

# Neuroendocrine Reactivity, Internalizing Behavior Problems, and Control-Related Cognitions in Clinic-Referred Children and Adolescents

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Literature on neuroendocrine-behavior relations suggests that cortisol reactivity to social challenge may be associated with children's internalizing problem behavior. To explore this possibility, and the role of control-related beliefs, we studied 102 7-17-year-old clinic-referred children. Measures of problem behavior, depression and anxiety, and control-related beliefs were collected, and Ss' saliva was sampled before and after a parent-child conflict task. Neuroendocrine activation (i.e., cortisol increase) in response to the interaction task was associated with Ss' (a) social withdrawal, social anxiety, and social problems; (b) socially inhibited behavior during the task; and (c) low levels of perceived social contingency and high levels of external attributions for personal successes and failures. Our findings are among the first to link children's behavioral response to social challenge, neuroendocrine activation, cognitions, and psychopathology.

Studies with adults and laboratory animals have focused on the stress reactivity of the hypothalamic-pituitary-adrenocortical (HPA) axis as one of the links among environmental events, behavior, and health (Chrousos & Gold, 1992; Gold, Goodwin, Chrousos, 1988; Kling et al., 1989). Recently, the focus of this endeavor has expanded to include the study of the joint effects of environment and biology on children's stress and coping (e.g., Gunnar, 1992). Theorists have also posited a role of individual differences in HPA stress reactivity in the pathogenesis of children's psychological problems (Boyce & Jemerin, 1990; Susman, Nottelmann, Dorn, Gold, & Chrousos, 1989). In addition, some findings with children support this association (Granger, Stansbury, & Henker, 1994; Kagan, Reznick, & Snidman, 1987; Tennes & Kreye, 1985). Yet, to our knowledge, no studies have examined these relations in children who are disturbed enough to warrant clinic referral.

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An individual-differences approach to the study of relations between clinic-referred children's HPA reactivity, behavioral responsiveness to the environment, and emotional and behavior problems seems well justified. That is, the consideration of normally and atypically developing populations can be mutually informative (Cicchetti, 1989), and clinic-referred children's problems may not only represent extremes on behavioral, cognitive, and emotional dimensions, but their pathology may indicate reorganization of the relations between physiological and behavioral processes (Stansbury & Gunnar, in press). Unfortunately, the few relevant studies with clinic samples have many limitations.

First, much of the information has been derived from studies that measure basal cortisol levels (McBurnett et al., 1991), the circadian profile of cortisol production, or changes in cortisol levels induced by experimentally administered dexamethasone (e.g., Dahl et al., 1989, 1991; Kruesi, Schmidt, Donnelly, Hibbs, & Hamburger, 1989; Pfeffer et al., 1989; Puig-Antich et al., 1989). Studies with nonreferred children suggest that HPA-behavior associations are more likely to be observed during HPA stress reactivity than basal activity (Gunnar, Marvinney, Isenee, & Fisch, 1989). Thus, it is surprising that we could find no studies with clinic samples that have examined HPA-behavior associations in stressful or challenging environments. It seems particularly important to explore the effects of psychosocial stressors on psychopathology-neuroendocrine relations in clinic populations.

Second, most previous studies have focused on single dimensions of psychopathology (e.g., depression). In the process, important but more complex or additive relationships might have been missed. McBurnett et al. (1991), for example, found that only the combination of anxiety and conduct problems was linked to high salivary cortisol. Such findings suggest the most fruitful approach to inquiry in this area is one that sustains a focus on multiple rather than single dimensions of psychopathology alone.

Third, we could not find any studies with clinic-referred children that incorporated measures of control-related constructs

in their designs. This may be a significant gap, in that theorists have posited a role of perceived control and contingency as moderators of HPA activation (Gunnar, Marvinney, et al., 1989; Levine, 1980; Rose, 1980). In addition, some findings support this linkage among adult samples (Breier, 1989; Levine, 1980; Rose, 1980). Given the large amount of literature suggesting that control-related beliefs are related to patterns of psychopathology in samples of adults (Alloy, Kelly, Mineka, & Clements, 1990; Barlow, 1988; Mineka & Kelly, 1989), and an emerging literature suggesting similar findings in samples of clinic-referred children (Proffitt & Weisz, 1992; Weisz, Sweeney, Proffitt, & Carr, 1993; Weisz, Weiss, Wasserman, & Rintoul, 1987), studies that assess both control-related beliefs and HPA responses in clinic samples of children would seem to be an appropriate next step.

Finally, the modal approach in studying relations between HPA activity and child psychopathology has been to identify behavioral dispositions and then search for related group differences in physiology. Correspondingly, studies typically use categorical as opposed to dimensional approaches in defining children's behavioral difficulties. Following the logic of Stansbury and Gunnar (in press), it may be informative to reverse this procedure (i.e., identify children who exhibit HPA reactivity that, theoretically, should be associated with psychopathology and then test group differences in children's behavioral difficulties).

Our study was designed to extend previous research by addressing some of these limitations. First, rather than study basal activity levels or HPA reactivity to chemical challenge (e.g., dexamethasone), we examined HPA activation in response to a quasi-naturalistic psychosocial stressor: a parent-child conflict discussion task. Second, we used a dimensional rather than categorical approach in defining child psychopathology. Third, when testing relations of HPA reactivity to patterns of behavioral dysfunction, we used both a dimensional and categorical approach in defining neuroendocrine reactivity. Finally, in response to recent evidence, we included measures of control-related beliefs in the assessment. Specific questions to be addressed involved which dimensions of psychopathology and perceived control, if any, would be associated with individual differences in HPA activity in anticipation of, and in response to, psychosocial challenge in clinic-referred children.

