the APSD factors and reward seeking on the point-subtraction game were examined. Because reward seeking on this task appeared to be moderated by clinical status (clinically-referred vs. non-referred) correlations were computed only within the clinically referred sample. This analysis revealed that only narcissistic traits were associated with reward seeking with ( $r(70) = .26, p < .01$ ), whereas impulsive conduct problems and callous-unemotional traits were not significantly associated with reward seeking on the Point-Subtraction Task ( $r_s(101) = .15$  and  $.10, ns$ ), respectively.

A second set of exploratory analyses examined the relationship between the two different types of reward seeking. Correlation analyses revealed that number of doors opened on the Door-Opening Task was unrelated to reward seeking during either half of the Point-Subtraction Task (first:  $r(94) = .06, ns$ ; second:  $r(94) = .01, ns$ ) or total reward seeking ( $r(94) = .02, ns$ ).

In summary, the reward tasks provided mixed support for greater reward seeking among High APSD boys. On the Door Opening task, there were no statistically significant group differences. From a dimensional perspective, greater scores on the callous-unemotional trait scale were associated with opening more doors on the Door Opening Task. On the Point-Subtraction Game, the high APSD group sought rewards at a significantly greater rate than the Externalizing group under conditions of low

provocation. Comparison boys also pursued rewards at a significantly greater rate than the Externalizing group under conditions of low provocation. The groups did not differ in reward seeking behavior under conditions of high provocation. Across the conditions of low and high provocation both the High APSD group and the Comparison group showed a significant decrement in reward seeking. The Externalizing group did not show significant change in their reward seeking behavior across the two levels of provocation. Reward seeking behavior on the Door Opening task was not significantly related to reward seeking on the Point Subtraction Game.

Resting EEG Alpha Power and Asymmetry.

A decision was made to use the EEG data from the eyes closed condition rather than to include both the eyes open and eyes closed conditions because this data was thought to be a more accurate index of resting EEG. Anecdotally, a number of the clinically referred boys had difficulty sitting still during eyes open condition and were observed to look around the room rather than at the picture of the space ship they had been instructed to focus on. The simple correlations between EEG for eyes closed and eyes open at each of the regions of interest were as follows: right frontal  $r(99) = .70$ , left frontal  $r(99) = .68$ , right parietal  $r(99) = .66$ , left parietal  $r(99) = .64$ . Table 18 presents the number of right handed boys by group. All analyses included left and right-handed boys. Results are first presented for EEG alpha power, followed by EEG asymmetry (laterality). Next, asymmetry scores are examined with the effects of anxiety removed. Finally, relations among frontal EEG asymmetry, disruptive behavior problems, and reward seeking variables are examined from a dimensional perspective.

Prior to group comparisons, the data for each psychophysiological index were examined for extreme data points. Outliers were defined as extreme data points that were three or more standard deviations from the mean of the total sample on a given psychophysiological index. No data for resting EEG met this criterion. One child (Externalizing = 1) did not have useable EEG data due to technical problems during acquisition.

Absolute EEG Alpha Power Values. The focus of the analyses of the EEG alpha power data was to examine relations between clinical group status and patterns of frontal

activation and frontal asymmetry. Preliminary analyses of the EEG data revealed that neither child IQ nor family SES were significantly associated with any of the dependent measures ( $r_s$  (100) from -.17 to .11, ns). Group means and standard deviations for alpha spectral power (7-12 Hz) during eyes closed are displayed graphically for the right and left hemisphere by region (frontal: Figure 7; parietal: Figure 8).

EEG alpha power data was analyzed by way of an omnibus repeated measures MANOVA with hemisphere and region as the repeated factors, group (High APSD, Externalizing, Comparison) as the between subjects factor, and alpha power (7-12 Hz) as the dependent measure. This analysis revealed a significant main effect of greater parietal power than frontal power ( $F(1, 83) = 207.82, p < .01, \eta^2 = .72$ ; frontal:  $M = 3.33, SD = .67$ , parietal:  $M = 3.85, SD = .74$ ). A significant hemisphere x region interaction ( $F(1, 83) = 6.12, p < .02, \eta^2 = .07$ ) was qualified by statistical interaction trend. This hemisphere x region x group interaction ( $F(2, 83) = 3.00, p < .055, \eta^2 = .07$ ) suggested that there was a differential group effect for the power values of the left and right hemispheres at a particular site. Repeated measures MANOVAs were then conducted separately for the frontal and parietal regions. Neither of these models were significant, indicating that the hemisphere x region x group interaction was distributed across the frontal and parietal regions (Frontal:  $F(2, 83) = 1.52, ns$ ; Parietal:  $F(2, 83) = 1.93, ns$ ). Single comparisons for frontal sites revealed that High APSD boys displayed significantly greater right than left frontal alpha activity ( $F(1, 19) = 6.12, p < .05, \eta^2 = .25$ ) as did Externalizing boys ( $F(1, 42) = 3.63, p < .06, \eta^2 = .08$ ), both of which indicating greater relative left frontal activation for these groups. Comparison boys did not show a

significant difference in alpha power at the frontal sites ( $F(1, 23) = 0.01$ , ns). Single comparisons for parietal sites revealed that High APSD boys displayed significantly greater left than right parietal alpha activity ( $F(1, 19) = 6.17$ ,  $p < .05$ ,  $\eta^2 = .25$ ), indicating greater relative right parietal activation. Neither Externalizing boys nor Comparison boys showed significant differences in parietal alpha activity (Externalizing:  $F(1, 42) = 1.03$ , ns; Comparison:  $F(1, 23) = .27$ , ns).

EEG Asymmetry Scores. Means and standard deviations for laterality scores by group are displayed in Table 19. One participant's data was excluded as an extreme value greater than 3 SDs from the overall sample. The EEG asymmetry data was analyzed by way of an omnibus repeated measures MANOVA with region as the repeated factor (frontal vs. parietal asymmetry score) with group (High APSD, Externalizing, Comparison) as the between subjects factor and asymmetry score ( $\ln \text{right} - \ln \text{left}$ ) as the dependent measure. This analysis revealed a main effect for region ( $F(1, 84) = 6.15$ ,  $p < .02$ ,  $\eta^2 = .07$ ) and a group x region interaction trend ( $F(2, 84) = 3.00$ ,  $p < .055$ ,  $\eta^2 = .07$ ).

Next, two one-way ANOVAs were computed separately for the frontal and parietal regions by group. Neither frontal asymmetry ( $F(2, 84) = 1.28$ , ns), nor parietal asymmetry was significantly different among the groups ( $F(2, 84) = 1.94$ , ns). This finding indicated that the group x asymmetry interaction was accounted for by a combination of asymmetry differences across the frontal and parietal regions. In the frontal region, the High APSD group showed the greatest frontal asymmetry (greater right frontal alpha—greater left frontal activation) and the Comparison group showed no frontal asymmetry. In the parietal region, the High APSD group showed the greatest parietal

asymmetry (greater left parietal alpha—greater right parietal activation), while the Comparison group showed the opposite pattern (greater right parietal alpha), but to a lesser extent (see Figure 9).

EEG Asymmetry Scores with the Effects of Anxiety Removed. Anxiety is known to be elevated among boys with conduct problems (Zoccolillo, 1992). Some of this distress is believed to be related to the consequences of conduct problem behavior for the individual child (Frick, et al., 1999). On the other hand, the EEG results reviewed thus far, as well as behavioral descriptions of conduct problem boys within the clinical literature, suggest that they have tendencies toward greater behavioral approach. Thus approach and withdrawal-related behavioral tendencies are likely to be present within the same group of children. At the same time, our model of EEG asymmetry reviewed earlier posits different patterns of cerebral asymmetry for greater approach versus withdrawal related behavioral tendencies. By contrast, Heller's (1993) model suggests that right parietal activation should be associated with trait anxiety. To address this issue, second set of analyses were conducted with the effects of anxiety included within the model as a covariate. This method served two purposes: first, it allowed for a direct examination of the relation between anxiety and patterns of cortical activation; second, it allowed for tests of the model with the effects of anxiety removed.

EEG asymmetry data were analyzed by way of an omnibus repeated measures MANCOVA with region as the repeated factor (frontal vs. parietal) with group (High APSD, Externalizing, Comparison) as the between subjects factor and with asymmetry score ( $\ln \text{Right} - \ln \text{Left}$ ) as the dependent measure. The CBCL Leguna Anxiety Scale as

served as the covariate. There was a significant main effect of region ( $F(1,83) = 16.43, p < .001, \eta^2 = .17$ ), a significant anxiety x region interaction ( $F(1, 83) = 9.28, p < .01, \eta^2 = .10$ ), and a significant asymmetry x group interaction, ( $F(2, 83) = 6.85, p < .01, \eta^2 = .14$ ). Next, ANCOVAs were conducted separately for each region, with group as the between subjects factor and anxiety as the covariate. Neither the group effect ( $F(2, 83) = 2.01, ns$ ) nor the anxiety-covariate effect was significant ( $F(1,83) = 1.52, ns$ ) for the frontal asymmetry measure. For the parietal region the group effect was statistically significant ( $F(2, 83) = 4.69, p < .01, \eta^2 = .10$ ) as was the anxiety covariate effect ( $F(1,83) = 7.30, p < .01, \eta^2 = .08$ ).

Single comparisons for parietal asymmetry, controlling for anxiety, showed that High APSD boys presented with asymmetry scores that were not significantly more negative in magnitude (greater relative left parietal asymmetry) than Externalizing boys, (contrast estimate = .15,  $p = .14$ ). However, High APSD boys' parietal asymmetry scores were significantly different from Comparison boys (contrast estimate = .39,  $p < .01$ ), with comparison boys exhibiting the opposite pattern to that of the clinical groups (greater relative right parietal asymmetry, or more activation on the left parietal side).

Following up on the significant effect of anxiety as a covariate within analysis of parietal asymmetry data, correlations were computed between anxiety and parietal asymmetry. Within the total sample, parietal asymmetry was not significantly related to anxiety ( $r(100) = .13, ns$ ). Parietal asymmetry was significantly related to anxiety within the clinically referred sample ( $r(76) = .23, p < .05$ ).

#### A Dimensional Approach to Resting Frontal EEG Asymmetry and Appetitive

Motivation. This section examines the relations among frontal EEG asymmetry, disruptive behavior problem variables, and reward seeking. Analyses were conducted in an attempt evaluate the conception of greater relative resting left-frontal activation as a dimension associated with a tendency toward greater approach-related behavior. To this end, relations between resting frontal asymmetry and disruptive behavior (CBCL externalizing behavior problems, oppositional defiant symptoms, and conduct disorder symptoms) were examined. These analyses revealed that resting frontal asymmetry was significantly and positively associated with externalizing behavior problems ( $r = .26$ ,  $p < .01$ ) and oppositional defiant symptoms ( $r = .23$ ,  $p < .025$ ) but not conduct disorder symptoms ( $r = .06$ , ns). The relation between APSD total and frontal asymmetry suggested a statistical trend ( $r = .19$ ,  $p = .05$ ). Resting frontal asymmetry was also significantly associated with reward seeking during the second half, but not the first half of the Point-Subtraction Game ( $r = .22$ ,  $p < .05$ ,  $r = .04$ , ns).

Interestingly, while resting frontal asymmetry was not significantly associated with a withdrawal-related behavioral index, CBCL internalizing behavior problems ( $r = .05$ , ns). Frontal asymmetry was associated with startle reactivity change across 4 to 7 s during threat ( $r = -.23$ ,  $p < .04$ ) such that positive asymmetry scores (greater right frontal alpha—left frontal activation) were associated with and increase in startle reactivity across 4 to 7 s during threat. Analogous startle reactivity change during safety was not statistically significant and showed a pattern in the opposite direction ( $r = .12$ , ns). Resting parietal asymmetry was unrelated to both approach-related and withdrawal related behavioral indices (with  $r$ s from  $-.02$  to  $-.18$ , ns).

In summary, resting frontal asymmetry appears to be a characteristic of clinically referred externalizing boys generally. Both the High APSD group and the Externalizing group showed greater frontal alpha power in the right frontal lead, indicating greater left frontal activation. Moreover, the magnitude of the effect increased with APSD severity. Notably, Comparison boys had comparable levels of alpha power in the frontal leads.

A Dimensional analysis was consistent with the conception of greater left frontal activation as an approach-related motivational tendency. Significant positive relations were observed between frontal EEG alpha asymmetry and approach-related measures (externalizing behavior problems, oppositional defiant symptoms, reward seeking under high provocation) and also by no significant relations between frontal asymmetry and withdrawal-related measures. Analysis of the resting EEG data also revealed group differences in parietal asymmetry. Specifically, High APSD boys presented with asymmetry in the parietal region indicating greater relative left parietal alpha activity, or more activation on the right parietal side. Neither externalizing boys nor Comparison boys displayed alpha asymmetry in the parietal region. Inclusion of anxiety as a covariate identified a significant relation with parietal alpha asymmetry but not with frontal asymmetry. In particular, greater relative right parietal activation was associated with increased levels of anxiety, but only within the clinical sample.

#### Physiological Reactivity to Affective Films

Cardiac Reactivity From Baseline to Film Viewing. The primary aims of the analysis of IBI data acquired during film clip viewing were two-fold. The first was to explore relative clinical group status differences in IBI, irrespective of film viewing

condition. The second was to examine changes in IBI from baseline across the three films. Seven children did not have useable IBI data due to technical problems during film viewing (High APSD = 2, Externalizing = 4, Comparison = 1). Inter-beat interval change scores were computed by subtracting each child's IBI score collected during baseline at rest from each of their IBI scores collected during viewing each of the films. Preliminary analysis of the IBI data revealed that neither child IQ nor family SES was significantly correlated with the sympathy film, the anger/argue film, or the anger/push film IBI change scores (child IQ:  $r_s(94) = -.16, -.08, \text{ and } -.09, \underline{ns}$ , family SES:  $r_s(94) = -.08, -.02, \text{ and } -.05, \underline{ns}$ ). Means and standard deviations for IBI change are presented in Table 20.

The relations between clinical group status and change in inter-beat interval (IBI) from baseline to three film conditions were examined within a repeated measures MANOVA. Mean IBI change served as the dependent measure and group (High APSD, Externalizing, Comparison) served as the between subjects factor. For this analysis, the repeated effect of IBI approached statistical significance (Roy's Largest Root  $F(2, 79) = 3.86, p < .05, \eta^2 = .09$ ) and the IBI x group interaction was statistically significant (Roy's Largest Root  $F(2, 79) = 4.49, p < .02, \eta^2 = .10$ ). Examination of the between subjects effect for the average IBI across the three conditions was not significant ( $F(2, 79) = .52, \underline{ns}$ ). This pattern of results indicated that that significant multivariate IBI x group interaction was due to group differences in the IBI profiles across the three films. Consequently, repeated measures MANOVAs were conducted with the aim of examining the profiles separately for each group. For the High APSD group, the repeated effect for IBI change was not significant, Roy's Largest Root  $F(2, 16) = .89, \underline{ns}, \eta^2 = .10$ . For the

Comparison group, the repeated effect for IBI was not significant, Roy's Largest Root  $F(2, 21) = .05$ , ns,  $\eta^2 = .01$ . However, the Externalizing group did show a significant repeated effect for IBI, Roy's Largest Root  $F(2, 40) = 8.41$ ,  $p < .001$ ,  $\eta^2 = .30$ . Tests of within subject contrasts revealed that the change in mean IBI for the Externalizing group was significant from the Sympathy Film to the Argument film  $F(1, 41) = 12.58$ ,  $p < .001$ , and from the Anger/Argument film to the Anger/Pushing film,  $F(1, 41) = 12.29$ ,  $p < .001$ . Group means are presented graphically in Figure 10.

In summary, analyses of IBI change during affective film viewing revealed that while on average the groups did not differ with regard to mean IBI across film viewing conditions, the Externalizing group was significantly reactive to the films. Neither High APSD group nor the Comparison group displayed statistically significant changes in mean IBI during film viewing. Comparison of effect sizes ( $\eta^2$ ) indicated that the effect size of change in heart-rate for the Externalizing group was three times that of the effect size for the High APSD group and thirty times greater than the effect size of the Comparison group.

#### Frontal EEG Activation Change in Response to Affective Films.

Outliers were defined as extreme data points that were three or more standard deviations from the mean of the total sample on a given psychophysiological index. No data for resting EEG or films met this criterion. Three children (Externalizing = 2, Comparison = 1) did not have useable EEG data due to technical problems during acquisition. Change scores (mean log transformed value during film viewing minus mean log transformed values associated with the Eyes Closed baseline) were calculated as an

index of film-induced left and right frontal and parietal lobe responses. A negative change score indicated increased activation. Anxiety served as a covariate for these analyses. Results are presented for the sympathy film, followed by the two anger films. A dimensional perspective was not adopted in this section.

Regional EEG Changes During a Sympathy Film. Group means and standard deviations for change in alpha spectral power (7-12 Hz) from baseline (eyes closed) to sympathy film viewing are displayed graphically for the left and right hemispheres by region (frontal: Figure 11; parietal: Figure 12). Film-induced changes in anterior and posterior EEG responses were examined within an omnibus repeated measures MANCOVA with hemisphere and region as the repeated factors with group (High APSD, Externalizing, Comparison) as the between subjects factor, change score served as the dependent measure, anxiety was included as a covariate. Within the sample there was a significant hemisphere x region x group interaction ( $F(1, 82) = 3.20, p < .05, \eta^2 = .06$ ) suggesting that there was a differential group effect for the power change scores of the left and right hemispheres and across the frontal and parietal regions.

A significant main effect for region indicated greater changes in alpha power at parietal sites than frontal sites ( $F(1, 82) = 23.97, p < .001, \eta^2 = .23$ ; frontal:  $\underline{M} = -.79, \underline{SD} = .54$ ; parietal  $\underline{M} = -1.76, \underline{SD} = .63$ ), and a significant main effect for hemisphere indicated greater changes in alpha power in the left hemisphere ( $F(1, 82) = 6.97, p < .01, \eta^2 = .08$ ; left:  $\underline{M} = 1.01, \underline{SD} = .55$ ; right:  $\underline{M} = .93, \underline{SD} = .61$ ). Other significant interactions included region x group ( $F(1, 82) = 4.27, p < .02, \eta^2 = .09$ ) and hemisphere x region ( $F(1, 82) = 12.53, p < .001, \eta^2 = .13$ ). The hemisphere x region x anxiety (covariate)

interaction was also statistically significant ( $F(1, 82) = 3.20, p < .05, \eta^2 = .06$ ).

Next, frontal and parietal regions were examined separately. For the frontal region, a hemisphere (left, right) x group (High APSD, Externalizing, Comparison) MANCOVA with was conducted. Anxiety served as the covariate. In this analysis, the hemisphere x covariate interaction was significant ( $F(1, 82) = 7.57, p < .01, \eta^2 = .08$ ). The hemisphere x group interaction suggested a statistical trend ( $F(2, 82) = 3.08, p = .05, \eta^2 = .07$ ). Specifically, the High APSD group and the Comparison group appeared to exhibit the opposite pattern change in frontal activity (see Figure 10) whereas the Externalizing group exhibited virtually no change across hemispheres (left:  $M = -.72, SD = .47$ ; right:  $M = -.69, SD = .53; r = .96, p < .001$ , for left and right frontal sites). Accordingly, for the frontal region, a post hoc analysis was conducted in which only the High APSD group and the Comparison group were compared on changes in anterior EEG responses within a repeated measures MANCOVA, with anxiety as a covariate. This analysis revealed a main effect of hemisphere ( $F(1, 41) = 4.18, p < .05, \eta^2 = .09$ ), a significant hemisphere x covariate (anxiety) interaction ( $F(1, 41) = 7.92, p < .01, \eta^2 = .16$ ), and a significant hemisphere x group interaction ( $F(1, 41) = 8.51, p < .01, \eta^2 = .17$ ). Next, Pairwise comparisons were conducted within each group, with anxiety controlled. The High APSD group showed significantly greater increases in activation on the right frontal side versus the left ( $F(1, 18) = 8.21, p < .01$ ). The anxiety covariate was also significant ( $F(1, 18) = 7.58, p < .02$ ). The Comparison group did not show statistically significant changes in activation across the hemispheres ( $F(1, 22) = .003, ns$ ). The anxiety covariate was not significant ( $F(1, 22) = 2.25, ns$ ). Estimated means (with the

effect of the covariate removed) are presented graphically in Figure 13.

For the parietal region, a hemisphere (left, right) x group (High APSD, Externalizing, Comparison) MANCOVA with was conducted. Anxiety served as the covariate. In this analysis, there was a main effect for hemisphere ( $F(1, 82) = 10.35, p < .01, \eta^2 = .11$ ). Neither the hemisphere x covariate interaction ( $F(1, 82) = 2.26, ns$ ), nor the hemisphere x group interaction were significant ( $F(1, 82) = 2.00, ns$ ).

Regional EEG Changes During an Anger/Argument Film. Group means and standard deviations for change in alpha spectral power (7-12 Hz) from baseline (eyes closed) to anger/argue film viewing are displayed graphically for the left and right hemispheres by region (frontal: Figure 14; parietal: Figure 15). Film-induced changes in anterior and posterior EEG responses were examined within an omnibus repeated measures MANCOVA with hemisphere and region as the repeated factors with group (High APSD, Externalizing, Comparison) as the between subjects factor, change score served as the dependent measure and anxiety served as a covariate. In this analysis, the main effect for region was significant ( $F(1, 82) = 22.89, p < .001, \eta^2 = .22$ ) and the hemisphere x region interaction was significant ( $F(1, 82) = 8.79, p < .01, \eta^2 = .10$ ), while the region x group ( $F(2, 82) = 3.40, p < .08, \eta^2 = .08$ ), and the region x hemisphere x group ( $F(2, 82) = 2.50, p < .09, \eta^2 = .06$ ) interactions suggested a statistical trends. The covariate, anxiety, did not interact significantly with any of the repeated or between subjects factors (all  $F_s < 1.60$ ) and was excluded from further analyses below. In order to explore the region x group interaction trend, average change scores were computed by averaging the left and right frontal and the left and right parietal sites separately. One-way

ANOVAs conducted separately for the frontal and parietal regions revealed that there were no group differences specific to the frontal ( $F(2, 82) = .84, ns$ ) or the parietal region ( $F(2, 82) = .41, ns$ ). Next, these two average change scores (frontal and parietal) were subtracted, yielding a measure of difference in activation change across the frontal and parietal regions. As expected, when this variable was used as a dependent measure within a one-way ANOVA, with group as the between subjects factor, the omnibus results were comparable to the region x group interaction above ( $F(2, 83) = 3.38, p < .04, \eta^2 = .08$ ). Post hoc contrasts within the one-way ANOVA indicated that the Externalizing group showed a greater a difference in brain activation change across the frontal and parietal regions than the High APSD group (difference score: Externalizing,  $M = -.51, SD = .43$ ; High APSD,  $M = .22, SD = .38$ ;  $t(83) = -2.56, p < .02$ ) which was due to less change in frontal activation for the Externalizing group. The High APSD group and the comparison group were not significantly different (Comparison,  $M = .37, SD = .42$ ;  $t(83) = -1.17, ns$ ).

As a set of post hoc analyses, the High APSD group was contrasted with the Comparison group. The omnibus repeated measures MANOVA with hemisphere and region as the repeated factors with group (High APSD, Comparison) as the between subjects factor, revealed a significant main effect of region ( $F(1, 42) = 23.10, p < .001, \eta^2 = .36$ ) with greater increases in activation in the parietal region versus the frontal region (frontal:  $M = -.85, SD = .56$ ; parietal:  $M = -1.15, SD = .62$ ), a significant hemisphere x region interaction ( $F(1, 42) = 6.00, p < .02, \eta^2 = .14$ ). A significant hemisphere x region x group interaction ( $F(1, 42) = 4.07, p < .05, \eta^2 = .09$ ) meant that there was a differential

group effect for changes in alpha power of the left and right hemispheres at a particular site. In the frontal region, High APSD boys showed greater changes in activation on the right versus the left hemisphere (frontal: left,  $\underline{M} = -.81$ ,  $\underline{SD} = .53$ ; right,  $\underline{M} = -.90$ ,  $\underline{SD} = .62$ ,  $t(19) = 1.73$ ,  $p = .10$ ), while in the parietal region, High APSD boys showed greater change in activation in the left versus the right hemisphere (parietal: left,  $\underline{M} = -1.19$ ,  $\underline{SD} = .68$ ; right,  $\underline{M} = -.96$ ,  $\underline{SD} = .63$ ,  $t(19) = -2.07$ ,  $p = .05$ ). Comparison boys showed comparable change in left versus right hemisphere activation, regardless of site (frontal: left,  $\underline{M} = -.86$ ,  $\underline{SD} = .61$ ; right,  $\underline{M} = -.85$ ,  $\underline{SD} = .53$ ,  $t(23) = -.02$ , ns; parietal: left,  $\underline{M} = -1.24$ ,  $\underline{SD} = .62$ ; right,  $\underline{M} = -1.20$ ,  $\underline{SD} = .68$ ,  $t(23) = -.45$ ).

Regional EEG Changes During an Anger/Pushing Film. Group means and standard deviations for change in alpha spectral power (7-12 Hz) from baseline (eyes closed) to anger/pushing film viewing are displayed graphically for the left and right hemispheres by region (frontal: Figure 16; parietal: Figure 17). Film-induced changes in anterior and posterior EEG responses were examined within an omnibus repeated measures MANOVA with hemisphere and region as the repeated factors, with group (High APSD, Externalizing, Comparison) as the between subjects factor and change score as the dependent measure. A significant main effect for hemisphere was observed ( $F(1, 83) = 5.28$ ,  $p < .03$ ,  $\eta^2 = .06$ ), as well as a significant main effect for region ( $F(1, 83) = 83.55$ ,  $p < .001$ ,  $\eta^2 = .50$ ). Neither the hemisphere x group ( $F(1, 83) = .35$ , ns), the region x group ( $F(1, 83) = 2.03$ , ns), the region x hemisphere ( $F(1, 83) = .43$ , ns) nor the hemisphere x region x group interactions were significant ( $F(1, 83) = .52$ , ns). Overall, change in activation was greater on the left side ( $\underline{M} = -1.09$ ,  $\underline{SD} = .59$ ) compared to the

right ( $M = -1.05$ ,  $SD = .63$ ) and change in activation was greater in the parietal region ( $M = -1.32$ ,  $SD = .64$ ) than in the frontal region ( $M = -.83$ ,  $SD = .52$ ). Compared to the previous films, the Anger-Pushing film appeared to “wash-out” individual differences in hemispheric and regional EEG. Inclusion of anxiety as a covariate within the model did not change the status of group, which was unrelated to changes in regional EEG alpha.

#### Ratings of Emotional Response to Affective Films.

Ratings of affective films included interest, sad, happy, angry, upset, and scared. Means and standard deviations for affect films are presented in Tables 21-23 for the sympathy, anger/argue, and anger/push films respectively. Group differences for affective films were evaluated by way of one-way analyses of variance comparing the three groups. Results of these analyses are presented in Table 24. Only the analysis for ratings of sadness during the sympathy film suggested differences among the groups  $F(2, 83) = 3.49$ ,  $p < .04$ . However, given the number of comparisons (18) this may have been a chance finding. Post hoc comparisons suggested that the revealed that the comparison group self-reported more sadness than either of the high APSD group (mean difference =  $.79$ ,  $p < .05$ ) or the externalizing group (mean difference =  $.60$ ,  $p < .05$ ). The high APSD group and the externalizing group were not significantly different in their self-reported sadness in response to the sympathy film (mean difference =  $.18$ ,  $ns$ ).

In summary, film-viewing conditions elicited increases in cortical activation from baseline. Also, greater increases were observed in parietal activation as a main effect for each of the three films. Both the sympathy film and the anger/argument elicited detectible individual differences in cortical activation change and anxiety emerged as an important

source of variance for the sympathy film viewing condition only. The anger/pushing film did produce statistically significant group differences in cortical activation. Across the sample for the anger/pushing film, boys showed greater increases in activation for the left hemisphere, across the frontal and parietal regions, without any significant region by hemisphere interactions. The magnitude of the change in cortical activation from baseline was significantly greater for the anger/pushing film than for the anger/argument film.

Specific findings for the sympathy and anger/argument films were as follows:

Contrary to predictions, the High APSD boys presented with the most pronounced changes in frontal and parietal activation for both the sympathy film and the anger film. In response to sympathy film viewing, High APSD boys showed greater relative increases in right frontal activation, versus left, when anxiety was statistically controlled. Neither the Externalizing group nor the comparison group showed differences in frontal activation change across the left and right hemispheres during sympathy film viewing. Within the parietal region, neither the Externalizing group nor the comparison group showed significant differences in cortical activation change across the left and right hemispheres. In contrast, the high APSD group exhibited significant increases in left parietal activation. During anger/argument film, the Externalizing group showed greater differential change across the frontal and parietal regions which was due to a combination of less activation overall frontally and more activation overall parietally. Post hoc comparisons between the High APSD group and the Comparison group indicated a trend toward greater increases in right frontal activation coupled with increases in left parietal activation for the High APSD group, with no significant hemispheric differences in frontal or parietal activation

change for the comparison group.

### Markers of Antisocial Behavior and Related Processes

This section presents results for measures of covert and overt antisocial behavior, aggressive and self-protective responding on the point subtraction game, and hostile attributional bias and aggressive responding to hypothetical vignettes. A dimensional approach was not examined in this section.

#### Covert and Overt Antisocial Behavior Among High APSD and Externalizing Boys.

High APSD boys were expected to be rated as presenting with a wider range of antisocial behaviors, particularly covert antisocial behaviors, than other clinically referred boys. Preliminary analyses revealed that IQ and SES were significantly correlated with overt antisocial behavior ( $r(101) = -.25, p < .05$  and  $r(101) = -.23, p < .05$ ) and covert antisocial behavior ( $r(101) = -.28, p < .01$  and  $r(101) = -.28, p < .01$ ) respectively, by caregiver report on the Interview for Antisocial Behavior (Table 3). The relation between clinical group status was examined first for covert antisocial behavior and then for overt antisocial behavior.

An ANCOVA with group (High APSD, Externalizing, Comparison) as the between subjects factor, covert antisocial behavior as the dependent measure, and child IQ and family socioeconomic status as covariates revealed a significant difference among group means for covert antisocial behavior ( $F(2, 83) = 8.80, p < .001, \eta^2 = .18$ ). Neither covariate accounted for a significant proportion of variance within the model (child IQ:  $F(1, 83) = .11, ns$ ; family SES:  $F(1, 83) = 1.01, ns$ ). An a priori contrast was conducted

within an ANOVA so that measures of effect size could be included. High APSD boys presented with significantly greater covert antisocial behavior than Externalizing boys,  $F(1,60) = 4.46, p < .05, \eta^2 = .07$ . Post hoc comparisons revealed that Comparison boys presented with significantly less covert antisocial behavior than either High APSD boys,  $F(1, 40) = 22.04, p < .001, \eta^2 = .34$  or Externalizing boys  $F(1, 64) = 9.48, p < .01, \eta^2 = .13$ .

An ANCOVA with group (High APSD, Externalizing, Comparison) as the between subjects factor, overt antisocial behavior as the dependent measure, and child IQ and family socioeconomic status as covariates revealed a significant difference among group means for overt antisocial behavior ( $F(2, 83) = 85.25, p < .001, \eta^2 = .67$ ). Neither covariate accounted for a significant proportion of variance within the model (child IQ:  $F(1, 83) = .88, ns$ ; family SES:  $F(1, 83) = .93, ns$ ). High APSD boys presented with significantly greater overt antisocial behavior than Externalizing boys,  $F(1, 60) = 38.94, p < .001, \eta^2 = .39$ . Post hoc comparisons revealed that Comparison boys presented with significantly less overt antisocial behavior than either High APSD boys,  $F(1, 40) = 193.94, p < .001, \eta^2 = .83$  or Externalizing Boys  $F(1, 64) = 76.46, p < .001, \eta^2 = .54$ . Means and standard deviations are presented separately for overt and overt antisocial behavior in Table 25.

In summary, High APSD boys were rated by their primary caregiver as presenting with significantly greater levels of both covert and overt antisocial behavior than were Externalizing boys. As expected the comparison group were rated as presenting with the least amounts of covert and overt antisocial behavior.

