

Reward Dominance: Associations with Anxiety, Conduct Problems, and Psychopathology in Children

Bridget S. O'Brien¹ and Paul J. Frick²

The associations between children's behavior and their performance on a task with a steadily increasing ratio of punished to rewarded responses was investigated in a group of clinic-referred ($n = 92$) and normal control ($n = 40$) children between the ages of 6 and 13. Clinic-referred children with an anxiety disorder played significantly fewer trials than clinic-referred children without an anxiety disorder but the response style of the anxious children did not differ from that of a normal control group. Children with severe conduct problems who had no anxiety disorder played more trials than (a) children with severe conduct problems and a comorbid anxiety disorder, (b) nonanxious children with attention-deficit hyperactivity disorder, and (c) children in the normal control group. The strongest evidence for the reward dominant response style was for nonanxious subjects with elevations on a measure of psychopathic features, irrespective of whether they also had conduct problems and irrespective of whether they were clinic-referred.

Gray (1970, 1976, 1982) has proposed a psychobiological theory of personality which has been quite influential to research on psychopathology (e.g., Fowles, 1988; Newman & Wallace, 1993; Raine, 1993). Gray proposed that behavioral patterns are related to the activity of two subsystems of the brain. The Behavioral Inhibition System (BIS) produces anxiety and inhibits ongoing behavior in the presence of novel stimuli, innate fear stimuli, and signals of nonreward or punishment. The Behavioral Activation System (BAS) activates behavior in response to cues of reward or nonpunishment.

Manuscript received in final form January 11, 1995.

We would like to thank the staff of the Alabama School-Aged Assessment Service and the Tuscaloosa County School System for their help in data collection. We would like to especially acknowledge the help of John Gurley in data collection.

¹University of Alabama, Tuscaloosa, Alabama 35487.
²Address all correspondence to Paul J. Frick, Ph.D., Department of Psychology, University

The BAS is antagonistic to the operation of the BIS and therefore behavioral patterns result from the relative balance of the two neural systems.¹

Gray (1976, 1982) has focused a great deal of his theoretical formulations on explaining anxious avoidance, which in his theory results from a dominant BIS relative to the BAS. However, other authors have applied Gray's theory to understanding people who show chronic patterns of antisocial behavior (e.g., Fowles, 1988; Gorenstein & Newman, 1980; Newman & Wallace, 1993; Raine, 1993), predicting the opposite balance of the two neural systems for antisocial individuals. From this theory, one would predict that antisocial individuals would have a "reward-dominant" style in which their behavior is more dependent on appetitive drives than on avoidance of punishment. Specifically, one would predict that antisocial individuals would be more likely than nonantisocial individuals to persist in a previously rewarded response, even if the rate of punishment for this response increased.

Support for this prediction comes from several studies of prisoners who scored high on ratings of psychopathy (Newman & Kosson, 1986; Newman, Patterson, & Kosson, 1987). Subjects were placed in a situation with competing rewards and punishments. They played a computerized card game which required a choice on each trial either to view the next card or to stop playing. With each winning card, the subject won money; losing cards resulted in monetary loss. Over 100 trials, the probability of finding a winning card in 10 dropped from 90% to 0%, thereby increasing the ratio of punished to rewarded responses over the course of the game. Consistent with the prediction of a reward-dominant response style, psychopathic prisoners chose to view significantly more cards than nonpsychopathic prisoners (Newman & Kosson, 1986; Newman et al., 1987).

Several studies have replicated these results in samples of antisocial children and adolescents (Daugherty & Quay, 1991; Newman, Widom, & Nathan, 1985; O'Brien, Frick, & Lyman, 1994; Scerbo et al., 1990; Shapiro, Quay, Hogan, & Schwartz, 1988). These studies which have tested the reward dominance paradigm with children and adolescents are important for extending Gray's theory to understanding childhood psychopathology. However, there are several important issues left unanswered in this growing body of research. First, most studies have focused on antisocial youth and have paid very little attention to the role of anxiety in children's performance on the reward dominance task. As previously mentioned, anxiety plays a major role in Gray's theory as a marker of the BIS. Daugherty and Quay

¹Gray's theory is a "psychobiological" theory because specific neural subsystems are proposed to underlie the BIS and the BAS. A discussion of the neuroanatomical basis of the subsystems is beyond the scope of this article and the reader is referred to Gray (1982) for a more detailed discussion of this research.

(1991) found that a small group of anxious children ($n = 9$) played significantly fewer trials on the reward dominance task than children with conduct disorder (CD), suggesting a greater sensitivity to the increasing rate of punishments in anxious children. However, the anxious children did not differ significantly from normal control children.

More importantly for understanding the response style of antisocial children, studies have failed to test the potential moderating effect of anxiety on the response style of antisocial children. This interaction is important because anxiety and conduct problems show a high rate of overlap in both community and clinic samples (Russo & Beidel, 1993). However, most studies using the reward dominance paradigm have defined antisocial youth in such a way as to eliminate those who were also anxious. For example, both the Shapiro et al. (1988) and Daugherty and Quay (1991) studies defined children with CD as having an elevation on the CD scale of the Revised Behavior Problem Checklist (RBPC; Quay & Peterson, 1983) and no additional scale elevations. As a result of this methodology, it is unclear whether a reward-dominant response style is characteristic of children with CD in general, or whether it is specific to those children with CD and no cooccurring anxiety disorder.

