Externalizing behavior problems in children and adolescents, including aggression and antisocial behavior (ASB), constitute the most common referral patterns for mental health services in the United States (Achenbach & Howell, 1993). Although recent official records of overall juvenile crime and violence suggest a long-anticipated decrease following decades of increasing rates (Snyder & Sickmund, 1995), ASB remains a compelling area of inquiry for several reasons. First, stability coefficients indicate a distressing pattern of continuity over the lifecourse (Loeber, 1982; Olweus, 1979), and these most likely represent an underestimate, given that measurement error is not typically accounted for in stability estimates (Frick & Loney, 1999; Moffitt & Caspi, 2001). Second, adolescence marks a developmental transition during which both the number of offenders and their rate of offending increase (Moffitt, 1993). Third, the identification of childhood precursors of serious ASB in adolescence, as well as mechanisms and processes underlying such predictions from childhood, is essential to constructing durable developmental models and corresponding prevention and intervention efforts. Thus, identifying viable predictors of serious adolescent ASB remains an important research goal (Loeber & Farrington, 2001). Our aim is to compare the predictive accuracy of several theoretically driven and objectively measured childhood predictors of adolescent delinquency from a well-characterized sample of boys with and without attention deficit hyperactivity disorder (ADHD).

First, ADHD is a condition characterized by developmentally extreme and inappropriate levels of hyperactivity or impulsivity and inattention or disorganization with cross-situational impairment, including difficulties at home, at school, and with social relationships (Lahey et al., 1994). Reliable associations have been identified with a wide spectrum of negative outcomes, including academic underachievement, conflictual parent–child interactions, and elevated rates of accidental injuries (Danforth, Barkley, & Stokes, 1991; Hinshaw, 1994; Mannuzza & Klein, 1999). Comorbidity with other disorders is generally high (Angold, Costello, & Erkanli, 1999), particularly with the disruptive behavior disorders, oppositional defiant disorder and conduct disorder (Biederman, Newcorn, & Sprich, 1991). However, despite their frequent overlap, a wealth of research suggests partial independence of ADHD and externalizing problems in terms of internal validity (e.g., separable factor structures) and diverging external correlates, including heritability, cognitive and neuropsychological risk factors, peer and family variables, and long-term outcomes (Hinshaw, 1987; Waschbusch, 2002).
Although there is consensus that early conduct problems is a better predictor of adolescent ASB than is early ADHD, children with ADHD are a viable sample for the study of risk factors for ASB given the role of ADHD in fueling early conduct problems (Hinshaw, Lahey, & Hart, 1993; Loeber, Green, Keenan, & Lahey, 1995). However, many investigations of the predictability of later ASB from childhood ADHD have been contaminated by significant comorbidity of the latter with conduct problems (Lilienfeld & Waldman, 1990). Tests of the independent contribution of ADHD to ASB have yielded inconsistent results (Barkley, Fisher, Edelbrock, & Smallish, 1990; Farrington, Loeber, & Van Kammen, 1990; Mannuzza et al., 1991; Mannuzza & Klein, 1999). For example, Satterfield, Swanson, Schell, and Lee (1994) found that hyperactive boys with high defiance/aggression scores were more likely to have felony arrests at follow-up than comparison children. Interestingly, hyperactive boys with low aggression/defiance scores also evidenced higher rates of felony arrests than controls. However, Satterfield and Schell (1997) later suggested that there was no risk for adolescent and adult criminality among hyperactive boys without co-occurring conduct problems, which echoes a recent review of this literature (Lahey, McBurnett, & Loeber, 2000).

It is essential to note that aggression and ASB exist in many different forms and types (Hinshaw & Lee, 2003). For example, Loeber and Schmaling’s (1985) meta-analytic review identified evidence for distinct overt and covert patterns of ASB. Overt behaviors include physical aggression, assault, and violence whereas covert behaviors include substance use, truancy, theft, and property destruction. Noncompliance represented the midpoint of this continuum, which corresponded to excessive irritability, oppositionality, and defiance. These important distinctions have provided a foundation for subsequent work examining potential differences between overt and covert ASB with respect to external correlates, predictive relations, and developmental trajectories (Edelbrock, Plomin, Rende, & Thompson, 1995; Loeber et al., 1993).