Aggressive and Self-protective Behavior During the Point Subtraction Game. The focus of analyses of the Point-Subtraction Game aggression data was to examine relations between clinical group status and patterns of aggressive and self-protective behavior under low and high levels of provocation from a hypothetical peer. Each of these types of behavior was analyzed separately. Preliminary analyses revealed that neither IQ nor family SES were significantly correlated with aggressive responding during the first half of the game ( $r(94) = .07, \underline{ns}$  and  $r(94) = -.04, \underline{ns}$ ), the last half of the game ( $r(94) = .04, \underline{ns}$  and  $r(94) = -.01, \underline{ns}$ ), or across the entire game ( $r(94) = .06, \underline{ns}$  and  $r(94) = -.01, \underline{ns}$ ). Similarly, neither IQ nor family SES were significantly correlated with self-protective responding during the first half of the game ( $r(94) = -.05, \underline{ns}$  and  $r(94) = .09, \underline{ns}$ ), the last half of the game ( $r(94) = -.01, \underline{ns}$  and  $r(94) = .06, \underline{ns}$ ), or across the entire game ( $r(94) = -.04, \underline{ns}$  and  $r(94) = .07, \underline{ns}$ ). Group means and standard deviations for aggressive and self-protective behavior on the Point-Subtraction Game are presented in Table 26.

The relations between clinical status and aggressive behavior on the Point-Subtraction game were examined using an omnibus repeated measures MANOVA with provocation level (first half of task—low, second half of task—high) as the repeated factor, group (High APSD, Externalizing, Comparison) as the between subjects factor and number of aggressive response choices (Button “B” choice) as the dependent measure. This analysis revealed no significant main effect for provocation Level (Roy’s Largest Root  $F(1, 78) = 1.30, \underline{ns}$ ), such that aggressive responding remained at comparable levels across the first and second halves of the task (first half:  $M = 5.6, SD = 3.76$ ; second half:  $M = 5.14, SD = 4.54$ ). The provocation level x group interaction was not significant  $F(2,$

78) = .75, ns. A between subjects ANOVA was conducted with group as the between subjects variable and the average aggressive response choices across the two halves of the task as the dependent measure. The main effect of group was not statistically significant,  $F(2, 78) = .77$ , ns. Means are depicted graphically in Figure 18.

As a follow-up analysis, child IQ was entered into a model tested above as a covariate. Child IQ did not interact with group in this model,  $F(1, 77) = .01$ , ns. The provocation level by group interaction remained non-significant,  $F(1, 77) = .54$ , ns.

The relations between clinical status and self-protective behavior on the Point-Subtraction game were examined using an omnibus repeated measures MANOVA with provocation Level (first half of task—low, second half of task—high) as the repeated factor, group (High APSD, Externalizing, Comparison) as the between subjects factor and number of aggressive response choices (Button “C” choice) as the dependent measure. This analysis revealed a significant main effect for provocation Level (Roy’s Largest Root  $F(1, 78) = 11.55$ ,  $p < .001$ ,  $\eta^2 = .13$ ), such that self-protective responding increased across the first and second halves of the task (first half:  $M = 7.00$ ,  $SD = 4.00$ ; second half:  $M = 8.46$ ,  $SD = 5.16$ ). The provocation level x group interaction was not significant ( $F(2, 78) = .05$ , ns). A between subjects ANOVA was conducted with group as the between subjects variable and the average self-protective response choices across the two halves of the task as the dependent measure. The main effect of group was not statistically significant,  $F(2, 91) = 1.20$ , ns. Means are displayed graphically in Figure 19.

In summary, within a reward-seeking context, High APSD boys were not significantly different from either Externalizing boys or comparison boys in their

aggressive responding. Moreover, groups of boys did not respond differently with regard to aggressive responding under low versus high levels of provocation. As well, there were no significant group differences in self-protective behavior on the Point-Subtraction game. For the entire sample, boys tended to respond to increased provocation level with a significant increase in self-protective behavior.

Hostile Attributional Bias. The relation between clinical group status and hostile attributional bias for hypothetical negative social outcomes was examined. Preliminary analyses revealed that child IQ, but not family SES was associated with hostile attributional bias within the full sample ( $r_s(101) = -.25, p < .02$  and  $-.06$ ), respectively. Neither relation was significant within the clinical sample ( $r_s(77) = -.06, ns$  and  $-.08, ns$ ), respectively. Thus the overall analysis proceeded with an ANCOVA with group (High APSD, Externalizing, Comparison) as the between subjects factor, hostile attributional bias score as the dependent measure, and child IQ as the covariate. This analysis revealed that after controlling for group differences in child IQ ( $F(1, 84) = 3.01, p < .08, \eta^2 = .04$ ), there were no differences among group means ( $F(2, 84) = .97, ns$ ). When the covariate was excluded from the analysis there was a statistical trend suggesting differences among group means ( $F(1, 85) = 2.63, p < .08, \eta^2 = .06$ ). The specific hypothesis that high APSD boys would show less hostile attributional bias than Externalizing boys was examined by way of an a priori contrast within the same model. High APSD boys and Externalizing boys offered comparable numbers of hostile attribution responses ( $t(85) = .78, ns$ ). However, a post hoc comparison revealed that as a group, the clinically referred sample offered more hostile attributional responses than comparison boys ( $t(75) = 2.27, p$

< .03). Group means and standard deviations for the hostile attributional bias measure are presented in Table 25.

Aggressive Response Generation. The relation between clinical group status and aggressive response generation for hypothetical social outcomes was examined. Preliminary analyses revealed that child IQ, but not SES, was significantly associated with aggressive response generation within the full sample ( $r_s(101) = -.28, p < .01$  and  $-.18, ns$ ), respectively. Neither relation was significant within the clinical sample ( $r_s(77) = -.06, ns$  and  $-.08, ns$ ), respectively. Thus, the overall analysis proceeded with an ANCOVA with group (High APSD, Externalizing, Comparison) as the between subjects factor, aggressive response generation score as the dependent measure, and child IQ as the covariate. This analysis revealed that after controlling for group differences in child IQ ( $F(1, 84) = 1.93, ns, \eta^2 = .02$ ), there was a trend suggesting differences among group means ( $F(2, 84) = 2.50, p < .06$ ). When the covariate was excluded from the analysis there was a statistically significant difference among group means ( $F(1, 85) = 4.57, p < .02, \eta^2 = .10$ ). The specific hypothesis that high APSD boys would show less hostile attributional bias than Externalizing boys was examined by way of an a priori contrast within the same model. High APSD boys and Externalizing boys offered comparable numbers of aggressive responses ( $t(85) = 1.34, ns$ ). However, both High APSD boys ( $t(85) = 2.96, p < .01$ ) and Externalizing boys ( $t(85) = 2.12, p < .03$ ) each offered more aggressive responses than comparison boys. Group means and standard deviations for the aggressive response generation measure are presented in Table 25.

In summary, High APSD boys were not significantly different from Externalizing

boys in terms of the frequency with which they offered aggressive responses to hypothetical social outcomes, or in terms of their aggressive response generation. As a group, clinically referred boys offered significantly more aggressive responses than comparison boys. The pattern of means and magnitude of the effects observed suggests a monotonic relationship between number of aggressive responses and clinical status (High APSD vs. Externalizing vs. Comparison). The relation between APSD total score and aggressive responses offered supports this conclusion ( $r(101) = .33, p < .001$ ).

## CHAPTER V

### Discussion

The current study was designed to examine the profile of a group of boys with severe early-onset conduct problems and a distinct physiological and behavioral profile. The central goal of this study was to characterize a subgroup of conduct problem children who present severe conduct problems and emotional and behavioral characteristics in line with the psychopathy construct. While the Antisocial Process Screening Device (Frick & Hare, 2001) is intended to be a downward extension of the psychopathy construct, it is at the very least premature to use this label with children. Instead, a decision was made to label children with extreme elevations on this measure “High APSD” boys. An approach-withdrawal motivational framework was adopted for heuristic purposes given its widespread use across a number of literatures including childhood antisocial behavior (Fowles, 1980; Quay, 1993), personality theory (Gray, 1987a), work in frontal EEG asymmetry (Fox, 1991; Sutton & Davidson, 1997) and affective modulation of the startle response (Lang, 1994). Overall, findings suggest that boys at the high end of the continuum of scores on the Antisocial Process Screening Device show a distinct pattern of psychophysiology and behavior. However, the measures collected within this study do not make a strong case for the conclusion that among clinically referred boys with externalizing problems, high APSD boys represent a unique subtype. A majority of the measures collected within this study place High APSD boys at different points along diverse dimensions as compared with Externalizing boys and Comparison boys. Differences were observed in all three general physiological indices (heart rate reactivity,

EMG startle, EEG) as well as for one of the behavioral measures and some of the questionnaire measures. The pattern of group differences was not consistently in line with the hypotheses proposed initially (see Table 21 for a summary of findings). Nonetheless, the pattern of data would suggest that High APSD children can be considered quantitatively different from other clinically referred externalizing boys or comparison boys. Linear regression analyses were conducted to explore an alternative conceptualization of the data from a dimensional perspective. Several of these analyses suggested that a dimensional approach could account for patterns within the data at least as well as the categorical approach initially proposed. To some extent, this was due to the statistical advantage of using the APSD as continuous measure versus the categories formed for this study. Moreover, other dimensions in addition to that embodied within the global APSD scale (externalizing behavior problems, oppositional defiant symptoms, callous-unemotional traits) may be important for characterizing approach, withdrawal and other emotion related processes amongst clinically referred children and comparison children as they are differentially related to key variables assessed within this project (see results and Appendix K). The following discussion examines the key domains assessed within this project (fear reactivity, reward seeking and approach-withdrawal, emotional responsivity to affective films, and markers of antisocial behavior) and associated findings. Results are discussed from a categorical perspective and also from a dimensional perspective.

#### Fear Reactivity and the “Low Fear” Hypothesis

Drawing on work in the adult literature (Lykken, 1957; Patrick, 1994), which

suggests a fear deficit among adult psychopaths, the fear construct was operationalized through a multimethod approach that included resting heart rate, self reports of trait fearlessness and fearfulness, and fear potentiated startle. Overall, the body of data does not support the position that children with high elevations on the APSD are characterized by “low-fear” compared to other children with elevated externalizing problems. There was some support that clinically referred children with externalizing problems screened in this study may be more fearless than nonreferred boys from the community.

### Resting Heart Rate

Given work which suggests low resting heart rate is associated with underarousal and psychological characteristics such as fearlessness, and that high heart rate has been linked with anxiety and a fearful temperament (Kagan, 1989a; Scarpa & Raine, 1997), we sought to extend these findings in High APSD boys who have been shown to present with high levels of conduct problems and are also thought to be fearless. Also low resting heart rate is often observed in child antisocial populations (Lorber, 2004; Ortiz & Raine, 2004). Contrary to predictions, no group differences for resting heart rate were observed among the High APSD, Externalizing, or Comparison groups. This finding was surprising given that Raine (2002a) presented a review implicating low resting heart rate as one of the most well-replicated biological markers of antisocial behavior risk. A possible explanation for the lack of findings for resting heart rate within the present study lies in the selection procedures for the comparison group who were selected for low levels of internalizing problems, including anxiety and the selection procedures for the clinically referred sample, which did not contain boys with internalizing symptoms in the

absence of externalizing symptoms. If greater autonomic arousal and relatively greater resting heart rate reflect higher levels of anxiety and fear, then the boys most likely to present with this characteristic were excluded from the study. Studies that sample broadly across the range of the fearful-fearless continuum may be more apt to detect an effect of resting heart rate as a correlate of antisocial behavior.

On the other hand, resting heart rate may not be as robust a marker as proposed by Raine (2002). For instance, the meta-analysis by Lorber (2004) suggests that resting heart rate effect sizes between antisocial groups and comparison groups are small and somewhat. In this meta-analysis, 41 studies that compared aggressive participants and controls found relatively small effect sizes, with 18 (44%) of the studies reporting null findings. Also noteworthy, Hare (1978) found no evidence of lower resting heart rate among adult criminal psychopaths in his review of the literature, and nor did Lorber (2004). In this sense, the finding for the High APSD group compared to other groups is similar to the adult literature on psychopathy.

#### Self-report Measures of Trait Fear

On a measure of trait fearfulness (harm avoidance), High APSD boys were not significantly different from the Externalizing group of boys. A statistical trend suggested clinically referred children (High APSD and Externalizing groups) generally rated themselves as less fearful than comparison boys on this measure. A second prediction made in this study was that High APSD boys would rate themselves as more fearless as operationalized by a thrill and adventure seeking measure. No group differences in terms fearlessness were observed. The thrill and adventure seeking measure was selected

because Frick and colleagues have used it successfully to operationalize the fearlessness construct (Frick et al., 2003; Frick et al., 1999). Yet, it is not clear that this measure is aptly construed solely along the continuum of fear. For instance, the forced choice item “I’d never do anything that’s dangerous” versus “I sometimes like to do things that are a little scary” could be considered to be engaging approach motivation as well as fear/withdrawal motivation. A similar point was made earlier about the Newman reward dominance task for engaging both approach and withdrawal motivation. By contrast, the harm avoidance measure would appear to be a more face valid index of a motivational system associated with fear, containing items such as “I keep my eyes open for danger” and “I check to make sure things are safe”.

#### Fear Potentiated Startle

As expected, threat of an air puff did potentiate startle, replicating findings by Grillon and colleagues (Grillon et al., 1999). Implementation of the air puff startle paradigm was aimed at extending the affect modulated startle findings from the adult psychopathy literature to children with severe conduct problems (Patrick et al., 1993). However, specific findings from the air puff paradigm suggest a more complex picture than was predicted based on the affective picture startle paradigm. Startle probes that occurred at 4.0 s into a threat stimulus indicated a trend toward reduced startle magnitude for the clinical sample as a whole (clinically referred boys with externalizing problems) versus Comparison boys. While this trend is consistent with an increased aversion threshold among externalizing boys, it does not support the hypothesis that diminished startle reactivity under threat is specific to High APSD boys. This result alone may

reflect the possibility High APSD boys and the Externalizing group of boys are comparable with respect to startle potentiation, at least by 4.0 s into stimulus viewing. Perhaps startle probes that occurred earlier during threat would have differentiated the clinical groups. For instance, Levenston et al. (2000) observed diminished startle for unpleasant pictures among psychopathic male inmates at 800 ms, but startle magnitude increased at later probe times (1.8 s, 3.0 s, 4.5 s), and Sutton et al. (2002) observed diminished startle among low anxious psychopathic female inmates at 2 s but not at 4.5 s. However, on the other hand, Vanman et al. (2003) observed no group differences in startle modulation at 800 ms, but diminished startle reactivity to unpleasant stimuli for adult psychopaths at 4.5 s.). In their study of behaviorally disordered children, van Goozen et al. (2004) did not report their startle modulation findings separately for the different probe times (3.5, 4.5, 5.5 s), leaving open the question of whether startle probe timing was an important variable for their study.

The late startle probes (7.0 s) during threat provided a dramatically different and unexpected finding. High APSD boys startled more strongly than other clinically referred boys or comparison boys. One interpretation of this finding is that High APSD boys were more fearful than other children in the sample as time progressed during condition of threat. This interpretation is contraindicated by the empirical literature (e.g., Raine, Reynolds, Venables, Mednick, & Farrington, 1998) as well as by self-reports of harm avoidance within this study. Another possibility is that this increase in startle magnitude reflects an increase in physiological arousal among the High APSD group, perhaps engaging the fight-flight system (Gray, 1991). Lang and colleagues have been able to

empirically isolate and document the contributions of affective valence and arousal to startle magnitude and each makes a contribution to startle potentiation (Bradley, Codispoti, Cuthbert, & Lang, 2001). That arousal plays a role in the airpuff task is supported by the pattern of findings across time during the safety signal. During this condition, dramatic decreases in startle magnitude were observed for the Comparison group, suggesting that the presence of the safety signal had the affect of reducing arousal levels for these boys. During the threat condition the High APSD group showed a marked increase in startle magnitude across 4.0 s and 7.0 s, while the Externalizing group startled somewhat more, and the Comparison group startled somewhat less over time. If this finding proves to be reliable, it could be useful for understanding the relation between emotion regulation ability and conduct problems. Most if not all startle research with adult psychopaths has focused on understanding what is believed to be a fear deficiency, or at least a deficit within an aversive system (Levenston et al., 2000; Patrick, 1994; Sutton et al., 2002), with focus on what happens earlier in stimulus processing. In turn, this fear deficiency is used as an explanation for the emotional callous and deficits in empathy observed in adult psychopaths and children with conduct problems (Blair, Colledge, Murray et al., 2001; Patrick, 1994). The finding of significantly greater startle later during threat observed in this study is also in line with what is often noted clinically. Under some conditions, adult psychopaths and children with conduct problems can show intense emotional responses and these reactions are likely to be related to violence. Perhaps a higher threshold for aversive stimulation allows these children to withstand the challenges of a stressful environment, with the added liability that when this threshold is

met, intense dysregulated emotion and behavior result.

Startle magnitude during the safety condition indicated that as a group clinically referred boys startled less than comparison boys during the early probe at 4.0 s, with no differences among the groups at 7 s. This would suggest that by 4.0 s into the safety condition, clinically referred boys were less aroused than the Comparison group at this point in time. Moreover groups of boys changed differentially across the safety condition from 4 to 7.0 s. High APSD boys did not change significantly, whereas Externalizing boys and Comparison boys showed a decrement in startle magnitude over this time span, suggesting they benefited from the presence of the safety signal.

A dimensional approach specifically directed at the airpuff task revealed two points of interest. First, among the APSD subfactors, the impulsive conduct problem (I/CP) factor best accounted for variability in startle change during safety and threat as compared to the other two factors. However, the relations between these change scores and DSM-IV symptoms subscales suggested that distinct processes may account for the different patterns of change observed across the three groups of boys. Change in startle magnitude during safety was best accounted for by ADHD symptom severity, suggesting that the greater the level of ADHD symptom severity the less change in startle magnitude across 4-7 s. This was largely due to the children with more severe ADHD symptoms who presented with relatively low levels of startle magnitude at 4 s that remained at a comparable magnitude at 7 s. By contrast, children with less severe ADHD symptoms (particularly the Comparison group) initially showed greater levels of startle magnitude that reduced to the level of other children as time progressed from 4 to 7 s. The results

for change safe point toward the importance of ADHD symptoms for understanding fear-related processes. A number of investigators have implicated the fear system in emotional callousness (Blair, Colledge, Murray et al., 2001; Frick, 1998a; Patrick, 1994). Attentional mechanisms are inextricably connected to the processing of signals of threat and danger (Armony & LeDoux, 2000). Findings from the present study suggest that a full account of fear processing within the airpuff startle paradigm will need to account for attention related processes and the impact of ADHD symptomatology on startle reactivity.

Again from a dimensional perspective, change in startle magnitude during threat was best accounted for by oppositional defiant disorder symptoms, with neither conduct disorder symptoms nor ADHD symptoms accounting for additional variance within the model. This finding suggests that startle change during threat may reflect the capacity for regulating negative emotion within a threatening context, particularly emotional characteristics such as irritability and anger tapped by the ODD symptom scale. Neither fear nor anxiety scales were related to startle change during threat. Interestingly, greater relative left frontal activation was associated with the tendency to show exaggerated startle magnitude over time during threat. Recently Jackson et al. (2003) reported that individuals who showed greater relative left frontal activation were characterized by greater change in startle reactivity from a negative stimulus period to the offset of the negative stimulus (difference score). This change reflected a greater decrement in startle reactivity. They interpreted this finding as an indication of a frontally mediated emotion regulation mechanism. Given that Jackson et al. (2003) used a static paradigm (affective

pictures), a different type of change score and a normal adult population, the results are not directly comparable to those of the present study. However both sets of findings point to the relevance of asymmetrical differences in frontal activation for understanding emotion regulation.

### Comparing the Airpuff Task and the Affective Picture Priming Paradigm

There are facets of the air puff startle paradigm and the affective picture paradigm that make them appreciably different and could account for differences observed in this study and those observed in the adult literature. The theoretical basis for using startle in this study relied on the adult psychopathy literature which has almost exclusively used affective pictures to modulate startle. Affective picture viewing represents a relatively passive experience in which pictures elicit relatively discrete emotional experiences, whereas the air puff paradigm represents an actual threat within a threatening context. Exploratory analyses, from the perspective of affective chronometry (Davidson, 2002), suggest that an active paradigm such as airpuff task elicits more dynamic emotion related processes than have been explored with affective pictures. Drawing on the valence model of appetitive and aversive states employed by Lang and colleagues (Lang et al., 1997), a safety signal during the airpuff indicates the absence of an aversive stimulus. If the air puff paradigm is a threatening context, during which physiological arousal levels are generally increased, then the safety signal should lead to a reduction in aversive state over time, as indicated by a significant reduction in startle magnitude from 4 s to 7 s, during the safety signal. This was the case, particularly for the Comparison group, but also for the Externalizing group.

The impact of stimulus potency for eliciting an aversive state may have also influenced the findings for the air puff paradigm. As reviewed previously, Levenston et al. (2000) designed their study within a framework which proposes that there is a general shift from the relative impact of attention to emotion on the startle reflex. For adult psychopaths they expected that a bias toward foreground attentional engagement over defensive reactivity would manifest in the potency of the negative stimulus presented to the individual and in the time course of the startle modulation effect. In other words, adult psychopaths would require a more intense unpleasant stimulus to show startle potentiation and on average startle potentiation for aversive content would be apparent later in stimulus processing. Levenston et al. (2000) observe that different types of stimuli (threat vs. victim), within the class of unpleasant stimuli, elicit startle magnitude effects of a different degree. The Levenston et al. (2000) findings with adult psychopaths support an interpretation that incorporates the issue of stimulus intensity for individual differences in startle potentiation. Among adult psychopaths, threat scenes can elicit startle potentiation (Levenston et al., 2000) and among normal adults, pictures with the most arousing content (threat, violent death) elicit the strongest startle responses (Bradley et al., 2001). Thus, threat of an air puff might also be anticipated to elicit potentiated startle in the present study, even among children expected to show patterns of startle reactivity similar to adult psychopaths. Indeed if threat of an air puff is a more potent stimulus than a passively viewed affective picture, in terms of engaging an aversive system, then some individual differences startle modulation under unpleasant stimulus conditions could be “washed out” as stimulus intensity increases.

### Summary of Fear Reactivity Findings

In the domain of fear reactivity, we assessed resting heart rate, harm avoidance, thrill and adventure seeking and fear potentiated startle. From the perspective of an approach-withdrawal framework, these measures reflect aspects of withdrawal related motivational tendencies related to Gray's BIS construct. By their own report, the clinically referred sample (boys with externalizing problems) appeared to be less fearful than Comparison group. However this effect did not reach statistical significance. Startle reactivity, early (4 s) during threat of an airpuff suggested a weak trend in the same direction. However, these results should be viewed against a comparison group who were, overall, not likely to be fearful given their low internalizing scores via the screening procedures (mean t score = 45). High APSD boys were not different from Externalizing boys in terms of startle reactivity early during threat or in terms of their self-reports of fearful behavior. Across the multimethod assessment no evidence suggested diminished fearful reactivity among High APSD boys as compared to externalizing boys. Instead the data suggest that clinically referred boys with externalizing behavior problems are at the lower end of the fearfulness continuum. Regression analyses suggested that those boys with the most extreme scores on the APSD were the most fearless (least harm avoidant).

### Reward Seeking, Resting Frontal Asymmetry, and Approach Motivation

Drawing on work with antisocial populations suggesting greater approach related behavioral tendencies such as reward dominance among conduct problem youth and also a model of frontal EEG asymmetry that accounts for motivational and emotional aspects

of behavioral approach, we sought to operationalize the approach construct with two reward seeking measures and assessment of resting frontal EEG asymmetry. Among the three approach-related measures, the Point Subtraction Game, and resting frontal asymmetry suggested greater relative approach related behavioral tendencies among High APSD boys. The Door-Opening Task, an index of reward dominance did not differentiate the groups. Each of these indices discussed in turn within a motivational framework.

#### Reward Seeking on the Door-Opening Task and the Point Subtraction Game

The Door-Opening Task did not differentiate groups of boys. Two factors may have played a role in the lack of group differences for the reward dominance task. First, the group selection criteria may have impacted the present results by excluding children with lower levels of externalizing problems ( $t$  score  $< 60$ ) but with elevated internalizing problems. Similarly, the Comparison group had a low level of internalizing problems. Since the range of broadband internalizing symptoms were restricted in the sample, it is likely that withdrawal constructs such as fear and anxiety in the absence of approach-related pathology were also restricted. Given that the Door-Opening Task includes elements of reward and punishment, initially engaging approach through greater reward (BAS) and later withdrawal through greater punishment (BIS), the exclusion of participants who are likely to have a  $BIS > BAS$  bias could have contributed to this null finding. These would have been the participants who would have opened the fewest numbers of doors. Evidence for this interpretation comes from studies using variants of this task have included anxious participants either as part of selected samples (Shapiro et

al., 1988), or as in Frick's work, an unselected clinically referred sample which included anxious patients (O'Brien & Frick, 1996). Anxiety, a BIS-related construct, accounted for group difference findings in these studies. A second, issue pertains to assessment reliability. The reward dominance task used in this study instantiated a single measure of reward dominance. Frick's reward dominance task, by contrast, presents the participant with essentially the same type of (win-loss game) in four random orders with different stimuli (door opening, fishing, card game, etc.). In this way, Frick's dependent measure reflects the participant's behavior across four situations, effectively extending the range of scores, and probably leading to a more reliable assessment of the reward dominance construct.

The Point Subtraction Game indicated that averaged, across low and high levels of provocation from a hypothetical peer, High APSD boys sought rewards at a greater rate than did Externalizing boys, but not more than Comparison boys. When high and low provocation were examined separately, High APSD boys were significantly different from Externalizing boys during low provocation only. In addition, both the High APSD group and the Comparison group responded to the increased level of provocation with a significant decrease in rewards sought. By contrast, the Externalizing group showed no change in reward seeking in response to increased provocation. Theorists have often referred to greater reward seeking among antisocial populations (Fonseca & Yule, 1995). That there were no differences between the High APSD group and the comparison group would suggest that reward-seeking and a greater approach bias reflect a relative difference among clinically referred boys, but does not suggest an extreme or excessive

tendency toward approach among High APSD boys. Also noteworthy, there are important differences between reward seeking in the Point Subtraction Game and reward seeking within the Door-Opening Task. Whereas reward and punishment are linked as possible outcomes for a response (opening a door on the Door-Opening Task), the Point Subtraction Game does not directly link punishment to the response of reward seeking. Instead the child directly chooses reward among other options (self-protection, aggression). As well, the Door-Opening Task begins as predominantly a reward task and then shifts to predominantly a punishment task over time. Therefore, behavior early in the task may be thought of as primarily eliciting reward-seeking behavior. However, once the task shifts toward greater punishment, persistence within the task may be thought of as mediated by sensitivity to punishment. This interpretation was supported by the relation between callous-unemotional trait score and number of doors open. Conceptually speaking then, reward seeking in the Point Subtraction Game may be thought of as a more pure index of approach motivation.

#### Resting Frontal EEG and Approach Motivation

Resting frontal EEG at the frontal leads, examined across the three groups of boys, did not reveal significant differences. However, the High APSD group and the Externalizing group did show a pattern of frontal asymmetry reflecting greater relative left frontal activation. The magnitude of the frontal asymmetry difference effect for High APSD boys was twice as large as for the Externalizing group and varied monotonically across the three groups (High APSD,  $\eta^2 = .25$  vs. Externalizing,  $\eta^2 = .11$  vs. Comparison,  $\eta^2 = .00$ ). The lack of significant findings across the three groups of boys could have

been due differences in cortical lateralization for left vs. right-handed boys, given our decision not to exclude left-handers from this study (10% of the sample). Correlation analyses that treated resting frontal EEG asymmetry as a dimension across the entire sample revealed greater left frontal asymmetry was associated with externalizing behavior, oppositional defiant symptoms and reward seeking during the second half of the Point Subtraction Game. The APSD was related to resting frontal asymmetry in the same manner as a statistical trend. These findings are consistent with the view that greater relative left frontal activation may be viewed as a diathesis toward approach. It is unclear why asymmetry was associated with greater reward seeking for the second half of the Point Subtraction Game, but not the first. One possibility, consistent with Davidson's (1998, 2000) theorizing is that the more evocative context of reward seeking during high provocation represented a requisite environmental demand for driving an approach related diathesis (greater left frontal activation at rest). The finding of greater relative left frontal activation among the externalizing sample is in accord with the work of Harmon-Jones and colleagues (Harmon Jones & Allen, 1998; Harmon-Jones & Allen, 1998). This is the first study to show greater relative left frontal brain activation is associated with approach related variables in a child sample. The interpretation of left frontal activation as a marker specific to anger is supported by its significant relation with oppositional defiant symptoms. In light of the finding of reduced left frontal gray matter volume in ADHD (Mostofsky, Cooper, Kates, Denckla, & Kaufmann, 2002), the non-significant relation between frontal asymmetry and ADHD contradicts an interpretation of the observed asymmetry as due to reduced right frontal gray matter volume, which could be

predicted given the high incidence of ADHD symptoms with the clinical sample. As noted earlier, the relation between resting frontal asymmetry and ODD symptoms is at odds with that of Baving et al. (2000) who found that boys with ODD, irrespective of age, did not show frontal asymmetry. Their strict exclusionary criteria (no ADHD, CD, or emotional disorder) were likely to have restricted the range of approach related symptoms, such as trait anger, within their sample of boys. Interestingly, Raine and colleagues (Raine, Yaralian, Reynolds, Venables, & Mednick, 2002) observed that persistently antisocial individuals (across ages 9 and 17 yrs.) had spatial deficits at 3 years of age in the absence of clear verbal deficits at the same age. Because spatial abilities are localized in the right cerebral hemisphere, Raine et al. (2002) proposed that early spatial impairments (reflecting right hemisphere dysfunction), could interfere with early bonding attachment and affect regulation in these children. Based Raine et al., we might expect to have observed frontal asymmetry in the High APSD group due to reduced right frontal activation. This did not appear to be the case given the comparable levels of right frontal activation in the High APSD and Comparison groups.

#### Summary of Findings For Approach Motivation

Measures selected to assess approach motivation provided some evidence of greater approach or BAS activity that again varied more as a function of the dimension of antisocial behavior rather than being specific to the High APSD group. For instance, although both the High APSD group and Externalizing group had greater relative right frontal alpha activity (left activation) the groups were not significantly different from one another. Only when frontal asymmetry was treated as a continuous measure did relations

between resting frontal asymmetry and measures of disruptive behavior problem measures emerge. On the other hand, reward seeking on the Point Subtraction Game differentiated the High APSD Group from the Externalizing Group but not from the Comparison group.

### Resting Parietal Activation

Moving on to the parietal region, High APSD boys showed parietal asymmetry at rest reflecting greater relative activation in the right hemisphere, which was not observed for the other two groups of boys. This was an unexpected finding. Interestingly, the model proposed by Heller and colleagues (1993; Heller & Nitschke, 1998) associated arousal with posterior brain regions. As noted earlier, Heller, et al., (1997) observed greater relative right parietal activation among anxious participants when they manipulated anxious arousal experimentally. Similarly, Bruder et al. (1997) found greater resting parietal activation among depressed patients with comorbid anxiety but not among those who were depressed without a comorbid anxiety disorder (see also Aftanas & Pavlov, in press, 2004). Consistent with Heller and colleagues' (Heller, 1993; Heller et al., 1997) notion of anxious arousal and parietal activation, increased anxiety across the clinical sample (only) was associated with greater right parietal activation. Frick and Ellis (1999) point out that among clinically referred children, those with severe conduct problems experience greater trait anxiety which reflects emotional distress resulting from pervasive social and emotional impairments. Thus, perhaps greater relative right parietal activation among High APSD boys reflects emotional distress that is not outwardly apparent, at least from the perspective of caregivers who rated these

children as emotional callous (APSD subscale).

