Further Evidence of Association Between Behavioral Inhibition and Social Anxiety in Children

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Objective: The authors sought to examine psychopathological correlates of behavioral inhibition in young offspring of parents with panic disorder and/or major depression.

Method: Behavioral inhibition, determined by using standard laboratory observations, was assessed in four groups of children (age 2–6 years): 129 children of parents with both panic disorder and major depression, 22 children of parents with panic disorder alone, 49 children of parents with major depression alone, and 84 comparison children of parents with neither panic disorder nor major depression. Psychopathology in children ≥5 years was compared between children with behavioral inhibition (N=64) and without (N=152).

Results: Social anxiety disorder (social phobia or avoidant disorder) was significantly more likely to be found in the children with behavioral inhibition (17%) than in those without (5%). Noninhibited children were significantly more likely than inhibited children to have disruptive behavior disorders (20% versus 6%, respectively) and had higher scores on the attention problems scale of the Child Behavior Checklist (mean=52.1 versus 50.8).

Conclusions: This study adds to the growing literature suggesting an association between behavioral inhibition and social anxiety disorder and an inverse relationship between inhibition and disruptive behavior disorders.

Knowing risk factors for childhood psychopathology would allow us to select children for preventive intervention trials. One risk factor for panic disorder is familial predisposition: the children of parents with panic disorder are at high risk for panic disorder and other anxiety disorders (1–4). However, because most of these children will not become ill, family history cannot be used to select children for preventive efforts. One strategy for improving prediction among those already at risk by having a parent with panic disorder is to find additional features that predict a very high risk for anxiety disorders.

One example is “behavioral inhibition to the unfamiliar” (behavioral inhibition), which reflects the consistent tendency to display fear and withdrawal in unfamiliar situations (5). Behavioral inhibition is stable, detectable early in life, and under some genetic control (6, 7). Children with behavioral inhibition are shy with strangers and timid in unfamiliar situations.

Behaviors of inhibited school-age children are similar to descriptions of children whose parents had panic disorder and to retrospective descriptions of childhood by adults with panic disorder or agoraphobia (8–10). Children with behavioral inhibition also show evidence of greater arousal in the limbic-sympathetic axes (11), which fits well with hypotheses about the neurophysiological concomitants of anxiety disorders (12). Moreover, family studies show modest rates of behavioral inhibition among children of parents with panic disorder (13, 14). These studies suggest that behavioral inhibition indexes a predisposition to development of anxiety disorders.

In our prior work, children with behavioral inhibition had a higher prevalence of multiple (i.e., at least two) anxiety disorders, with overanxious and phobic disorders particularly prominent (15, 16). Although this work suggested a link between behavioral inhibition and anxiety disorders, its inferences were tentative because of the small study size. We also could not determine whether behavioral inhibition was a specific precursor to anxiety or a more general precursor to other psychopathology (13, 17, 18).

Because of these uncertainties, we conducted the present study to evaluate three competing hypotheses: 1) behavioral inhibition is a nonspecific index of proneness to development of psychopathology; 2) behavioral inhibition is a nonspecific index of proneness to development of anxiety disorders; and 3) behavioral inhibition is a specific index of proneness to development of specific anxiety disorders.

Method

Three parent groups were recruited (19): 1) those with panic disorder either with or without comorbid major depression (N=131, 102 of whom had major depression and an additional 11 of whom had spouses with major depression), those with major depression without panic disorder or agoraphobia (N=39), and a comparison group with neither panic disorder nor major depression (N=61). The numbers of children of appropriate age for assessment of behavioral inhibition (i.e., 2–6 years) within the three parent groups were 151, 49, and 84, respectively. The study was...
### INHIBITION AND ANXIETY

**TABLE 1. Situational Battery Used to Measure Behavioral Inhibition in 2-, 4-, and 6-Year-Old Children of Parents With Panic Disorder and/or Major Depression and a Comparison Group of Parents With Neither Panic Disorder nor Depression**