Because of their observable nature and clear predictive power to later aggression and ASB, overt manifestations of aggressive behavior (e.g., fighting, verbal aggression) are frequently investigated as predictors of adolescent delinquency (Coie, Terry, Lenox, Lochman, & Hyman, 1995; Loeber et al., 1995). However, covert ASB (e.g., stealing, property destruction) has been shown to be an important marker or indicator of the developmental progression from oppositional defiant disorder to conduct disorder during middle childhood (Hinshaw et al., 1993). Further, in a series of cross-sectional studies, covert ASB, measured during childhood utilizing a laboratory paradigm, was associated with multiple indexes of poor outcome and with responsiveness to pharmacologic intervention (Hinshaw, Heller, & McHale, 1992; Hinshaw, Simmel, & Heller, 1995; Hinshaw, Zupan, Simmel, Nigg, & Melnick, 1997).

The potential importance of noncompliance for predicting adolescent ASB is evidenced by several key developmental themes. First, as reviewed by Coie and Dodge (1998), noncompliance shows significantly higher base rates than either overt or covert behaviors, particularly in early childhood; however, these difficulties typically attenuate by middle childhood for most children. For a smaller portion of children, noncompliance likely portends the development and onset of more serious ASB, including physical aggression and covert behaviors (Lahey et al., 2000).

Negative peer regard is a powerful predictor of poor outcomes, including lowered self-esteem and difficulties with overall adjustment (Parker, Rubin, Price, & DeRosier, 1995). Children with ADHD receive higher rates of negative peer nominations and lower rates of positive nominations than do comparison children (Whalen & Henker, 1992). In addition, highly aggressive youth with ADHD suffer from an even more negative sociometric profile (Hinshaw & Melnick, 1995). A key question, therefore, is whether (a) childhood peer status and (b) childhood externalizing problems predict later ASB once the influence of the other is removed. Past literature in this regard has been inconsistent (Coie et al., 1992; Kupersmidt & Coie, 1990; Laird, Jordan, Dodge, Pettit, & Bates, 2001), with some investigators finding evidence for an interactive model, whereby children exhibiting both aggression and negative peer status show more maladjustment at follow-up relative to children with only one such factor (Bierman & Wargo, 1995; Coie et al., 1995).

The aforementioned material points highlight several key unresolved issues in the field: (a) The relation between childhood ADHD and adolescent ASB is still uncertain, given the frequent comorbidity between ADHD and conduct problems in childhood; (b) the conceptual and empirical distinctions between overt and covert ASB, along with the intermediate category of noncompliance, are not typically made—they require separate tests of predictive relations to adolescent delinquency with simultaneous control for the influence of childhood ADHD; and (c) the causal status of peer relationships in relation to adolescent delinquency is ambiguous. Based on these considerations, our central aim is to test the predictive strength of theoretically selected and objectively measured childhood predictors—overt and covert ASB, noncompliance, and peer status—in relation to the severity of adolescent delinquency. Our sample includes carefully selected boys with ADHD, plus normal-range comparison boys, all observed initially during childhood (Hinshaw & Melnick, 1995; Hinshaw et al., 1997; Nigg, Hinshaw, Carte, & Treuting, 1998).

Utilizing an established indicator of adolescent delinquency severity as our primary outcome measure...
(see Loeber, Stouthamer-Loeber, Van Kammen, & Farrington, 1991), we hypothesized that aggression, noncompliance, peer status, and covert ASB would all make significant increments in explained variance to outcomes at a 5-year follow-up, systematically controlling for the influence of ADHD versus comparison status. We also hypothesized that peer status would make contributions to the prediction of delinquency severity, over and above the externalizing indicators. Finally, we speculated that predictive relations would be stronger for boys with ADHD than comparison boys, given the potential for multiplicative effects of childhood ADHD with both early ASB and early peer status in predicting to adolescent delinquency (Loeber et al., 1995; Moffitt, 1990).