### Psychophysiological Responsivity to Affective Films

One of the defining characteristics of boys with elevated APSD scores is emotional callousness (Frick, 1995). This study sought to examine changes in the heart rate and EEG as indices of physiological reactivity to affective films. Several recent studies indicate affect-processing deficits among children with elevated APSD scores. Even as work in the child literature argues for emotion specific deficits among High APSD children (Blair, 1999; Blair, Colledge, Murray et al., 2001), the adult literature on psychopathy suggests that the potency of the affective content is also a critical variable (Levenston et al., 2000). On the other hand, the adult literature with normal participants finds that affective films elicit patterns of frontal asymmetry in lawful ways (Jones & Fox, 1992). It was expected that High APSD boys would show less heart rate reactivity than Externalizing or Comparison boys when viewing a series of affective films. With regard to EEG, it was predicted that high APSD boys, who are believed to be more emotionally callous, would be less reactive within the frontal region than other clinically referred boys or comparison boys. Specifically we predicted that High APSD boys would not show significant changes in frontal EEG asymmetry in response to affect eliciting films whereas boys without extreme elevations on the APSD and comparison boys were expected to show increased right frontal activation (change from baseline) in response to viewing a sympathy film and increased left frontal activation (change from baseline) in response to viewing two anger films.

### Heart Rate Reactivity to Affective Films

In contrast to the resting heart rate data collected in this study, heart rate reactivity across three affective film clips indicated group differences in heart rate responsivity across the sympathy and anger films. Specifically, the Externalizing group was more reactive than either the High APSD group or the Comparison group. This finding suggests emotional hypo-responsivity among High APSD children compared to other clinically referred externalizing children. The Comparison group presented with a profile across the three film clips that was not statistically different from the High APSD group. These findings are surprising given the marked distress of the High APSD group as indexed by CBCL internalizing problems (mean t score = 70) vs. that of the Comparison group (mean t score = 45), vs. the Externalizing group (mean t score = 64). One implication of this finding is that the reduced cardiac reactivity as a correlate of severe conduct problems specifically applies to the population of boys with externalizing problems rather than to boys within this age range as a whole. As noted earlier, the selection criteria for the Comparison group (t score < 60 for internalizing and externalizing) may have contributed to these findings by restricting the range of emotion-related symptoms within this group.

Overall, the finding of hypo-responsivity among High APSD boys compared to other externalizing boys is consistent the work of Blair (1999) who found that boys with elevations on the APSD showed reduced skin conductance (EDR) in response to others distress cues. Interpretation of the psychophysiological underpinnings of the heart rate reactivity findings for High APSD group is complex given the conjoint inputs of

sympathetic and parasympathetic inputs into the heart (Bernston, Cacioppo, & Quigley, 1991), coupled with role of attention in processing affective information. Interestingly these findings are in line with the notion of an increased aversion threshold among adult psychopaths (Patrick et al., 1993). Although, as noted earlier theorists have provided a number of different (but related) models for deficits in emotional reactivity among adult psychopathic individuals as well as among children with extreme scores on the APSD including fearlessness (Lykken, 1995) and chronic underarousal (Eysenck & Gudjonsson, 1989) and more recently deficits in functioning of the amygdala (Blair, Colledge, Murray et al., 2001). Alternatively, in the adult literature Hare (1998) has argued that “rather than being incapable of experiencing anticipatory fear, psychopaths appeared to have ready access to a dynamic protective mechanism that attenuated the psychological/emotional impact of cues associated with impending pain or punishment”(p. 108). Such a mechanism, more broadly conceived, could account for the fact that High APSD boys have difficulty regulating emotion yet were hypo-responsive compared to Externalizing boys.

#### EEG Responsivity to Affective Films

On average, each of the film clips led to increases in cortical activation from baseline. However, contrary to predictions, High APSD boys showed the most pronounced changes in patterns of activation for both the sympathy film and the anger-argument film.

For the sympathy film, neither the Externalizing group nor the Comparison group showed hemispheric differences in frontal or parietal activation change from baseline.

The High APSD group showed an increase in right frontal activation versus left, when anxiety was controlled. And, within the parietal region, the High APSD group showed increases in left parietal activation from baseline to viewing the sympathy film that was not observed for the Externalizing or the Comparison groups. Drawing on the extant literature (Jones & Fox, 1992; Tomarken et al., 1990), the finding for the frontal region would suggest that the High APSD group responded in a manner consistent with the experience of negative affect and withdrawal related tendencies while viewing the sympathy film.

The left parietal finding is less easily explained. In normal adults, the right temporoparietal region, rather than the left, has been implicated in the experience of emotion and the modulation of autonomic and behavioral arousal (Heller, 1993). Indeed, for resting EEG within the clinically referred sample, maternal anxiety ratings were associated with parietal EEG asymmetry implicating greater activation in the right parietal region. Recent work using brain mapping indicates that lesions within the right inferior parietal cortex are associated with impairment in the recognition of fear and sadness in others (Adolphs, Damasio, Tranel, & Damasio, 1996) whereas normal participants listening to sad stories during positron emission tomography (PET) showed increased activity in the right inferior parietal cortex (Decety & Chaminade, 2003). High APSD boys displayed a pattern opposite of what would be expected based on these recent findings. Moreover, their pattern of parietal reactivity was clearly different from the other boys in this sample. Because this finding was not predicted, it may reflect a spurious finding. However, there is a growing body of adult psychopathy literature that

suggests abnormal processing of affective information among adult psychopaths. Recently, (Kosson, Suchy, Mayer, & Libby, 2002) observed that adult psychopaths were less accurate at identifying affective information than nonpsychopaths when experimental conditions promoted reliance on right hemisphere resources (responding with the left hand). Kosson et al. (2002) propose that this finding might reflect dysfunction in right hemisphere mechanisms for processing emotional content or reduced asymmetry for processing emotional content among adult psychopaths. Consistent with the notion of deficient processing of affective information within the right cerebral hemisphere and in light of the observed increases in relative left parietal activation, one possibility is that High APSD boys relied more on left hemisphere resources to process content of the sympathy film, at least within the parietal region.

The anger/argument film did not elicit asymmetric brain activation changes at either the frontal or the parietal regions. Collapsed across hemisphere, within region, the Externalizing boys were observed to show greater differential activation across the frontal and parietal regions that appeared to be due to a combination of less activation change frontally and more activation change parietally than the High APSD group. The High APSD group and the Comparison group showed changes that were not different across the frontal and parietal regions. Post hoc comparisons between the High APSD group and the Comparison group suggested trends toward greater increases in right frontal activation for the High APSD group coupled with increases in left parietal activation, findings which mirror the cortical responses observed for the High APSD group during the sympathy film.

The anger/pushing film produced the largest changes in cortical activation, but did not yield any detectable individual differences. This finding has implications for work on cerebral asymmetry and emotion because the level of intensity of this film appeared to wash away individual differences in cortical activation. Similarly, across films, with increasing intensity of affective content, individual differences in asymmetrical cortical activation became less apparent giving way to greater total cortical activation overall. Both these observations would suggest affective films of less intensity might be more suitable for eliciting hemispheric differences in activation and for eliciting levels of cortical activation with a range that covaries with individual differences in children.

While it is true that High APSD boys presented with the most apparent asymmetries at baseline, both in the frontal and parietal regions, these initial differences should not be viewed as driving the differences that occurred during the film clips. We would expect EEG alpha changes from an eyes-closed to any eyes-open condition, these changes could have manifested in any number of ways cortically and differentially for the groups. Indeed the advantage of examining EEG alpha change from baseline to film viewing versus EEG alpha acquired during film viewing alone is that for the latter, any patterns of change observed could also be attributed to the influence of baseline EEG alpha.

Across both the heart rate data and the EEG change data findings were generally not robust. Affect ratings generated by the boys generally were not significantly different across the groups. Analysis of change in ratings across the three films indicated there

were significant changes across the films for ratings of sad, happy, upset, and interested, but these changes were not accompanied by consistent changes in electrophysiology. These changes were mainly from the sympathy film to the anger films. Boys generally gave ratings that averaged below 2 on a four-point scale for all emotions rated, suggesting that the film manipulation did not work. Also worthy of mention, the second two films depicted adults while the initial film depicted a child. It may have been that the adult angry interaction films did not effectively elicit vicarious emotions in the boys in this sample.

Beyond the pattern of change in cortical activation that characterized the High APSD group during film viewing, two other unexpected physiological findings emerged that are worthy further discussion. The first is greater relative right parietal activation during the baseline condition. This finding is consistent with the notion of greater distress within this group as corroborated by the relation between left parietal asymmetry (greater activation on the right side) and anxiety. A recent paper by Compton (1999) implicates the right parietal region not only in the experience of arousal, but also the ability to regulate arousal in response to emotional stimuli. High APSD children showed relatively more activation in the left parietal region in response to affective films compared to baseline EEG. Research supports a model in which autonomic control of cardiac regulation is differentially specialized across the two hemispheres such that sympathetic activity is mainly subserved by the right cerebral hemisphere and parasympathetic activity is mainly subserved by the left cerebral hemisphere (Hugdahl, 1995; Wittling, 1997). Perhaps these changes reflect an anomaly among High APSD

boys in the way that they regulate autonomic arousal under emotion eliciting conditions.

Comparing physiological responsivity to affective films across the heart rate and EEG data, findings appear divergent. This result is not uncommon among studies incorporating multiple measures of psychophysiological reactivity (Scarpa & Raine, 1997). On the one hand, autonomic responsivity to affective film clips suggests that High APSD boys are less responsive than Externalizing boys. On the other hand, changes in cortical activation suggest that High APSD boys are more reactive in terms of patterns of hemispheric change across the frontal and parietal regions under conditions of viewing a sympathy film, and an anger-argument film.

### Markers of Antisocial Behavior

Unequivocally, High APSD boys were rated as presenting with the most extreme levels of conduct problems, including both covert and overt antisocial behavior. Given the minimal overlap between the Interview for Antisocial Behavior and the APSD, this finding indicates that High APSD boys do represent a subgroup among clinically referred boys who present with the most severe conduct problems (overt and covert), at least from the perspective of their primary caregiver. The hypothesis of greater levels of covert antisocial behavior among High APSD boys was conceived out of the notion that some antisocial individuals, those who are relatively more fearless, would be more inclined to commit covert antisocial acts. Fear is thought to be involved in concern about being caught (Lykken, 1995), concern for others' feelings (Blair, Jones, Clark, & Smith, 1997) and developmental processes in which linkages between transgressions and consequences promote conscience development (Kochanska, 1993).

Greater overt antisocial behavior among High APSD boys, while not predicted, does fit with the notion among adult psychopaths of greater versatility of antisocial behavior patterns than other antisocial individuals. Moreover, adult psychopaths are known to commit a disproportionate number of violent acts among all adult offenders (Harris, Rice, & Cormier, 1991). Greater overt antisocial behavior among High APSD children could have arisen from statistical and measurement-related issues inherent in the use of screening measures and cutoffs that relate to the dependent measure of interest (overt antisocial behavior). For instance, common variance from the same informant completing the measure, coupled with the fact that the cutoff for the Externalizing group

included individuals with relatively lower levels of antisocial behavior overall, could have contributed to this finding.

#### Aggressive Behavior in the Laboratory

While differences in overall levels of antisocial behavior, per caregiver informant, were clearly apparent for the High APSD, Externalizing, and Comparison groups, this was not the case for rate of aggressive behavior on the Point Subtraction Game. It was expected that High APSD boys would present with the highest levels of aggression. All boys responded with similar levels of aggressive behavior across the task and level of provocation did not impact their aggressive responding. That comparison boys and boys with differing levels of externalizing behavior problems did not differ in terms of aggressive responding is surprising given other indicators of aggressive behavioral tendencies including group differences on the APSD and the Interview for Antisocial Behavior.

A recent study by Waschbusch et al. (2002) may shed some light on the lack of group differences in aggressive behavior observed in this study. They found that boys with comorbid ADHD/ODD/CD behaved more aggressively than ADHD boys, ODD/CD boys, or boys with no diagnosis on a competitive reaction time task, but only under low levels of provocation. Under high levels of provocation, all three groups showed comparable levels of aggression. Waschbusch et al. (2002) interpret their findings as indicating that it is developmentally appropriate to aggress under high levels of provocation. Within the current study, the low level of provocation in the Point Subtraction Game may have exceeded the threshold sufficient to elicit aggressive

responding from all the boys. Alternatively, other parameters of the Point Subtraction Game may have contributed to the lack of individual differences among the groups of boys. For instance, inclusion of the nonaggressive option, which protected the child's winnings, may have contributed the results. In fact, although no individual differences were observed for the self-protective response, increased provocation was associated with increased protective responding. Retaliation did not have any direct impact on the child's winnings in the game because they could not keep what they subtracted from the other child.

Overall, and in light of the primary goal of this study, which was to characterize High APSD boys, three main conclusions can be drawn from the Point Subtraction Game. First, clinically referred boys with externalizing problems, are not always more aggressive than boys who do not present with elevated externalizing behaviors (Comparison Group). Second, given the opportunity to pursue rewards or to aggress, High APSD boys sought rewards more often than other clinically referred children. Third, when given the opportunity, High APSD boys respond prosocially to a degree that was not different from the other groups of boys. However, this last finding is strictly behavioral and does not necessitate similar motivations among the groups (e.g., self-interest vs. pacifism).

#### Hostile Attributional Bias

Assessment of hostile attributional bias through social cognitive vignettes was included as a measure that would differentiate High APSD boys from Externalizing boys. Externalizing boys were expected to show greater levels of hostile attributional bias.

Contrary to expectation, clinically referred and comparison boys were not significantly different with respect to hostile attributional bias. This finding runs contrary to theorizing by Frick and colleagues (Frick & Ellis, 1999) as well as findings in a recent study with a nonreferred sample (Frick et al., 2003). Frick et al. (2003) found that children with higher levels of callous-unemotional traits and elevated APSD scores showed less hostile attributional bias than boys with comparable levels of conduct problems but lower levels of callous-unemotional traits. Such differences in social cognition do not appear to be present among High APSD boys and Externalizing boys who are clinically referred. As detailed below, the boys from the Frick et al. (2003) sample did not present with APSD scores as extreme as those which characterize the High APSD boys described within this paper. It may be that findings from community and school based studies do not generalize to clinically referred children. If we think about the processes that lead to hostile attributional bias among clinically referred children, as a group these children often tend to experience social rejection and conflict with peers that leads to their being seen at clinics in the first place. It is surprising that given the greater levels of conduct problems among High APSD boys, which include conflict across multiple social domains, we would not see more pronounced hostile attributional bias among these children. In fact, a study of adult inmates by Serin (1991) did find that psychopaths were the most likely to respond to hypothetical situations involving frustration that they would be more angry and had a greater hostile attributional bias than other inmates (see also Blackburn & Lee Evans, 1985). The hostile attributional bias measure was selected because High APSD boys were expected to be

less elevated on this measure than Externalizing boys. Perhaps a more suitable social cognitive measure would have been an assessment that examined anticipation of positive outcomes for aggressing (Dodge, Lochman, Harnish, Bates, et al., 1997), a cognitive style thought to be associated with proactive aggression. Some support for the relation between psychopathic characteristics and positive outcome expectations (tangible rewards, dominance of others) for aggression has recently been reported in the adolescent psychopathy literature (Pardini, Lochman, & Frick, 2003).

#### Summary of Findings Across the Multi-Method Approach to Subtyping

The central focus of this study was to characterize the physiological and behavioral profile of a group of clinically referred boys with high elevations on the Antisocial Process Screening Device. Lykken (1995) has written about different configurations of approach and withdrawal motivation that are believed to be associated with antisocial behavior. Findings from this study suggest that APSD severity varies monotonically with greater levels of behavioral approach and negatively with levels of withdrawal related tendencies. High APSD boys may also be differentiated from other Externalizing boys in regard to their autonomic responsivity, as evidenced in their cardiac reactivity to affective films. Frontal cortical reactivity was not consistent with an “unreactive” description of the High APSD group. On the contrary, the High APSD group showed the most pronounced changes from their baseline levels of frontal cortical activation as compared to the other groups during the sympathy film and to a lesser extent during the anger-argue film. Lastly, with respect to overt and covert antisocial behavior, caregiver ratings represented two dimensions along which High APSD group

was at the high end, the Comparison group was at the low end, and the Externalizing group somewhere in between. In contrast, child self-reports of hostile attributional bias and aggressive response generation to hypothetical social vignettes discriminated on the basis of clinical status (referred versus nonreferred), but did not place the High APSD group at the high end of these dimensions. The point-subtraction game reminds us that boys with severe conduct problems are not always the most aggressive.

#### Categorical and Dimensional Approaches.

Implicit within the subtyping approach was the expectation that these boys would present with a unique profile, a subtype. However, the term “unique profile” left as an open question whether “uniqueness” would manifest dimensionally or categorically. Indeed the categorical-dimensional distinction continues to be an ongoing debate in the psychopathology literature (Sonuga-Barke, 1998). Recent work has argued for a dimensional approach to psychopathology (Krueger & Piasecki, 2002) and comparisons across normality and psychopathology (child and adult) suggests comparable dimensional structures, at least from the perspective of contemporary assessment instruments (O'Connor, 2002). Concurrently, evidence of taxonicity has emerged in several different research areas in the adult literature (e.g., bulimia nervosa, (Gleaves, Lowe, Green, Cororve, & Williams, 2000) schizotypy, (Blanchard, Gangestad, Brown, & Horan, 2000)). In the adult psychopathy literature (Harris, Rice, & Quinsey, 1994) identified evidence of a taxon within an inmate sample. Harris et al. (1994) suggested the presence of a taxon underlying PCL-R factor II scores (antisocial history) and childhood antisocial history items. This evidence for childhood antisocial history items

points to Moffitt's designation of early-onset conduct disorder as a potential subtype present in childhood. However, with respect to the taxonicity of psychopathy, Lilienfeld (1998) notes that the failure of Harris et al. (1994) to find support for factor I (emotional detachment), the core personality features thought to underlie psychopathy, does not justify the designation of psychopathy as a taxon. Alternatively, an adult study by Blackburn and Coid (1998) concluded that psychopathy is a dimension (also within an inmate sample). Blackburn and Coid (1998) applied factor analytic techniques and correlation analyses to structured clinical psychiatric interview data and the Minnesota Multiphasic Personality Inventory, finding these measures related to the PCL-R in a continuous fashion. To some extent these diverging conclusions (taxonomic vs. dimension) may reflect differing statistical approaches and the data applied to the approach.

A recent theoretical paper by Pickles and Angold (2003) argued that the categorical-dimensional debate is misconceived because under certain circumstances, aspects of psychopathology can be thought of as categorical while other aspects manifest along continuous dimensions (see also Rutter, 2003). Pickles and Angold (2003) point out that decisions about the presence of a form of psychopathology can be relatively clear-cut or an arbitrary cut point along a dimension. At the same time practical considerations such as whether to treat or not (incarcerate or not) may warrant a categorical decision from a clinical (judicial) perspective, while interventions conceived broadly from a public health perspective may involve a widespread intervention with the aim of shifting large numbers of persons along a dimension. At the level of the

instruments used to evaluate various forms of psychopathology, categorical and dimensional distinctions are in play simultaneously. For instance, an informant first decides if a behavior is present (categorical decision) and then uses a scale to make a severity rating (dimensional). These types of distinctions and decisions affect all levels of the research from the formulation of the research question, through the selection of measurements, data collection, statistical analysis and interpretation of results.

Among the design decisions made in the present study was to classify groups of clinically referred boys with the Antisocial Process Screening Device for comparison with a nonreferred sample of boys. Analogous, although not identical approaches have been adopted by three of the major research efforts applying the psychopathy construct to characterize a subset, or subsets of children (Blair, Colledge, Murray et al., 2001; Frick et al., 2003; Lynam, 1998). In these efforts, cut points were imposed along continuous questionnaire measures. These cut points yield reifications of psychopathological entities (fledgling psychopath, Lynam, 1998; child with psychopathic tendencies, Blair, Colledge, Murray et al., 2001; callous-unemotional conduct problem youth, Frick et al., 2003) in ways analogous to those achieved through the Diagnostic and Statistical Manual for Mental Disorders. This design decision naturally flows into a discussion of subtypes and developmental trajectories without directly addressing an implicit alternative model(s), those of dimensions and cumulative risk for a particular outcome across time. The present study does not point to either approach as superior, although on balance more evidence was in line with a dimensional conception of severe conduct problems in relation to dependent measures examined in this study. However, from a purely

statistical standpoint, in many cases a dimensional approach will outperform a categorical approach, because imposing categories on a dimension reduces variance in the criterion measure of interest.

The Antisocial Process Screening Device Viewed Against Other Disruptive Behavior Dimensions.

What can be gleaned from the regression approach taken in the results presented in Appendix O is that different aspects of disruptive behavior problems and associated constructs relate differentially to the measures collected within this study in ways that reflect broadness of dimension (Antisocial Process Screening Device vs. CBCL Externalizing Scale) as well as the type of the construct under investigation (oppositional defiant symptoms vs. callous-unemotional traits). When disruptive behavior disorder measures were treated as continuous dimensions, two general patterns emerged. First, the APSD was not the criterion most strongly accounted for by predictor variables. When a subset of fear reactivity and approach related variables were used to predict the APSD total score, only the startle change variables emerged as significant predictors. By contrast, broadband externalizing behavior problems were more strongly associated with indicators of approach motivation and fear reactivity. When the criterion was broadband CBCL externalizing behavior problems, five out of five predictors, including resting frontal asymmetry, reward seeking on the point subtraction game, startle change during threat and safety, and harm avoidance accounted for unique variance within the model (significantly or as trends). Similarly, four out of five predictors (excluding harm avoidance) were associated with the oppositional defiant symptom dimension when

treated as a dimension. Regression analyses that focused specifically fear reactivity and insensitivity to punishment for predicting callous-unemotional traits indicated that the door-opening task, startle during safe and harm avoidance each accounted for unique variance. Second, oppositional defiant symptoms and callous-unemotional traits related to specific sets of independent variables in predictable ways that would have not been identified with a sole focus on a subgroup approach or by the dimension instantiated by the APSD. Two general conclusions may be drawn from the regression approach. First, findings suggest that the physiological and behavioral measures collected within this study are at least as important in accounting for the continuous variability in disruptive behavior disorder symptoms generally rather than for understanding specific aspects of the Antisocial Process Screening Device as a developmental analog to the psychopathy construct. Second, dimensions that reflect different aspects of clinically referred boys (callous-unemotional traits, oppositional defiant symptoms) with externalizing problems probably reflect different processes with somewhat different correlates.

#### Are the Boys From this Sample Comparable to Those of Other Investigators

##### Based on the Screening?

The APSD cutoff of greater than or equal to 25 is nearly comparable to Blair who has used a cutoff of greater than 25 in a several of his published studies (e.g., Blair, Colledge, & Mitchell, 2001), but he has also used a cutoff of 28 (Blair, Colledge, Murray et al., 2001). Notably, Blair has relied on teachers to complete his ratings and his samples typically include a wider age range (e.g., ages 9-17, Blair, Colledge, Murray et al., 2001). However, there are no published data comparing the validity of caregivers

versus teachers, or showing differential validity across different age groups. Comparison with the work of Frick and colleagues is somewhat more problematic because they typically combine parent and teacher information in their use of the APSD. The informant with the greater rating is used in computing a score. The only published study from Frick's lab to report descriptive information based on caregiver informant came from a large normative sample. If we compare participants from the present study to Frick's community sample, which for boys, had  $M = 10.7$ ,  $SD = 5.8$  on the APSD, per parent report, then High APSD boys in the present study, who had  $M = 26.8$  would have been 2.47  $SDs$  above the boys in this community sample (at the 99.32 percentile of this sample). Given that the community sample had 419 boys, only three boys in the same normative sample would have met the 25 or greater cutoff used within the present study. Worthy of mention, Frick et al. (2003) used this normative sample to identify a subgroup of boys with high elevations on callous-unemotional traits and conduct problems. All of the children selected in the current study would have had APSD scores sufficient to land them in this "high risk" group. Lastly, if we consider the internal consistency of the parent report APSD administered in the current study, we find it to be adequate when the clinical sample is considered alone ( $\alpha = .84$ ) or along with the comparison sample ( $\alpha = .88$ ).

#### Limitations of the Study

This study should be considered within its limitations, as an attempt to subtype conduct problem boys and also against the backdrop of the wider research priority, to understand antisocial behavior in young people.

### Reliance on Informant Ratings

First, this study relied on caregiver informant ratings as a means of identifying the groups of boys. As such, ratings on the Antisocial Process Screening Device in this study are probably an underestimate of ratings on these characteristics compared to the work of Frick and colleagues. They have typically relied on the combination of parent and teacher informants, with the higher rating from a given informant serving as the score on a given item. Reliance on one informant in this study excludes important information that often reflects a partially independent perspective on the child's behavior (Jensen et al., 1999). Use of multiple informants is an obvious means of improving upon selection procedures. There is evidence suggesting that clinicians are able to distinguish childhood dimensions that resemble the core behavioral and affective components of psychopathy (Salekin, Rogers, & Machin, 2001). Obtaining information from clinicians could be helpful in reliably evaluating the presence of the psychopathy construct in children. In addition, the APSD itself is a significant departure from the PCL-R, which relies on an interview with the identified individual, as well as a file review on the individual, all utilized by a trained clinician who makes judgments on individual items. A downward extension of the PCL-R, which uses this format, has been developed for adolescent samples of offenders (Forth & Mailloux, 2000). It is likely that other assessment formats, such as that used by Forth and Mailloux (2000) that includes the rich descriptive information available to a clinician will improve diagnostic clarity. Recently, Piatigorsky and Hinshaw (2004) showed that a Q-sort methodology that used an expert-derived psychopathy prototype could be used to assess psychopathic traits in preadolescent boys.

Interestingly, Piatigorsky and Hinshaw (2004) also found that the prototypic child with psychopathic traits presented not only with emotional callousness, but also with emotive behavior reflecting overreaction, irritability, and anger. Perhaps this work will ultimately inform developmental aspects of conceptualizing psychopathic characteristics unique to childhood, a research area in need of fuller exploration (Johnstone & Cooke, 2004).

Beyond the issue of using a single informant lays the issue of using questionnaire information as a means of classifying individuals, given the inherent problems with questionnaire ratings. As theorists have noted (Beauchaine & Waters, 2003; Davidson, Jackson, & Kalin, 2000), movement away from questionnaire based methods will be important for advancing work on classification of psychopathology. Kahneman (1999) argued convincingly that a multitude of cognitive biases enter into informant ratings. For instance, Beauchaine and Waters (2003) recently showed that manipulating participants' response sets can affect whether or not a taxon is uncovered within a data set. They concluded that investigators using taxometric procedures should probably not rely solely on informant ratings for classification purposes.

#### Age Range of the Sample

The age range of 8-12 years used within this sample may be viewed as a study limitation in that the findings may generalize more or less to any specific age within the sample. However, the age range used within this study is more conservative than most of the studies that have used the APSD (e.g., Frick and colleagues, ages 6-13; Barry et al., 2000; Barry, Fleming, Manwell, & Copeland, 1997; Frick et al., 1994; Blair and colleagues, ages 9-17; Blair, Colledge, Murray et al., 2001). Also, child age did not

figure prominently in any of the study findings. There were no statistically significant age differences among the High APSD group, Externalizing group and Comparison group. In addition, the APSD was unrelated to child age across the total sample ( $r(101) = -.06$ ) or the clinical sample ( $r(77) = -.04$ ).

#### Focus on Boys with Conduct Problems

The lack of studies on conduct problems in girls continues to make it a research priority, both in terms of the relative dearth of studies that have included girls and the adoption of the methodologies and models from the literature on boys for studying girls (Keenan et al., 1999; Silverthorn & Frick, 1999). The focus on boys with conduct problems within this study limits the generalizability of the findings only to boys. Given the paucity of work on girls with conduct problems, and the increased priority given that the gender gap with respect to delinquency may be narrowing, mainly due to an increase in girl's delinquency (Farrington, 1987; Office of Juvenile Justice and Delinquent Prevention (OJJDP)), completion of an analogous study as that reported among clinically referred females would be an important contribution to the literature.

#### Exclusion of Environmental Variables

This study focused on endogenous factors in its approach to subtyping boys with conduct problems. Referral status and socioeconomic (SES) status were the only exogenous factors including in the study, and SES was treated as a nuisance variable. Thus, a clear limitation of this study is that it does not address the influences of environment and variables that reflect the transaction of person and environment. There exists a veritable laundry list of environmental variables including parenting practices

(harsh coercive parenting, parental monitoring), peer relationships, family climate, neighborhood characteristics, cultural characteristics and cohort characteristics, each forming a complex network of influence on antisocial behavior. In fact, a recent literature review by Raine (2002b) concluded that the antisocial-biology relationship is often moderated by environmental (social) variables such that these relationships are strongest among individuals from benign home backgrounds.

While beyond the scope of this study, the role of environmental influences in shaping and maintaining patterns of emotional functioning among children with disruptive behavior disorders is a clear research priority. Particularly, influences such as exposure to adverse rearing conditions and quality of parent-child relationships. Recent research suggests that emotional callousness may moderate the relationship between ineffective parenting and conduct problems, such that ineffective parenting is positively associated with conduct problems, but only for children with low to moderate callous-unemotional traits (Wootton et al., 1997). Children with high levels of emotional callousness are believed to be on a different developmental trajectory than their low callous counterparts that is not as strongly related to ineffective parenting. At the same time, work in the developmental literature following an analogous line suggests that for the relatively fearless child, the attachment relationship with a primary caregiver mediates the development of conscience (Fowles & Kochanska, 2000). And, other work implicates the interaction of genotype and environment (child abuse) in the cascade towards severe antisocial behavior (Caspi et al., 2002). Specifically, individuals with the genetic polymorphism conferring lower levels of the neurotransmitter-metabolizing

enzyme monoamine oxidase A (MAOA) who had a childhood history of maltreatment were most likely to present with severe antisocial behavior at age 26 (Caspi et al., 2002).

### Conclusions

A battery of physiological, behavioral and informant measures were used to operationalize the domains of fear distress reactivity, reward seeking and approach motivation, physiological reactivity to affective films, and markers of antisocial behavior. Screening procedures isolated a group of clinically referred boys with severe conduct problems who were compared to clinically referred boys with less severe conduct problems and comparison boys.

In light of this study's limitations, the pattern of results suggest that boys with extreme scores on the Antisocial Process Screening Device present with the most severe patterns of antisocial behavior (overt and covert) among the clinically referred youth. The physiological and behavioral measures collected herein reflect a complex montage. Both resting frontal asymmetry (left frontal activation) and reward seeking during the PSG (time 1) are consistent greater approach motivational tendencies among the High APSD group. Resting frontal asymmetry was weakly related to APSD severity but subsequent analyses from a dimensional perspective suggest that other indicators of disruptive behavior problems (externalizing symptoms, ODD symptoms) may be more strongly associated with this physiological marker. Fear reactivity was not a robust marker across the indicators selected for differentiation of the High APSD group. Instead, ratings of harm avoidance were characteristic of clinically referred boys with externalizing problems generally. Likewise, diminished startle early during threat (4 s)

suggested a trend. Measures of physiological reactivity to affective films suggested that High APSD boys are less autonomically reactive than the selected Externalizing group, but not less reactive than boys recruited from the community. On the other hand, changes in cortical asymmetry across the frontal and parietal regions suggest that High APSD boys were the most reactive. In depth analysis of the airpuff fear potentiated startle paradigm suggest this measure taps more than just fear reactivity. In fact, the exaggerated startle observed across the threat condition may actually be a marker of affective regulatory deficits seen in oppositional defiant disorder. Emotional callousness and diminished emotional responsivity among youth with severe conduct problems continues to be an area of focus in the research literature. That exaggerated startle during late threat emerged as a marker specific to the High APSD group, suggests that this marker might provide a window into a different regulatory process associated with severe conduct problems, potentially related to explosive and violent behavior.

The differences between the subtyping approach adopted in this study and the post hoc dimensional approach is more apparent than real, because the subgroups are actually at different points along the dimension of the APSD. In the absence of the larger samples required for taxometric analyses, the subtyping approach employed in this study may serve as proxy for characterizing the behavioral and physiological profile of boys with severe conduct problems as indexed by high elevations on the APSD. The data herein suggest that a dimensional perspective can account for the data at least as well as the subtyping approach, particularly because of the statistical advantage gained by using the a larger sample and the full variability across dependent measures such as the APSD.