In a sample of prepubertal boys, we provided a preliminary test of the interaction of anxiety and behavior problems in predicting children's response style (O'Brien et al., 1994). Using a reward dominance task similar to the ones used in previous research with children, we found that children with disruptive behavior disorders showed a reward-dominant response style only when elevated levels of anxiety were controlled. These findings provide preliminary support for the contention that reward dominance is only characteristic of CD children without significant levels of anxiety. However, the small sample used in this study, especially the small number of children with significant levels of anxiety ($n = 8$), makes replication of these results important.

A second and related issue is whether or not the reward-dominant style is associated with psychopathy, antisocial behavior, or both. Psychopathy and antisocial behavior are often considered interchangeable terms. However, Hare and colleagues (Hare, Hart, & Harpur, 1991; Harpur, Hare, & Hakstian, 1989) have demonstrated that the interpersonal and affective styles which characterize psychopathy (e.g., lack of guilt, lack of empathy, superficial charm) are at least partially independent of criminal and antisocial behavior. The independence of these constructs has also been demonstrated in children (Frick, O'Brien, Wootten, & McBurnett, 1994).

The distinction between psychopathy and antisocial behavior seems to be especially critical in the study of reward dominance. In a recent review summarizing reward dominance studies in adults, Newman and Wallace

(1993) concluded that a reward dominance response style is more clearly related to psychopathic features than to antisocial behavior in general, suggesting that antisocial behavior may be more "etiologically heterogeneous" (p. 707). In studies of youth, the specific association between response style and psychopathic features has not been tested explicitly. However, given that the absence of anxiety is a crucial part of the definition of psychopathy (Hare et al., 1991), one might speculate that by focusing on children with CD who are not anxious, reward dominance studies have tended to define children who more closely correspond to traditional definitions of psychopathy.

A final issue that is important in understanding reward dominance in children is whether or not there are features of the experimental task which may influence children's response styles. Newman et al. (1987) found that when a visual display of cumulative feedback (money won and lost) was presented to subjects along with a 5-sec pause between opportunities to respond, psychopathic prisoners did not differ from controls on the reward dominance task. The authors concluded that the pause interrupted the subjects' response set and increased their use of the visual feedback. Unfortunately, it is unclear whether it was the cue, the pause, or the combination of the two which was crucial to the change in performance.

The present investigation was designed to begin to address these issues, which are crucial for understanding the association between psychopathology and a child's response style on a task of competing rewards and punishment. Specifically, several predictions based on Gray's theory were tested. First, because of their greater sensitivity to cues of punishment, children with anxiety disorders were predicted to play fewer trials on the reward dominance task than nonanxious clinic-referred children and nonanxious normal control children. Second, children with conduct problems were predicted to play more trials despite increasing rates of punishment than other clinic-referred children and normal control children. However, based on our previous study (O'Brien et al., 1994) and based on the increased sensitivity to punishment predicted to be associated with anxiety, we predicted that this pattern would only be found for children with conduct problems without cooccurring anxiety disorders. Our explanation for this second prediction was that, by defining children with conduct problems in such a way as to eliminate children with cooccurring anxiety, we would come closer to approximating traditional definitions of psychopathy. Therefore, our third prediction was that children who showed psychopathic features would show the clearest evidence of a reward dominance style, irrespective of whether or not they also exhibited significant conduct problems. Fourth, we predicted that the combination of visual feedback and a forced pause would increase the sensitivity of children to the increasing rate of punishment, causing them to play fewer trials on the reward dominance task.

METHOD

Subjects

Subjects were 100 children between the ages of 6 and 13 ($M = 8.77$, $SD = 1.89$). Ninety-two subjects were children referred to a university-based outpatient diagnostic and referral service from 1990 to 1993. The initial pool of subjects was 100 consecutive referrals. Four subjects were excluded from the analyses because of mental retardation. Another four subjects were excluded because the reward dominance task was improperly administered (i.e., the child was allowed to skip an entire game). The remaining 40 subjects formed the normal control group. They were recruited from classes in the local public school system. Exclusionary criteria for the control groups were scores above 67T on any scale of the Child Behavior Checklist (CBCL; Achenbach, 1991), placement in special classes, or previous mental health treatment. Approximately 400 letters and consent forms were given to teachers to send home with children. CBCL forms were sent home with the 151 children who returned the consent form. Forty-one children who returned completed CBCL forms met our inclusionary criteria. One subject was dropped from analyses because he failed to play more than five trials across all conditions of the reward dominance task. This was felt to be insufficient data on which to estimate his response style. Demographic information for both the clinic and normal control groups are provided in Table I. The two groups did not differ significantly on any of these demographic variables.