## Method

The data reported here were collected as part of the initial assessment for a large prospective study of children's mental health care. Interviews were conducted with children and mothers within days of the families' intake assessment at one of several community-based clinics in central and southern California. Children were recruited after intake but before treatment, so as to permit the study of correlates of HPA activity, when problems were likely to be in an acute, intense, and severe phase, but before clinic intervention could influence the relationships of interest here.

### Subjects

The sample of 102 participants (62 male and 40 female subjects) ranged in age from 7 years 0 months to 17 years 9 months ( $M = 12$  years 1 month) and was 51% White, 20.6% Hispanic, 18.6% African

American, and 9.8% other racial or ethnic backgrounds. The median annual family income was approximately \$22,000, and the average parent education level corresponded to completion of high school. As is typical in outpatient clinics, the youngsters were referred for a variety of problems. We did not select for diagnosis because we sought information about the correlates of HPA activity in children with a range of behavioral and emotional problems. As is also typical in clinic-referred populations, a large proportion of the children presented with coexisting internalizing and externalizing problem behavior profiles. Using T scores greater than 65 as the cutoff point, 44.1% had scores in the clinical range on both the Internalizing and Externalizing scales of the Child Behavior Checklist (CBCL; Achenbach, 1991b), 26.5% had scores below clinical cutoffs on both CBCL summary scales, 17.6% had scores above clinical criteria for the Externalizing but not the Internalizing CBCL scale, and 11.8% met clinical criteria for the Internalizing but not the Externalizing CBCL scale. We excluded conditions likely to interfere with reliable self-report and the detection of the relationships of interest; these included mental retardation, organic impairment interfering with cognitive function, and childhood onset psychosis. To control for elevated cortisol levels in conjunction with high fevers during the onset of colds (Flinn & England, 1992), we excluded from the analyses saliva samples collected from children with temperatures greater than 101° F.

### Parent-Child Conflict Discussion Task

*Rationale.* For several reasons a parent-child conflict discussion task was used as the psychologically challenging event. First, studies show that naturally occurring parent-child conflicts often precede increases in children's cortisol levels (Flinn & England, 1992). Second, there are now well-developed procedures for parent-child interaction tasks, and studies show that interactions during such tasks are associated with patterns of children's behavior problems (Burge & Hammen, 1991; Cook, Kenny, & Goldstein, 1991). Third, parent-child discord is likely to be a particularly salient social stressor for clinic-referred children because it is often associated with children's referral problems (Weisz & Weiss, 1991). Finally, a parent-child conflict task can be used to engender an individualized, yet controllable and ecologically valid, challenging event.

*Procedures.* Prior to the interaction portion of the larger project's interview, children and mothers independently rated 13 topics thought to be potential sources of parent-child problems (e.g., chores, schoolwork, following instructions, curfew). Interviewers then compared the two sets of ratings and chose a topic that both parent and child evaluated as a source of conflict and for which the ratings indicated that both people were similarly invested. That is, for a topic to be selected, the parent and child ratings had to be less than 2 rating points apart (on a 6-point scale), and the sum of the ratings had to be maximized.<sup>1</sup>

Later, mothers and children were reunited to complete three interaction tasks. The sequence of activities was designed to be progressively more interactive as well as more likely to provoke conflict. The first task was intended to familiarize the dyad with the activity setting and thus placed few interactive demands on the child; mothers were asked to teach the children how to plan a meal for a large family. The next activity provided an opportunity for the children to play a more active role in problem solving and negotiating during a cooperative interaction task; the dyads were asked to work together to generate a plan for a hypothetical weekend vacation they may spend together. Finally, mother

<sup>1</sup> The average discrepancy between child and parent ratings was 0.20 ( $SD = 1.44$ ). The average sum across informants was 8.02 ( $SD = 2.22$ ) out of 10. The most common discussion topics were related to chores (23.5%), relations with siblings (12.7%), school performance and conduct (11.8%), noncompliance (11.8%), relations with friends (11.8%), and bedtime (7.8%).

and child were asked to discuss the conflict topic with the goal of reaching some solution. The teaching, planning, and conflict discussion activities continued uninterrupted for 4, 5, and 6 min, respectively. Except for explaining task instructions during the transition periods, the interviewers did not intervene in any way.

### *Cortisol Measurement*

Saliva samples were collected from each child before (pretask) and approximately 20 min after (posttask) the parent-child interaction task. Pretask assessments were used to index laboratory baselines, and the posttask level was used to index HPA activation. Saliva sampling procedures were adapted from those used by Gunnar, Mangelsdorf, Larson, and Hertzgaard (1989). Each child tasted about 5 mg of sugar-sweetened, grape-flavored Kool-Aid crystals and then chewed on a sterile cotton dental roll. After 2-3 min, the cotton was removed from the child's mouth. A syringe was used to compress the saturated cotton and express the saliva into a cryogenic tube.

The majority of interviews occurred in the late afternoon and evening. The average time of day for pretask and posttask saliva collections were 4:26 p.m. ( $SD = 3$  hr 10 min, range = 9:41 a.m. to 8:46 p.m.) and 5:27 p.m. ( $SD = 3$  hr 15 min, range = 10:30 a.m. to 9:35 p.m.). On average, the interval between pre- and posttask saliva collections was 1 hr ( $SD = 22$  min).

Saliva samples were immediately frozen and then stored at  $-80^{\circ}\text{C}$  until packed in dry ice and flown to the University of Minnesota, where they were assayed using a modification of the Amersham Amerlex radioimmuno assay for cortisol. Samples were assayed in duplicate with all samples from each subject analyzed with the same assay batch. The correlation between assay duplicates was .98; thus, the two measurements were averaged to form the scores used in the analyses.