Method

Overview of Procedures

In 1991, 1993, 1994, and 1995, we conducted parallel summer research programs at the University of California, Berkeley, for independent samples of preadolescent boys with and without ADHD. Each summer enrichment program was 6 weeks in length and held at nearby schools. Prior to the start of each camp and following mailed questionnaires to parents and teachers, all participating families came to the Berkeley campus for in-person evaluations. Following full informed consent procedures, precamp assessments addressed four primary domains: (a) individual child variables, such as IQ, academic achievement, neuropsychological functioning, and self-reports of internalizing problems; (b) parental structured interviews and rating scales regarding their child’s level of psychopathology; (c) parent self-reports of their own childhood symptomatology and current levels of psychopathology; and (d) videotaped observations of parent–child and family interactions.

For the summer programs, designed to blend structure and naturalism, participants were grouped into two classrooms on the basis of their age (younger class: ages 6 to 9.5; older class: ages 9.6 to 12), with each composed of 20 to 25 boys. Activities included outdoor play (games and sports), classroom events, and small-group exercises. All classes and interactions were monitored daily, thus yielding objective measures of externalizing (physical and verbal aggression; noncompliance) and internalizing behavior (social isolation; withdrawn). A laboratory measure of covert ASB (property destruction and theft) was also administered to all children during the last week of each program. Finally, peer sociometrics were gathered at the end of the first and last week of each camp program. Boys with ADHD participated in double-blind, placebo controlled trials of methylphenidate during each summer program, but all data reported herein reflect unmediated or placebo periods of observation following 24-hr washout periods. Because of the short half-life of methylphenidate, medication effects on pertinent measures are likely to be negligible.

Between 5 and 6 years following their initial involvement in the summer camps, families were contacted to participate in a follow-up visit to Berkeley. Parents provided full consent and adolescents assented to all relevant procedures. A packet of questionnaires was also sent to two teachers of each participant. During the 3-hr visit, parents completed structured diagnostic interviews and checklists of adolescent psychopathology. Youth were interviewed separately and received testing on a standard measure of academic achievement. Adolescent self-reports included delinquency (ASB, substance use or abuse) and internalizing behavior (anxiety, depression). When families were unable or unwilling to come to campus for the assessment, detailed telephone interviews with parents and guardians were conducted to ascertain the adolescent’s school achievement, ASB, and overall psychosocial development. For 14 families, the length of time between baseline and follow-up was longer (6.5 to 7 years), given that locating out-of-state families, plus the presence of family stressors and “clinical realities” (e.g., adolescent in residential treatment facility) rendered a uniform time frame impossible.

Participants

The sample of 100 boys with ADHD was recruited through a series of physician and mental health referrals as well as via parent self-help groups (see Nigg et al., 1998, for details). Initial eligibility criteria were a diagnosis of ADHD from the community and prior treatment with stimulant medication for at least 4 months prior to the onset of the summer program. Relevant exclusion criteria for all potential participants included (a) mental retardation (IQ < 70), (b) neurological disorders or psychosis, and (c) other medical conditions that prevented participation in all of the activities of the summer program.

Additional inclusion criteria for probands required clear impairment on at least three of four following empirically established measures and cutoff scores: (a) the Conners Abbreviated Symptom Questionnaire and the 2 standard deviation criterion of 15 (Goyette, Conners, & Ulrich, 1978); (b) the Attention Problem scale of the Child Behavior Checklist (Achenbach, 1991a), with the empirically derived T score of 60 (Chen, Faraone, Biederman, & Tsuang, 1994); (c) structured parent interviews with an abbreviated Diagnostic Interview for Children and Adolescents (Herjanic, 1981), with the required five symptoms of attention problem disorder from Loney’s (1987) Divergent and Convergent Items; and (d) ADHD symptoms from the Disruptive Behavior Disorders Checklist (Pelham,
Gnagy, Greenslade, & Milich, 1992), with the criterion of eight or more symptoms from the Diagnostic and Statistical Manual of Mental Disorders (3rd ed., rev. [DSM–III–R], American Psychiatric Association, 1987). Caregivers reported onset of ADHD behaviors prior to age 7 in all cases, consistent with the early onset and impairment required for the diagnosis. Finally, teacher ratings were collected, but their observations of seemingly unmedicated behaviors did not coincide with the medicated status of all children with ADHD; thus, their ratings were not included as part of the inclusion criteria and diagnostic assessments.