Table I. Demographic Characteristics of the Clinic and Control Groups^a

	Clinic (n = 92)	Normal (n = 40)
Mean Age (SD)	8.71 (2.01)	8.91 (1.55)
Gender (% male)	79	80
Ethnicity (% white)	78	65
Mean full-scale IQ (SD)	94.67 (13.82)	
Mean family income (SD)	27,485 (24,386)	

^aFull-scale IQ was measured by the Wechsler Intelligence Scale—Revised (Wechsler, 1974). Intelligence and family income were obtained for the clinic sample only.

Diagnosis of Children

Diagnostic groups were formed among the clinic subjects based on combined parent, teacher, and child reports on the National Institute of Mental Health (NIMH) Diagnostic Interview Schedule for Children (DISC 1.5; Shaffer, Fisher, Piacentini, Schwab-Stone, & Wicks, 1992). Child-reported symptoms for the DISC (DISC-C) were used only for children 9 years of age and older, as the reports of younger children on structured interviews have not been shown to be reliable (Edelbrock, Costello, Dulcan, Kalas, & Conover, 1985). Symptoms were considered present if endorsed by any informant, as recommended by Piacentini, Cohen, and Cohen (1992) as the preferred method of combining symptoms across multiple informants. Children were placed into three overlapping groups based on strict application of DSM-III-R criteria (American Psychiatric Association, 1987). Children with diagnoses of simple phobia, social phobia, overanxious disorder, avoidant disorder, or separation anxiety were included together in the anxious (ANX) group. Children with diagnoses of oppositional defiant disorder (ODD) and conduct disorder (CD) were included together in the conduct problem (CP) group. Children with diagnosis of attention-deficit hyperactivity disorder (ADHD) without conduct problems formed an ADHD group.

Interviewers were advanced graduate students in clinical psychology who had completed at least two courses in psychological assessment and who had been trained in standardized administration of the DISC. Forty-one percent of the parent interviews and 45% of the child interviews were observed through one-way mirrors and independently coded by the observer. Kappa statistics were used to determine interviewer and observer agreement on diagnoses, if the diagnosis was coded at least twice by either the interviewer or observer. Kappas for ODD, CD, and ADHD according to parental report were all 1.0. For the parent-reported anxiety disorders, kappas ranged from .78 to 1.0, with a median value of .94. Kappa's for child report of ODD and ADHD were also 1.0 but there were too few instances of CD reported when an observer was present to calculate kappas for child reports of this diagnosis. The only child-reported anxiety disorder for which kappas could be reported was for simple phobia ($\kappa = .94$).

In addition to checking the reliability of diagnoses, we also tested the validity of groups formed from our diagnostic procedures. Children with an anxiety disorder were compared with all nonanxious clinic control children and the normal control group. These groups differed significantly on the Anxiety/Depression scale of the parent-completed CBCL (Achenbach, 1991) [$F(2, 131) = 22.26, p < .001$], with the anxiety disorder group ($M = 7.67, SD = 5.6$) differing significantly from both the nonanxious clinic control ($M = 3.37, SD = 3.6$) and the normal control ($M = 2.32, SD = 2.31$).

groups. Next, children with either an ODD or CD diagnosis were compared to children with an ADHD diagnosis and normal control children. The groups differed on both the Aggression [$F(2, 115) = 37.76, p < .001$] and Delinquency [$F(2, 115) = 14.06, p < .001$] scales of the CBCL. Children with diagnoses of ODD/CD had higher scores on both the Aggression ($M = 15.58, SD = 5.5$) and Delinquency ($M = 5.75, SD = 5.0$) scales than the other two groups of children.

Psychopathy Ratings

The Psychopathy Screening Device (PSD; Frick & Hare, *in press*) is a 20-item rating scale completed by a child's parent and teacher. The PSD was designed to measure the essential characteristics of psychopathy in a way that is analogous to the Psychopathy Checklist—Revised (Hare, 1991), which has been used extensively in research with adults. A previous study using the PSD in children found evidence for two factors: a Callous/Unemotional factor and an Impulsivity/Conduct Problems factor (Frick et al., 1994). A six-item scale derived from a unit weighting of items that loaded significantly on the Callous/Unemotional factor was used as a measure psychopathic traits in this study. A child's score on this scale was determined by summing the ratings on each item from the parent and teacher forms. The coefficient alpha for unstandardized variables for this scale using a combination of parent and teacher report was .81 in the full sample.

Reward Dominance Task

A computer task was designed to measure reward dominance using the same paradigm as employed in past research (e.g., Daugherty & Quay, 1991; Newman et al., 1987). However, the task was modified to include four games which varied along the two within-subjects conditions described below. In order to maximize motivation for points, subjects were allowed to view three prize boxes prior to playing the games. Each box listed the range of point totals needed to choose a prize from that box. The most appealing and expensive prizes were contained in a box requiring near optimal performance across all games. The box requiring the lowest point totals contained only stickers. Subjects were instructed that they could stop at any time and exchange their points for a prize.