Moreover, the dimensional approach facilitates comparison of different criterion measures.

This study drew on the psychopathy construct in identifying boys with severe conduct problems. However it cannot address the implicit question that underlies investigators' attempts to apply the psychopathy construct to children. Specifically, can these children be viewed as psychopathic? Implicit within the term "psychopath" is the assumption of a relatively stable constellation of personality characteristics in a mature person. While it is true that children and adults are similar in many ways, almost no one would argue that children are adults. From this perspective, the term "psychopath" is probably best reserved for adults, particularly given its strong negative connotations.

Table 1

Descriptive Characteristics (Means, Standard Deviations, Percentages) for Demographic Variables and Screening Measures

Group	Age	Ethnicity	IQ	SES	Internalizing	Externalizing	APSD Total
High APSD (n=20)	10.58 (1.58)	Cau. 15% Af. Am. 80% Hisp. 0% Other 5%	96.15 (12.65)	32.10 (11.24)	70.25 (9.85)	76.95 (7.04)	26.80 (1.54)
Externalizing (n=44)	10.47 (1.15)	Cau. 25% Af. Am. 63% Hisp. 7% Other 5%	98.48 (13.93)	39.50 (12.77)	63.45 (10.66)	67.80 (6.44)	14.24 (4.12)
Comparison (n=24)	10.69 (1.31)	Cau. 29% Af. Am. 63% Hisp. 4% Other 4%	111.92 (14.7)	48.07 (8.25)	45.25 (6.94)	44.08 (7.98)	7.68 (3.22)

Table 2

Family Characteristics: Family Make-up and Custody of Child

Family Make-up:	Number of Adults in the Home		Number of Children in the Home				
High APSD	2.10 (.91)		3.25 (1.16)				
Externalizing	1.83 (.83)		2.29 (1.38)				
Comparison	1.79 (.78)		2.47 (1.29)				

Caretaker with Custody of the child	Biological Parents	Adoptive Parents	Biological Mother Only	Biological Father Only	Other Relative	Court / Child Welfare Services	Other Primary Caretaker
High APSD	4 (20%)	-	12 (60%)	-	4 (20%)	-	-
Externalizing	13 (30%)	2 (4.5%)	24 (54%)	-	3 (7%)	-	2 (4.5%)
Comparison	16 (66.6%)	-	8 (33.3%)	-	-	-	-

Table 3

## Family Characteristics: Child's Relationship to Mother and Father Figure by Group

<u>Mother Figure:</u>							
	Biological		Adoptive		Foster		Grandmother
High APSD	16 (80%)		-		1 (5%)		3 (15%)
Externalizing	38 (48.7%)		2 (4.5%)		1 (2.3%)		3 (6.8%)
Comparison	24 (100%)		-		-		-
<u>Father Figure:</u>							
	Biological	Step	Adoptive	Foster	Grandfather	Mother's boyfriend	No Father Figure
High APSD	11 (55%)	-	1 (5%)	1 (5%)	1 (5%)	3 (15%)	3 (15%)
Externalizing	25 (56%)	7 (16%)	-	2 (5%)	-	3 (7%)	7 (16%)
Comparison	22 (92%)	-	-	-	-	1 (4%)	1 (4%)

Table 4

Family Characteristics: Mother's Current Marital Status and Relationship to Child's Biological Father by Group

	<u>Current Marital Status:</u>				
	Married	Separated	Divorced	Widowed	Single
High APSD	6 (30%)	3 (15%)	4 (20%)	-	7 (35%)
Externalizing	16 (36%)	2 (5%)	8 (18%)	2 (5%)	16 (36%)
Comparison	16 (67%)	1 (4%)	2 (8%)	-	5 (21%)
<u>Marital Relationship with Child's Father:</u>					
	Married	Separated	Divorced	Widowed	Never Married
High APSD	4 (20%)	2 (10%)	-	-	14 (70%)
Externalizing	8 (18%)	1 (2 %)	8 (18%)	1 (2 %)	26 (59%)
Comparison	15 (63%)	1 (4%)	2 (8%)	-	6 (25%)

Table 5

Means and Standard Deviations for Clinical and Comparison Groups on the Antisocial Process Screening Device Subscales

	Callous- unemotional	Impulsive Conduct Problems	Narcissism
Hi APSD (n = 20)	7.05 (1.64)	13.85 (1.60)	5.90 (1.02)
Externalizin g (n = 44)	3.41 (1.90)	7.95 (2.74)	2.88 (1.47)
Comparison (n = 24)	1.54 (1.44)	4.44 (2.12)	1.70 (1.47)
Total Sample (n = 101)	4.03 (2.59)	8.70 (3.96)	3.47 (2.04)

Table 6

Diagnoses and Symptoms (Means and Standard Deviations) Met in the Past Month for DSM-IV Disruptive Behavior Disorders

Group	Diagnoses (Past Month)			Symptoms (Past Month)		
	ODD	CD	ADHD	ODD	CD	ADHD
Hi APSD (n = 20)	19	14	14	6.6 (0.93)	3.35 (2.87)	13.9 (2.10)
Externalizing (n = 44)	19	7	25	3.47 (2.32)	1.00 (3.30)	9.48 (4.29)
Comparison (n = 24)	0	0	0	0.13 (2.70)	0.25 (2.26)	0.96 (3.24)

ODD = oppositional defiant disorder, CD = conduct disorder, ADHD = Attention-Deficit Hyperactivity Disorder (any type)

Table 7

Correlations Among Child IQ, Family Socioeconomic Status and Questionnaire Dependent Variables

	Arguing/Fighting (IAB)	Covert Antisocial Behavior (IAB)	Harm Avoidance	Thrill and Adventure Seeking	Vignette Hostile Attributional Bias (HIWC)	Vignette Aggressive Responding (HIWC)
WISCIQ	-0.25**	-0.28**	0.09	0.10	-0.25**	-0.28**
HOLHED4F	-0.23*	-0.28**	0.19	0.11	-0.06	-0.19
n = 101	*p < .05, **p < .01					

Table 8

Means and Standard Deviations for Startle Probe Magnitude During Safe and Threat Signals for Early and Late Presentation

Group	safe 4.0-s	threat 4.0-s	safe 7.0-s	threat 7.0-s	Intertrial Interval
Hi APSD (n = 15)	47.45 (3.45)	46.22 (2.45)	52.72 (3.42)	57.42 (4.37)	48.10 (2.52)
Externalizing (n = 40)	48.32 (3.76)	45.70 (3.44)	52.57 (5.63)	54.65 (5.19)	49.35 (3.18)
Comparison (n = 23)	50.44 (4.43)	45.17 (2.61)	54.80 (4.93)	53.00 (3.67)	48.29 (2.12)
Total Sample (n = 89)	48.84 (3.94)	46.10 (3.47)	52.93 (5.18)	54.34 (4.75)	48.89 (2.79)

Table 9

Means and Standard Deviations for Startle Probes Amplitude During Safe and Threat Signals for Early and Late Presentation

Group	safe 4.0-s	threat 4.0-s	safe 7.0-s	threat 7.0-s	Intertrial Interval
Hi APSD (n = 15)	48.16 (3.37)	51.22 (3.56)	45.50 (5.15)	57.08 (5.74)	47.86 (3.37)
Externalizing (n = 40)	50.23 (5.74)	52.26 (5.30)	44.87 (6.15)	53.38 (5.23)	49.03 (3.69)
Comparison (n = 23)	50.15 (6.08)	54.22 (5.58)	45.31 (3.81)	52.25 (4.23)	48.58 (2.85)
Total Sample (n = 89)	49.98 (5.39)	52.36 (5.29)	45.58 (6.13)	55.56 (5.16)	48.76 (3.31)

Table 10

Multiple Regression with Change Threat and Change Safe Predicting APSD Total Score

		$\beta$	$R^2$	$t$	$p$	$R^2\Delta$
	Model		.13			
1.	Change threat	-.21		-2.44*	.02	
	Change safe	-.25		-2.23*	.03	
	Model					
2.	Change threat	-.21		-1.91†	.06	
	Change safe	-.245		-2.36*	.02	
	Interaction Change threat x Change safe	-.10		-.86	.39	.00

† $p < .10$ ; \*  $p < .05$

Table 11

Summary of Multiple Regression Analyses for APSD Factors Predicting Startle Change During Safety: Backward Elimination and Interaction Effects

		$\beta$	$R^2$	t	p	$R^2\Delta$
Model 1	APSD I/CP	-.81	.07	-.81	.48	
	APSD NAR	-.07		-.50	.62	
	APSD CU	-.10		-.10	.48	
Model 2	APSD I/CP		.06	-1.28	.21	-.00
	APSD CU	-.11		-.84	.40	
Model 3	APSD I/CP	-.23	.06	-2.24	.03*	-.01
Model 4	Full Model with Interaction Effects					
Block 1	CU	0.43	.07	1.15	0.26	
	I/CP	-0.43		-1.38	0.17	
	NA	-0.35		-0.96	0.34	
Block 2	CU x ICP	-0.17	.11	-0.30	0.77	.04
	NA x I/CP	0.94		1.73	0.09	
	CU x NA	-0.69		-1.36	0.18	

\*p < .05

Table 12

Summary of Multiple Regression Analyses for APSD Factors Predicting Startle Change During Threat: Backward Elimination and Interaction Effects

		$\beta$	$R^2$	t	p	$R^2\Delta$
Model 1	APSD I/CP	-.36	.11	-2.36*	.02	
	APSD NAR	.15		1.02	.31	
	APSD CU	-.08		-.57	.57	
Model 2	APSD I/CP	-.39	.10	-2.82**	.01	.00
	APSD NAR	.13		.93	.36	
Model 3	APSD I/CP	-.31	.09	-2.98**	.04	-.01
Model 4	Full Model with Interaction Effects					
Block 1	CU	-0.45	.11	-1.22	0.23	
	I/CP	-0.58		-1.87†	0.07	
	NA	0.18		0.51	0.61	
Block 2	CU x ICP	0.58	.12	1.02	0.31	.01
	NA x I/CP	-0.05		-0.10	0.92	
	CU x NA	-0.01		-0.01	0.99	

†p < .10, \*p < .05, \*\*p < .01

Table 13

Summary of Multiple Regression Analyses for DSM Disruptive Behavior Disorder Symptoms  
Predicting Startle Change During Safety: Backward Elimination and Interaction Effects

	Backward Elimination	$\beta$	$R^2$	t	p	$R^2\Delta$
Model 1	ADHD	-0.43	.12	-2.85**	0.01	
	CD	0.07		0.45	0.65	
	ODD	0.07		0.42	0.68	
Model 2	ADHD	-0.40	.12	-3.17**	0.00	.00
	ODD	0.09		0.75	0.46	
Model 3	ADHD	-0.34	.12	-3.39**	0.00	.00
Full Model with Interaction Effects						
Model 4						
Block 1	ADHD	0.20	.12	0.50	0.62	
	CD	0.12		0.23	0.82	
	ODD	0.21		0.65	0.52	
Block 2	CD x ODD	0.47	.17	0.69	0.49	.05
	CD x ADHD	-0.48		-0.84	0.40	
	ADHD x ODD	-0.77		-1.16	0.25	

\*\*p < .01

Table 14

Summary of Multiple Regression Analyses for DSM Disruptive Behavior Disorder Symptoms  
Predicting Startle Change During Threat: Backward Elimination and Interaction Effects

	Backward Elimination	$\beta$	$R^2$	t	p	$R^2\Delta$
Model 1	ADHD	0.04	.11	0.27	0.79	
	CD	-0.02		-0.13	0.90	
	ODD	-0.34		-1.98*	0.05	
Model 2	ADHD	0.04	.11	0.25	0.80	.00
	ODD	-0.35		-2.35*	0.02	
Model 3	ODD	-0.33	.11	-3.21**	0.00	.00
Model 4	Full Model with Interaction Effects					
Block 1	ADHD	0.13	.11	0.32	0.75	
	CD	-0.24		-0.46	0.65	
	ODD	-0.33		-0.97	0.34	
Block 2	CD x ODD	0.25	.11	0.35	0.73	.00
	CD x ADHD	0.05		0.08	0.94	
	ODD x ADHD	-0.17		-0.25	0.80	

†p < .10, \*p < .05, \*\*p < .01

Table 15

Means and Standard Deviations for Trait Fearlessness and Trait Fearfulness Measures

Group	Thrill and Adventure Seeking (Trait Fearlessness)	Harm Avoidance (Trait Fearfulness)
Hi APSD (n = 20)	19.68 (3.10)	17.06 (4.27)
Externalizing (n = 44)	19.09 (3.14)	18.02 (4.35)
Comparison (n = 24)	19.67 (2.73)	19.42 (3.79)
Total Sample (n = 101)	19.33 (3.05)	17.76 (4.34)

Table 16

Multiple Regression with Thrill and Adventure Seeking and Harm Avoidance Predicting APSD Total Score

	$\beta$	$R^2$	$t$	$p$	$R^2\Delta$
Model		.06			
1. Thrill and Adventure Seeking (TAS)	-.08		-.78	.44	
Harm Avoidance (HA)	-.26		-2.60**	.01	
Model					
2. Thrill and Adventure Seeking (TAS)	-.13		-.31	.76	.00
Harm Avoidance (HA)	-.34		-.53	.14	
Interaction TAS x HA	.09		.13	.90	

\*\* $p < .01$

Table 17

Means and Standard Deviations for Reward Seeking Dependent Measures

Group	Door Opening Task		Point Subtraction Game			
	Sample Size	Doors Opened	Sample Size	Low Provocation Rewards	High Provocation Rewards	Total Rewards
Hi APSD	20	67.85 (22.34)	19	14.37 (4.32)	12.89 (3.14)	27.26 (7.22)
Externalizing	44	67.14 (29.84)	40	11.33 (4.53)	11.47 (4.27)	22.95 (8.02)
Comparison	24	61.38 (31.00)	24	13.79 (3.5)	12 (2.43)	25.79 (5.18)
Total Sample	101	65.14 (28.85)	94	12.68 (4.1)	11.7 (3.67)	24.38 (7.1)

Table 18

Number and Percentage of Right-handed Boys by Group

Group	Number Right-handed	Percentage Right-handed
Hi APSD (n = 20)	18	90.0%
Externalizing (n = 44)	38	86.4%
Comparison (n = 24)	22	91.6%

Table 19

Means and Standard Deviations for EEG Asymmetry of 7-12 Hz (Alpha Band) at Frontal and Parietal Sites (Right-Left) During Eyes Closed

Group	Frontal (ln right – ln left)	Parietal (ln right – ln left)
Hi APSD (n = 20)	0.083 (0.150)	-0.197 (0.355)
Externalizing (n = 43)	0.054 (0.186)	-0.065 (0.429)
Comparison (n = 24)	0.003 (0.154)	0.037 (0.350)
Total Sample (n = 100)	0.051 (0.166)	-0.065 (0.384)

Table 20

Means and Standard Deviations for IBI Change From Baseline to Film Viewing

Group	Sympathy Film	Anger/Argue Film	Anger/Push Film
Hi APSD (n = 18)	0.020 (0.028)	0.009 (0.041)	0.015 (0.045)
Externalizing (n = 43)	0.029 (0.036)	0.010 (0.043)	0.029 (0.040)
Comparison (n = 23)	0.016 (0.043)	0.016 (0.051)	0.014 (0.041)
Total Sample (n = 94)	0.024 (0.038)	0.013 (0.045)	0.024 (0.042)

Table 21

Means and Standard Deviations for Affect Ratings to a Sympathy Film (Nadia) by Group

Group	Interested	Sad	Happy	Angry	Upset	Scared
High APSD (n=19)	3.16 (0.96)	2.21 (1.08)	1.74 (0.99)	2.16 (1.30)	1.95 (1.13)	1.89 (1.15)
Externalizing (n=43)	2.98 (.91)	2.40 (1.00)	1.98 (1.01)	1.60 (.79)	1.95 (1.11)	1.44 (.70)
Comparison (n=24)	2.67 (1.05)	3.00 (1.18)	1.71 (0.81)	1.63 (1.01)	1.83 (1.01)	1.38 (0.77)
Total Sample	2.93 (.97)	2.52 (1.10)	1.85 (.95)	1.73 (.99)	1.92 (1.08)	1.52 (.85)

Table 22

Means and Standard Deviations for Affect Ratings to an Anger-Argue Film by Group

Group	Interested	Sad	Happy	Angry	Upset	Scared
High APSD (n=19)	2.32 (1.11)	1.16 (0.38)	1.37 (0.68)	1.47 (0.91)	1.42 (0.84)	1.16 (0.69)
Externalizing (n=43)	2.44 (1.20)	1.81 (1.03)	1.44 (.93)	2.02 (1.10)	1.72 (.96)	1.40 (.88)
Comparison (n=24)	2.63 (1.25)	1.62 (1.17)	1.33 (0.48)	1.62 (1.14)	1.58 (0.83)	1.42 (0.93)
Total Sample	2.47 (1.19)	1.62 (.97)	1.40 (.77)	1.79 (1.09)	1.62 (.90)	1.35 (.85)

Table 23

Means and Standard Deviations for Affect Ratings to an Anger/Pushing Film by Group

Group	Interested	Sad	Happy	Angry	Upset	Scared
High APSD (n=19)	2.47 (1.12)	1.58 (0.90)	1.63 (1.01)	1.84 (1.12)	1.95 (1.13)	1.11 (0.32)
Externalizing (n=43)	2.52 (1.25)	1.81 (1.04)	1.50 (.94)	2.02 (1.14)	1.74 (.94)	1.52 (1.04)
Comparison (n=24)	2.46 (1.29)	1.62 (0.97)	1.29 (0.62)	2.00 (1.32)	1.79 (1.06)	1.25 (0.44)
Total Sample	2.49 (1.22)	1.71 (.99)	1.47 (.88)	1.98 (1.18)	1.80 (1.01)	1.35 (.80)

Table 24

One-way ANOVA Results for Affect Ratings of Films  
Comparing Study Groups

	Rating	F	p
Nadia	Interested	1.48	.23
	Sad	3.49	.04*
	Happy	.778	.46
	Angry	2.28	.11
	Upset	.10	.90
	Scared	2.46	.09
Anger/Argue	Interested	.37	.69
	Sad	3.00	.06†
	Happy	.16	.85
	Angry	2.13	.13
	Upset	.76	.47
	Scared	.61	.54
Anger/Push	Interested	.03	.98
	Sad	.46	.63
	Happy	.83	.44
	Angry	.16	.85
	Upset	.28	.76
	Scared	2.14	.13

†p < .10, \*p < .05

All tests evaluated at F (2, 83)

Table 25

Means and Standard Deviations for Hostile Attributional Bias, Aggressive Responding, Arguing and Fighting and Covert Antisocial Behavior

Group	Arguing and Fighting (IAB)	Covert Antisocial Behavior (IAB)	Vignette Hostile Attributional Bias (HIWC)	Vignette Aggressive Response Generation (HIWC)
Hi APSD (n = 20)	100.70 (14.75)	30.45 (13.30)	13.00 (1.86)	22.05 (6.48)
Externalizing (n = 44)	69.39 (19.86)	21.45 (13.13)	12.59 (1.81)	20.05 (5.78)
Comparison (n = 24)	29.83 (12.62)	11.54 (2.98)	11.71 (2.27)	17.08 (4.00)
Total Sample (n = 101)	68.41 (29.90)	21.58 (12.93)	12.55 (1.95)	20.22 (5.79)

Table 26

Means and Standard Deviations for Aggressive and Self-Protective Responding on the Point-Subtraction Game

Group	Sample Size	Low Provocation Aggressive Responding	High Provocation Aggressive Responding	Total Aggressive Responding	Low Provocation Self-Protective Responding	High Provocation Self-Protective Responding	Total Self-Protective Responding
Hi APSD	19	4.53 (3.45)	4.26 (4.36)	8.79 (7.57)	6.32 (4.41)	7.58 (5.94)	13.89 (9.62)
Externalizing	39	6.39 (4.49)	5.23 (5.12)	11.28 (8.78)	6.49 (3.98)	8.33 (5.40)	15.15 (8.54)
Comparison	24	5.75 (2.95)	5.75 (3.57)	11.5 (6.11)	8.00 (4.00)	9.62 (4.05)	17.63 (7.45)
Total Sample	94	5.34 (3.67)	5.05 (4.79)	10.39 (7.69)	7.13 (3.98)	8.55 (5.21)	15.68 (8.51)

Table 27

Summary of Multiple Regression Analyses for Measures of Fearful Reactivity and Reward Seeking /Approach-withdrawal Predicting APSD Total Score

	$\beta$	$R^2$	$t$	$p$	$R^2\Delta$
Model 1		.17			
Harm Avoidance	-.14		-1.27	.21	
Reward Seeking (PSAG)	-.03		-.31	.76	
Startle Change Threat	-.20		-1.86†	.07	
Startle Change Safe	-.24		-2.20*	.03	
Resting Frontal EEG Asymmetry	.15		1.42	.16	
Final Model		.12			
Startle Change Threat	-.25			-2.39*	-.05
Startle Change Safe	-.23			-2.22*	

† $p < .10$ , \* $p < .05$ , (note: interaction term for this model is presented in Table 5)

Table 28  
Summary of Multiple Regression Analyses for Measures of Fearful Reactivity and  
 Reward Seeking /Approach-withdrawal Predicting CBCL Externalizing t-score

		$\beta$	$R^2$	$t$	$P$	$R^2\Delta$
Model 1			.25			
	Harm Avoidance	-.24		-2.42*	.02	
	Startle Change Threat	-.20		-1.94†	.06	
	Startle Change Safe	-.21		-2.05*	.04	
	Reward Seeking (PSAG)	-.19		-1.92†	.06	
	Resting Frontal EEG Asymmetry	.21		2.06*	.04	
Model 2	Resting Frontal EEG Asymmetry	-.35		-.67	.51	
	Reward Seeking (PSAG)	-1.09		-1.96†	.05	
	Startle Change Threat	-.46		-.64	.52	
	Startle Change Safe	.37		.73	.47	
	Harm Avoidance	-.80		-1.82†	.07	
	Harm Avoidance x Change Threat	.27		.52	.61	
	Harm Avoidance x PSAG 2	1.07		1.46	.15	
	Frontal Asymmetry x Harm Avoidance	-.50		-.83	.41	
	Harm Avoidance x Change Safe	-.30		-.73	.47	
	Frontal Asymmetry x Change Threat	.18		1.43	.15	
	Frontal Asymmetry x Change Safe	-.31		-1.84†	.07	

Table 28 Continued

Change Threat x PSAG 2	.15	.30	.77
Change Safe x PSAG 2	-.21	-.49	.63
Frontal Asymmetry x PSAG 2	.55	1.72†	.09
Change Threat x Change Safe	-.21	-1.50	.14

---

† $p < .10$ , \* $p < .05$ , \*\* $p < .01$

Table 29

Summary of Multiple Regression Analyses for Measures of Fearful Reactivity  
Predicting Oppositional Defiant Symptoms: Backward Elimination and Interaction  
Effects

	$\beta$	$R^2$	$t$	$p$	$R^2\Delta$
Model 1		.23			
Reward Seeking (PSAG)	.23		2.33*	.02	
Resting Frontal EEG Asymmetry	-.19		-1.88	.06	
Harm Avoidance	-.15		-1.49	.14	
Startle Change Threat	-.23		-2.31*	.02	
Startle Change Safe	-.21		-2.08*	.04	
Model 2		.21			.02
Reward Seeking (PSAG)	-.21		-2.03*	.04	
Resting Frontal EEG Asymmetry	.20		1.90†	.06	
Startle Change Threat	-.29		-2.80**	.01	
Startle Change Safe	-.22		-2.18*	.03	
Model 3					
Full Model with Interaction Effects					
Resting Frontal EEG Asymmetry	-.54		-1.41	.16	
Reward Seeking (PSAG)	-.33		-2.76**	.01	
Startle Change Threat	.11		.24	.81	
Startle Change Safe	-.32		-.94	.35	

Table 29 Continued

Frontal Asymmetry x PSAG 2	.59	1.76†	.08
Change Safe x Change Threat	-.06	-.51	.61
Change Threat x PSAG 2	-.21	-.50	.62
Change Safe x PSAG 2	.06	.18	.86
Frontal Asymmetry x Change Threat	.12	1.08	.29
Frontal Asymmetry x Change Safe	-.06	-.45	.65

† $p < .10$ , \* $p < .05$ , \*\* $p < .01$

Table 30

Summary of Multiple Regression Analyses for Measures of Fearful Reactivity Predicting Callous-Unemotional Traits: Backward Elimination and Interaction Effects

		$\beta$	$R^2$	$t$	$p$	$R^2\Delta$
Model						
1			.20			
	Harm Avoidance	-.16		-1.63	.11	
	Door Opening Task	.30		3.10**	.01	
	Startle Change Threat	-.12		-1.21	.23	
	Startle Change Safe	-.21		-2.14*	.04	
Model						
2	Harm Avoidance	-.17	.19	-1.74†	.08	-.01
	Door Opening Task	.32		3.28**	.01	
	Startle Change Safe	-.22		-2.25*	.03	
Model	Full Model with Interaction Effects		.19			
Block	Harm Avoidance (HA)	-.29		-1.09	.28	
2	Door Opening Task	.15		.36	.72	
	Startle Change Safe	.22		-.08	-.17	
Block	Doors x Startle Change Safe	.02		.05	.96	
2	Startle Change Safe x HA	-.19		-.70	.49	
	Doors x HA	.24		.51	.61	

\* $p < .05$ , \*\* $p < .01$

Table 31

Summary of Findings Across Group Comparisons: High APSD Group vs. Externalizing Group vs. Comparison Group

<u>Domain and Measures</u>	<u>Group Differences</u>
<b>Dependent Measures Assessing Fear Related Processes</b>	
<u>Resting Heart Rate</u>	ns
<u>Fear Potentiated Startle</u>	
Threat	(4 s) High APSD, Externalizing < Comparison ( <i>trend</i> )
Safety	(7 s) High APSD > (Externalizing, Comparison)
<u>Self-reported Fear</u>	
Thrill and Adventure Seeking	(4 s) Comparison > (High APSD, Externalizing)
Harm Avoidance	Comparison > (High APSD, Externalizing) ( <i>trend</i> )
<b>Dependent Measures Assessing Reward Seeking and Approach-Withdrawal</b>	
<u>Door Opening Task</u>	ns
<u>Point Subtraction Game</u> (Reward Seeking)	(High APSD, Comparison) > Externalizing
Resting Frontal EEG Asymmetry (greater left-frontal activation)	High APSD > Externalizing > Comparison
<b>Physiological Reactivity to Affective Films</b>	
Cardiac Reactivity	Externalizing > (High APSD, Comparison)
<b>Regional EEG Activity</b>	
Sympathy Film	High APSD group R > L frontal change, no change for the Externalizing or Comparison groups
Anger-Argue Film	High APSD group R > L frontal change, R < L parietal change; Externalizing, Comparison no significant asymmetry changes.
Anger-Pushing Film	ns

Table 31 Continued

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<b>Markers of Antisocial Behavior and Related Processes</b>	
<b>Interview for Antisocial Behavior</b>	
Covert Antisocial Behavior	High APSD > Externalizing > Comparison
Overt Antisocial Behavior	High APSD > Externalizing > Comparison
<b>Point Subtraction Game</b>	
Aggressive Behavior	ns
Self-Protective Behavior	ns
<b>Hypothetical Social Vignettes</b>	
Hostile Attributional Bias	High APSD, Externalizing > Comparison
Aggressive Response Generation	High APSD, Externalizing > Comparison

---

Figure 1

Mean (SD) Heart Inter-beat Interval Collected During Eyes Closed by Group

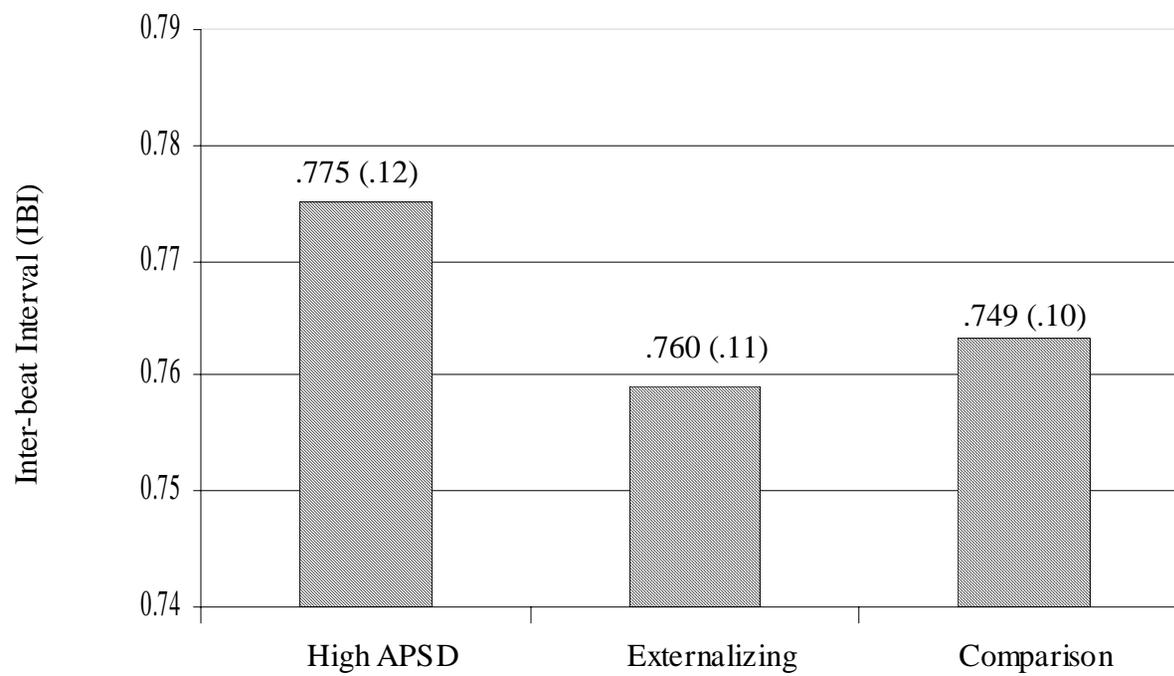


Figure 2

Mean EMG Startle Magnitude for Safe and Threat Conditions and Early and Late Probe Times Collapsed Across Groups