<table>
<thead>
<tr>
<th>Situationa</th>
<th>Children Encountering Situation</th>
<th>Variable Measuredb</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>An unfamiliar room containing unfamiliar objects</td>
<td>2- and 4-year-olds</td>
<td>Number of objects with which the child played</td>
<td>1=at least four of six objects, 3=one or no objects</td>
</tr>
<tr>
<td>An unfamiliar female examiner asking that her actions with the unfamiliar objects be imitated</td>
<td>2- and 4-year-olds</td>
<td>Number of actions imitated by the child</td>
<td>1=imitates all actions, 3=imitates one or no actions</td>
</tr>
<tr>
<td>Electrodes being placed on body</td>
<td>2-, 4-, and 6-year-olds</td>
<td>Amount of resistance (4- and 6-year-olds)</td>
<td>1=no resistance, 3=refusal</td>
</tr>
<tr>
<td>Blood pressure cuff being placed on arm</td>
<td>2-, 4-, and 6-year-olds</td>
<td>Amount of resistance (4- and 6-year-olds)</td>
<td>1=no resistance, 3=refusal</td>
</tr>
<tr>
<td>A spatial memory evaluation</td>
<td>2-year-olds</td>
<td>Delays in compliance (4-year-olds)</td>
<td></td>
</tr>
<tr>
<td>A drop of liquid being placed on the tongue</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiving criticism after failing to build a difficult block construction</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked to perform acts not permitted at home (e.g., spilling juice on the table, hitting the examiner’s hand)</td>
<td>2- and 4-year-olds</td>
<td>Delays in compliance (4-year-olds)</td>
<td></td>
</tr>
<tr>
<td>A second unfamiliar room</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A stranger with a toy</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An adult dressed in a clown costume</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A toy dinosaur moving and talking</td>
<td>2-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked to stand with eyes closed</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked to stand in the dark</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked for memories of a story</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A door opening with a gloved hand putting an object on the floor and then closing the door</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked to recall a series of digits</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The modified Stroop procedure (27)</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being questioned about a series of orally presented words</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being asked for memories of a second story</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate measuring (sitting and standing, each performed twice)</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure measuring (sitting and standing, each performed twice)</td>
<td>4- and 6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Matching Familiar Figure Test</td>
<td>6-year-olds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children Encounter Situation</td>
<td>Variable Measuredb</td>
<td>Ratings</td>
<td></td>
</tr>
<tr>
<td>6-year-olds</td>
<td>Impulsivity</td>
<td>1=reflective, 3=impulsive</td>
<td></td>
</tr>
</tbody>
</table>

a The mother was present during testing for all children.
b In addition to any situation-specific behaviors assessed, investigators rated the 2-year-old children on the amount of distractibility, vocalizations, and smiling exhibited over the entire battery on a 3-point scale (1=minimal, 3=maximal) and provided dichotomous ratings of whether each situation was feared or not (i.e., whether distress or avoidance was displayed), which were summed into total number of fear responses. For the 4- and 6-year-old children, investigators additionally rated the level of fear, shyness, resistance, and overall inhibition over the entire battery on a 4-point scale (1=none, 4=extreme) as well as the number of smiles and number of spontaneous comments displayed over the entire battery. The 4-year-olds were additionally rated on their voice quality on a 4-point scale (1=spontaneity, 4=whispering).

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**Diagnostic Assessments**

To grant optimal freedom from bias: 1) only the project coordinator knew the ascertainment group of the parent; 2) staff assessing behavioral inhibition were blind to other data; and 3) psychiatric interviewers were blind to ascertainment status and the behavioral inhibition classification of children.

Both parents were interviewed with the Structured Clinical Interview for DSM-III-R (22). Social class was assessed with the Hollingshead Four-Factor Index (23). Psychiatric assessments of children ages 5 and older used the Schedule for Affective Disorders and Schizophrenia for School-Age Children—Epidemiologic Version (K-SADS-E) (24), which was completed by the children's mothers, who also completed the Child Behavior Checklist (25, 26).

Interviews were conducted by raters supervised by two senior psychiatrists (J.F.R., J.B.). Kappa coefficients of agreement were computed between the interviewers and board-certified psychiatrists who listened to audiotaped interviews. On the basis of 173 interviews, kappas ranged from 0.64 for alcohol abuse to 0.99 for attention deficit hyperactivity disorder, with median and mean kappas of 0.86. Good agreement was seen for major diagnoses of interest (panic disorder: kappa=0.96; major depression: kappa=0.86; anxiety disorders: kappa range=0.83–0.96; disruptive behavior disorders: kappa range=0.93–0.99). All subjects were diagnosed on the basis of a consensus judgment by two senior psychi-
A summary score was derived from a principal factors factor analysis (with varimax rotation) of all the behavioral variables in Table 1, computed separately for 2-, 4-, and 6-year-old children. We retained factors having eigenvalues greater than one and selected for each age group the factor score that best reflected behavioral inhibition. Children in each age group who had behavioral inhibition summary scores in the upper 20th percentile of children in their age range were classified as inhibited.