Following the viewing of prizes, each subject was instructed to play four simple games on a computer. Each game was set up in the same manner: a stimulus (card, door, box, or person with a fishing pole) appeared on the screen and the child chose whether to press a key to view what was on the

other side of the card (behind the door, under the box, or on the fishing pole), or to press a key to stop the game and receive the points earned to that point. In each game, there was a successful outcome (happy face, plus sign, hidden object, or fish) and an unsuccessful outcome (sad face, minus sign, empty box, no fish). Each child began each game with 50 points, and a point was added or taken away based on the outcome of each trial. Over 100 trials, the rate of rewarded outcomes per 10 trials dropped from 90% to 0%. The number of trials played in each game was recorded by the computer and used as the dependent variable in all analyses.

The two within-subject conditions (cue vs. no-cue and pause vs. no-pause) were counterbalanced across the four stimulus games. In the cue condition (C), a tally of the child's points was displayed on the screen and continuously updated as the game proceeded. In the no-cue condition (NC), the child was shown a tally of points before and after the game but received no feedback on point totals during the game. In the pause condition (P), a 5-sec pause occurred between the outcome of each trial and the child's next opportunity to respond. In the no-pause condition (NP), a 1-sec pause prevented continuous responding. The games always appeared in the same order (card, door, box, fishing). However, the order of presentation of the conditions was counterbalanced across subjects within the clinic and normal samples in a Latin squares design.

Procedure

All clinic subjects were accompanied to the evaluation by at least one custodial parent, in most cases the child's mother. Following parental consent and child assent, each subject was assessed during a 5- to 8-hour period. Subjects were first administered the Wechsler Intelligence Scale for Children—Revised (WISC-R; Wechsler, 1974) to screen for mental retardation. Following a break for lunch, subjects over age 9 were administered the DISC-C. All other subjects started the computer task immediately following lunch. The computer task was administered in a quiet office with one experimenter present. Experimenters were undergraduate students majoring in psychology and receiving course credit for their participation in the project. They were blind to the results of the DISC interviews and referral questions. Students were given detailed written instructions to follow during the administration of the computer task. Each child played two games before completing a series of questionnaires, then returned to play the final two games. While the child was being tested, the parents were administered an unstructured interview to obtain demographic information and the parent DISC (DISC-P). Following these interviews, they completed

the PSD and the CBCL. The DISC for teachers (DISC-T) was administered by phone to the child's teacher during the week following the assessment and the PSD was mailed to the child's teacher to complete and return in a self-addressed stamped envelope.

Normal control subjects were tested at the child's school during school hours, with parental consent and child and teacher assent. The reward dominance task was administered in a quiet room with one trained experimenter, who was an undergraduate major in psychology. The same prize boxes and same instructions were used for normal control subjects as were used for the clinic subjects. The child Matching Familiar Figures Test (MFFT; Kagan, 1966) was administered after the first two games, as an interference task, to equate the procedures employed with the clinic subjects.

RESULTS

Preliminary Analyses

Preliminary analyses were conducted to test for the effects of possible confounding variables. A series of two-way analyses of variance were conducted to test for an effect for the order of presentation of the within-subjects conditions and possible Order \times Diagnostic Group interactions. Although the order of presentation was counterbalanced within the clinic and normal control sample, the task was administered without knowledge of the child's subsequent diagnosis. Therefore, it was important to determine if we should control for order of presentation in comparisons within the clinic sample. This did not seem necessary because there was no main effect for order of presentation and there were no Order \times Diagnostic Group interactions for any method of dividing the clinic sample employed in subsequent analyses.

Among the 92 clinic subjects, the correlation between full-scale IQ and total trials was not significant ($r = .12$). In addition, the number of trials played on the reward dominance task was uncorrelated with two measures of impulsivity. First, within the clinic sample, each child was assigned a composite score based on the number of symptoms of impulsivity from the DSM-III-R definition of ADHD reported as present by either parent, child, or teacher.* Second, parents' rating (0 to 2) on the CBCL item "Acts impulsively"

*The symptoms of impulsivity which formed the composite score were "Difficulty waiting turn in games or group situations," "Frequently blurting out answers before the question is finished," "Often interrupting others or bursting into the activity of others," and "Getting into dangerous physical situations without thinking of the consequences." Within the clinic sample, the number of symptoms of impulsivity was significantly correlated with parental report on the CBCL item "Acts impulsively" (.38, $p < .001$), providing justification for use of the CBCL item as a measure of impulsivity in the full sample.

"impulsively" was used as a measure of impulsivity in the full sample. Total trials played was not significantly correlated with either measure of impulsivity ($r = -.02$ and $r = .02$, respectively). Also, the two measures of impulsivity were not significantly correlated with the number of trials played when the within-subjects conditions were examined separately (r_s ranging from $-.10$ to $.02$).

Within-Subjects Conditions

Because subjects were exposed to the same contingencies over four different games, the possibility of practice effects were considered. The mean number of trials and points for all subjects across the four games are presented in Table II, showing no consistent change in the number of trials played across games. Also reported in Table II are the overall means and standard deviations for the number of trials played across the four within-subjects conditions. Subjects tended to play fewer trials in conditions with the forced 5-sec pause. As would be expected, in all analyses there was a main effect for the pause condition. However, there were no significant effects of the cue condition and there was no Pause \times Cue interactions as was predicted. Also, there were no consistent interactions between the within subjects conditions and any of the between subjects groupings. Therefore, the subsequent presentation of results focuses only on between-group effects.