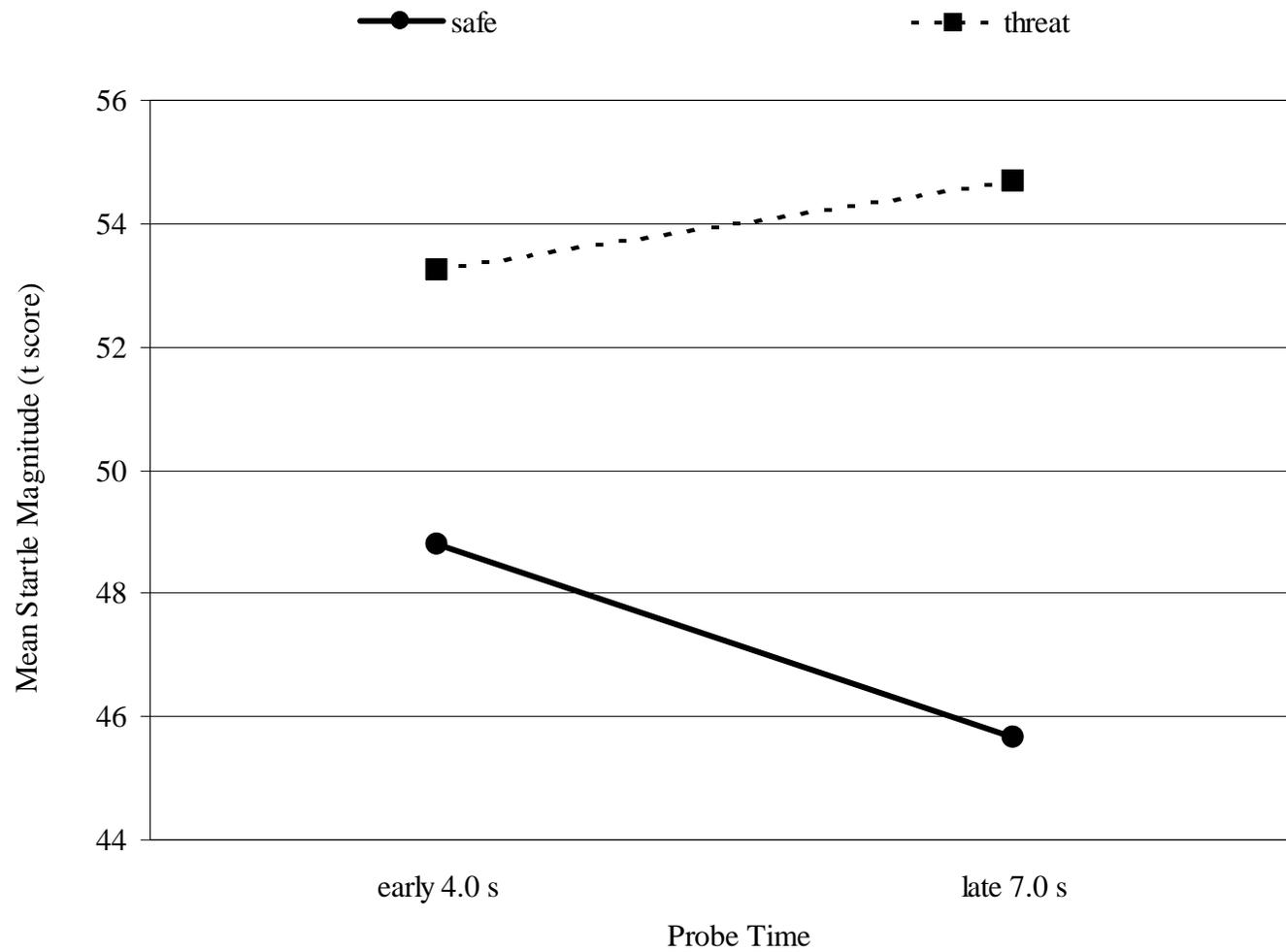


Figure 3

Mean EMG Startle Magnitude for Safe and Threat Conditions and Early and Late Probe Times by Group

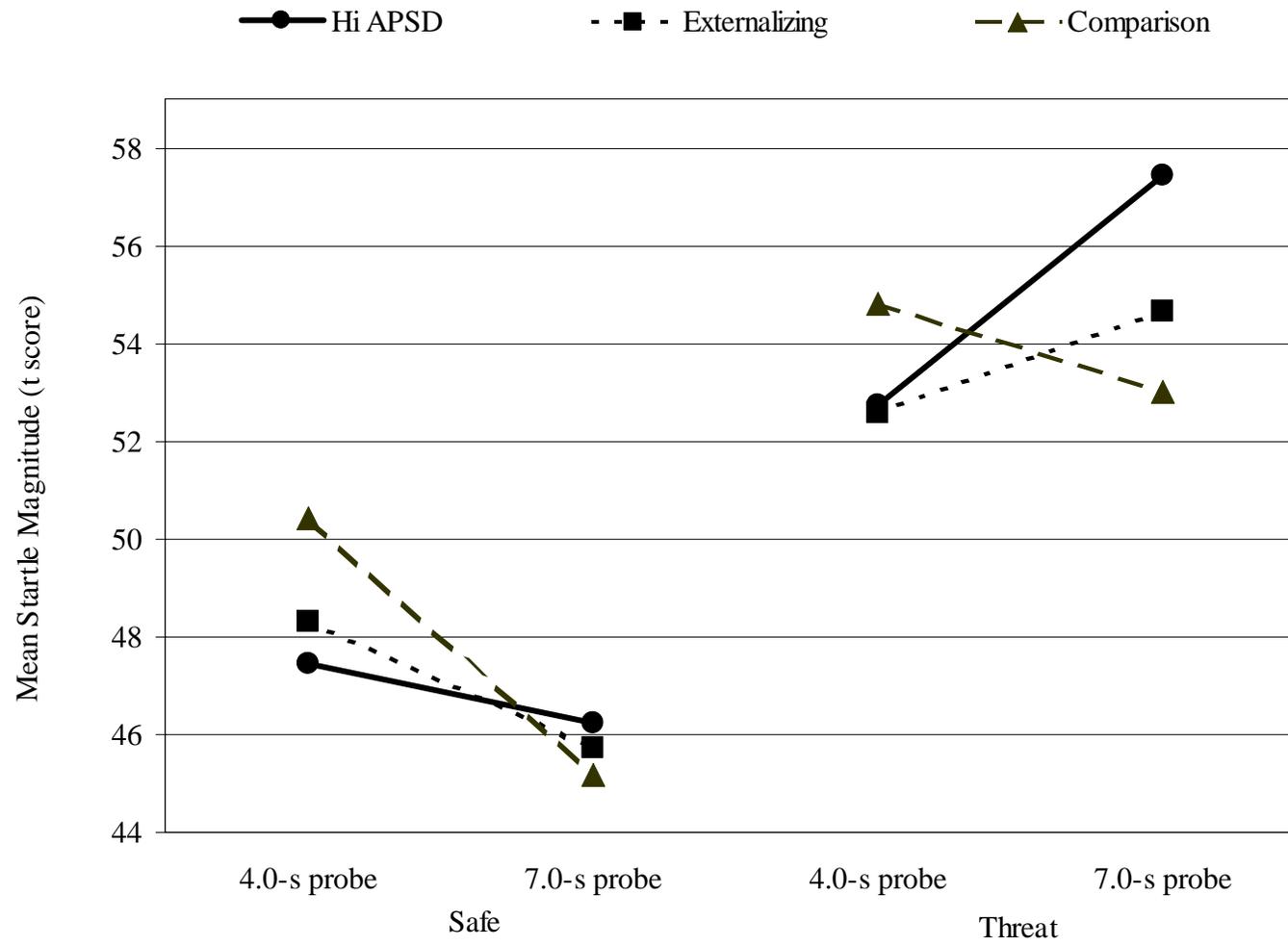


Figure 4

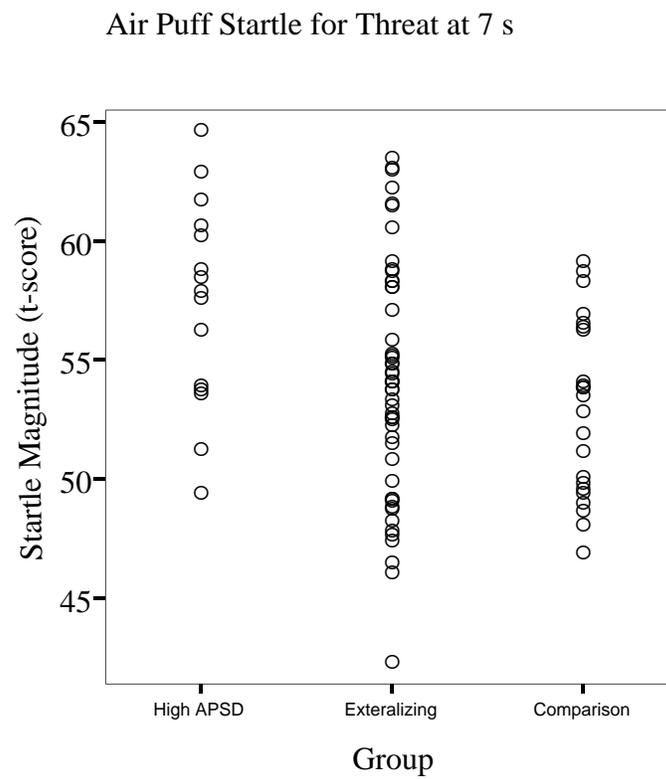
Distribution of Startle Scores at 7 s During Threat

Figure 5

Mean EMG Startle Amplitude for Safe and Threat Conditions and Early and Late Probe Times by Group

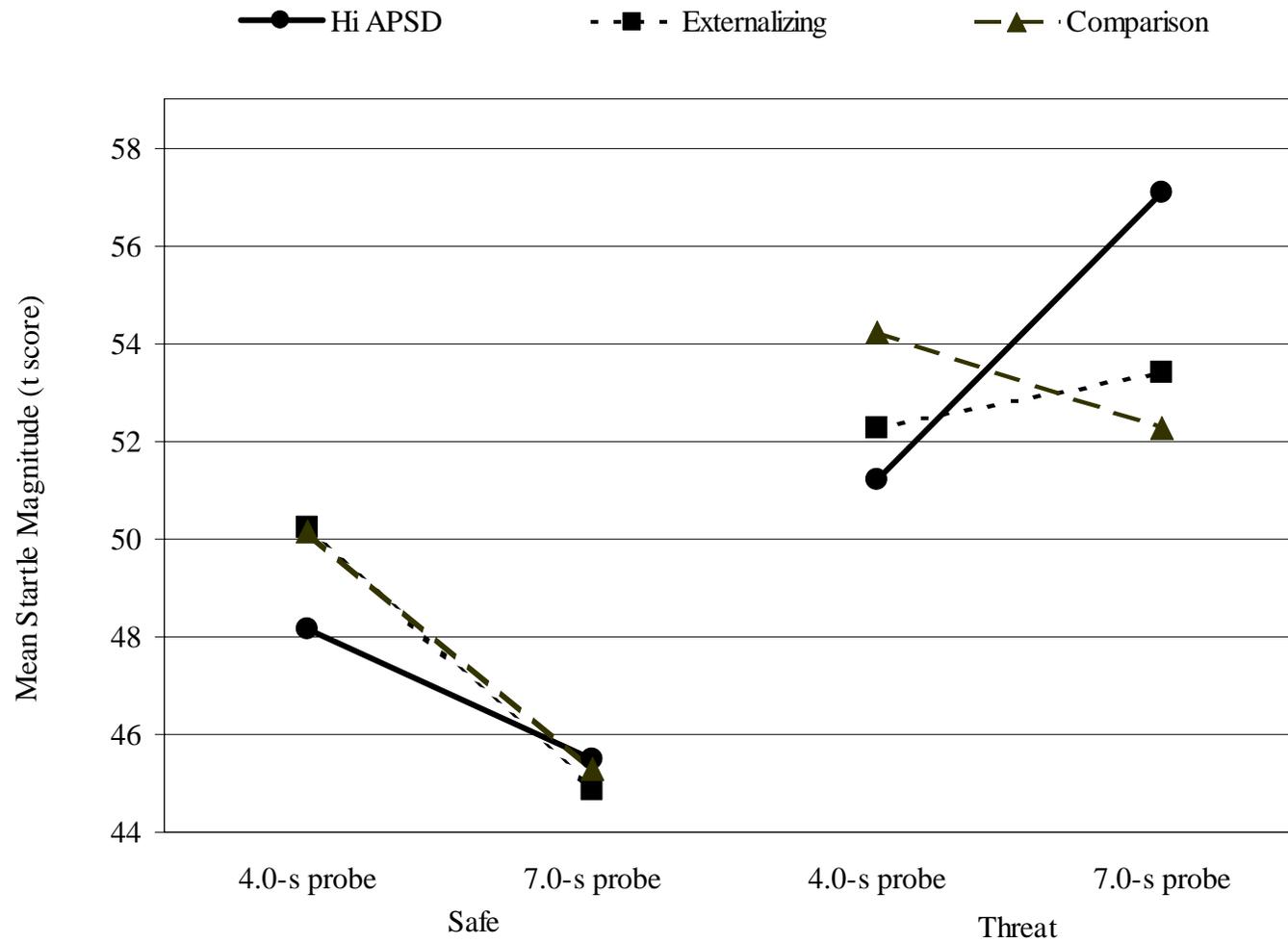


Figure 6

Mean Rewards Earned on the Point-Subtraction Game for Low and High Provocation Levels by Group

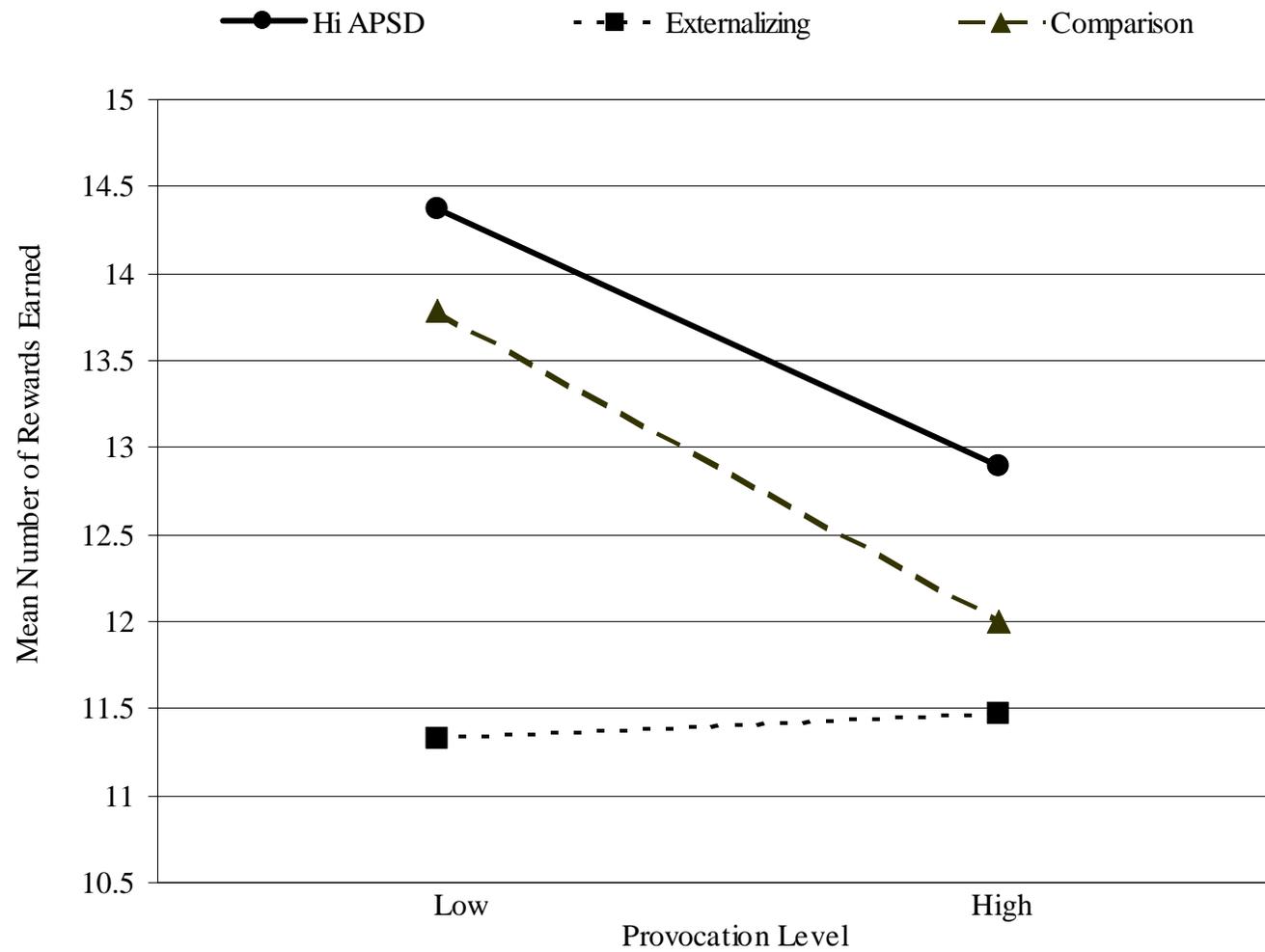


Figure 7

Frontal EEG Alpha Power for the Left and Right Hemispheres with Eyes Closed

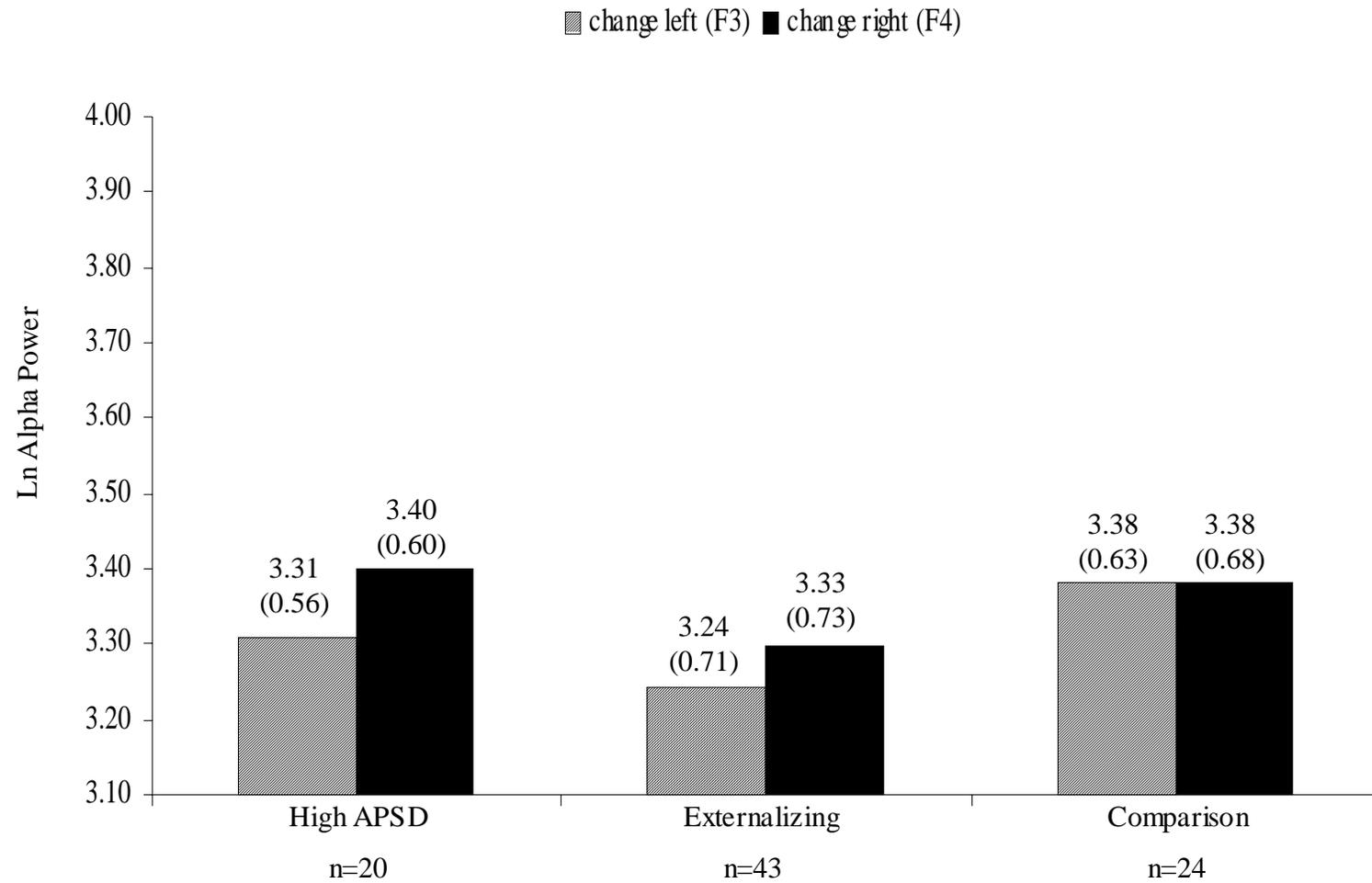


Figure 8

Parietal EEG Alpha Power for the Left and Right Hemispheres with Eyes Closed

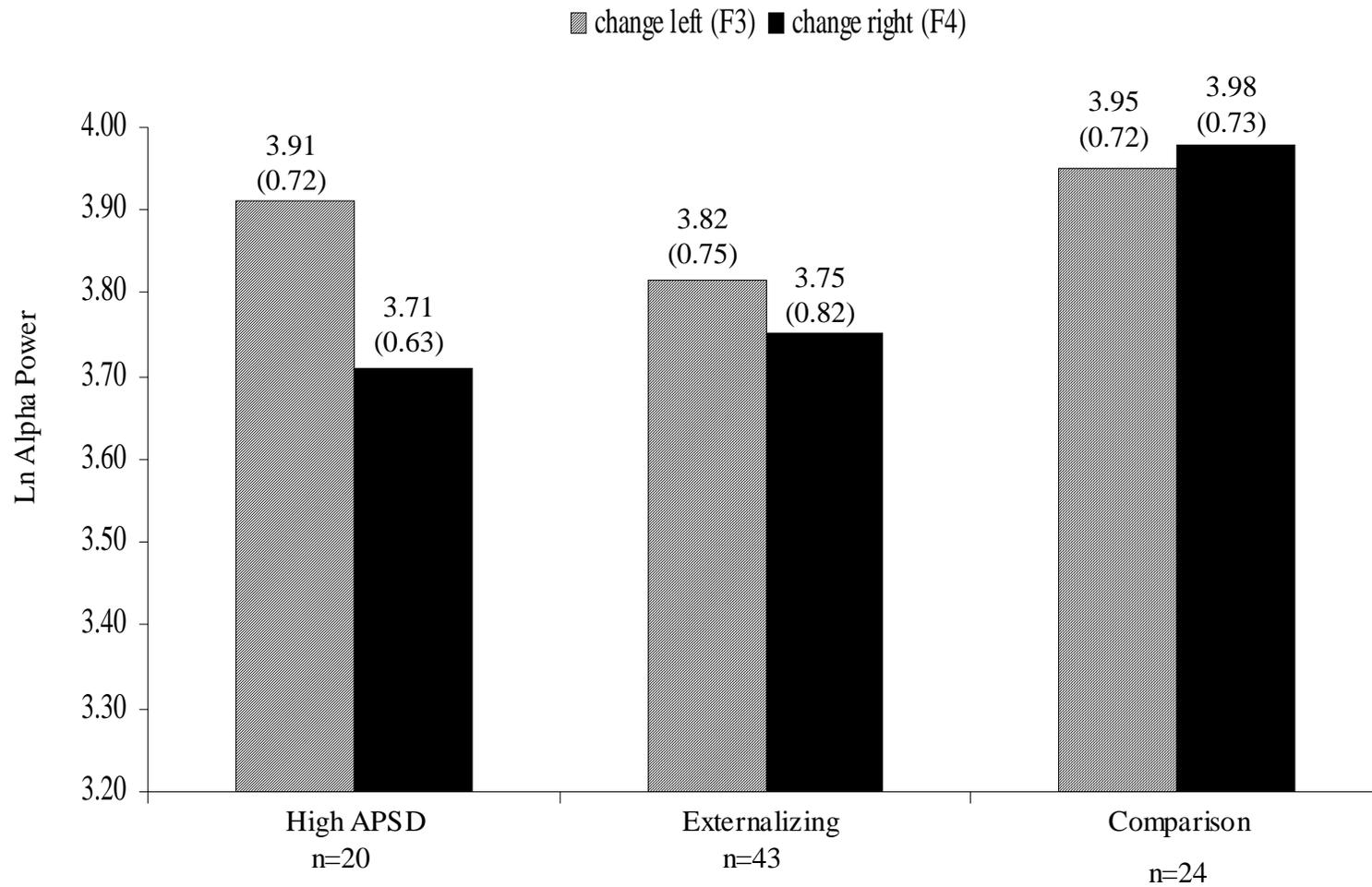


Figure 9

Mean Asymmetry Score for Frontal and Parietal Regions for Resting EEG with Eyes Closed

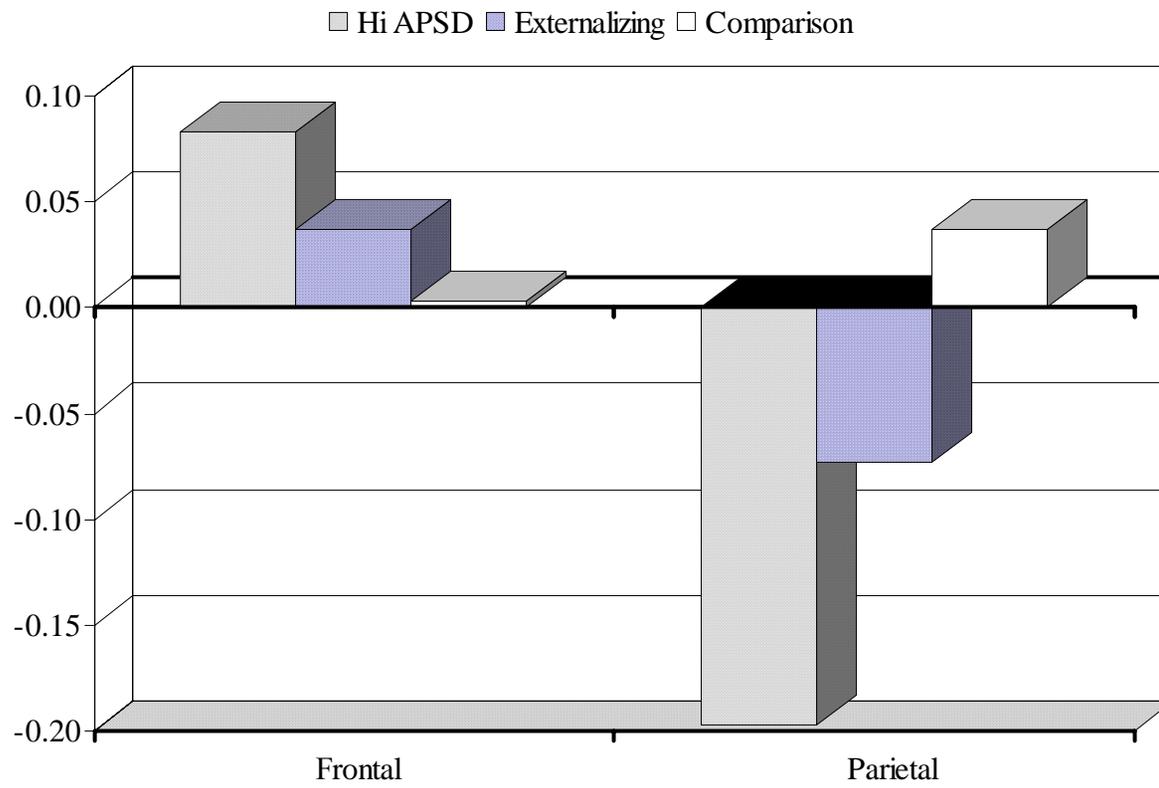


Figure 10

Mean Change in Interbeat Interval From Baseline to Film Viewing by Group

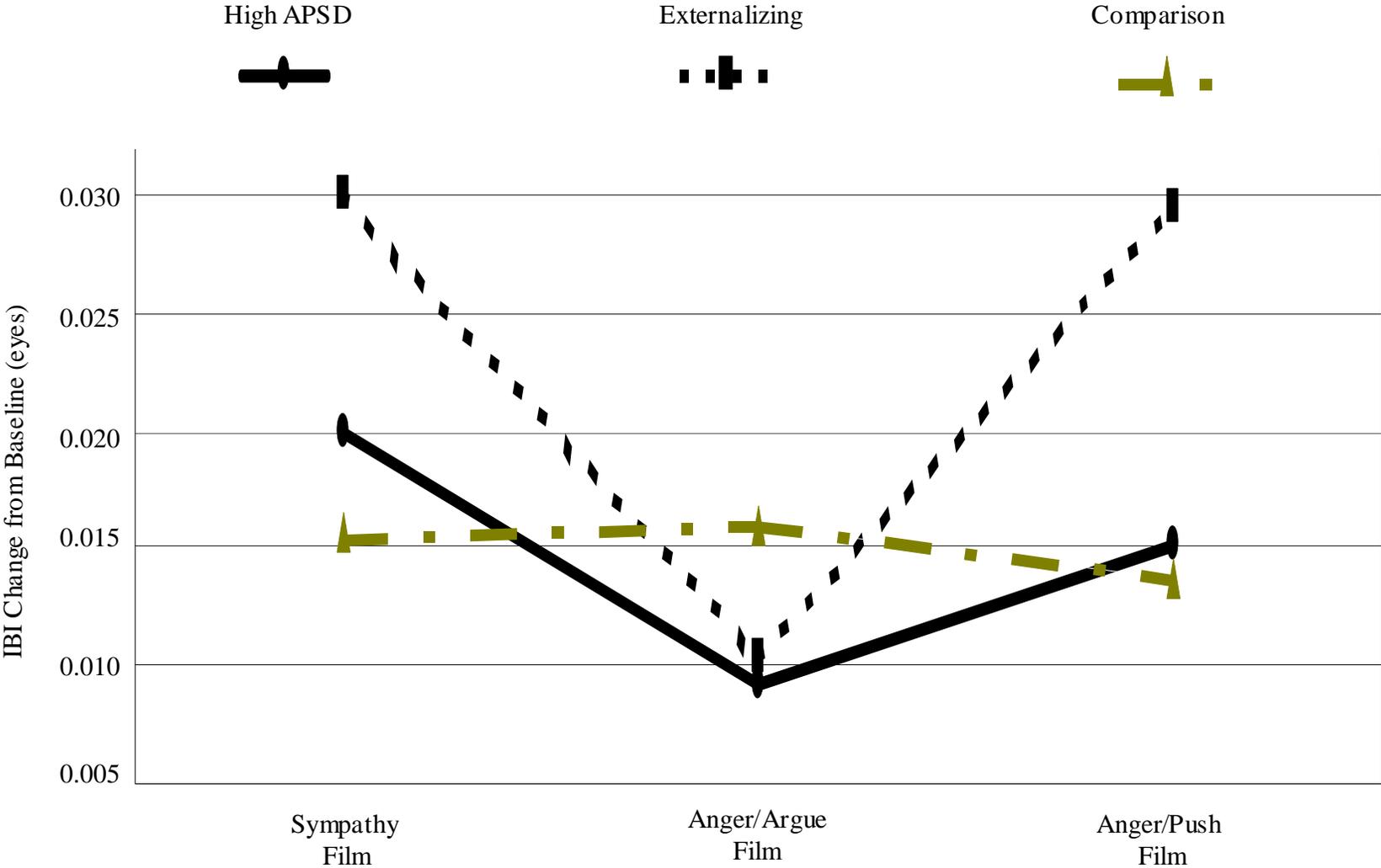


Figure 11

Change in Frontal EEG Alpha Power From Baseline to Sympathy Film Viewing for the Left and Right Hemispheres