### *Assessing Problem Behavior*

Independently, the children completed the Youth Self-Report (YSR), and the parents filled in the Child Behavior Checklist (CBCL; Achenbach, 1991a, 1991b). These standardized measures list 118 child behavior problems. They generate T scores that reflect a child's status relative to others of the same sex and age on the Internalizing, Externalizing, and Total Problems scales, as well as in eight narrow-band syndromes: Anxiety/Depression (e.g., complains of loneliness; feels worthless or inferior; feels unhappy, sad, or depressed); Somatic Complaints (e.g., physical problems without known medical cause, such as stomachaches or cramps, rashes or skin problems, and headaches); Social Problems (e.g., clings to adults or too dependent, does not get along with other children, gets teased a lot); Aggression (e.g., argues a lot; gets in many fights; stubborn, sullen, or irritable); Delinquency (e.g., lying or cheating, vandalism, steals); Attention Problems (e.g., impulsive, cannot concentrate, daydreams); Social Withdrawal (e.g., likes to be alone, shy or timid, withdrawn, does not get involved with others); and Shy or Timid Problems (e.g., hears or sees things that are not there, repeats certain acts over and over). The scales are also designed to facilitate comparisons across informants. Validity, internal consistency, and test-retest reliability have been extensively documented (see Achenbach 1991a, 1991b). The scores used in the analyses were cross-informant ratings for each summary and syndrome scale; these were computed by converting respective CBCL and YSR scale values to z scores and then averaging across parent and child ratings. To facilitate interpretations, CBCL and cross-informant CBCL and YSR values presented in the text and tables have been reconverted to T scores.

Given that previous research has tested relations between children's internalizing problems and HPA activity (e.g., Dahl et al., 1991; McBurnett et al., 1991; Puig-Antich et al., 1989) and that the 1991 cross-informant profiles for the CBCL and YSR do not discriminate between

symptoms of anxiety and depression (i.e., symptoms of both problem types are included in one syndrome scale), we had children also complete the Social Anxiety Scale for Children (SASC) and the Children's Depression Inventory (CDI). The SASC is a 10-item self-report measure of children's feelings of social anxiety. Items of the SASC represent three components of social anxiety: fear of negative evaluation, social avoidance, and social distress. La Greca, Dandes, Wick, Shaw, and Stone (1988) reported an internal consistency, as measured by Cronbach's alpha, of .76 and a test-retest reliability over a 2-week period of .67. The validity of the SASC is supported by findings linking scores to related constructs, such as chronic anxiety measured by the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1978) and peer neglect (La Greca et al., 1988).

The 27-items of the CDI are designed to survey most major depressive symptoms (Kovacs, 1983). The CDI has well-documented psychometric properties. Internal consistency measured by coefficient alpha ranges from .84 to .94 (Kovacs, 1980; Saylor, Finch, Spirito, & Bennett, 1984; Smucker, Craighead, Craighead, & Green, 1986). Test-retest reliability over periods of 1, 3, 4, and 6 weeks ranges from .38 to .87 (Kovacs, 1980; Smucker et al., 1986).

### *Assessing Control-Related Constructs*

Following Weisz and colleagues' two-dimensional model of perceived control, which construes control as a function of outcome contingency and personal competence (Weisz, 1986; Weisz & Stipek, 1982), we used three approaches to measuring children's control-related beliefs. The first was the 24-item Personal Experience Form A of the Multidimensional Measure of Children's Perceptions of Control (MMPCPC; Connell, 1980, 1985). This well-standardized measure distinguishes among children's attributions to external, internal, and unknown causes regarding their successes and failures. Children's ratings of how true each item is are summed to form six scores: internal success and failure, powerful-other success and failure, and unknown success and failure. The validity of the internal and external MMPCPC scales is supported by findings linking scores to other control-related constructs, such as perceived and actual competence (Connell, 1985; Connell & Tero, 1982). However, evidence linking the MMPCPC unknown scales to other measures of perceived control is scant; thus, we excluded these scales from the analyses. Test-retest reliability of the various scales over periods of 9 and 17 months range from means of .32 to .34 (Connell, 1985). As for internal consistency, averaged coefficient alphas range from .59 to .68 across the six scales (Weisz et al., 1993).

Second, children's contingency beliefs were assessed via the Perceived Contingency Scale for Children (PCSC; Weisz, Proffitt, & Sweeney, 1991). The PCSC includes 30 self-report items, all focused on perceived contingencies for children in general. Children's ratings of how true each item is are summed to form three contingency scores: Academic, Behavioral, and Social. Weisz et al. (1993) reported subscale alphas of .69, .75, and .74 and test-retest reliability over a 10-day interval of .78, .48, and .70 for the Academic, Behavioral, and Social subscales, respectively.

Third, children's perceived competence was measured via the Self-Perception Profile for Children (SPPC; Harter, 1985). This 36-item scale is designed to assess perceived competence and self-adequacy across five specific domains: academic, social, behavioral, athletic, and physical appearance (the social domain questions emphasize social acceptance by others). Harter (1982) reported test-retest reliabilities for the earlier form of her scale, with 3-month reliabilities for the subscales ranging from .70 to .87 and 9-month reliabilities ranging from .69 to .80. For the current version, Harter (1985) reported internal consistency alphas for the behavioral and social domains ranging from .71 to .77 and .75 to .80, respectively.