Table II. Means and Standard Deviations Across Games and Across Within-Subjects Conditions

	Game 1, Card Playing	Game 2, Door Opening	Game 3, Present Opening	Game 4, Fishing
Mean trials (<i>SD</i>)	64.95 (28.79)	66.77 (27.80)	58.13 (27.71)	59.52 (26.62)
Mean points (<i>SD</i>)	57.72 (10.60)	57.42 (10.24)	60.72 (9.50)	60.67 (9.65)
	No pause, no cue	No pause, cue	Pause, no cue	Pause, cue
Mean trials (<i>SD</i>)	68.87 (26.78)	70.37 (25.80)	54.53 (28.13)	55.58 (27.23)
Mean points (<i>SD</i>)	57.30 (11.04)	56.77 (10.19)	61.27 (9.51)	61.19 (8.66)

Anxiety and Reward Dominance. To study the potential relation of anxiety to performance on our reward dominance task, the clinic group was divided into those children meeting criteria for an anxiety disorder ($n = 57$) and those not meeting criteria for an anxiety disorder ($n = 35$). A 3 (Anxious, Non-Anxious Clinic, Normal Control) \times 2 (Cue) \times 2 (Pause) mixed analysis of variance (ANOVA) revealed a main effect for diagnostic group [$F(2, 129) = 4.62; p < .01$]. Table III presents a summary of these results. Anxious subjects played significantly fewer trials than the nonanxious clinic children. However, contrary to predictions, the anxious children did not differ significantly from the normal control children.

Conduct Problems and Reward Dominance. The next set of analyses examined the relations between a conduct problem (CP) diagnosis (either CD or ODD) and performance on the reward dominance task taking into account the overlap between a CP diagnosis and the presence of an anxiety disorder. As expected from past research, there was a significant association between a conduct problem diagnosis and anxiety disorder diagnosis [$\chi^2(1, n = 138) = 20.02, p < .001$].⁴

Therefore, children with a CP diagnosis were divided into those with ($n = 25$) and those without ($n = 9$) a comorbid anxiety disorder. The performance on the reward dominance task of these two groups of children were compared to a nonanxious clinic control group of children with ADHD ($n = 18$) and the normal control group ($n = 40$) which was screened for high levels of anxiety. These results are also reported in Table III. In this analysis, the effect for group membership was significant [$F(3,$

⁴Diagnostic comorbidity is a common phenomenon in clinic samples of children (Lahey, Loeber, Quay, Frick, & Grimm, 1992; Spitzer, Davis, Barkley, & Castellon, 1990; Walker et al., 1991). One of the best studied type of comorbidity is the high rate of overlap between ADHD and ODD/CD (Hinshaw, 1987). In our sample, 76% of children with a diagnosis of CD or ODD met criteria for ADHD and 38% of those diagnosed with ADHD met criteria for either CD or ODD, which are rates consistent with past research in clinic samples (see Hinshaw, 1987). A less-well-studied comorbidity, but one critical in the present study, is the comorbidity between conduct problems (CD/ODD) and anxiety disorders. In our sample 44% of the children with an anxiety disorder had a comorbid diagnosis of CD or ODD and 75% of the children with CD or ODD had a comorbid diagnosis of an anxiety disorder. A recent review of the prevalence of this type of comorbidity suggests that these rates of overlap are higher than are typically found in community samples (where figures of 22% and 33% are more common) but they are typical of rates found in severely disturbed clinic samples (Russo & Beidel, 1993). For example, both Walker et al. (1991) and Woolson et al. (1989) found that approximately 75% of the children with either an ODD or CD diagnosis had a cooccurring anxiety disorder in consecutive referrals to an outpatient clinic or to an inpatient psychiatric unit, respectively. We also have data to suggest that this strong association between symptom domains is not specific to DSM-III-R criteria. Specifically, in our sample the Anxiety-Depression scale of the parent-completed CBCL was highly correlated with the CBCL Aggression ($r = .70, p < .001$) and Delinquency ($r = .50, p < .001$) scales.

Table III Between Group Comparisons on Number of Trials Played on the Reward Dominance Task^a

		Nonanxious		Normal	
		control clinic (n = 35)	control (n = 40)	control (n = 40)	Group effect ^b
Mean trials		228.06 ^c (64.44)	284.34 ^b (75.31)	267.80 ^b (87.41)	<i>F</i> (2, 120) = 4.8
SD		(72.55)	(75.59)	(87.41)	
Mean trials	Anxious CD/ODD (n = 9)	Nonanxious ADHD (n = 18)	Nonanxious ADHD (n = 40)	Nonanxious no psychopathy (n = 46)	Group effect ^b
SD	(61.03)	(29.72)	(22.67)	(24.79) ^b (87.41)	<i>F</i> (1, 86) = 1.0 ^d
Mean trials	Nonanxious psychopathy (n = 20)	Anxious psychopathy (n = 37)	Nonanxious no psychopathy (n = 46)	Nonanxious no psychopathy (n = 46)	Group effect ^b
SD	(60.30)	(222.70 ^b (72.69)	(36.04 ^b (91.17)	(36.04 ^b (91.17)	<i>F</i> (2, 109) = 6.1 ^d

^aMean trials are the total number of trials played across all four within subject conditions. Group effect refers to the main effect for the between group condition in the mixed ANOVA design. Means with different subscripts differed between groups at the $p < .05$ level using Duncan's procedure to make pairwise comparisons.