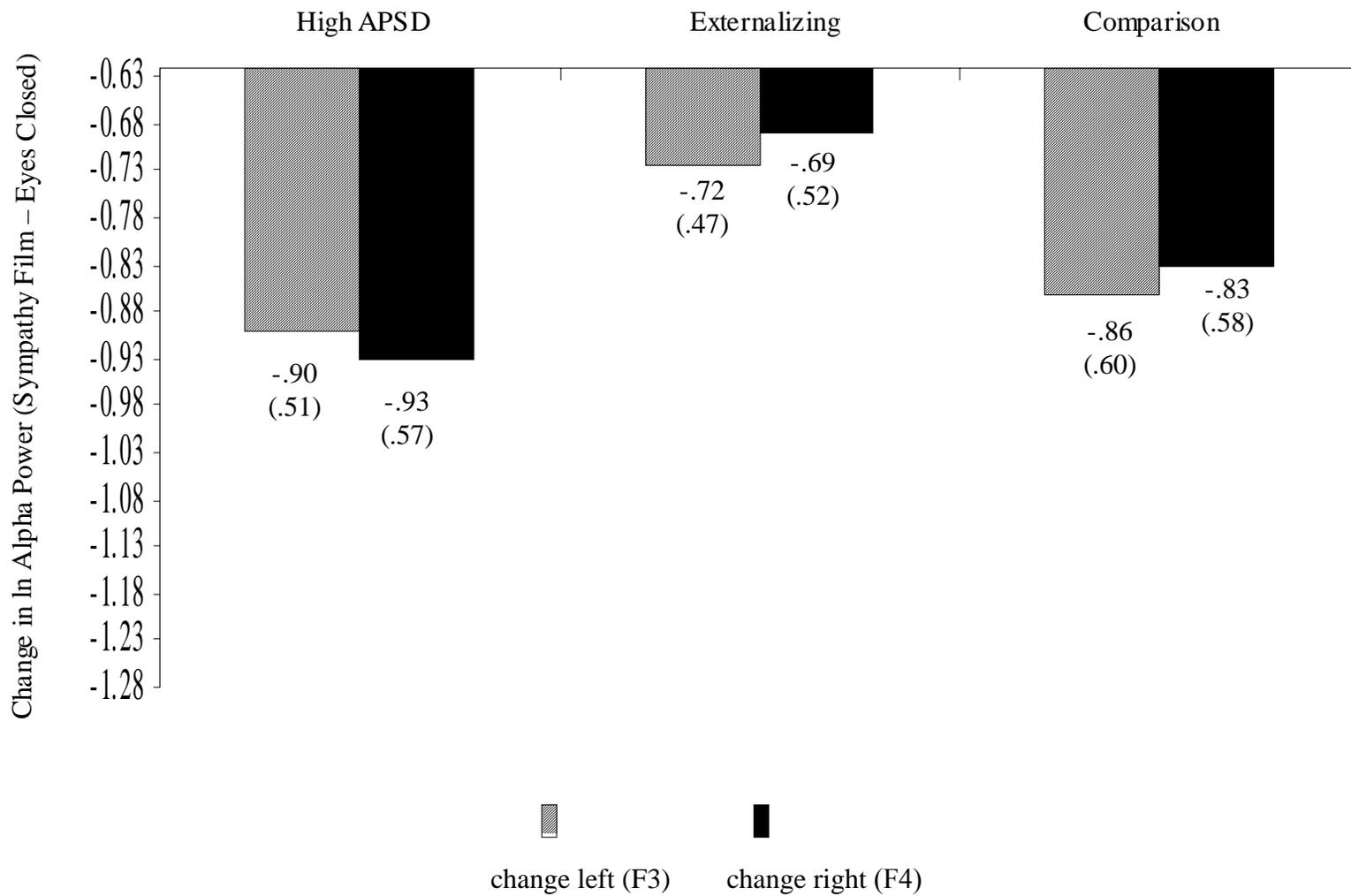


Figure 12

Change in Parietal EEG Alpha Power From Baseline to Sympathy Film Viewing for the Left and Right Hemispheres

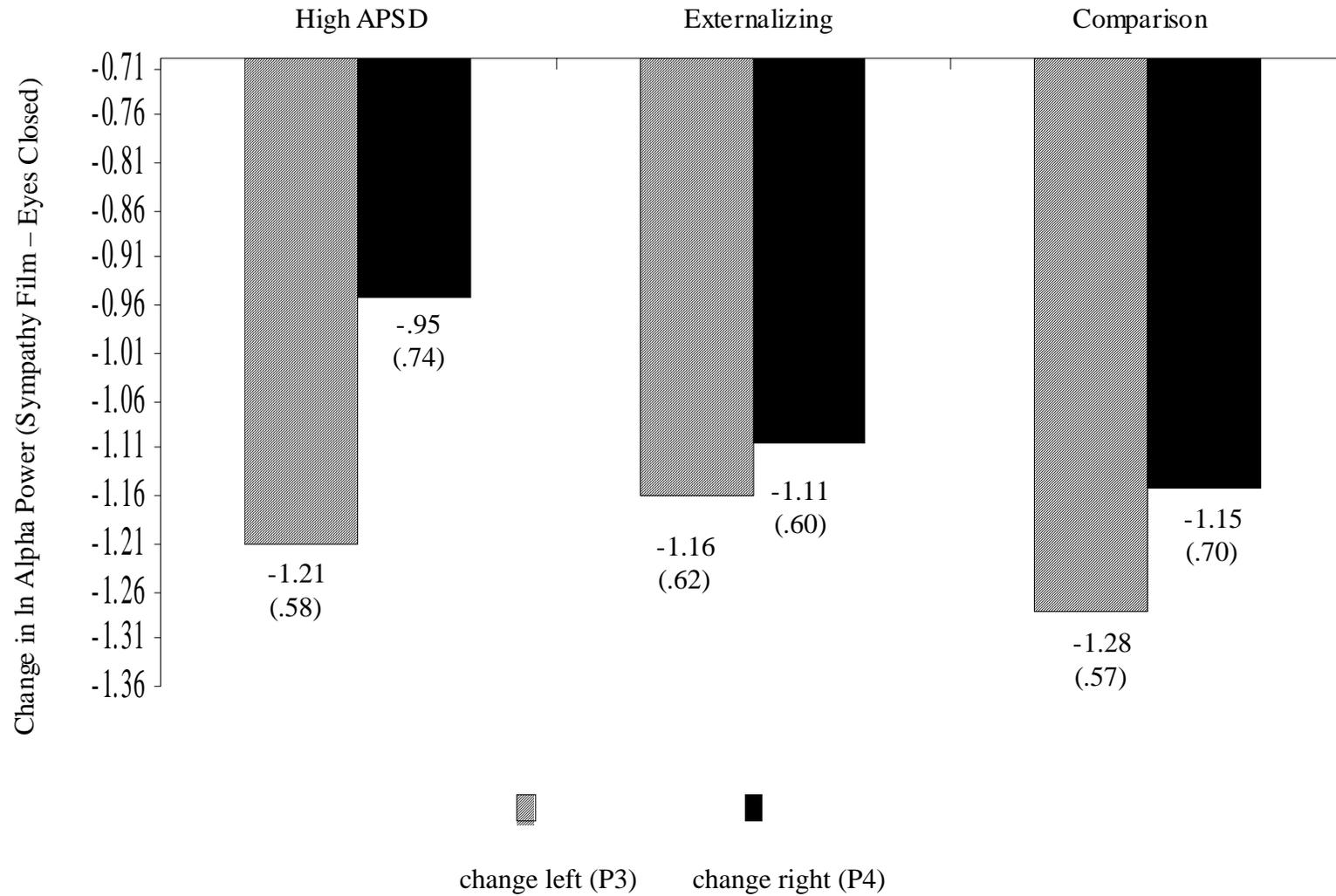


Figure 13

Change in Frontal EEG Alpha Power (Baseline to Sympathy Film Viewing) for High APSD and Comparison Groups Only (Anxiety Controlled)

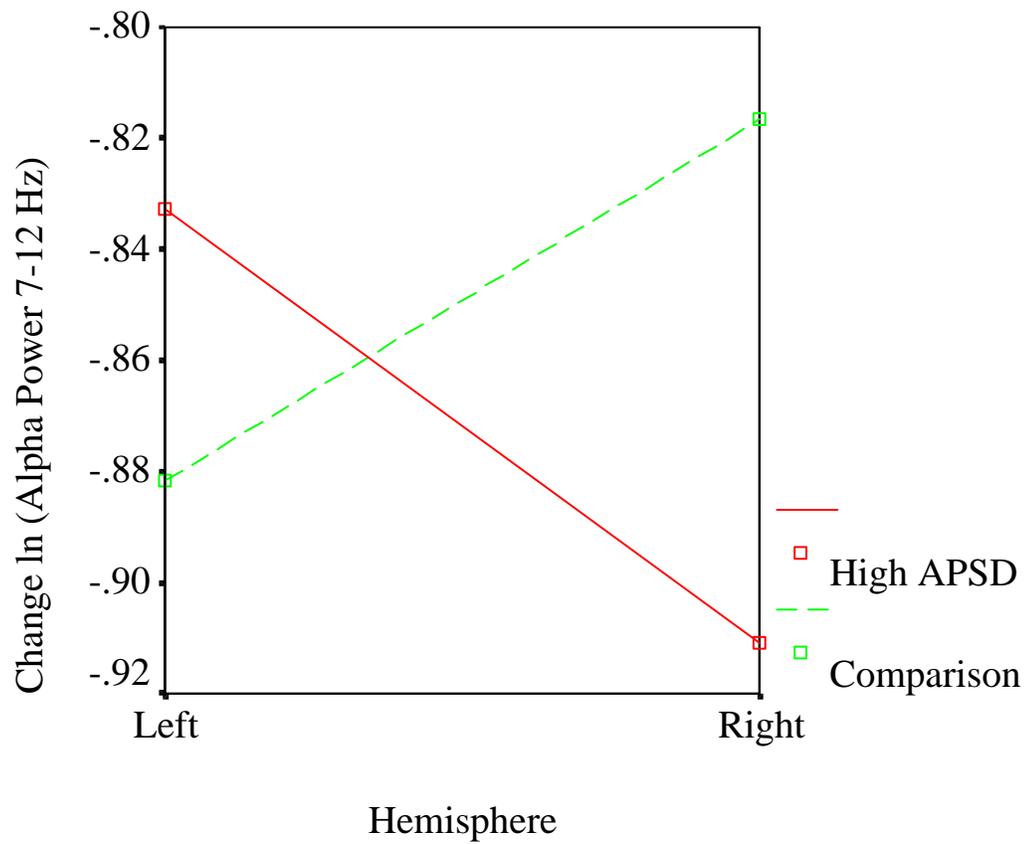


Figure 14

Change in Frontal EEG Alpha Power From Baseline to Anger/Argue Film Viewing for the Left and Right Hemispheres

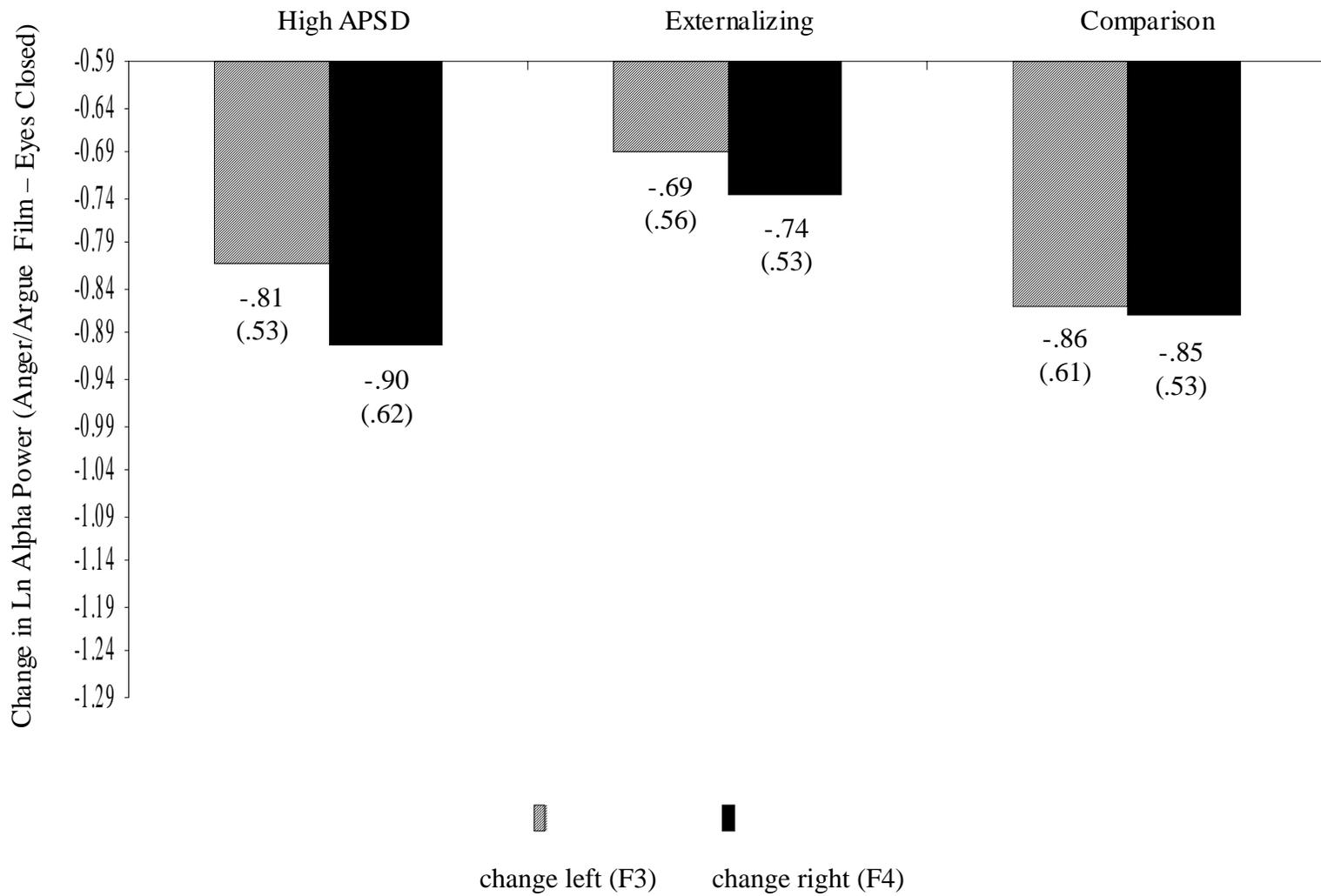


Figure 15

Change in Parietal EEG Alpha Power From Baseline to Anger/Argue Film Viewing for the Left and Right Hemispheres

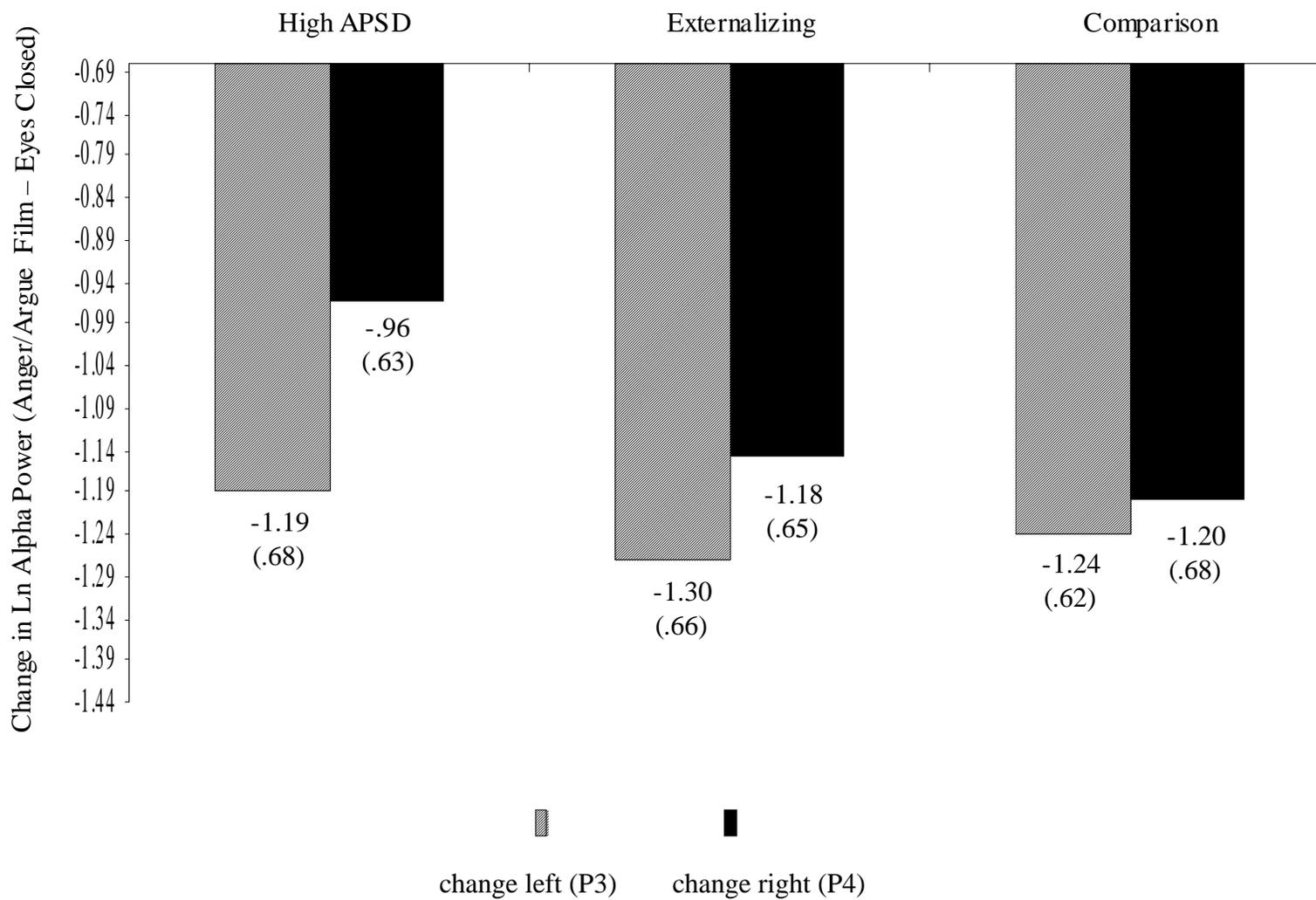


Figure 16

Change in Frontal EEG Alpha Power From Baseline to Anger/Push Film Viewing for the Left and Right Hemispheres

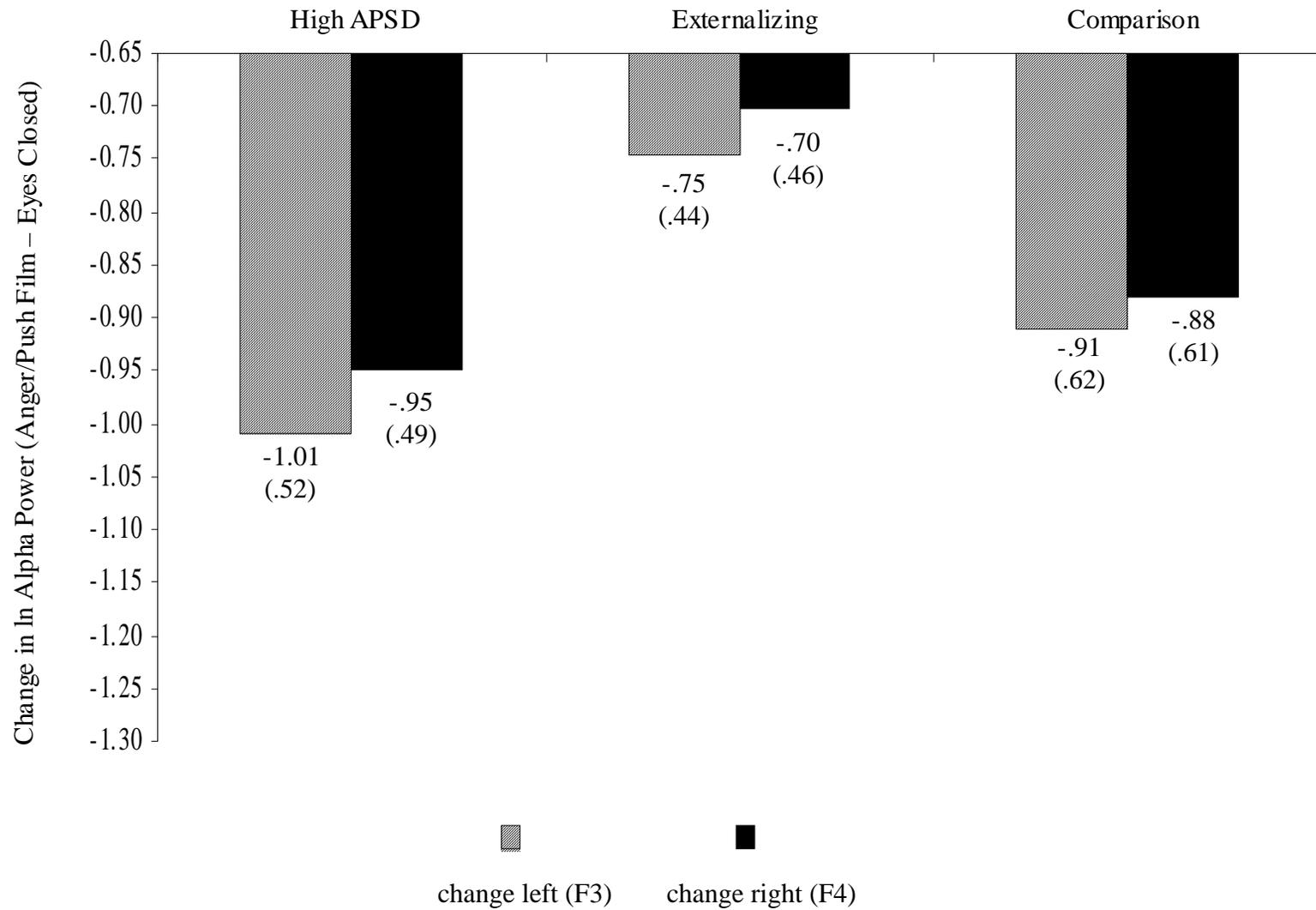


Figure 17

Change in Parietal EEG Alpha Power From Baseline to Anger/Push Film Viewing for the Left and Right Hemispheres

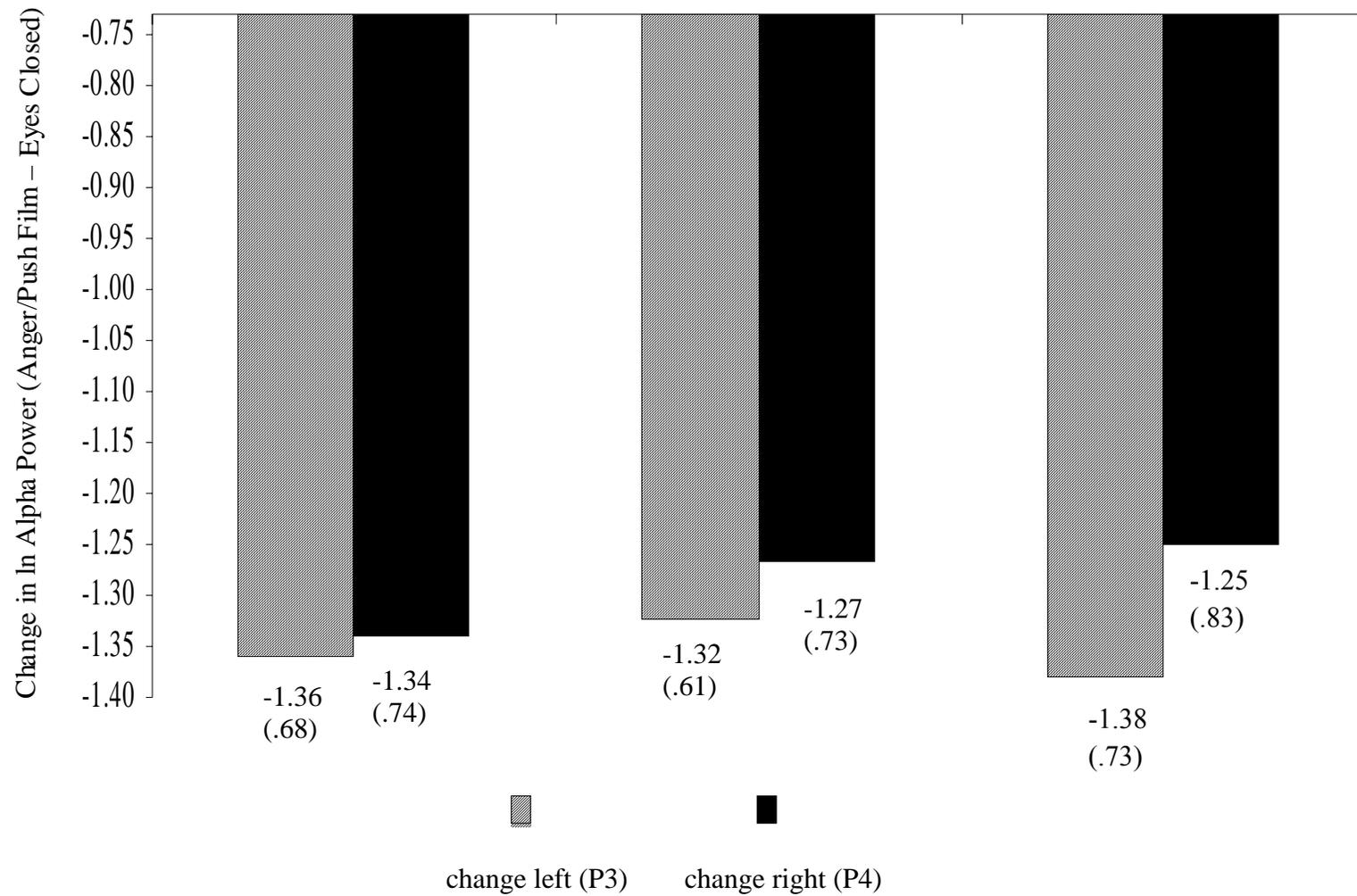


Figure 18

Mean Aggressive Response Choices on the Point-Subtraction Game for Low and High Provocation Levels by Group

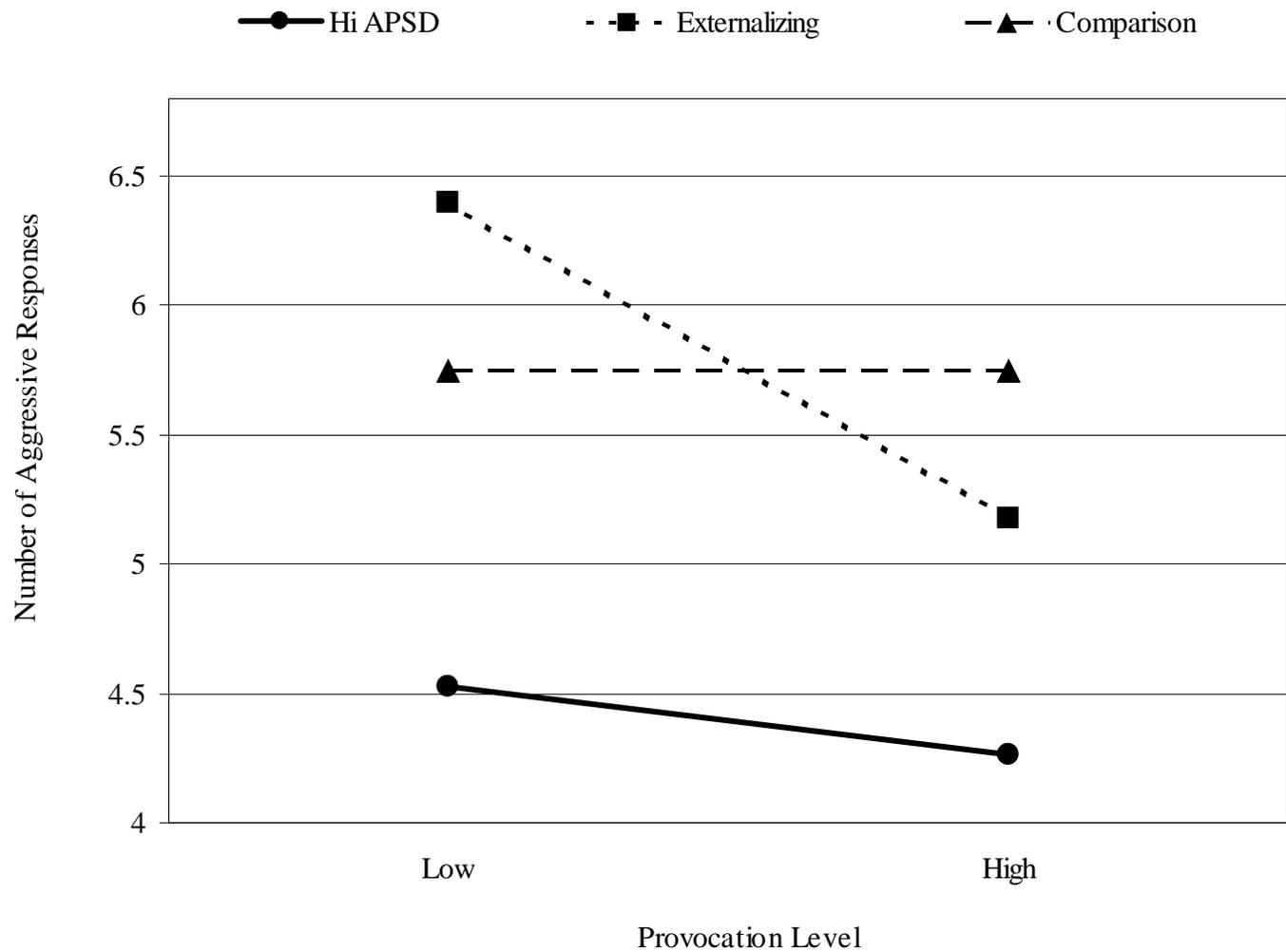
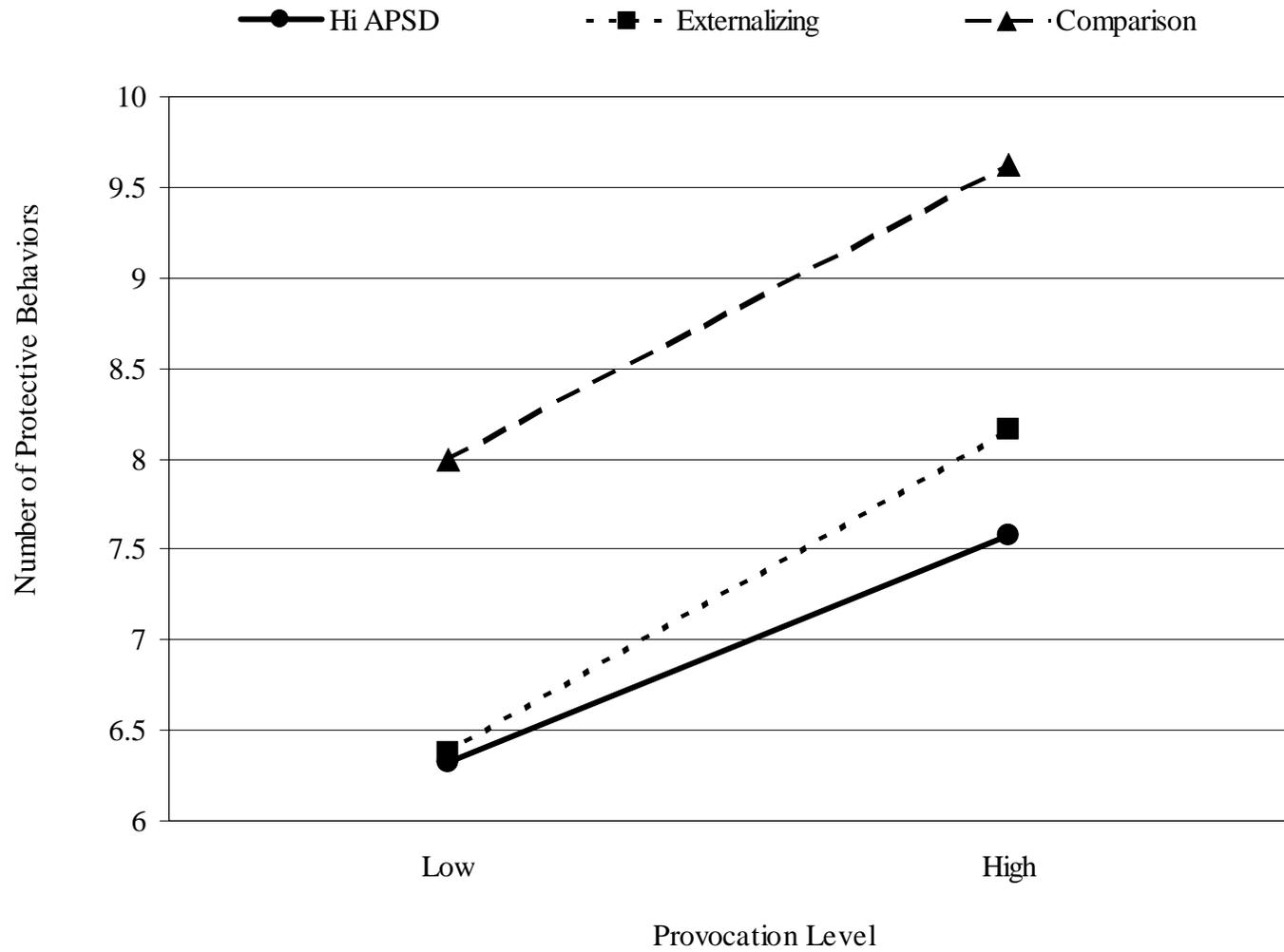


Figure 19

Mean Self-Protective Response Choices on the Point-Subtraction Game for Low and High Provocation Levels by Group



**APPENDICIES**

Participant initials: \_\_\_\_\_

## Appendix A

## SCREENING PHASE



## Informed Consent Forms

**CHILDREN'S HOSPITAL**

Department of Neuroscience and Behavioral Medicine  
 111 Michigan Avenue, NW  
 Washington, DC 20010  
 (202) 884-5000

## CONSENT TO PARTICIPATE IN A CLINICAL RESEARCH PROJECT

**TITLE OF PROJECT:** Subtyping Boys with Conduct Problems  
**PRINCIPAL INVESTIGATOR:** Michael J. Crowley, M.A., Doctoral Candidate, UMD, College Park  
 Tel. 301-405-7234  
**CO-INVESTIGATORS:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center  
 Tel. 202-884-5995  
 Nathan A. Fox, Ph.D., Professor of Human Development, UMD, College Park  
 Tel. 301-405-2816  
**INSTITUTIONAL SPONSOR:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center

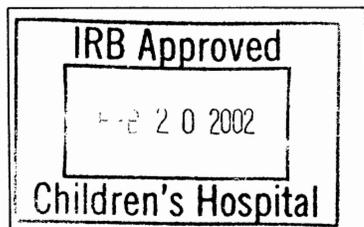
**INTRODUCTION:** We invite you to participate in the research study named above at Children's Hospital and the University of Maryland at College Park. Before you can decide whether or not to volunteer for this study, you must understand the purpose, how it may affect you and your child, any risks to you and your child, and what is expected of you. This process is called informed consent.