Rates of comorbidity with aggressive-spectrum disorders (such as oppositional defiant disorder) were comparable to other reports among samples with ADHD (Angold et al., 1999; Biederman et al., 1991). Specifically, 54 of the 100 probands surpassed the DSM–III–R criteria (based on mother reports) of five or more symptoms out of nine for oppositional defiant disorder. Reliable and valid measures of conduct disorder were not collected at baseline, given the young age of many participants.

A sample of 77 comparison children were recruited from newspaper advertisements and announcements posted in local schools and social service agencies, within the same communities as for the boys with ADHD. Families who expressed interest in the summer program completed parent ratings of child behavior and were supplemented by teacher reports of similar domains. Externalizing behavior that was scored as being on the borderline of clinically significant was grounds for exclusion from the summer camp. Because of incomplete data at baseline for 2 comparison families, whose sons left the summer programs prematurely, only 75 children were sought for participation in our follow-up study.

Table 1. Descriptive Statistics for ADHD and Comparison Groups at Baseline

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADHD (n = 100)</th>
<th>Comparison (n = 75)</th>
<th>df</th>
<th>t*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td>112.1</td>
<td>21.1</td>
<td>173</td>
<td>−1.69</td>
</tr>
<tr>
<td>SES*</td>
<td>50.7</td>
<td>10.6</td>
<td>173</td>
<td>−1.05</td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WISC Verbal IQ</td>
<td>106.7</td>
<td>17.04</td>
<td>172</td>
<td>3.2**</td>
</tr>
<tr>
<td>Woodcock–Johnson Reading**</td>
<td>55.9</td>
<td>32.5</td>
<td>171</td>
<td>3.6**</td>
</tr>
<tr>
<td><strong>Behavioral (maternal ratings)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASQ</td>
<td>20.5</td>
<td>4.5</td>
<td>173</td>
<td>−21.8**</td>
</tr>
<tr>
<td>CBCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention problems</td>
<td>71.2</td>
<td>7.6</td>
<td>173</td>
<td>−17.6**</td>
</tr>
<tr>
<td>Externalizing</td>
<td>65.9</td>
<td>9.7</td>
<td>173</td>
<td>−12.9**</td>
</tr>
<tr>
<td>Internalizing</td>
<td>63.6</td>
<td>9.7</td>
<td>173</td>
<td>−8.1**</td>
</tr>
</tbody>
</table>

Note: ADHD = attention deficit hyperactivity disorder; SES = socioeconomic status; WISC = Wechsler Intelligence Scale for Children; CASQ = Conners Abbreviated Symptom Questionnaire; CBCL = Child Behavior Checklist.

*Group differences were tested via two-tailed, independent-sample t tests. *Hollingshead (1975) continuous variable score. *National percentile rank.

*p < .05. **p < .01.

The ethnic diversity of the sample mirrors the richness of the San Francisco Bay area. Of the 175 male participants, 102 were Caucasian (58%), 28 were African American (16%), 18 were Hispanic (10%), 23 were Asian (13%), and 4 were of Native American descent (3%). Group comparisons (ADHD vs. comparison) are provided on a range of pertinent demographic, cognitive, academic, and behavioral indexes (see Table 1). As expected, children with ADHD demonstrated significantly more behavior problems (maternal reports of externalizing and internalizing patterns), greater academic difficulties, and lower verbal intelligence. On average, however, these families earned higher levels of family income than did comparisons. Further analyses revealed that Caucasian children were overrepresented among probands $\chi^2(4, N = 175) = 47.5, p < .01$.