### Assessing Task Behavior and Affect

Immediately after the social interaction task, the children completed a brief checklist regarding their behavior and affect during the conflict discussion. Four individual items were summed to form two post hoc task behavior scores: Social Inhibition (e.g., "I felt afraid to talk," "I tried to avoid talking") and Anxious/Inhibited Affect (e.g., "I felt 'scared,' 'nervous'"). Interitem correlations for these scores were .38 ( $p < .001$ ) and .40 ( $p < .001$ ), respectively.

### Results

We first address how neuroendocrine activity, for all of the children as a group, was influenced by their participation in the parent-child discussion task. Next, we report linear relationships among pre- versus posttask cortisol levels and behavior problem, cognitive, and task behavior measures. Because the significant predictors within each set of variables were not completely orthogonal, we used multiple regression analyses to determine how well the variables within each set as a whole (e.g., the overcontrolled behavior problem measures as a group) would predict cortisol levels and to assess each variable's unique contribution to the prediction controlling for all other predictors within each set. The significant predictors from each set of measures were then considered simultaneously in a single regression equation. Finally, group differences were explored between children considered to be higher and lower HPA reactors; the two groups were compared on behavioral and cognitive variables. We used multivariate analysis of variance (MANOVA) procedures in these last analyses. To balance protection against chance findings with the need to avoid Type II errors in this relatively new research venture, we have also noted which univariate effects were observed in the absence of significant multivariate effects; such univariate effects have been described here for heuristic and exploratory purposes.

#### Neuroendocrine Activity: Effects of Age, Gender, Sampling Occasion, and Time of Day

In the first analysis we used sampling occasion (pre- vs. posttask cortisol levels) as a repeated measure, gender as a blocking variable, and sampling time of day and age as covariates in a  $2 \times 2$  analysis of covariance. Results revealed a main effect for sampling occasion,  $F(1, 100) = 11.19, p < .001$ , indicating that on average cortisol levels dropped from pretask ( $M = 0.24 \mu\text{g}/\text{dl}$ ,  $SD = 0.15$ , range = 0.04–0.93  $\mu\text{g}/\text{dl}$ ) to posttask ( $M = 0.20 \mu\text{g}/\text{dl}$ ,  $SD = 0.14$ , range = 0.02–0.88  $\mu\text{g}/\text{dl}$ ). For descriptive purposes, we computed delta cortisol scores (posttask minus pretask cortisol levels). Higher delta scores reflect larger increases in cortisol from pre- to posttask. Delta scores ranged from 0.44 to  $-0.46 \mu\text{g}/\text{dl}$  ( $M = -0.04 \mu\text{g}/\text{dl}$ ,  $SD = 0.12$ ); 65 children's cortisol scores decreased, 35 children's cortisol levels increased, and 3 children's cortisol scores did not change. With respect to sampling time of day, both pretask,  $r(100) = -.23, p < .025$ , and posttask,  $r(100) = -.40, p < .001$ , cortisol levels were higher when interviews were conducted earlier than later in the day. As expected, pretask cortisol levels were associated with posttask levels,  $r(100) = .65, p < .001$ . By contrast, there were no significant associations between the children's age or

gender and cortisol levels; thus, it was appropriate to carry out subsequent analyses without controlling for gender and age.<sup>2</sup>

#### Neuroendocrine Reactivity: Regression Analyses

In the next set of analyses we examined associations of children's behavior problems, control-related beliefs, and task behavior scores with posttask cortisol levels. To control for nonbehavioral factors that could influence HPA reactivity, we used residualized cortisol scores. The residualized posttask scores were produced using linear regression by predicting posttask cortisol from pretask cortisol levels and sample collection time ( $R = .70, F(2, 99) = 48.16, p < .001$ ), then subtracting the predicted scores from the observed posttask cortisol levels.

**Problem behavior.** Multiple regression equations were computed predicting residualized posttask cortisol levels from (a) undercontrolled behavior problems (i.e., the CBCL-YSR Aggression and Delinquency syndrome scales), (b) overcontrolled behavior problems (i.e., the CBCL-YSR Somatic Complaint, Social Withdrawal, and Anxiety/Depression syndrome scales, as well as self-ratings on the CDI and SASC total scales), and (c) nonspecific problems (i.e., the CBCL-YSR Social, Attention, and Thought Problem syndrome scales). In the analysis using overcontrolled behavior problems as predictors, the overall effect was highly significant. As shown in Table 1, the cross-informant Social Withdrawal scale scores and self-reported levels of social anxiety (SASC) were positively correlated with cortisol reactivity. By contrast, the multivariate regression for undercontrolled problems was not significant. Univariate tests did reveal, however, that aggressive behavior problems were positively associated with cortisol reactivity (see Table 1). Neither the multivariate equation nor any univariate tests approached significance for measures of the children's nonspecific behavior problems.<sup>3</sup>

**Control-related constructs.** As previously, separate multivariate regression equations were computed predicting residualized posttask cortisol levels from the measures of the three

<sup>2</sup> In addition to checking for effects of gender and age, we thought it would be useful to explore the possibility that cortisol levels before the discussion task were high and then decreased because of hypothalamic-pituitary-adrenal activation associated with anticipatory anxiety about the conflict discussion. This interpretation would be supported if patterns of children's behavior problems and control-related cognitions were associated with pretask cortisol levels, pretask cortisol levels were associated with the children's subsequent behavior during the interaction task, or both. Multivariate regression equations were computed predicting pretask cortisol levels (residualized for sample collection time) from behavior problem, control-related belief, and task behavior scores. There were no significant associations observed in any of these analyses.

<sup>3</sup> Because links between high salivary cortisol and the combination of anxiety and conduct problems have been reported (McBurnett et al., 1991), we computed a stepwise regression equation predicting residualized posttask cortisol levels from the cross-informant Aggression and Social Withdrawal scales, self-ratings of social anxiety, and four terms representing interactions among these predictors. Only the cross-informant Social Withdrawal scale added significantly to the prediction ( $r = .28, F(1, 96) = 8.11, p < .01$ ). All subscale scores used in this analysis were z scores.