This consent form gives you information about the study which will be discussed with you. Once you understand the study, and if you agree to participate, you will be asked to sign this Informed Consent document. You will also be asked to sign an additional consent form to allow your child's teacher to provide data concerning your child's behavior and emotions. Following your participation and the participation of your child's teacher in the first portion of the study, you and your child may be asked to participate in an additional parts of the study. You will be given a copy of this document to keep. Before you learn about the study, it is important that you know the following:

- You/your child's participation is entirely voluntary;
- You may decide not to participate or to withdraw from the study at any time without penalty.
- If the study is changed in any way that could affect your participation, you will be told about the changes and may be asked to sign a new informed consent.

**A. PURPOSE OF STUDY**

The purpose of this research is to identify different subtypes of boys who show aggressive behavior and associated characteristics of their behavior. You and your child qualify for this study because you are the parent or guardian of a boy 7-12 years of age who, is seeking a psychological evaluation and/or treatment at Children's National Medical Center.

**IRB USE:**

Children's IRB Protocol No.: 2491  
 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 1 of 4

Participant initials: \_\_\_\_\_

**SCREENING PHASE****B. PROCEDURE**

In this part of the study, you will be asked to complete questionnaires regarding yourself and your child. Questionnaires will concern demographic information, parenting, and your child's behavior, emotions, and temperament. If you are waiting to be seen or are no longer being seen, at Children's Hospital, then you have been given the opportunity to participate via a phone call. If you expressed interest in participating, a questionnaire packet and consents, with a self-addressed stamped envelope, was mailed to you.

You will also be asked to sign an additional consent form to allow your child's teacher to provide data concerning your child's behavior and emotions. Following your participation and the participation of your child's teacher in the first portion of the study, you **may** be asked to participate in the second part of the study. You would be asked to sign additional consent forms giving consent for yourself and your child if you volunteer to participate in an additional part of the study to occur at the University of Maryland.

As you wait for your a session, or meeting at the clinic, you will be told about the study and given the opportunity to participate. You will be told that the study is about behavior, aggression, and emotion in boys. If you volunteer to participate, the questionnaires you complete will be used for research purposes.

The questionnaires will take approximately 30 minutes to complete and will be completed during one regular visit to Children's Hospital or they may be returned through the mail. Records will be stored in locked file cabinets at the Child Development Lab at the University of Maryland.

**C. POTENTIAL RISKS/DISCOMFORT**

A potential risk of participation in this study is that some of the questions may bring up issues involving your child that are upsetting to you. However, the questionnaires cover information, such as child behavior problems, routinely discussed in clinical settings.

**D. POTENTIAL BENEFITS**

I understand that the study is not designed to help me or my child personally, but that the investigator hopes to learn more about the connection between emotion and child behavior problems in clinically referred children. Scientific advances in this area may have implications for diagnosis and/or treatment of children similar to your child in the future.

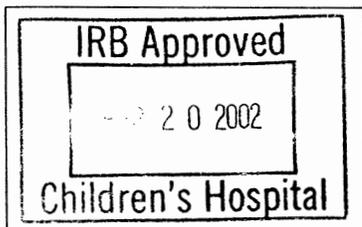
A brief summary statement will be added to my child's treatment chart based on the measures completed. This statement is meant to inform the assessment and treatment of my child if they are still being seen at Children's Hospital.

**E. ALTERNATIVES TO PARTICIPATION**

If you decide not to participate in this study or if you choose to withdraw from this study at any time, Children's Hospital will continue to treat your child with the same care and professionalism that it treats all its patients.

**F. QUESTIONS**

We want you to ask questions about any part of this study or consent form either now or at any time in the future. If you have research or medical questions about this study, call the Principal Investigator, Michael J. Crowley, at 301-405-7234. If you believe you have been injured as a result of being in this study, you should call the Principal Investigator, Michael J. Crowley, at 301-405-7234. If you have any questions or concerns about your rights in this research study at any time, please call Children's Hospital's Manager of Customer Relations, at (202) 884-5000 or call the Chief Academic

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**SCREENING PHASE**

Officer of the Children's National Medical Center at (202) 884-5000. This research study has been independently reviewed by the Institutional Review Board (IRB) of Children's Hospital, and the Institutional Review Board (IRB) of the University of Maryland at College Park.

**G. CONFIDENTIALITY**

As far as the law allows, you/your child's research and medical records will be kept confidential. However, the Food and Drug Administration (FDA) and U.S. Department of Health and Human Services have the right to inspect your medical records relating to this research for the purpose of verifying data. Your child's research records, just like hospital records, may be subpoenaed by court order or may be inspected by federal regulatory authorities.

All information gathered in the study will be completely confidential to the research staff. Identifying information, collected in order to locate persons for follow-ups if applicable, will only be accessible to research staff.

**H. COMPENSATION**

Neither Children's Hospital nor the Principal Investigator can guarantee or assure that the stated risks, or other unknown consequences will not occur. In the event that injury of illness is caused that you believe is directly related to participation in this research study, Children's Hospital requests that you contact the office of, Chief Academic Officer; Chief Operating Officer-CRI at (202) 884-5000. Children's Hospital does not provide a blanket compensation or medical care system for such incidents, but assures participants and their families that the hospital will carefully investigate each reported circumstance to determine whether medical treatment or some other form of compensation is required. However, you/your child will receive any immediate emergency treatment necessary.

**I. ADDITIONAL ELEMENTS**

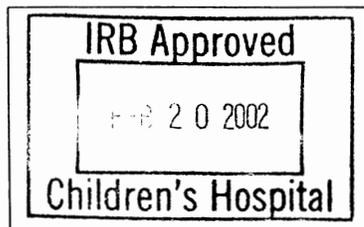
There are no additional costs to you or your child should you agree to participate in this study. You will receive \$10.00 as compensation for your participation in this first phase of the study that will occur during a regular visit to Children's Hospital.

**VOLUNTARY AUTHORIZATION:**

Before giving your child's consent by signing this document, the methods, inconveniences, risks and benefits, and alternatives have been explained and your questions have been answered. It is understood that you may ask questions at any time and that you are free to withdraw from the study at any time without causing bad feelings or affecting your or your child's medical care.

Your participation may be ended by the Principal Investigator or by the sponsor for reasons that would be explained. New information developed during the course of this study that may affect your willingness to continue in this research study will be given to you as it becomes available. You understand that signed copies of this consent document will be: (1) retained on file by the Principal Investigator, (2) filed Medical Records Department in patient's CNMC medical record, (3) filed in you/your child's clinical chart, and (4) given to you/your child to keep.

You understand that you do not give up any of your legal rights by signing this document. You can obtain further information from co-investigator and institutional sponsor Dr. Mark A. Stein, whose phone number is (202-884-5995).

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 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 3 of 4

Participant initials: \_\_\_\_\_

**SCREENING PHASE**



Printed Name of Participant: \_\_\_\_\_

Medical Record Number: \_\_\_\_\_

Printed Name of Parent(s)/Guardian(s): \_\_\_\_\_

Signature of Participant: \_\_\_\_\_

*(Participant must be 18 years of age or older)*

Signature of Parent(s)/Guardian(s): \_\_\_\_\_

Translator's Signature (if, applicable): \_\_\_\_\_

Language: \_\_\_\_\_

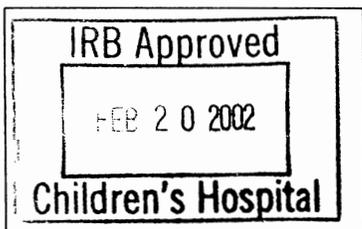
**INVESTIGATOR'S AFFIDAVIT:**

I certify that I have explained to the above individual(s) the nature and purpose of the study, potential benefits, and possible risks associated with participation in this study. I have answered any questions that have been raised and have witnessed the above signature on the date indicated below.

Printed Name of Individual Obtaining Consent: \_\_\_\_\_

Title: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**IRB USE:**



Children's IRB Protocol No.: 2491  
UMD IRB No.: 00717  
Date: 2/20/02  
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Participant initials: \_\_\_\_\_

ASSESSMENT PHASE



**CHILDREN'S HOSPITAL**  
 Department of Neuroscience and Behavioral Medicine  
 111 Michigan Avenue, NW  
 Washington, DC 20010  
 (202) 884-5000

## CONSENT TO PARTICIPATE IN A CLINICAL RESEARCH PROJECT

---

**TITLE OF PROJECT:** Subtyping Boys with Conduct Problems  
**PRINCIPAL INVESTIGATOR:** Michael J. Crowley, M.A., Doctoral Candidate, UMD, College Park  
 Tel. 301-405-7234  
**CO-INVESTIGATORS:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center  
 Tel. 202-884-5995  
 Nathan A. Fox, Ph.D., Professor of Human Development, UMD, College Park  
 Tel. 301-405-2816  
**INSTITUTIONAL SPONSOR:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center

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**INTRODUCTION:** We invite you and your child to participate in the research study named above at Children's Hospital and the University of Maryland at College Park. Before you can decide whether or not to volunteer for this study, you must understand the purpose, how it may affect you and your child, any risks to you and your child, and what is expected of you. This process is called informed consent.

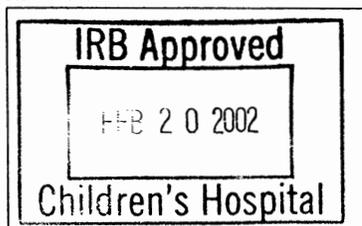
This consent form gives you information about the study that will be discussed with you and your child. Once you understand (and possibly your child understands) the study, and if you agree to participate and allow your child to participate, you will be asked to sign this Informed Consent document. Your child's assent will be requested if the child is (7) years of age or older. You will be given a copy of this document to keep. Before you learn about the study, it is important that you know the following:

- You/your child's participation is entirely voluntary;
- You may decide not to participate or to withdraw from the study at any time without penalty.
- If the study is changed in any way which could affect your participation, you will be told about the changes and may be asked to sign a new informed consent.

### A. PURPOSE OF STUDY

The purpose of this research is to better understand aggressive behavior in boys and associated characteristics of their behavior and emotions. You and your child qualify for this study because you are the parent or guardian of a boy, 7-12 years of age, referred to Children's National Medical Center for psychological or psychiatric treatment or evaluation, who was selected for participation based on your participation in the screening phase of this study.

### IRB USE:



Children's IRB Protocol No.: 2491  
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Participant initials: \_\_\_\_\_

ASSESSMENT PHASE



## B. PROCEDURE

In this part of the study, conducted at the University of Maryland, you will be asked to participate in a diagnostic interview, regarding your child. In this part of the study, we will also be collecting several physiological measures from your child. Because physiological measurements are affected by psychoactive medications, we ask that if your child is taking a short acting stimulant medication, you refrain from administering this medication on the day of the assessment. While your child is seated in a chair in our playroom, he will have a lycra stretchable cap placed on his head by a trained experimenter. An experimenter will place 2 pediatric electrodes on his back to enable the recording of heart rate. In addition, we will be placing two small stickers near your child's left eye in order to take note of when he blinks.

First, we will ask your child to sit for six minutes (3 minutes eyes open; 3 minutes eyes closed) while EEG and heart rate are recorded. Following this, your child will view two video clips while EEG and heart rate are again recorded. Next he will watch two video clips. The first 2-minute clip shows a girl with a handicap and the second 2-minute clip shows a couple arguing about friends and finances. Next, he will wear a collar and a brief air-puff will be administered to his neck to see how reactive he is. Bursts of white noise (like the static on a radio) will be presented through earphones intermittently.

The white noise (100 decibels given in 25 bursts of 50 milliseconds each) is similar to the amount of noise you would hear in a woodshop intermittently. Earphones consist of foam earplugs inserted in each ear. You may preview the level of noise before your child volunteers for the study. Your child can stop the procedure if he is uncomfortable or if the noise is too loud (or ask that it be reduced).

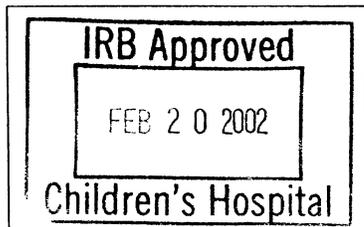
Next he will play two computer games, one in which he plays against himself, and another that is a competitive task. In each of the games he earns points on the computer and wins a nominal prize. Following these procedures, the cap and pediatric electrodes will be removed. Your child will take a short break. Your child will be asked to answer a brief set of questions about emotions. Then he will listen to a series of stories to which he will be asked to respond. Stories will involve children in situations, one set will involve whether the child sees others intentions as hostile. Your child will be asked what the intentions of the story characters were and how they themselves might react. Finally your child will be asked to answer questions about general knowledge and to build patterns with blocks.

If you volunteer your child to participate, physiological data from the EEG, heart rate and eye blinks, as well as behavioral data from the computer games, will be used for research purposes. Records will be stored in locked file cabinets at the Child Development Lab at the University of Maryland. The lab visit to the at the Child Development Lab at the University of Maryland, College Park, will take approximately 2 hours and 15 minutes to complete. Your child will receive a prize for his participation.

## C. POTENTIAL RISKS/DISCOMFORT

A potential risk of participation in this study is that some of the questions may bring up issues involving your child that are upsetting to you. However, the questionnaires cover information, such as child behavior problems, routinely discussed in clinical settings. The specific risk of exposure for this level of noise for children is unknown but unprotected exposure to 100 dB for 15 minutes or less is not damaging for adults.

### IRB USE:



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 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 2 of 4

Participant initials: \_\_\_\_\_

ASSESSMENT PHASE



#### D. POTENTIAL BENEFITS

I understand that the experiment is not designed to help me or my child personally, but that the investigator hopes to learn more about the connection between emotion and child behavior problems in clinically referred children. Scientific advances in this area may have implications for diagnosis and/or treatment of children similar to your child in the future.

#### E. ALTERNATIVES TO PARTICIPATION

If you decide not to participate in this study or if you choose to withdraw from this study at any time, Children's Hospital will continue to treat your child with the same care and professionalism that it treats all its patients.

#### F. QUESTIONS

We want you to ask questions about any part of this study or consent form either now or at any time in the future. If you have research or medical questions about this study, call the Principal Investigator, Michael J. Crowley, at 301-405-7234. If you believe you have been injured as a result of being in this study, you should call the Principal Investigator, Michael J. Crowley, at 301-405-7234. If you have any questions or concerns about your rights in this research study at any time, please call Children's Hospital's Manager of Customer Relations, at (202) 884-5000 or call the Chief Academic Officer of the Children's National Medical Center at (202) 884-5000. This research study has been independently reviewed by the Institutional Review Board (IRB) of Children's Hospital, and the Institutional Review Board (IRB) of the University of Maryland at College Park.

#### G. CONFIDENTIALITY

As far as the law allows, you/your child's research and medical records will be kept confidential. However, the Food and Drug Administration (FDA) and U.S. Department of Health and Human Services have the right to inspect your medical records relating to this research for the purpose of verifying data. Your child's research records, just like hospital records, may be subpoenaed by court order or may be inspected by federal regulatory authorities. All information gathered in the study will be completely confidential, and only available to the research staff. Identifying information, collected in order to locate persons for follow-ups if applicable, will only be accessible to research staff.

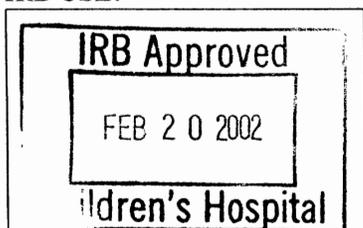
#### H. COMPENSATION

Neither Children's Hospital nor the Principal Investigator can guarantee or assure that the stated risks, or other unknown consequences will not occur. In the event that injury of illness is caused that you believe is directly related to participation in this research study, Children's Hospital requests that you contact the office of, Chief Academic Officer; Chief Operating Officer-CRI at (202) 884-5000. Children's Hospital does not provide a blanket compensation or medical care system for such incidents, but assures participants and their families that the hospital will carefully investigate each reported circumstance to determine whether medical treatment or some other form of compensation is required. However, you/your child will receive any immediate emergency treatment necessary.

#### I. ADDITIONAL ELEMENTS

There are no additional costs to you or your child should you agree to participate in this study. You will receive \$40.00 dollars to defray the cost of your transportation and parking when you return to the clinic at Children's Hospital for this portion of the study. Your child will receive a prize for his participation in this portion of the study.

**IRB USE:**



Children's IRB Protocol No.: 2491  
 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 3 of 4

Participant initials: \_\_\_\_\_

ASSESSMENT PHASE

**VOLUNTARY AUTHORIZATION:**

Before giving your and your child's consent by signing this document, be sure that the methods, inconveniences, risks and benefits, and alternatives have been explained and your questions have been answered. It is understood that you may ask questions at any time and that you are free to withdraw from the study at any time without causing bad feelings or affecting your or your child's medical care.

Your participation may be ended by the Principal Investigator or by the sponsor for reasons that would be explained. New information developed during the course of this study that may affect your willingness to continue in this research study will be given to you as it becomes available. You understand that signed copies of this consent document will be: (1) retained on file by the Principal Investigator, (2) filed Medical Records Department in patient's CNMC medical record, (3) filed in you/your child's clinical chart, and (4) given to you/your child to keep.

You understand that you do not give up any of your legal rights by signing this document. You can obtain further information from co-investigator and institutional sponsor Dr. Mark A. Stein, whose phone number is (202-884-5995).

Printed Name of Participant: \_\_\_\_\_

Medical Record Number: \_\_\_\_\_

Printed Name of Parent(s)/Guardian(s): \_\_\_\_\_

Signature of Participant: \_\_\_\_\_

*(Participant must be 18 years of age or older)*

Signature of Parent(s)/Guardian(s): \_\_\_\_\_

Translator's Signature (if, applicable): \_\_\_\_\_

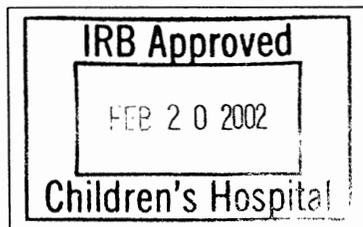
Language: \_\_\_\_\_

**INVESTIGATOR'S AFFIDAVIT:**

I certify that I have explained to the above individual(s) the nature and purpose of the study, potential benefits, and possible risks associated with participation in this study. I have answered any questions that have been raised and have witnessed the above signature on the date indicated below.

Printed Name of Individual Obtaining Consent: \_\_\_\_\_

Title: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**IRB USE:**

Children's IRB Protocol No.: 2491  
 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 4 of 4

Participant initials: \_\_\_\_\_

ASSESSMENT PHASE



**CHILDREN'S HOSPITAL**  
**Department of Neuroscience and Behavioral Medicine**  
 111 Michigan Avenue, NW  
 Washington, DC 20010  
 (202) 884-5000

**ASSENT (ages 7 to 12)**  
**TO PARTICIPATE IN A CLINICAL RESEARCH PROJECT**

---

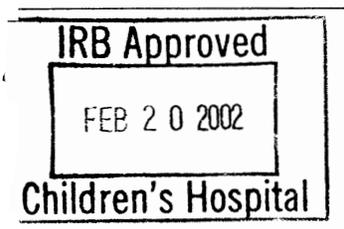
**TITLE OF PROJECT:** Subtyping Boys with Conduct Problems  
**PRINCIPAL INVESTIGATOR:** Michael J. Crowley, M.A., Doctoral Candidate, UMD, College Park  
 Tel. 301-405-7234  
**CO-INVESTIGATORS:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center  
 Tel. 202-884-5995  
 Nathan A. Fox, Ph.D., Professor of Human Development, UMD, College Park  
 Tel. 301-405-7234  
**INSTITUTIONAL SPONSOR:** Mark A. Stein, Ph.D., Chief of Psychology, Children's National Medical Center

---

**A. PROCEDURE**

1. If you decide to participate in this study, you will meet with a research assistant. This takes about 2hrs 15 minutes at the Child Development Laboratory (University of Maryland, College Park) .
2. First you will be asked watch some short video tapes. At the same time we ask you to wear a cap that measures brain waves. We will also put some stickers on your cheek and back for other measurements.
3. For one task will give you a puff of air on your neck to see how reactive you are. In this task you will hear brief noises that sound like TV static. If you think these noises are too loud or you are uncomfortable, you can stop the procedure or ask that it the noise be reduced.
4. You will be read stories with pictures. We will ask you to pretend you are in the story. You tell why people in the story did what they did. Then you tell what you would do.
5. You will be asked to answer some questions feelings.
6. Then you would play two computer games where you earn points for small prizes.
7. Next you will answer some information questions and play with some blocks.
8. For helping with this part of the study you may choose a prize.

**IRB USE:**



*Children's IRB Protocol No.: 2491*  
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 Date: 2/20/02  
 Page 1 of 2



### B. POTENTIAL RISKS/DISCOMFORT

1. There are no known long-term risks to wearing the cap, or putting the stickers on your skin. They are for taking measurements like those done in a doctor's office. They are not known to cause pain or discomfort.
2. There are no known long-term risks to watching the video clips or the slides.
3. There are no known risks to playing the computer games or answering the questions.

### C. BENEFITS

1. There is no known personal benefit to your participation in this part of the project.
2. Your participation helps us to better understand kids like you.

This Study Has Been Explained To Me      Yes \_\_\_ No \_\_\_  
 I Understand This Information              Yes \_\_\_ No \_\_\_  
 I Agree To Participate In This Research    Yes \_\_\_ No \_\_\_

#### ***Acknowledgement of Assent:***

Printed Name of Participant: \_\_\_\_\_ MR#: \_\_\_\_\_  
 (child is between 7 & 12 years of age)

Signature of Participant: \_\_\_\_\_

Printed Name of Individual Obtaining Assent: \_\_\_\_\_ Date: \_\_\_\_\_

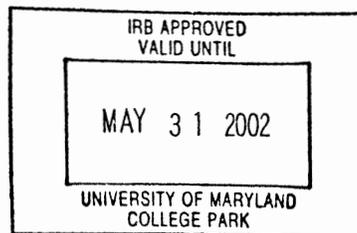
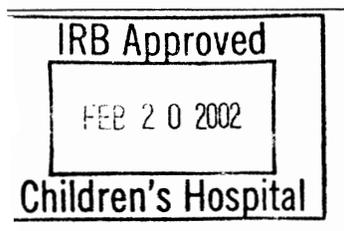
Title: \_\_\_\_\_ Signature: \_\_\_\_\_

**I have witnessed the explanations made by the investigator and heard the responses to questions. I have no conflicting interest in the activity proposed.**

Printed Name of Witness: \_\_\_\_\_

Signature of Witness: \_\_\_\_\_

### **IRB USE:**



*Children's IRB Protocol No.: 2491  
 UMD IRB No.: 00717  
 Date: 2/20/02  
 Page 2 of 2*

- Title of Project:** An Investigation of Child Behavior, Aggression, and Emotion in Clinically Referred Boys: Control Participants – Screening Phase
- Statement of consent:** You give consent for yourself and your child to participate in a program of research being conducted at the Child Development Laboratory at the Department of Human Development, University of Maryland, College Park. You understand that your decision to participate is completely voluntary.
- Purpose:** To help better understand emotion in boys. We would like you to help us with a research study examining emotion in boys, ages 8-12. The information we receive from you and your child will be compared to that collected from boys clinically referred for behavior problems and information from their primary caregiver.
- Procedures:** In this part of the study, you will be asked to complete questionnaires regarding yourself and your child. Questionnaires will concern demographic information, parenting, and your child's behavior, emotions, and temperament. If you expressed interest in participating, a questionnaire packet and consents, with a self-addressed stamped envelope, was mailed to you.  
Following your participation you may be asked to participate in the second part of the study. You would be asked to sign additional consent forms giving consent for yourself and your child if you volunteer to participate in an additional part of the study to occur at the University of Maryland. If you volunteer to participate, the questionnaires you complete will be used for research purposes.  
The questionnaires will take approximately 20 minutes to complete and will be returned through the mail. Records will be stored in locked file cabinets at the Child Development Lab at the University of Maryland.
- Confidentiality:** You understand that all information collected during the course of this visit will remain confidential and neither your name, nor your child's name, will be identified at any time.
- Risks:** You understand that there are no know long-term effects associated with the tasks or events experienced during this visit.
- Benefits:** You understand that the experiment is not designed to help you, or your child personally, but that the investigator hopes to learn more about implementing these tasks with children for studies involving emotion and child behavior. If you have any questions, you understand that you are free to ask them at any time during the procedure. Your participation in this project is completely voluntary and you may choose to withdraw at any time without penalty.

**Principal Investigator** Nathan A. Fox, Ph.D.  
Institute for Child Study  
3304 Benjamin Building  
University of Maryland  
College Park, MD 20742  
(301)405-7234

**Parent Signature:** \_\_\_\_\_

**Child's Name:** \_\_\_\_\_

**Date:** \_\_\_\_\_

UMD IRB No.: 00717



Title of Project: An Investigation of Child Behavior, Aggression, and Emotion in Clinically Referred Boys: Control Participants – Assessment Phase

Statement of consent: You give consent for yourself and your child to participate in a program of research being conducted at the Child Development Laboratory at the Department of Human Development, University of Maryland, College Park. You understand that your decision to participate is completely voluntary.

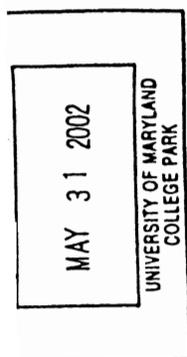
Purpose: To help better understand emotion in boys. We would like you to help us with a research study examining emotion in boys, ages 8-12. The information we receive from you and your child will be compared to that collected from boys clinically referred for behavior problems and information from their primary caregiver.

Procedures: In this part of the study, conducted at the University of Maryland, you will be asked to participate in a diagnostic interview, regarding your child. In this part of the study, we will also be collecting several physiological measures from your child. Because physiological measurements are affected by psychoactive medications, we ask that if your child is taking a short acting stimulant medication, you refrain from administering this medication on the day of the assessment. While your child is seated in a chair in our playroom, he will have a lycra stretchable cap placed on his head by a trained experimenter. An experimenter will place 2 pediatric electrodes on his back to enable the recording of heart rate. In addition, we will be placing two small stickers near your child's left eye in order to take note of when he blinks.

First, we will ask your child to sit for six minutes (3 minutes eyes open; 3 minutes eyes closed) while EEG and heart rate are recorded. Following this, your child will view two video clips while EEG and heart rate are again recorded. Next he will watch two video clips. The first 2-minute clip shows a girl with a handicap and the second 2-minute clip shows a couple arguing about friends and finances. Next, he will wear a collar and a brief air-puff will be administered to his neck to see how reactive he is. Bursts of white noise (like the static on a radio) will be presented through earphones intermittently.

Next he will play two computer games, one in which he plays against himself, and another that is a competitive task. In each of the games he earns points on the computer and wins a nominal prize. Following these procedures, the cap and pediatric electrodes will be removed. Your child will take a short break. Your child will be asked to answer a brief set of questions about emotions. Then he will listen to a series of stories to which he will be asked to respond. Stories will involve children in situations, one set will involve whether the child sees others intentions as hostile. Your child will be asked what the intentions of the story characters were and how they themselves might react. Finally your child will be asked to answer questions about general knowledge and to build patterns with blocks.

If you volunteer your child to participate, physiological data from the EEG, heart rate and eye blinks, as well as behavioral data from the computer games, will be used for research purposes. Records will be stored in locked file cabinets at the Child Development Lab at the University of Maryland. The lab visit to the at the Child Development Lab at the University of Maryland, College Park, will take approximately 2 hours and 15 minutes to complete. Your child will receive a prize for his participation. You will receive \$40.



**Confidentiality:** You understand that all information collected during the course of this visit will remain confidential and neither your name, nor your child's name, will be identified at any time.

**Risks:** You understand that there are no know long-term effects associated with the tasks or events experienced during this visit.

**Benefits:** You understand that the experiment is not designed to help you, or your child personally, but that the investigator hopes to learn more about implementing these tasks with children for studies involving emotion and child behavior. If you have any questions, you understand that you are free to ask them at any time during the procedure. Your participation in this project is completely voluntary and you may choose to withdraw at any time without penalty.

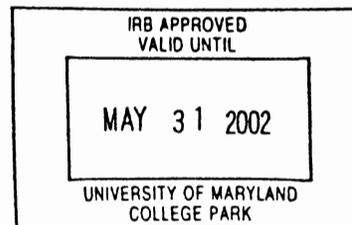
**Principal Investigator** Nathan A. Fox, Ph.D.  
Institute for Child Study  
3304 Benjamin Building  
University of Maryland  
College Park, MD 20742  
(301)405-7234

**Parent Signature:** \_\_\_\_\_

**Child's Name:** \_\_\_\_\_

**Date:** \_\_\_\_\_

UMD IRB No.: 00717



## Appendix B

### Screening and Assessment Call Scripts

I) Hi my name is (full name) and I'm calling on behalf of Children's Hospital and the University Of Maryland. May I please speak with \_\_\_\_\_? (Thanks)

1A) "This is \_\_\_\_\_."

Hi, how are you?

"Fine/Good/etc."

Good. Well, the reason that I am calling you today is because we are conducting some research at Children's Hospital that is in conjunction with the University of Maryland and we feel that it may be of interest to you. The research involves emotional development in boys' ages 8-12 years old. **(Go to II)**.

2A) "Sure, hold on one minute."

Thanks...

"Hello/This is \_\_\_\_\_."

(Is this \_\_\_\_\_?)

("Yes it is")

Hi, my name is \_\_\_\_\_ and I'm calling on behalf Children's Hospital. The reason that I am calling you today is because we are conducting some research at Children's Hospital that is in conjunction with the University of Maryland and we feel that it may be of interest to you. The research involves emotional development in boys' ages 8-12 years old. **(Go to II)**.

1B) "Not right now. Can you call back?"

Sure, when is a good time for you?

"\_\_\_\_\_"

Okay, great. I will call you back then... Bye.

2B) "Not right now. Can I call you back?"

Sure, you can reach me at 202-884-6068. (This is the principal Investigator's number, Mike Crowley.) (Thanks!)

3B) "Okay/Sure/(etc.)"

**(Go to II)**

4B) "How did you get my number?"

Well, like I said, this research is through Children's Hospital and we are recruiting families who are being seen or waiting to be seen at Children's; through Outpatient Psychiatry.

5B) "Well, I haven't even gotten my appointment yet."

Oh, you haven't? I am not in charge of intake at Children's but I can give you the main number if you want to call and check on your appointment. Were you seen in DC or one of the other Children's clinics?

**5B<sub>1</sub>)** "Well, I'm a little tired of waiting. We sent out packet back to Children's hospital a long time ago and I haven't heard anything (since the initial call/ they haven't called back yet to make an appointment.)?"