Baseline Measures

Observations of social interactions. Microanalytic observations of verbal and physical aggression and noncompliance were obtained through a well-validated, time-sampled observational system (see Hinshaw & Melnick, 1995). Teams of four trained undergraduate observers rotated throughout summer camp periods. During individual 1-hr playground and classroom periods, observers coded behaviors from the “sideline.” Facilitated by randomized rosters of boys’ names and unaware of their diagnostic and medication status, observers followed audiotaped commands through headphones. Three-second “find” commands were followed by 5-sec “observe” and 3-sec “record” intervals. Behaviors were then placed in one of six mutually exclusive categories of social interaction (noncompliance, verbal or physical aggression, social isolation, compliant, and
prosocial). Only the first two categories were used in this study.

Noncompliance was conceptualized and measured separately from verbal and physical aggression. Corresponding behaviors included annoying, intrusive, and norm-violation acts but did not actually involve verbal threats or taunts and physical contact with another individual. Verbal aggression was operationalized as swearing, explicit verbal threats and insults, or other inappropriate comments directed toward peers or staff; physical aggression constituted acts directed toward others resulting in physical contact, such as kicking, hitting, and shoving. We summed the verbal and physical aggression categories because of relatively low base rates of aggression. Observational measures were transformed into proportion scores by dividing the frequencies by the total number of intervals. Across all four summers, the overall base rate was 12% for noncompliance and 2% for aggression (verbal + physical).

To assess reliability among raters, pairs of observers were unaware that they were holding identical rosters of boys’ names. Approximately 17% of the time, interobserver agreements were calculated. Raters were considered in agreement when they recorded the same behavioral code during the 5-sec observe command. The occurrence-only agreement percentages were .65 for overt aggression and .73 for noncompliance (Hinshaw & Melnick, 1995). In cases of disagreement, we utilized data from the coder scoring the lower base rate category (e.g., aggression, as opposed to noncompliance). Given the low base rates of these ratings, kappa is an overly stringent measure of reliability; thus, we feature the rigorous, occurrence-only agreement percentages for these categories.

Peer sociometrics. At the end of the first and last week of each summer program, all participants were asked to nominate three classmates with whom he would most and least like to be friends (Hinshaw & Melnick, 1995). Each confidential interview was conducted separately from the current classroom or outdoor activity and, consequently, away from classmates and other staff. Picture boards with identical head-and-shoulders photographs of classmates were available; children were instructed to choose friends they would work independently on a worksheet in the absence of adult supervision. Temptations, in the form of dollar bills, change, and desirable small toys, were available; in addition, some boys spontaneously destroyed property (e.g., writing on desk and walls with permanent markers). A continuous measure of stealing (0 to 5) was composed by adding the dollar amount of money stolen ($0, $1, or $2) and the number of toys taken (0 to 3). Property destruction was also assessed (0 to 3) with a score of zero indicating no damage and 3 representing significant damage (e.g., writing on the furniture and walls or destroying materials such as pencils or paper). This laboratory paradigm has been validated by differentiating known groups, predicting external criterion measures (parent and staff ratings of ASB), and demonstrating adequate test–retest reliability (see Hinshaw et al., 1995). Lending further support to its validity, observed stealing and property destruction formed a unique empirical factor of covert behavior that was separate from the observational measures of verbal + physical aggression (Hinshaw et al., 1995). Furthermore, there was only a modest correlation between observed aggression and the total sum of covert ASB, r(173) = .20. p = .01.

Follow-up measure: Severity of delinquent behavior. Following the procedures outlined by Loeber, Farrington, Stouthamer-Loeber, and Van Kammen (1998) and Loeber et al. (1991), pairs of trained undergraduates utilized data from multiple informants (parent, teacher, youth) and assigned an individual severity score (1 to 4) for each of the adolescents who participated in the follow-up. Raters were instructed to examine endorsements of individual items as well as their frequency, severity (e.g., repetitive), and onset/duration. Parents and teachers completed the Child Behavior Checklist (Achenbach, 1991a) and Teacher Report Form (Achenbach, 1991b), respectively, whereas the adolescents reported behaviors on the Youth Self-Report (Achenbach, 1991c) and Self-Reported Delinquency (Elliott, Ageton, Huizinga, Knowles, & Canter, 1983; Elliott & Huizinga, 1989). A score of 1 denotes no relevant ASB; 2 refers to minor forms such as theft valued below $5 or not paying for a bus or subway ride; 3 includes gang fighting or joyriding, substance use, or significant property destruction; and 4 denotes the most severe forms such as physical assault and rob-
bery. The kappa between the two undergraduate raters was quite acceptable ($\kappa = .70$). In 21 cases, the raters were not in agreement. To resolve these discrepancies and decide on a final rating, both authors conducted independent ratings of these 21 cases and their reliability was assessed ($\kappa = 1.0$). As a final check, we made independent ratings of approximately 10% of the remaining participants (88 total; 10 were randomly selected) and the kappa was satisfactory ($\kappa = .76$).