Table 1  
Multiple Regression Results Predicting Residualized Postdiscussion Cortisol Levels

Predictor	Standardized $\beta$	$t$	$p$
<b>Behavior problems</b>			
Undercontrolled ( $R = .21$ ), $F(2, 99) = 2.39$ , $p = .097$			
Aggression (CBCL-YSR)	.28	2.02	.046
Delinquency (CBCL-YSR)	-.12	0.84	.403
Overcontrolled ( $R = .39$ ), $F(5, 92) = 3.40$ , $p = .007$			
Social Withdrawal (CBCL-YSR)	.33	2.70	.008
Somatic Complaints (CBCL-YSR)	.12	0.10	.322
Anxiety/Depression (CBCL-YSR)	-.17	1.10	.276
Social Anxiety (SASC)	.27	2.45	.016
Depression (CDI)	-.17	1.45	.150
Nonspecific ( $R = .25$ ), $F(3, 98) = 2.23$ , $p = .089$			
Thought Problems (CBCL-YSR)	.10	0.80	.427
Attention Problems (CBCL-YSR)	.06	0.47	.638
Social Problems (CBCL-YSR)	.13	1.03	.303
<b>Control-related beliefs</b>			
Perceived control (MMCPC; $R = .16$ ), $F(4, 97) = .71$ , $p = .584$			
Internal Success	-.06	0.62	.534
Internal Failure	-.02	-0.17	.867
Other Success	.04	0.32	.747
Other Failure	.14	1.19	.235
Perceived contingency (PCSC; $R = .27$ ), $F(3, 97) = 2.58$ , $p = .058$			
Academic	-.19	1.59	.110
Behavioral	.27	2.19	.031
Social	-.20	1.93	.056
Perceived competence (SPPC; $R = .03$ ), $F(3, 96) = 0.92$ , $p = .432$			
Academic	.15	1.29	.201
Behavioral	.01	0.08	.938
Social	-.11	1.08	.281
<b>Task behavior and affect (<math>R = .26</math>), <math>F(2, 93) = 3.52</math>, <math>p = .033</math></b>			
Social Inhibition	.31	2.63	.010
Negative Affect	-.13	-1.10	.274

*Note.* Standardized beta values reflect the unique relationship between the children's residualized posttask cortisol levels and the predictor in question, controlling for the other predictors within each equation. CBCL-YSR = cross-informant (parent-child) behavior problem ratings on the 1991 Child Behavior Checklist and Youth Self-Report; SASC = Social Anxiety Scale for Children (La Greca, Dandes, Wick, Shaw, & Stone, 1988); CDI = Children's Depression Inventory (Kovacs, 1983); MMCPC = Multidimensional Measure of Children's Perceptions of Control (Connell, 1985); PCSC = Perceived Contingency Scale for Children (Weisz, Proffitt, & Sweeney, 1991); SPPC = Self-Perception Profile for Children (Harter, 1985).

different control-related belief constructs. The multivariate equation for contingency-related beliefs (the PCSC) approached significance. As shown in Table 1, univariate tests revealed that high levels of behavioral contingency beliefs, and low levels of social contingency beliefs, about outcomes for children in general each contributed uniquely to the prediction. By contrast, neither the multivariate regressions nor univariate tests for measures of children's attributions of causes of their personal successes and failures (the MMCPC) or perceived competencies (the SPPC) reached significance.

*Task-related social inhibition and negative affect.* The multivariate equation predicting residualized posttask cortisol levels from self-reported socially inhibited behavior and anxious or inhibited affect during the task was significant. As shown in Table 1, self-ratings of social inhibition during the interaction task were positively associated with cortisol reactivity.

*Additive and interactive effects of behavior problems, cognitions, and task behaviors: Regression analysis.* To test the relative and combined sensitivity of behavior problems, control beliefs, and task behavior measures as predictors of HPA reac-

tivity, we computed a stepwise regression equation predicting cortisol reactivity from the most robust predictor from each set of measures (i.e., behavior problems, cognitions, and task behaviors). Residualized postcortisol levels were predicted from cross-informant ratings of social withdrawal, self-report ratings of social inhibition during the task, the Behavioral Contingency subscale of the PCSC, and four terms representing the interactions among these variables (i.e., Social Withdrawal  $\times$  Task Inhibition, Social Withdrawal  $\times$  Contingency Beliefs, Contingency Beliefs  $\times$  Task Inhibition, and the product of all three variables).<sup>4</sup> The CBCL-YSR Social Withdrawal scale, socially inhibited behavior during the task, and the Contingency Belief  $\times$  Task Inhibition interaction each added significantly to the prediction of cortisol reactivity ( $R = .41$ ),  $F(3, 92) = 6.25$ ,  $p <$

<sup>4</sup> The Behavioral Contingency subscale of the Perceived Contingency Scale for Children was reverse scored, so that higher scale values indicated the negative or undesirable pole consistently across all measures used in the generation of interaction terms. All subscale scores used in this analysis were z scores.

.001. Standardized betas were .22 ( $p < .025$ ), .20 ( $p < .05$ ), and .23 ( $p < .025$ ), respectively.