**Statistical Approach**

We first tested associations between predictor and outcome variables and demographic characteristics, considering a characteristic potentially confounding if it was related to both predictor and outcome variables at p<0.10. Then we tested whether behavioral inhibition in the child predicted specific outcomes while controlling for potentially confounding demographic variables (28). Multiple members of a single family were not independently sampled. To deal with this problem, we used the generalized estimating equation method to estimate general linear models (29), as implemented in Stata (30). We used Wald's chi-square test to assess the statistical significance of individual regressors. When this was not possible because of small cell sizes, we used Fisher's exact test for two-way tables or exact logistic regression or more complex models (31).

To determine whether the association of behavioral inhibition with outcomes could be accounted for by parental diagnosis, we used the generalized estimating equation method to predict the outcome by using behavioral inhibition with parental diagnosis covaried. If behavioral inhibition predicted outcome in such an equation, its association could not be accounted for by parental diagnosis. We also examined the interaction between behavioral inhibition and parental diagnosis in predicting outcome. All analyses were two-tailed and used the 5% significance level.

**Results**

Of the 284 children who underwent the situational battery for assessment of behavioral inhibition, 216 were assessed with the K-SADS-E and 239 were assessed with the Child Behavior Checklist. Because of overlap in children assessed with each of these measures, a total of 269 children were included in the analyses. No demographic differences were detected between inhibited and noninhibited children (Table 2). The group of inhibited children had more subjects who were female and of a lower social class. Even though the differences did not reach statistical

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**TABLE 2. Demographic Characteristics of 2-, 4-, and 6-Year-Old Children With or Without Behavioral Inhibition**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Children With Behavioral Inhibition (N=84)</th>
<th>Children Without Behavioral Inhibition (N=185)</th>
<th>Analysis²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Age at interview (years)</td>
<td>5.9</td>
<td>0.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Socioeconomic status ³</td>
<td>2.2</td>
<td>0.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Number of siblings in family</td>
<td>2.0</td>
<td>0.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>

²Children were offspring of parents with panic disorder and/or major depression and a comparison group of parents with neither panic disorder nor depression. Behavioral inhibition was defined by 1) the number of spontaneous comments and smiles during administration of a situational battery (for the 4- and 6-year-olds) or by the number of fears or extent of vocalization or smiling displayed (for the 2-year-olds), and 2) factor-derived summary scores. For the 4- and 6-year-old children, a global behavioral inhibition rating could be substituted for one of these two criteria.

³Generalized estimating equations to correct for intrafamilial clustering were used to test significance of associations.

⁴As per the Hollingshead Four-Factor Index (23).

⁵Analysis based on binary comparison of Caucasian versus non-Caucasian children.
Children were offspring of parents with major depression, panic disorder either with or without comorbid major depression, and a comparison group of parents with neither panic disorder nor depression. Behavioral inhibition was defined by 1) the number of spontaneous comments and smiles during administration of a situational battery (for the 4- and 6-year-olds) or by the number of fears or extent of vocalization or smiling displayed (for the 2-year-olds), and 2) factor-derived summary scores. For the 4- and 6-year-old children, a global behavioral inhibition rating could be substituted for one of these two criteria.

Results were consistent regardless of behavioral inhibition definition. The rate of any disruptive behavior disorder was significantly higher in noninhibited children than in inhibited children across all three behavioral inhibition definitions (dichotomous: odds ratio=0.18, 95% CI=0.04–0.80 [Wald χ²=5.1, df=1, p=0.02]; global: odds ratio=0.34, 95% CI=0.14–0.84 [Wald χ²=5.4, df=1, p=0.02]; summary: odds ratio=0.32, 95% CI=0.12–0.83 [Wald χ²=5.4, df=1, p=0.02]). Similarly, the significantly higher rates of avoidant disorder and social anxiety disorder reported in the children with behavioral inhibition remained significant per the global definition (avoidant: odds ratio=5.4, 95% CI=1.1–27.7 [Wald χ²=4.1, df=1, p=0.04]; social anxiety disorder: odds ratio=3.3, 95% CI=1.2–8.8 [Wald χ²=5.51, df=1, p=0.02]) and the summary definition (avoidant: odds ratio=4.4, 95% CI=1.0–19.2 [Wald χ²=3.82, df=1, p=0.05]; social anxiety disorder: odds ratio=3.04, 95% CI=1.15–8.01 [Wald χ²=5.07, df=1, p=0.02]) of behavioral inhibition.

Discussion

Behavioral inhibition in children was selectively associated with a higher risk for avoidant disorder and social phobia and a lower risk for disruptive behavior disorders. No association was detected between behavioral inhibition and other disorders, which suggests that behavioral inhibition may have specific associations with social anxiety in children.