To check the reliability of the delinquency severity measure for the 35 families for whom follow-up data were gathered via telephone interviews, three raters reviewed a representative 14 cases and appraised delinquency severity independently. In 11 of the 14 cases, all three raters provided identical ratings (79% agreement). For the three remaining cases, two of the three raters agreed and the final rater deviated by 1 metric point. Independent-sample $t$ tests were executed for all predictors and the single outcome measure, contrasting the use of “standardized” or “nonstandardized” (telephone interview) procedures for delinquency severity ratings. There were no significant differences: noncompliance: $t(134) = -.08, p = .94$; social preference: $t(134) = -.05, p = .96$; overt aggression: $t(134) = .58, p = .57$; covert ASB: $t(134) = .29, p = .78$; or diagnostic status: $\chi^2(1, n = 134) = 2.67, p = .10$.

## Results

### Diagnostic Group Differences and Associations Among Predictors and Outcome

Table 2 provides diagnostic group differences between boys with ADHD and comparison boys for each of the four primary predictors at baseline and the outcome measure from the prospective follow-up visit. At baseline, as expected, the boys with ADHD, relative to the typically developing boys, were significantly more noncompliant, showed higher rates of overt aggression and covert ASB, and were less well regarded by their peers at the summer camp. Five years later, the probands were rated as being much more seriously delinquent than their non-ADHD counterparts. Given our use of multiple regression analyses and the problems presented by multicollinearity, we examined the magnitude and pattern of associations among our predictors and with the outcome (see Table 3). Overall, the

### Table 2. Mean Values for ADHD and Comparison Boys on Predictor and Outcome Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADHD ($n = 100$)</th>
<th>Comparison ($n = 75$)</th>
<th>df</th>
<th>$t^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Externalizing predictors:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overt aggression$^b$</td>
<td>.033</td>
<td>.06</td>
<td>173</td>
<td>-5.08*</td>
</tr>
<tr>
<td>Noncompliance</td>
<td>.177</td>
<td>.14</td>
<td>173</td>
<td>-3.94*</td>
</tr>
<tr>
<td>Covert ASB$^c$</td>
<td>1.23</td>
<td>1.8</td>
<td>172</td>
<td>-4.78*</td>
</tr>
<tr>
<td>Sociometric predictor:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social preference$^d$</td>
<td>-.07</td>
<td>.23</td>
<td>173</td>
<td>5.93*</td>
</tr>
<tr>
<td>Outcome measure$^e$</td>
<td>1.31</td>
<td>.94</td>
<td>142</td>
<td>-5.08*</td>
</tr>
<tr>
<td>Delinquency severity$^f$</td>
<td>.552</td>
<td>.80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ADHD = attention deficit hyperactivity disorder; ASB = antisocial behavior; overt aggression = physical + verbal aggression.

$^a$Group differences were tested via two-tailed, independent–sample $t$ tests. $^b$Combination of verbal and physical aggression proportions. $^c$Combination of stealing and property destruction measures. $^d$Positive nomination proportion minus negative nomination proportion. $^e$Total sample size with available delinquency severity outcome measure (ADHD = 86, Comparison = 58). $^f$Aggregate rating of delinquency severity at follow-up.

$p < .00$.