The source of the Contingency Belief  $\times$  Task Inhibition interaction was determined using median splits to construct a between-subjects variable representing the factorial combinations of higher and lower scores on the two measures. Simple effects tests revealed that children ( $n = 22$ ) who perceived the outcome of behavior as being contingent on children and what they do and expressed low levels of social inhibition during the discussion had significantly lower cortisol reactivity ( $M = -0.09 \mu\text{g}/\text{dl}$ ) when compared with children ( $n = 17$ ) who had high levels of perceived behavioral contingency and expressed high levels of socially inhibited behavior during the task ( $M = 0.04 \mu\text{g}/\text{dl}$ ; Student Newman-Keuls tests,  $p < .05$ ). Specific contrasts showed that children in the high behavioral contingency–low social inhibition group had significantly lower cortisol reactivity ( $M = -0.09 \mu\text{g}/\text{dl}$ ) when compared with the average of all other children ( $M = -0.03 \mu\text{g}/\text{dl}$ ),  $t(92) = 2.83$ ,  $p < .01$ , and children in the high behavioral contingency–high social inhibition group had significantly higher cortisol reactivity ( $M = 0.04 \mu\text{g}/\text{dl}$ ) when compared with the average of all other children ( $M = -0.06 \mu\text{g}/\text{dl}$ ),  $t(92) = 2.41$ ,  $p < .025$ .

#### *HPA Reactors Versus Nonreactors: Behavioral and Cognitive Differences*

In the next set of analyses we examined differences on the behavioral and cognitive variables between groups of children considered to be higher and lower HPA reactors in this social context. Groups of higher ( $n = 25$ ) and lower ( $n = 25$ ) cortisol reactors were formed using the upper and lower quartiles of the delta cortisol distribution as cutoff points. The groups did not differ significantly with respect to age, gender, or sample collection time. The average cortisol elevation in the higher reactor group was  $0.09 \mu\text{g}/\text{dl}$  (range =  $0.03$ – $0.44$ ), a mean increase of 39% above pretask levels. The average cortisol drop in the lower reactor group was  $-0.19$  (range =  $-0.09$ – $-0.46$ ), a mean decrease of 50% below pretask levels.

The groups did differ with respect to pretask cortisol levels,  $t(48) = 3.17$ ,  $p < .01$ ; on average, higher reactors had lower levels ( $M = 0.23 \mu\text{g}/\text{dl}$ ) than did lower reactors ( $M = 0.28 \mu\text{g}/\text{dl}$ ) prior to the discussion task. This pattern of pretask cortisol differences is consistent with previous observations that higher basal levels of cortisol are more likely to be associated with a decrease after moderately stressful stimuli, whereas low baseline levels tend to result in an increase (e.g., Lewis, 1992; Sapolsky, 1992). Thus, in all subsequent analyses, we compared group differences between higher and lower reactors via a one-way MANOVA with pretask cortisol levels covaried.

*Behavior problems.* The first MANOVA compared the two reactor groups with respect to specific measures of internalizing problems: the CBCL–YSR Social Withdrawal, Anxiety/Depression, and Somatic Complaints syndrome scales, as well as scores on the CDI and SASC. The multivariate effect of group was significant,  $F(5, 43) = 2.80$ ,  $p < .05$ . Univariate results, shown in Table 2, revealed that higher reactors had higher scores than lower reactors on the Social Withdrawal scale,  $F(1, 47) = 5.41$ ,  $p < .025$ , and the SASC Social Anxiety measure,  $F(1, 47) = 7.79$ ,  $p < .01$ . By contrast, the CBCL–YSR Somatic Com-

plaints and Anxiety/Depression scales, and CDI depression scores, did not show significant group differences. The multivariate group effect on nonspecific problem behaviors was also not significant,  $F(3, 45) = 1.45$ ,  $p = .24$ , but univariate tests revealed that higher reactors had more social problems than did lower reactors,  $F(1, 47) = 4.50$ ,  $p < .05$ . There were no significant differences observed for measures of undercontrolled problem behavior.

*Control-related beliefs.* Next, group differences were tested, again using a MANOVA, on the four MMCPSC subscales related to perceived control. The multivariate group effect was not significant, but univariate results, shown in Table 2, indicated that higher reactors were more likely than lower reactors to make external attributions for both personal successes,  $F(1, 47) = 5.21$ ,  $p < .05$ , and failures,  $F(1, 47) = 5.77$ ,  $p < .025$ . The multivariate group effect for the three scales related to contingency beliefs was also significant,  $F(3, 44) = 3.35$ ,  $p < .05$ . Univariate tests revealed that higher reactors were more likely to perceive the outcome of social interactions as being less contingent on children and what they do than were lower reactors,  $F(1, 46) = 3.57$ ,  $p = .065$ . Neither the multivariate nor univariate group effects for the three subscales related to perceived competence approached significance.

*Social inhibition and negative affect.* Although the multivariate group effect for task behavior was not significant,  $F(2, 44) = 2.58$ ,  $p = .087$ , univariate tests revealed that higher reactors ( $M = 4.17$ ) were more socially inhibited during the discussion task than were lower reactors ( $M = 2.79$ ),  $F(1, 45) = 4.08$ ,  $p < .05$ .

*Additive and interactive effects of behavior problems, cognitions, and task behaviors: Discriminant function analysis.* To test how much of the between-groups variance in HPA reactivity was accounted for by using behavior problems, control beliefs, and task behavior measures simultaneously and evaluate whether interactions between cognitive and behavioral measures would explain a unique portion of the between-groups variance, we computed a linear discriminant function analysis. The analysis used stepwise procedures and Wilks's lambda. Only variables that discriminated between groups in the univariate analyses were considered. To simplify interpretations, the significant predictors within each set of measures were combined to represent a single behavior problem score (cross-informant ratings of social withdrawal and social problems, and the SASC self-ratings of social anxiety), a control belief score (MMCPSC subscales measuring external attributions for personal success and failure, and the PCSC subscale tapping social contingency), and a task behavior score (i.e., self-ratings of social inhibition during the task).<sup>5</sup> Interactive terms were then computed to represent Behavior Problems  $\times$  Control Beliefs, Behavior Problems  $\times$  Task Behavior, Task behavior  $\times$  Control Beliefs, as well as the product of all three variables. The resulting equation accounted for 40.82% of the between-groups variance in HPA reactivity,  $\chi^2(4, N = 50) = 22.56$ ,  $p < .001$ , and

<sup>5</sup> The significant predictors within each set of measures were converted to z scores, summed, and averaged. Then, to provide for similar directional scaling across measures, the Social Contingency subscale of the Perceived Contingency Scale for Children was reverse scored, so that higher scale values indicated the negative or undesirable pole.