^b $p < .05$.

^c $p < .01$.

^d $p < .001$.

($S = 3.10$; $p < .05$). The nonanxious CP children played significantly more trials than the other three groups of children. Importantly, the response style of the anxious CP children did not differ either from the ADHD or normal control groups.

Psychopathy and Reward Dominance. The final set of analyses were conducted to determine whether scores on a measure of psychopathic features predicted performance on the reward dominance task independent of DSM-III-R diagnosis and clinic status. Again, given the importance of anxiety, children with elevations (greater than 1 standard deviation above the mean of the normal control sample) on the Callous/Unemotional (CU) scale of the PSD were divided into those with ($n = 37$) and without ($n = 29$) a cooccurring anxiety disorder. These two groups were compared to a control group of children who had no elevation on the CU scale and had no anxiety disorder ($n = 46$). These groups were formed irrespective of whether the child was from the normal or clinic sample.

The results of this analysis are reported in Table III. Again, consistent with predictions, nonanxious children who showed psychopathic features played significantly more trials than the other two groups [$F(2, 109) = 6.77$, $p < .001$]. However, further illustrating the moderating effect of anxiety, the anxious children who also showed elevations on the measure of psychopathic features did not differ from the nonanxious control group.

This analysis using the measure of psychopathic features to form groups left two important questions unanswered. First, it is possible that the reward-dominant style for nonanxious children with psychopathic features was due to the presence of severe conduct problems in a significant proportion of this group. Second, the relative contribution of normal and clinic-referred children with psychopathic features to the group effect is unclear from this analysis. To answer the first question, nonanxious children with psychopathic (PSY) features were divided into those with a conduct problem diagnosis (PSY+CP; $n = 8$) and those without a conduct problem diagnosis (PSY-only; $n = 22$). Both groups differed from children without psychopathic traits (Non-PSY; $n = 45$) on the mean number of trials played [$F(2, 72) = 4.30$, $p < .01$]. The mean of the PSY+CP group (310.63) and the mean of the PSY-only group (292.77) differed significantly from the control group mean (243.07) but the response style of the two groups high on psychopathic features was not significantly different.⁶ To address the

⁶Eight of the nine children who had a conduct problem diagnosis without an anxiety disorder were above the cutoff on our measure of psychopathic characteristics. This finding supports our contention that this subgroup of children with conduct problems more closely approximates traditional conceptualizations of psychopathy. However, this meant that there was only one nonanxious child with conduct problems who did not have elevations on the measure of psychopathic features which did not allow for statistical analysis.

second question, the number of trials played by nonanxious clinic-referred children with psychopathic features ($M = 195.73$, $n = 22$) was compared to the number of trials played by normal control children with psychopathic features ($M = 291.43$, $n = 7$). The difference in means was small and not significant. As a result, elevations on the CU scale of the PSD were associated with a reward-dominant response style irrespective of the present of severe conduct problems and irrespective of clinic status.

DISCUSSION

Our results suggest that children's response styles on a task of competing rewards and punishment are largely consistent with the predictions made by Gray's (1970, 1976, 1982) psychobiological theory of personality. First, our results suggest that the presence of anxiety among clinic children increases children's ability to inhibit reward-seeking behavior in the presence of cues to punishment, consistent with Grey's formulation of the activity of the BIS. However, this sensitivity to punishment cues was not as strong as predicted. As Daugherty and Quay (1991) found, anxious children played fewer trials than clinic control children but they did not differ significantly from normal control children.

Stronger evidence for the importance of anxiety, however, came from analyses designed to test the potential moderating influence of anxiety on the response style of children with conduct problems. Consistent with the findings of a preliminary study using an independent sample (O'Brien et al., 1994), children with conduct problems exhibited a reward-dominant response style (i.e., played more trials despite increasing loss of points) only in the absence of a comorbid anxiety disorder. This pattern of findings provides an important point of clarification for interpreting past research which failed to explicitly test the moderating influence of anxiety on reward dominance in children with conduct problems (e.g., Daugherty & Quay, 1991; Shapiro et al., 1988). It suggests that the reward-dominant response style is only evident for a distinct subgroup of children with conduct problems. These findings add to a growing body of research suggesting that the absence of anxiety delineates an important subgroup of children with conduct problems (see Lahey et al., 1992; McBurnett et al., 1991). Our theoretical prediction was that this subgroup of children more closely approximates the construct of psychopathy (Frick et al., 1994). Our findings that the reward-dominant response style is unique to this subgroup supports this contention (Newman & Wallace, 1993).