Our prior work also found significant associations between behavioral inhibition and overanxious, avoidant, and phobic disorders (15, 16). Moreover, at a 3-year follow-up (ages 8–11), these children had significantly higher rates of multiple anxiety disorders, avoidant disorder, separation anxiety disorder, and agoraphobia (16).

Our findings linking behavioral inhibition with social anxiety support a body of literature documenting similar results. Parents of inhibited children have histories of
overanxious and avoidant disorders in childhood (32), and prospective studies have supported the link between behavioral inhibition and social phobia in children. In one, youngsters classified as inhibited at 21 or 31 months had significantly higher rates of current general social anxiety at age 13 than uninhibited youngsters (33). No other types of anxiety differed between groups.

Hayward and colleagues (34) assessed behavioral inhibition (using retrospective self-reports) in a sample of over 2,000 ninth-graders subsequently interviewed for depression and social phobia at yearly intervals throughout high school. Subjects who showed evidence of behavioral inhibition had a greater than fivefold risk of developing social phobia than other subjects. Retrospective studies of adults...
with social anxiety or social phobia have reported links between social anxiety disorders and childhood behavioral inhibition. Mick and Telch (35) found that college undergraduates with social anxiety scored significantly higher on behavioral inhibition than those with generalized anxiety disorder or comparison subjects.

In our study, behavioral inhibition was associated with social anxiety mainly among children whose parents had panic disorder either with or without depression. This is consistent with the idea that the familial factors that cause behavioral inhibition could overlap with those that cause panic disorder and possibly depression. It also suggests that behavioral inhibition predicts children's social anxiety beyond what can be predicted by the parental disorders. Thus, our results suggest that parental panic disorder and child behavioral inhibition could be used to identify children at high risk for social anxiety who may benefit from preventive and early intervention strategies.

The finding that behavioral inhibition was less common among children with disruptive behavior disorders confirms findings by other groups of an inverse association between behavioral inhibition or anxiety and disruptive behavior. For example, Walker et al. (36) reported that the presence of comorbid anxiety disorders in boys with conduct disorder was inversely associated with predatory activity and aggression. Similarly, Kerr et al. (37) reported that behavioral inhibition protected both disruptive and nondisruptive boys against delinquency.

Our findings should be viewed in light of some methodological limitations. Because we relied on cross-sectional data, we cannot be certain that behavioral inhibition preceded the onset of social anxiety disorder in the children affected with this disorder. The assessment of psychopathology in the children used interviews with mothers. Parents with psychiatric disorders may have exaggerated symptoms in their children, whereas mothers without psychopathology may have underreported problem behaviors (38, 39). The lack of direct psychiatric interviews with children may have decreased the sensitivity of some diagnoses, especially for “internalizing” disorders. However, we found high rates of these disorders in our study. Also, the children in our study had a mean age of 6 at the time of diagnostic assessment. Young children have limited expressive and receptive language abilities; they cannot easily sequence events in time and have difficulties with abstraction. Thus, there is a real question about whether their self-perceptions, memories, feelings, and reported behavior can be reliably assessed through self-report, especially with regard to lifetime history of psychopathology (40). Although limited, studies of interview techniques for young children suggest that their responses are unreliable (41).

Also since our proband parents were clinically referred, the generalizability of our findings is limited to referred study groups. Although we made a distinction between parents with panic disorder and major depression and those with panic disorder only, because of the variable age at onset it is possible that some of the parents with only panic disorder will eventually develop major depression. Finally, we must be cautious when making inferences about disorders that showed no association with behavioral inhibition because our study group is still young; further follow-up is needed to assess emergent disorders.

Despite these considerations, in a comprehensive examination of psychiatric correlates of the laboratory-based temperamental trait termed “behavioral inhibition” in a large group of children, we found that behavioral inhibition was selectively associated with a greater risk for avoidance disorder and social phobia in children, which suggests that behavioral inhibition may have specific associations with social anxiety in young children. Considering that behavioral inhibition can be identified earlier in life than manifest anxiety, repeated confirmation of these findings could have important implications for the prevention of anxiety disorders in children.

References

23. Hollingshead AB: Four-Factor Index of Social Status. New Haven, Conn, Yale University, Department of Sociology, 1975
24. Orvaschel H: Schedule for Affective Disorders and Schizophrenia for School-Age Children—Epidemiologic Version (K-SADS-E), 5th ed. Fort Lauderdale, Fla, Nova Southeastern University, Center for Psychological Studies, 1994