**Table 2**  
*Comparisons of Higher and Lower Cortisol Reactors on Measures of Behavior Problems, Control-Related Beliefs, and Task Behavior*

Predictor	Higher reactors		Lower reactors		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
<b>Behavior problems</b>					
<b>CBCL-YSR cross-informant scales</b>					
Social Withdrawal	65.02	9.40	59.00	5.03	<.05
Social Problems	67.16	9.85	59.84	8.24	<.05
Somatic Complaints	64.28	7.18	60.14	8.15	<i>ns</i>
Anxiety/Depression	64.78	8.52	61.62	7.77	<i>ns</i>
<b>Self-report scales</b>					
Social Anxiety (SASC)	10.24	4.27	6.40	3.79	<.01
Depression (CDI)	12.28	10.32	10.80	6.87	<i>ns</i>
<b>Control-related beliefs</b>					
<b>Perceived control (MMCP)</b>					
Internal Success	3.42	0.44	3.35	0.43	<i>ns</i>
Internal Failure	3.12	0.57	2.85	0.72	<i>ns</i>
Other Success	2.54	0.89	2.06	0.52	<.05
Other Failure	2.54	0.66	2.12	0.45	<.05
<b>Perceived contingency (PCSC)</b>					
Academic	28.71	5.44	30.56	5.38	
Behavioral	30.62	4.03	29.08	5.94	
Social	27.54	4.09	29.36	2.86	.065
<b>Perceived competence (SPPC)</b>					
Academic	16.56	4.44	14.80	4.04	<i>ns</i>
Behavioral	17.20	4.09	16.20	4.03	<i>ns</i>
Social	16.60	4.38	17.88	4.48	<i>ns</i>
<b>Task behavior and affect</b>					
Social Inhibition	4.17	2.22	2.79	1.41	<.05
Negative Affect	6.32	2.73	5.60	2.10	<i>ns</i>

*Note.* CBCL-YSR = cross-informant (parent and child) Child Behavior Checklist-Youth Self-Report problem behavior profile (Achenbach, 1991a, 1991b); SASC = Social Anxiety Scale for Children (La Greca, Dandes, Wick, Shaw, & Stone, 1988); CDI = Children's Depression Inventory (Kovacs, 1983); MMCP = Multidimensional Measure of Children's Perceptions of Control (Connell, 1985); PCSC = Perceived Contingency Scale for Children (Weisz, Proffitt, & Sweeney, 1991; Weisz, Sweeney, Proffitt, & Carr, 1993); SPPC = Self-Perception Profile for Children (Harter, 1985).

correctly classified 76.0% of the higher reactors and 84.0% of the lower reactors (80.0% of all cases). The equation was a linear combination of control-related beliefs (standardized discriminant function coefficient = .37), behavior problems (.43), socially inhibited task behavior (.41), and pretask cortisol levels (-.64).

### Discussion

When correlates of clinic-referred children's HPA activity were explored in this social context, we observed an intriguing pattern. There were no significant associations between HPA activity measured in anticipation of the socially challenging parent-child discussion task. By contrast, cortisol levels measured after the interaction task were correlated with high levels of children's overcontrolled behavior problems (i.e., social withdrawal and social anxiety) and social inhibition during the task. Cortisol reactivity was also correlated with children's beliefs about the contingencies governing social and behavioral outcomes for children in general. More specifically, higher levels of cortisol reactivity were correlated with low levels of beliefs that the outcomes of social interactions were contingent on children and what they do. High levels of cortisol reactivity were also corre-

lated with high levels of beliefs that behavioral outcomes were contingent on children. However, this relationship was influenced by the children's behavioral responses to the interaction task. That is, children with high levels of behaviorally oriented contingency beliefs and low levels of social inhibition in response to the conflict task had lower levels of cortisol reactivity, but children with high levels of behavioral contingency beliefs who were socially inhibited during the conflict task had higher levels of cortisol reactivity. It was also shown that when measures of children's behavior problems, control beliefs, and task behaviors were considered simultaneously, each of these domains explained a unique portion of the variance in cortisol reactivity.

A similar set of findings emerged when differences between extreme groups of higher and lower cortisol reactors were explored. More specifically, compared with their lower reactive peers, clinic-referred children who showed higher neuroendocrine reactivity to the social conflict task were more socially withdrawn and socially anxious, had more social problems, and perceived themselves as having less personal control over the outcomes of their lives. Highly reactive youngsters also tended to perceive social outcomes as being less contingent on children in general than did low reactors. Consistent with the regression

analyses, measures of children's behavior problems, control beliefs, and task behaviors each explained a unique portion of the between-groups variance in cortisol reactivity.

A particularly significant aspect of these findings is that they are among the first to suggest that aspects of cognition, behavior, and psychopathology may be related to individual differences in clinic-referred children's HPA reactivity to social stressors. The findings suggest several implications.