However, we attempted a more explicit test of the specific link between psychopathic features and the reward-dominant response style. Consistent

with our predictions, our strongest findings for a reward-dominant style emerged when groups were formed on the basis of psychopathic features and the absence of an anxiety disorder. Furthermore, when nonanxious children with psychopathic features were divided into those with and without conduct problems, both groups of children with psychopathic features played more trials on our reward dominance task than children without psychopathic features. These findings suggest that the reward dominance response style was associated with psychopathic features, irrespective of the presence of conduct problems.

It is important to note that simply defining children along psychopathic dimensions, without taking into account the presence of anxiety, did not predict performance on the reward dominance task. This is consistent with the adult literature in which people defined by psychopathic traits can be divided into "primary" and "secondary" psychopaths based on the presence or absence of anxiety (Sutker, Bugg, & West, 1993). Our findings suggest that it is the nonanxious children with psychopathic features (*i.e.*, primary psychopathy) who show the reward-dominant style predicted by Gray's theory. Our interpretation of these findings within the framework of Gray's theory is in terms of a relative balance between the BAS and BIS systems. That is, nonanxious children with psychopathic features show stronger activity of the BAS relative to the BIS, leading to the reward-dominant response style. In children with anxiety and psychopathic features, the activity of the BIS, which is indexed by high levels of anxiety, counteracts any tendency toward reward dominance.

Newman and Wallace (1993) have proposed an interesting alternative theory that could also fit our data. Specifically, a child's failure to respond to increases in the ratio of punishments to rewards could simply reflect a "fundamental deficit in response modulation" (*p.* 707; Newman & Wallace, 1993). This refers to a person's inability to shift goal-directed behavior in response to changes in contingencies once a motivational set has been established. Put simply, nonanxious children with psychopathic features could have played longer on our task simply because any motivational set was established early in the task. In this theory, the difficulty in response regulation may not be specific to reward-dominant motivational sets. We prefer the reward dominance interpretation because it helps to explain the moderating effect of anxiety on children's performance. However, Newman and Wallace (1993) have cogently argued that there may be multiple pathways to disinhibitory syndromes and that nonanxious children with psychopathic features may have different etiological factors (*e.g.*, deficits in response modulation) from anxious children with psychopathic features. Whichever interpretation future research ultimately indicates is most useful, these data

provide additional evidence for extending the concept of psychopathy to children (Frick et al., 1994).

One final aspect of the present study which deserves note is the test of a visual cue and a 5-sec forced pause as potential moderators to a child's response style. There was a strong and consistent main effect for the pause condition. A forced 5-sec pause between opportunities to respond reduced the number of trials played by all subjects, regardless of the presence of a visual cue for point totals and regardless of a child's diagnostic status. This finding suggests that the forced pause is more crucial than the visual cue in reducing response perseveration, a clarification of the results of Newman et al. (1985), at least as they apply to children. One possible interpretation of the effectiveness of the pause condition would be that it prevented impulsive responding. However, measures of impulsivity did not correlate with a child's response style on our task, including response styles in conditions without a forced pause. Further study of potential moderators to the reward-dominant response style is important because of the potential treatment applications for children with antisocial behaviors (see Frick & O'Brien, 1994).

REFERENCES

- Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile*. Burlington: University of Vermont, Department of Psychiatry.
- American Psychiatric Association. (1987). *Diagnostic and statistical manual for mental disorders* (3rd ed., rev.). Washington, DC: Author.
- Daugherty, T. K., & Quay, H. C. (1991). Response perseveration and delayed responding in childhood behavior disorders. *Journal of Child Psychology and Psychiatry*, 32, 453-461.
- Edelbrock, C. S., Costello, A. J., Dulcan, M. K., Kulus, R., & Conover, N. C. (1985). Age differences in the reliability of psychiatric interview of the child. *Child Development*, 56, 255-273.
- Fowles, D. C. (1988). Psychophysiology and psychopathology: A motivational approach. *Psychophysiology*, 25, 373-391.
- Frick, P. J., & Hare, R. D. (in press). *The Psychopathy Screening Device—PSD*. Toronto: Multi-Health Systems.
- Frick, P. J., & O'Brien, B. S. (1994). Conduct disorders. In R. T. Ammerman and M. Hersen (Eds.), *Handbook of child behavior therapy in the psychiatric setting* (pp. 189-216). New York: Wiley.
- Frick, P. J., O'Brien, B. S., Wootton, J. M., & McBurnett, K. (1994). Psychopathy and conduct problems in children. *Journal of Abnormal Psychology*, 103, 700-707.
- Gorenstein, E. E., & Newman, J. P. (1980). Disinhibition psychopathology: A new perspective and a model for research. *Psychological Review*, 87, 301-315.
- Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behavior Research and Therapy*, 8, 249-266.
- Gray, J. A. (1976). The neuropsychology of anxiety. In I. G. Sarason & C. D. Spielberger (Eds.), *Stress and anxiety* (Vol. 3, pp. 3-26). Washington, DC: Hemisphere.
- Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septohippocampal system*. Oxford, England: Oxford University Press.
- Hare, R. D. (1991). *The Hare Psychopathy Checklist—Revised*. Toronto: Multi-Health Systems.
- Hare, R. D., Hart, S. D., & Harpur, T. J. (1989). Psychopathy and the DSM-IV criteria for antisocial personality disorder. *Journal of Abnormal Psychology*, 100, 243-244.