Children's sees many families so sometimes there is a wait to get an \_\_\_\_\_ appointment. Would you still like to hear about the study, or would it be better for me to call you back in a few weeks when you have scheduled your appointment?

6B) "Children's Hospital? How come I see a University of Maryland Number on my caller ID?"

This study is being conducted by Children's Hospital but is a joint project with the University of Maryland. It has been reviewed by the institutional review boards of both Children's Hospital and the University of Maryland. And since it is a joint project, we are sometimes at the University of Maryland – and then we make calls from there.

II) The research has two parts. In the first part I will mail you a packet of questionnaires. The questionnaires ask about your son's/grandson's/etc. emotions and behaviors. When you send back the packet we will reimburse you \$10 for your time.

1A) "We have to pay \$10?"

No, we send YOU \$10 for completing the packet (and returning it to us).

(Go to III).

III) Some of families who participate in the first part of the study will be invited to the University of Maryland to participate in the second phase.

1B) "We don't have much time, I don't think that we could come in."

Well, then if you were invited to participate in the second part, it will only be for a couple of hours one day – and we would work that out with your schedule when that came up.

For this part of the study, you will be reimbursed \$40 dollars and your son/grandson will receive an age appropriate prize worth \$10.

1C) "Age appropriate? What do you mean by that?"

Well, it's because the study covers a wide range of ages (8 to 12 years old) and boys in that age range vary so much in their interests.

During this part of the study we will be collecting psychophysiological measures such as EEG and heart rate while the boys watch video clips and play computer games. Then we would ask the boys some questions about how they would behave in different situations. And at the same time the moms/parents participate in a diagnostic interview about their son's behaviors.

IV) Does this sound like something you would be interested in participating in?

1A) "Yes..."

Okay, great... (Go to V)

2B) "No..."

Okay, well thank you for your time. Would you like a number that you could call if you change your mind at some point?

2B<sub>1</sub>) "Sure..."

Okay, (ready?), it's 202-884-6068... Bye.

2B<sub>2</sub>) "No, we really aren't interested."

Okay, well thank you anyway... Bye.

V) \* A couple things I want to mention to you, is that your decision to participate is completely voluntary;

\* You'd still get the same quality treatment at Children's Hospital regardless of whether or not you decide to participate.

\* And, any information you provide will be completely confidential.

\* And you always reserve the right to drop out of the study at any time. (Go to VI)

VI) There's one more question I have for you before you go. Is your child currently taking any medication?

1A) "No."

Okay, well great... the reason that we ask is that if he does end up coming in for the second part of the study we ask that the children not be on any medications.

So if you did decide to put him on some meds at a later time then just let us know if the second part of the study comes up... (Thanks!)

2A) "Yes..."

Which ones?

"\_\_\_\_\_"

I ask this because if you were invited for the second part we would ask that he not take his medication on the day he visited the lab. Would that be alright?

(depending on the types of meds he is taking and long term or not).

VII) Okay, great, well then I'll be sending you a consent form along with a packet of questionnaires, and a self-addressed envelope. I should mention, by signing the consent form you are not obligating yourself in any way, you are only indicating that you have understood what has been explained to you.

VIII) Now I just need to verify your address...

IX) Do you have any questions?

1A) "(Yes...) \_\_\_\_\_?"

\_\_\_\_\_. If you have any more questions once you receive the packet, there are a list of numbers included in the packet for a Michael Crowley and a Dr. Mark Stein at Children's; they are the principal investigators in the study and will be able to answer any additional questions you have.

2A) "No..."

Okay, well if you have any questions at a later time, the packet I'm sending you will list phone numbers for Michael Crowley and Dr. Mark Stein at Children's; they are the principal investigators in the study and will be able to answer any questions you have.

Okay, well thank you so much for your time. And you should see the packet in the mail the first part of next week...

*Calling Script for Invitation to Assessment Phase*

Hi, my name is \_\_\_\_\_ and I'm calling on behalf of Children's Hospital and the University of Maryland. May I speak with \_\_\_\_\_?

The reason that I am calling you this evening is because **A While Back / Recently** you completed a packet for the first part of our study. I would like to first thank you for your participation in the first part of the study and I would like to invite you to come in for the second part of the study. This part will take place at the University of Maryland. You will be reimbursed \$40 for your time and your son/child will receive an age appropriate prize worth \$10.

During this part of the study we will be collecting psychophysiological measures such as EEG and heart rate while the boys watch video clips and play computer games. Then we will ask the boys some questions about how they would behave in different situations. At the same time the moms/parents will be participating in a diagnostic interview about their sons/child's behavior. This would all take about 2 hours and you will be reimbursed \$40 for your time. Your son/child will also receive an age appropriate prizes worth about \$10.

Now, I'm hoping to set up a convenient time for you and your son to come to the University for this part of the study. When is a good time for you?

(Set up a time using the calendar from Mike)

\*\*Before you mentioned that your son was currently taking \_\_\_\_\_ medication. We ask that he not take his short acting medication on the day that he is coming to the University. Will this be a problem?

And is transportation okay for you to come to the university?

- a. Okay great, what type of vehicle will you be driving? And color?
- b. For our families who do not have their own transportation we provide a cab. We will need to give your name, phone number, and address to our cab driver. Will this be okay?

Okay, great, now I just want to verify your address because I will be sending you a letter in the mail with directions on how to get to campus and a map of campus.

(Verify address)

One last question, Will anyone else be joining you and (CHILD'S NAME)?

Okay, great. Well, then you will be receiving the letter in the mail shortly and there is a phone on the letter if you have any questions. Thank you so much and we will see you on \_\_\_\_\_. Bye.

(\*\*) This means to check their case file to make sure that they are not taking medication that they can go off of for the day (short-acting meds). If it does not say they are taking any meds (or it doesn't list either way) check with them to make sure they are not on meds.

(\*)Possible question the parent may ask:

Why is my son being invited?

Well, I can't tell you the exact details because it could possibly affect the results of the study, but I can tell you that it has to do with the ratings that you gave on the behavior and emotion measures that you completed in your packet.

## Appendix C

### Recruitment Letter – Comparison Group

Hello! We are writing from the Child Development Laboratory at the University of Maryland. For the past fifteen years, we have been studying the ways in which children develop, socially and emotionally, from infancy throughout childhood. Our research has been recognized on television programs such as *Dateline*, *20/20*, and *Good Morning America*, as well as in the written media: *Life* and *USA Today*.

We are contacting parents and their children to participate in a study investigating emotion and behavior in boys 8-12 years of age. The funding for this project is provided by the National Institute of Mental Health (National Institutes of Health).

Upon receiving the completed questionnaire (enclosed) from you, we may contact you by phone to provide you with greater detail and to invite you to participate in the first part of our study. Families will be compensated \$10.00 for participating in the first part of the study, and if selected, families will be compensated \$40.00 for their participation in the second part of the study. Please note that returning the enclosed questionnaire does not commit you to our project in any way and all information provided will be kept private and confidential.

If you have any questions, please feel free to contact us at (301) 405-8249. We do appreciate your time, interest, and any information you can provide us with. Thank you very much.

Sincerely,

Nathan Fox, Ph.D.  
Professor of Human Development

Michael J. Crowley, M.A.  
Doctoral Candidate  
Clinical Psychology

## Appendix D Child Survey

### University of Maryland – Child Development Lab

Child's birth date: \_\_\_\_\_

Child's gender: Female \_\_\_\_ Male \_\_\_\_

Child's full name: \_\_\_\_\_

Child's sibling order: Child is \_\_\_\_ of \_\_\_\_ (ex. 1<sup>st</sup> of 3)

Was your child born within 2 weeks of her/his due date? Yes \_\_\_\_ No \_\_\_\_

What was your child's method of delivery? Natural \_\_\_\_ Cesarean Section \_\_\_\_ Other \_\_\_\_

If "other", please explain: \_\_\_\_\_

Did you and/or your child experience any birth complications? Yes \_\_\_\_ No \_\_\_\_

If "yes", please explain: \_\_\_\_\_

How many days did your child spend in the hospital after birth? \_\_\_\_\_

Has your child experienced any serious illnesses or problems in development since birth?

Yes \_\_\_\_ No \_\_\_\_

If "yes", please explain: \_\_\_\_\_

Has your child received long-term medication? Yes \_\_\_\_ No \_\_\_\_

If "yes" please explain: \_\_\_\_\_

**Parent's education:** *Mother:*

\_\_\_\_ High School Graduate

\_\_\_\_ College Graduate

\_\_\_\_ Graduate School Graduate

\_\_\_\_ Other

*Father:*

\_\_\_\_ High School Graduate

\_\_\_\_ College Graduate

\_\_\_\_ Graduate School Graduate

\_\_\_\_ Other

**Parent's employment:** *Mother:* \_\_\_\_\_ hours/week *Father:* \_\_\_\_\_ hours/week

**Ethnic Group:** *Mother:*

\_\_\_\_ African-American

\_\_\_\_ Asian

\_\_\_\_ Caucasian

\_\_\_\_ Hispanic

\_\_\_\_ Other

*Father:*

\_\_\_\_ African-American

\_\_\_\_ Asian

\_\_\_\_ Caucasian

\_\_\_\_ Hispanic

\_\_\_\_ Other

**Child's Handedness:** Left \_\_\_\_ Right \_\_\_\_

May we contact you about our research project? Yes \_\_\_\_ No \_\_\_\_

Mother's name: \_\_\_\_\_

Address: \_\_\_\_\_

Phone:           (      )                W (      )

## Appendix E

### General Information Questionnaire

Child's Race:       Caucasian                       African American                       Hispanic  
                           Asian                                       Native American                       Other

Child in custody of (check one):       biological parents       adoptive parents  
 biological mother only       biological father only       other relative  
(specify) \_\_\_\_\_  court / child welfare services       other primary caretaker of  
child \_\_\_\_\_

Number of adults living in child's home \_\_\_\_\_  
Number of children living in child's home \_\_\_\_\_

#### MOTHER OR MOTHER FIGURE

Relationship       Biological mother                       Stepmother                       Adoptive mother to  
child  
                          Foster mother                       Grandmother                       Father's girlfriend  
Age \_\_\_\_\_

Race:               Caucasian                       African American                       Hispanic  
                          Asian                                       Native American                       Other

#### Marital Status:

What is your current marital status?

married     separated     divorced     widowed     single

Were you ever married to the child's biological father?     yes     no

If yes, what is your current marital relationship to that person?

married                       separated                       divorced                       widowed

How many times have you been married? \_\_\_\_\_

#### Educational Level:

less than 7 years     junior high school (grades 7-9)     some high school (grades  
10-11)  high school graduate                       some college or technical school     college  
graduate  
 graduate, professional training (masters degree or beyond)

Occupation: Job Title (present or most recent) \_\_\_\_\_

Job duties \_\_\_\_\_

full-time employment                       part-time employment                       student  
 homemaker                                       currently unemployed

## FATHER OR FATHER FIGURE

Relationship:  Biological father  Stepfather  Adoptive father to child:  
 Foster father  Grandfather  Mother's boyfriend

Age \_\_\_\_\_

Race:  Caucasian  African American  Hispanic  
 Asian  Native American  Other

## Marital Status:

Mom, please answer for the father.

What is the father or father figure's current marital status?

married  separated  divorced  widowed  single

Was the current father figure ever married to the child's biological mother?  yes  
 no

If yes, what is his current marital relationship to that person?

married  separated  divorced  widowed

How many times has the father figure been married? \_\_\_\_\_

## Educational Level:

less than 7 years  junior high school (grades 7-9)  some high school (grades  
 10-11)  high school graduate  some college or technical school  college  
 graduate  
 graduate, professional training (masters degree or beyond)

Occupation: Job Title (present or most recent) \_\_\_\_\_

Job duties \_\_\_\_\_

full-time employment  part-time employment  student  
 homemaker  currently unemployed

## Appendix F

### Items from the Antisocial Process Screening Device

Blames others for his/her mistakes.  
Engages in illegal activities.  
Is concerned about how well he/she does at school or work. (reversed)  
Acts without thinking of the consequences.  
His/her emotions seem shallow and not genuine.  
Lies easily and skillfully.  
Is good at keeping promises. (reversed)  
Braggs excessively about his/her abilities, accomplishments, or possessions.  
Gets bored easily.  
Uses or “cons” other people to get what he/she wants.  
Teases or makes fun of other people.  
Feels bad or guilty when he/she does something wrong. (reversed)  
Engages in risky or dangerous activities.  
Can be charming at times, but in ways that seem insincere or superficial.  
Becomes angry when corrected or punished.  
Seems to think that he/she is better than other people.  
Does not plan ahead or leaves things until the “last minute”.  
Is concerned about the feelings of others. (reversed)  
Does not show feelings or emotions.  
Keeps the same friends. (reversed)

## Appendix G

### Items Assessing Arguing and Fighting and Covert Antisocial Behavior from the Interview for Antisocial Behavior

#### Arguing and Fighting

Temper tantrums?  
Teasing others?  
Using obscene language?  
Talking back to parents?  
Respecting authority?(parents, teachers, other adults)  
A negative attitude, saying "no" often?  
Controlling his/her behavior?  
Moving around and yelling a lot?  
Being cruel, bullying or being mean to others?  
Getting into many fights?  
Getting along with other children?  
Punching, kicking, or biting others?  
Verbally threatening people?  
Getting mad all of a sudden?  
Starting arguments?  
Fighting with brother and sisters?  
Not being able to take turns or wait for something?

#### Covert Antisocial Behavior

Breaking into cars, stores, etc.?  
Breaking windows of buildings, cars, etc.?  
Stealing from stores?  
Stealing from parents or friends?  
Setting fires?  
Being cruel to animals?  
Running away from home overnight?  
Lying?  
Truancy or playing "hookey" from school?  
Inappropriate sexual play?

## Appendix H

### Social Problem Solving Vignettes

1. Pretend that you are standing on the playground playing catch with a kid named Todd. You throw the ball to Todd and he catches it. You turn around, and the next thing you realize is that Todd has thrown the ball and hit you in the middle of your back. The ball hits you hard, and it hurts a lot.
  - a) **Why do you think Todd hit you in the back?**
  - b) **What would you do about Todd after he hit you?**
  
2. Pretend that you see some kids playing on the playground. You would really like to play with them, so you go over and ask one of them, a kid named Alan, if you can play. Alan says no.
  - a) **Why do you think Alan said no?**
  - b) **What would you do about Alan after he said no?**
  
3. Pretend that you are walking to school and you're wearing brand new sneakers. You really like your new sneakers and this is the first day you have worn them. Suddenly, you are bumped from behind by a kid named John. You stumble into a mud puddle and your new sneakers get muddy.
  - a) **Why do you think John bumped you?**
  - b) **What would you do about John after he bumped you?**
  
4. Pretend that you are a new kid in school and you would really like to make friends. At lunchtime you see some kids you would like to sit with and you go over to their table. You ask if you can sit with them and a kid named Carl says no.
  - a) **Why do you think Carl said no?**
  - b) **What would you do about Carl after he said no?**
  
5. Pretend that you go to the first meeting of a club and want to join. You would like to make friends with the other kids in the club. You walk up to some of the other kids and say, "Hi!" but they don't say anything back.
  - a) **Why do you think the other kids don't answer you?**
  - b) **What would you do about the other kids after they didn't answer you?**

6. Pretend that you are walking down the hallway in school. You're carrying your books in your arm and talking to a friend. Suddenly, a kid named Brett bumps you from behind. You stumble and fall and your books go flying across the floor. The other kids in the hall start laughing.
  - a) **Why do you think Brett bumped into you?**
  - b) **What would you do about Brett after he bumped you?**
  
7. Pretend that it is your first day on the track team. You don't know a lot of the other kids and you would like to make friends with them. During practice, you walk up to a group of kids on the team and say, "Hi," but no one answers you.
  - a) **Why do you think the other kids didn't answer you?**
  - b) **What would you do about the other kids after they didn't answer you?**
  
8. Pretend that you and your class went on a field trip to the zoo. You stop to buy a coke. Suddenly, a kid named David bumps your arm and spills your coke all over your shirt. The coke is cold, and your shirt is all wet.
  - a) **Why do you think David bumped into you?**
  - b) **What would you do about David after he bumped into you?**

## Appendix I

### Harm Avoidance Items from the Multidimensional Anxiety Scale for Children

I usually ask permission  
I keep my eyes open for danger  
I try hard to obey my parents and teachers  
I check things out first  
I try to do things other people will like  
I stay away from things that upset me  
I try to do everything exactly right  
If I get upset or scared, I let someone know right away  
I check to make sure things are safe

## Appendix J

### Thrill and Adventure Seeking Items from the Sensation Seeking Scale for Children

1. A: I'd like to try mountain climbing.  
B: I think people who do dangerous things like mountain climbing are foolish.
2. A: I'd never do anything that's dangerous.  
B: I sometimes like to do things that are a little scary.
3. A: I think riding fast on a skateboard is fun.  
B: Some of the daring acts of skateboard riders seem scary to me.
4. A: I would not like to learn to fly an airplane.  
B: I think it would be fun to learn to fly an airplane.
5. A: I don't like to swim in water that is over my head.  
B: I like to swim in deep water.
6. A: I would like to try jumping from a plane with a parachute.  
B: I would never try jumping from a plane with a parachute.
7. A: Sailing on the ocean in a small boat would be dangerous and foolish.  
B: I think it would be fun to sail on the ocean in a small boat.
8. A: I think skiing fast down a snowy mountain would be dangerous.  
B: I think skiing fast down a snowy mountain would be exciting and fun.
9. A: I'd never touch a bug or snake.  
B: Bugs or snakes are fun to hold and play with.
10. A: I enjoy the feeling of riding my bike fast down a big hill.  
B: Riding my bike fast down a big hill is too scary for me.
11. A: Riding dirt-bikes or motorcycles seems like a lot of fun.  
B: It seems scary and dangerous to ride dirt-bikes or motorcycles.
12. A: I like to do "wheelies" on my bike.  
B: Kids who do "wheelies" on their bikes will probably get hurt sometime.

**Appendix K**

Film Affect Ratings completed for each of the films.

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	Not at all	A little bit	Quite a bit	Very
Interested	1	2	3	4
Sad	1	2	3	4
Happy	1	2	3	4
Angry	1	2	3	4
Upset	1	2	3	4
Scared	1	2	3	4

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## Appendix L

### Door Opening Task

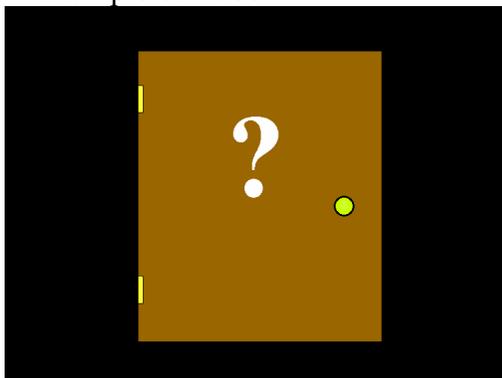
In this Game, you will see a bunch of doors on the computer screen – one at a time. Each door will have a question mark on it. Behind some of the doors are happy faces, and behind some of the doors, are sad faces. You can take a chance and open the door by pressing the right button. (point) If a happy face is behind the door, you will win a nickel. If a sad face is behind the door, you will lose a nickel. You must open the doors in the order that the computer gives them to you. You can't skip any doors, BUT you can stop playing this game any time you want. Just tell me that you want to stop.

Once you decide to stop, I will write down how much money you made and you can exchange it for a prize at the end. You will start with 12 nickels.

Do you have any questions before we start?

Remember, you have to tell me when you want to stop.

1. Example of a door.



2. Example of a happy face leading to a reward.



3. Example of a sad face, leading to a punishment (loss of a coin on the screen).



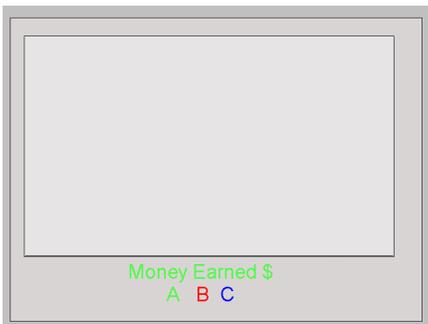
4. Current number of coins are presented (updated) after each smile or frown.



## Appendix M

### Point Subtraction Game

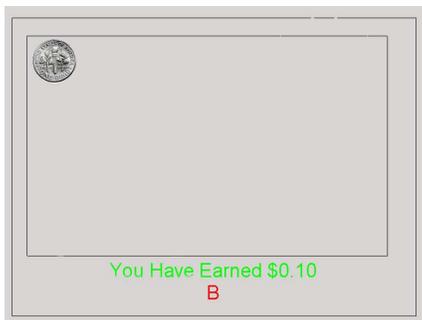
#### 1. Initial screen



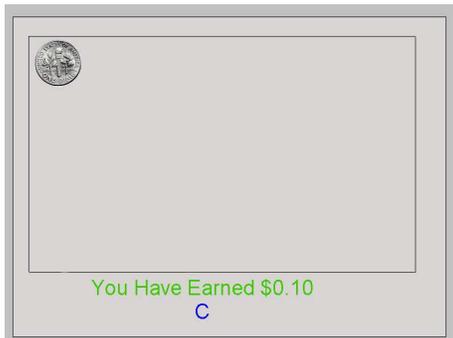
#### 2. A screen in which "A" has been selected and the process of earning a reward was initiated.



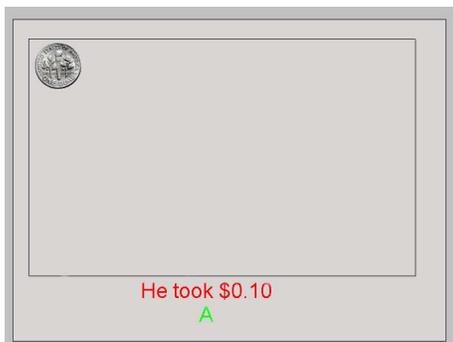
#### 3. A screen in which "B" has been selected and the process of subtracting a reward from a hypothetical peer is initiated.



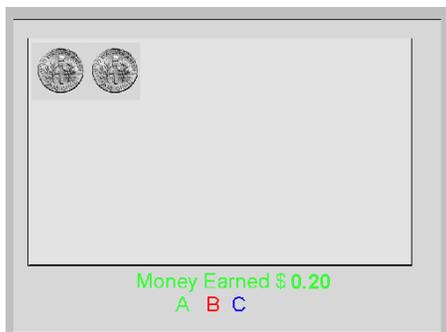
4. A screen in which “C” has been selected and the process of protecting winnings is initiated.



5. A screen in which provocation has occurred (loss of a coin).



6. A screen in which earnings are displayed and the three response options are available (following completion of a previously chosen option, A or B or C).



## Appendix N

### EMG Startle Amplitude for Safety and Threat within the Airpuff Paradigm

The data analytic approach for the startle amplitude data consisted of an omnibus repeated measures MANOVA with condition (safe, threat) and probe time (4.0 vs. 7.0 s) as repeated factors. The means and standard deviations for the startle amplitude data are presented in Table 4. This analysis revealed a significant main effect for Condition (Roy's Largest Root  $F(1, 77) = 57.91, p < .001, \eta^2 = .44$ ). Across participants, startle amplitude tended to be greater under the threat condition than the safe condition. The interaction of condition x probe time was significant ( $F(1, 77) = 22.07, p < .001, \eta^2 = .23$ ), supporting the a priori plan to assess the safe and threat conditions separately. Figure X depicts this interaction. The means for the startle amplitude data during safe (4.0 s and 7.0 s) and threat (4.0 s and 7.0 s) are presented graphically in Figure X.

Startle Amplitude for Safety and Threat within the Air Puff Paradigm. For the safe condition, a repeated measures MANOVA with probe time (4.0 vs. 7.0 s) as repeated factors, group (High APSD, Externalizing, Comparison) as the between subjects factor, and mean startle amplitude as the dependent measure revealed a significant main effect for probe time (Roy's Largest Root  $F(2, 75) = 22.50, p < .001, \eta^2 = .26$ ). Across participants, startle amplitude tended to decrease from the early to the late probe time during safety. The probe time x group interaction was not significant (Roy's Largest Root  $F(2, 75) = 1.57, ns, \eta^2 = .05$ ), indicating that the groups showed comparable changes in startle amplitude across 4 s and 7 s during the safe condition (Figure X).

For the threat condition, a repeated measures MANOVA with probe time (4.0 vs. 7.0 s) as repeated factors, group (High APSD, Externalizing, Comparison) as the between subjects factor, and mean startle amplitude as the dependent measure revealed a significant main effect for probe time (Roy's Largest Root  $F(2,75) = 3.67, p < .06, \eta^2 = .05$ ). Across participants, startle amplitude tended to increase from the early to the late probe time during threat. The probe time x group interaction was also significant (Roy's Largest Root  $F(2, 75) = 5.21, p < .05, \eta^2 = .13$ ), indicating that the groups showed differential changes in startle amplitude across 4 s and 7 s (Figure X).

Planned comparisons at 4 s during threat, did not detect differences in startle reactivity between the High APSD boys and either the Comparison boys ( $t(75) = -1.77, ns$ ), or the Externalizing boys ( $t(75) = .66, ns$ ). A post hoc analysis suggested a trend whereby clinically referred boys (High APSD and Externalizing) startled less than Comparison boys ( $t(75) = 1.78, p < .06$ ) at 4 s during threat. At 7 s during threat there was a significant difference among group means ( $F(2, 75) = 4.36, p < .05, \eta^2 = .11$ ). Planned comparisons at 7 s during threat detected differences in startle reactivity between the High APSD boys and both the Comparison boys ( $t(75) = 2.87, p < .01$ ), and the Externalizing boys ( $t(75) = 2.40, p < .05$ ). A post hoc analysis indicated that the Externalizing boys and the comparison boys were not significantly different from one another ( $t(75) = .85, ns$ ). Pairwise comparisons for startle probe amplitude from 4 s to 7 s during threat revealed that the High APSD group showed a significant increase in startle reactivity (difference  $M = -5.85, SD = 7.82, F(1, 14) = 8.41, p < .01, \eta^2 = .38$ ). The Externalizing group did not change significantly in startle amplitude (difference  $M = -1.28, SD = 7.49, F(1,39) = 1.11, ns$ ) and the Comparison group showed a decrease in

startle amplitude that was not significantly different over the times assessed (difference  $\underline{M} = 1.97$ ,  $\underline{SD} = 6.63$ ,  $\underline{F} (1, 22) = 2.03$ ,  $\underline{ns}$ ,  $\eta^2 = .08$ ).

## Appendix O

### Supplementary Regression Analyses from a Dimensional Perspective

A Dimensional Approach to the Study of Conduct Problem Behavior. The goal of this section was to examine relations between severe conduct problems and measures of physiological reactivity and behavior. Specifically, this section examines the predictive power of variables from the Fear reactivity and the Reward seeking and Approach-withdrawal domains in accounting for variability psychopathic characteristics, externalizing symptoms, oppositional defiant symptoms, and callous-unemotional traits. Among the many criterion variables selected for exploration with a dimensional approach, these were selected for the following reasons: The APSD served as the core criterion variable for the categorical approach and thus the use of this measure from a dimensional perspective achieves symmetry with the main thrust of the thesis. The Externalizing symptom score was chosen because, among the measures of conduct problems collected within this study, this measure represents a broader spectrum of functioning than the APSD and one that is more strongly grounded in behavioral referents than the APSD. The second two measures were chosen because they reflect emotional characteristics that figure prominently among children with conduct problems and disruptive behavior disorders, namely anger/irritability (oppositional defiant symptoms) and emotional callousness (callous-unemotional traits).

A Dimensional Approach to the Antisocial Process Screening Device. From the Fear reactivity domain, startle change during threat, startle change during safety and harm avoidance emerged as independent variables that accounted for variability within the clinical and comparison samples. From the Reward seeking and approach-withdrawal

domain, reward seeking on the point subtraction game (first half) and resting frontal EEG asymmetry accounted for variability within the clinical and comparison samples. These variables served as predictors within a regression model (Table 27). The full model accounted for 17% of the variance in PSD score ( $F(5, 78) = 3.19, p < .01$ ). However, only change threat and change safe emerged as significant predictors within this model (Table 17). When the same regression analysis was conducted with backward elimination, only startle change during threat and startle change during safe remained in the model ( $R^2 = .12, F(2, 83) = 5.73, p < .01$ ). This model was comparable to that arrived at earlier when the individual startle variables were used to predict the APSD total score. In that model, the interaction term did not contribute significantly to the model (Table 6).

A Dimensional Approach to Externalizing Problems. The set of variables used to in the previous section were examined as predictors of externalizing problem severity utilizing the CBCL externalizing t-score as a dependent measure within a regression model (Table 28). In this analysis, the full model accounted for 25% of the variance in externalizing behavior problems ( $F(5, 83) = 5.63, p < .001$ ). In this model all five predictors (startle change during threat, startle change during safety, harm avoidance, reward seeking on the point subtraction game (first half) and resting frontal EEG) remained as statistically significant or as statistical trends. Interaction terms did not contribute significant variance beyond the individual predictors ( $F(10, 68) = 1.47, ns$ ) and none of the interaction terms entered significantly into the model above and beyond the individual predictor variables (all  $t_s < 1.5, ns$ ).

A Dimensional Approach to the study of Oppositional Defiant Disorder

Symptoms. Given the body of literature supporting the conception of anger as an approach motivation (Harmon Jones & Allen, 1998), we sought to account for the variability within oppositional defiant disorder symptoms relying on the five predictors used in the previous model. In this regression analysis (Table 29), the full model accounted for 23 % of the variance in oppositional defiant symptoms ( $F(5, 78) = 4.54, p < .001$ ). Regression analysis with backward elimination yielded a 4-variable model (excluding harm avoidance) and accounted for 21 % of the variance in oppositional defiant symptoms ( $F(4, 79) = 5.10, p < .001$ ). First order interaction terms did not enter significantly into the model.

A Dimensional Approach to the Study of Emotional Callousness. Frick and colleagues have emphasized the importance of emotional callousness as correlate of severe conduct problems. Furthermore, they propose that callous-unemotional traits should be negatively associated with indices of fearful reactivity. Drawing on past work that suggests that ratings of fear, punishment sensitivity, and aversive reactivity each reflect aspects of fearful reactivity, analyses within this section draw upon measures collected across the assessment battery with the goal of predicting emotional callousness. Specifically, harm avoidance (trait fearfulness), startle reactivity change during the airpuff task (aversive reactivity), and number of doors opened during the door-opening task (punishment insensitivity), and their interaction terms were used to predict the callous-unemotional factor of the APSD. Although the door-opening task was initially used as an indicator of reward seeking and has been operationalized as a measure of reward dominance by other investigators, we included this measure because punishment

(response cost) is also an aspect of the task and because of the simple relation between doors open and callous-unemotional traits within this study. A multiple regression with backward elimination was computed with harm avoidance, number of doors, startle change safe and startle change threat (Table 30). On the first step, the block of fearful reactivity variables significantly predicted callous-unemotional traits, accounting for 20% of the variance ( $F(3, 97) = 6.26, p < .01$ ). Harm avoidance, number of doors and startle change during safety each contributed unique variance to the prediction. Startle change during threat was the only predictor that did not enter significantly into the model ( $\Delta F(1, 90) = 1.47, ns$ ). A second set of regression analyses that included the three significant predictors and their first order interaction terms indicated that the interaction terms did not contribute significant variance to the model ( $\Delta F(3, 86) = .20, ns$ ).

Summary of the Dimensional Approach. In summary, the four dependent measures (APSD score, externalizing problems, oppositional defiant symptoms, and callous-unemotional traits) related to a different degree to the predictor variables examined in regression models. Startle change during safety and startle change during threat were the only variables that emerged as significant predictors of the APSD total score. Externalizing behavior problems by contrast, were significantly predicted by both the startle variables, as well as by harm avoidance, reward seeking during the Point Subtraction game rewards earned, and resting frontal asymmetry. Oppositional defiant symptoms were significantly predicted by reward seeking during the Point Subtraction game and both the startle variables. Resting frontal EEG asymmetry emerged as a statistical trend ( $p < .06$ ). Callous-unemotional traits were predicted by harm avoidance, number of doors on the door-opening task and startle change during safety.

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