In general, the discriminating pattern of differences in HPA reactivity to social conflict can be interpreted in line with infant and adult studies on the psychobiological correlates of stress and coping (Gunnar, 1986). A central assumption guiding this research has been that HPA activation is likely to be triggered when individuals are challenged with an environmental event in which they are highly invested, the demands of which exceed available coping resources, induce negative emotions, or both (Gunnar, 1992; Gunnar, Marvinney, et al., 1989). This suggests that an individual's HPA responsiveness may depend on a confluence of person variables (e.g., behavior problems, temperament, coping styles, and strategies) and situational variables (e.g., intensity and personal relevance of the environmental event). The pattern of behavioral and cognitive differences in this study—in the context of the parent-child conflict discussion task—supports this notion.

The pattern of findings may be helpful heuristically, particularly for theorists and researchers interested in relations among patterns of children's cognitions, behavioral coping responses, and the development of psychopathology. One etiological possibility suggested by the findings is that aspects of the biological systems underlying children's neuroendocrine responses to the social environment stimulate some of their internalizing behavior problems (e.g., Chrousos & Gold, 1992). It is also possible, of course, that the causal arrow points in the opposite direction. Internalizing behavior problems may lead to a lower threshold for, or exaggerated HPA reactivity to, mildly stressful environmental events. Alternatively, HPA stress reactivity may indicate biological vulnerability to the effects of repeated, chronic, or prolonged exposure to psychosocial stressors (Gold et al., 1988), a vulnerability that is also expressed in the development of internalizing problems.

To sort out the etiological possibilities and assess their relative plausibility will require longitudinal research in which children's behavior problems, control-related cognitions, and neuroendocrine activity are assessed across time. It is also evident that the spectrum of events in the social environment that trigger children's neuroendocrine responses should be elaborated. The results of such endeavors may have implications for treatment. In addition, exaggerated HPA reactivity to psychosocial stressors of mild intensity and duration may serve as a marker of vulnerability to particular behavioral or emotional difficulties (e.g., Kling et al., 1989).

The relation of these findings to those of McBurnett et al. (1991) deserves mention. Their findings suggest that there is value in focusing on multiple dimensions of psychopathology, not just one. We did so, but unlike McBurnett et al., who found a relation between cortisol and anxiety plus conduct problems, we found cortisol reactivity to be linked primarily to social anxiety and social inhibition rather than conduct problems.<sup>6</sup> However, there are numerous procedural differences between these

studies. For instance, McBurnett et al. collected only a single saliva sample, whereas we collected two samples to assess cortisol reactivity. This and other differences make direct comparison of results difficult.

Previous findings with adult and animal populations suggest that the controllability of stimulation is linked to HPA activity (see reviews, Gunnar, Marvinney, et al., 1989; Levine, 1980; Stansbury & Gunnar, in press). Evidence also supports the notion that the HPA stress response is affected more by the perception or expectation of control than by the actual "fact" of control (e.g., Weiss, 1971). Moreover, some studies have revealed that depressed and anxious adults may have increased sensitivity to uncontrollable stress (Alloy et al., 1990; Barlow, 1988; Mineka & Kelly, 1989), and others suggest that there may be important interrelationships between these cognitive deficits and heightened HPA reactivity (Breier, 1989). Our findings parallel and extend this pattern of observations. They support the notion that perceived control is among the factors determining the impact of social stressors on children's HPA activity and that specific patterns of their behavioral and emotional difficulties may be associated with increased psychobiological sensitivity to uncontrollable stress. Interestingly, however, increased HPA sensitivity in children was associated with anxiety and inhibition, but not depression (see Dahl et al., 1989, 1991), whereas in adults, studies show relations between HPA sensitivity and depression (Gold et al., 1988; Kling et al., 1989).

Although our study yielded some potentially important findings, it provides only a partial picture of relations among children's cognitions, problem behavior, and biological responsiveness to the social environment. Several limitations qualify the interpretation of these data. For instance, without a nonreferred control group it is not possible to conclude that increases in cortisol in response to conflict-oriented parent-child discussions are specific to children with behavioral and emotional problems. In addition, without having measured cortisol levels in the absence of psychosocial challenge, we cannot be sure that the observed increases in cortisol were specific to the children's reactions to the interaction task. Another limitation concerns the lack of information about the behavior of the children's partners in the social interaction. It is possible that the children's cortisol reactivity was moderated by parental behavior. It is also feasible that the pattern of correlates of HPA reactivity observed in this study is a function of the task used. Had a task been used that challenged the children with a "loss" or "failure" experience, cortisol-depression associations rather than cortisol-anxiety or inhibition relations might have emerged as the predominant pattern. In other words, it may be that a particular psychosocial challenge may be a stressor in one specific domain and may have its impact on a diathesis specific to that domain.

<sup>6</sup> The cross-informant Child Behavior Checklist-Youth Self-Report (CBCL-YSR) Aggression subscale was positively associated with cortisol reactivity in the univariate analyses, but not so in the corresponding multivariate tests. When the relative sensitivity of main, additive, and interactive effects among CBCL-YSR Aggression and Social Withdrawal subscales and self-ratings of social anxiety (the Social Anxiety Scale for Children) as predictors of cortisol reactivity were assessed in an overarching stepwise regression, only the CBCL-YSR Social Withdrawal subscale added significantly to the prediction.

Further investigations of the associations among clinic-referred children's HPA activity, behavior problems, and cognitions in quasi-naturalistic and everyday social contexts seem justified. In particular, naturalistic and analog data are needed to assess the cross-situational consistency of such individual differences in HPA reactivity as those revealed here. Finally, as noted previously, carefully controlled longitudinal work will be needed to identify the various causal possibilities suggested by the findings.

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