- Hanson, T. J., Hare, R. D., & Haworth, A. R. (1991). Two-factor conceptualization of psychopathy: Construct validity and assessment instruments. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, 3, 19-27.
- Hinshaw, S. P. (1997). On the distinction between attentional deficits/hyperactivity and conduct problems/aggression in child psychopathology. *Psychology Bulletin*, 101, 443-463.
- Kagan, J. (1966). Reflection-impulsivity: The generation and dynamics of perceptual tempo. *Journal of Abnormal Psychology*, 71, 17-24.
- Lahey, B. B., Loeber, R., Quay, H. C., Frick, P. J., & Grimm, J. (1992). Oppositional defiant disorder and conduct disorders: Issues to be resolved for DSM-IV. *Journal of the American Academy of Child and Adolescent Psychiatry*, 31, 539-546.
- McBurnett, K., Lahey, B. B., Frick, P. J., Risch, C., Loeber, R., Hart, E. L., Christ, M. A. G., & Hanson, K. S. (1991). Anxiety, inhibition, and conduct disorder in children: II. Relation to salivary cortisol. *Journal of the American Academy of Child and Adolescent Psychiatry*, 30, 193-196.
- Newman, J. P., & Kossen, D. S. (1986). Passive avoidance learning in psychopathic and nonpsychopathic offenders. *Journal of Abnormal Psychology*, 95, 252-256.
- Newman, J. P., Patterson, C. M., & Kossen, D. S. (1987). Response perseveration in psychopaths. *Journal of Abnormal Psychology*, 96, 145-148.
- Newman, J. P., & Wallace, J. F. (1993). Diverse pathways to deficient self-regulation: Implications for disinhibitory psychopathology in children. *Clinical Psychology Review*, 13, 683-720.
- Newman, J. P., Widom, C. S., & Nathan, S. (1985). Passive avoidance syndromes of disinhibition: Psychopathy and extraversion. *Journal of Personality and Social Psychology*, 48, 1316-1327.
- O'Brien, B. S., Frick, P. J., & Lyman, R. D. (1994). Reward dominance among children with disruptive behavior disorders. *Journal of Psychopathology and Behavioral Assessment*, 16, 131-145.
- Piacentini, J. C., Cohen, P., & Cohen, J. (1992). Combining discrepant diagnostic information from multiple sources: Are complex algorithms better than simple ones? *Journal of Abnormal Psychology*, 101, 51-64.
- Quay, H. C., & Peterson, D. R. (1983). *Intern manual for the Revised Behavior Problem Checklist*. Coral Gables, FL: University of Miami, Applied Social Sciences.
- Raine, A. (1993). *The psychopathology of crime: Criminal behavior as a clinical disorder*. New York: Academic Press.
- Russo, M. F., & Beidel, D. C. (1993). Comorbidity of childhood anxiety and externalizing disorders: Prevalence, associated characteristics, and validation issues. *Clinical Psychology Review*, 14, 199-221.
- Sacerdote, A., Raine, A., O'Brien, M., Chan, C., Rhee, C., & Smiley, N. (1990). Reward dominance and passive avoidance learning in adolescent psychopaths. *Journal of Abnormal Child Psychology*, 18, 451-463.
- Shaffer, D., Fisher, P., Piacentini, J., Schwab-Stone, M., & Wicks, J. (1992). *NIMH Diagnostic Interview Schedule for Children, Version 1.3*. New York: Columbia University.
- Shapiro, S. K., Quay, H. C., Hogan, A. E., & Schwarz, K. P. (1983). Response perseveration and delayed responding in undersocialized aggressive conduct disorder. *Journal of Abnormal Psychology*, 97, 371-373.
- Spitzer, R. L., Davies, M., Barkley, R., & Castelloe, A. (1990). The DSM-III-R field trials for the disruptive behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29, 660-697.
- Sutker, P. B., Bugg, F., & West, J. A. (1993). Antisocial personality disorder. In P. B. Sutker & H. E. Adams (Eds.), *Comprehensive handbook of psychopathology* (2nd ed., pp. 337-370). New York: Plenum Press.
- Walker, J. L., Lahey, B. B., Russo, M. F., Frick, P. J., Christ, M. A., McBurnett, K., Loeber, R., Stouthamer-Loeber, M., & Green, S. M. (1991). Anxiety, inhibition, and conduct disorder in children: I. Relations to social impairment. *Journal of the American Academy of Child and Adolescent Psychiatry*, 30, 187-191.

- Achenbach, T. (1974). *Manual for the Wechsler Intelligence Scale for Children—Revised*. New York: The Psychological Corporation.
- Woolson, J. L., Rosenthal, S. L., Rindis, M. A., Sparrow, R. S., Cicchetti, D., & Zimmerman, L. B. (1989). Childhood comorbidity of anxiety/depressive disorders and behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, 28, 707-711.