### Table 3. Intercorrelations Among Predictor and Outcome Variables

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overt aggression</td>
<td></td>
<td>.42**</td>
<td>.20**</td>
<td>-.29*</td>
<td>.28**</td>
<td>.23**</td>
<td>-.002</td>
<td>-.08</td>
<td>-.05</td>
<td>-.07</td>
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<tr>
<td>2. Noncompliance</td>
<td></td>
<td></td>
<td>.45**</td>
<td>-.45**</td>
<td>.45**</td>
<td>.20**</td>
<td>-.18*</td>
<td>.002</td>
<td>-.17*</td>
<td>-.18*</td>
</tr>
<tr>
<td>3. Covert antisocial behavior</td>
<td></td>
<td></td>
<td></td>
<td>-.36**</td>
<td>.36**</td>
<td>.10</td>
<td>-.06</td>
<td>-.06</td>
<td>-.10</td>
<td>-.09</td>
</tr>
<tr>
<td>4. Social preference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.31**</td>
<td>-.27**</td>
<td>.21**</td>
<td>.04</td>
<td>.17</td>
<td>.21**</td>
</tr>
<tr>
<td>5. Delinquency severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.30**</td>
<td>-.24**</td>
<td>-.05</td>
<td>-.09</td>
<td>-.34**</td>
</tr>
<tr>
<td>6. CBCL Internalizing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.17*</td>
<td>-.01</td>
<td>-.28**</td>
<td>-.28**</td>
</tr>
<tr>
<td>7. Academic achievement (reading)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.04</td>
<td>.07</td>
<td>.67**</td>
</tr>
<tr>
<td>8. SES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.05</td>
<td>.14</td>
</tr>
<tr>
<td>9. Ethnicity</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>.05</td>
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<tr>
<td>10. Verbal IQ (VIQ)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note: CBCL = Child Behavior Checklist; SES = socioeconomic status. $^a$ $p < .05$. $^*$ $p < .01$. 

$710$
correlations showed some overlap, but the predictors were not redundant. For example, overt aggression and social preference were only modestly associated \( r(173) = -0.29 \), whereas noncompliance showed a somewhat stronger association with covert ASB \( r(173) = 0.45 \). A similar pattern emerged for predictor–criterion correlations, with no single predictor approaching redundancy status with the outcome measure. Consequently, we retained all predictors for our analyses. Finally, patterns of association with other potential confounds such as socioeconomic status, academic achievement (Reading), Verbal IQ (VIQ), and parent-reported internalizing behaviors were examined. Socioeconomic status was not significantly correlated with the main predictors or outcome; ethnicity was correlated only with internalizing behavior; and both academic achievement and internalizing behavior showed moderate correlations with the other variables. We thus retained VIQ, Reading, and internalizing behavior in our analyses.

**Logistic Regressions: Predicting Adolescent Delinquency Severity**

Given the prospective, longitudinal design of this study, participant attrition is a potential threat to the representativeness of those who continued in the follow-up study. Overall, 144 participants out of 175 total (82.3%) were involved in the follow-up assessments. Of this group of 144, 109 families (75%) provided at least one of the four primary ASB measures that were independently rated for delinquency severity. For the remaining 35 adolescents and their families who were not able to complete the standard questionnaires and rating scales, the in-depth telephone interviews yielded information on delinquency, academic achievement, and social development. Importantly, Pearson chi-squared and independent sample \( t \) tests suggest no significant differences between participants who continued in the study and those who did not based on our predictors and single outcome measure. Variables included diagnostic status (ADHD vs. Comparison), \( \chi^2(1, N = 175) = 2.21, p = .14 \); peer status, \( t(173) = 1.57, p = .12 \); observed physical and verbal aggression, \( t(173) = -0.34, p = .73 \); noncompliance, \( t(173) = 2.8, p = .01 \); covert ASB, \( t(172) = -2.28, p = .078 \). Thus, the follow-up sample appears representative of the baseline sample on these behavioral measures.

Because the outcome measure is not truly continuous but is instead ordinal, some of the assumptions underlying linear regression may be violated. Consequently, we employed logistic regressions after dichotomizing our delinquency severity index. Specifically, we dichotomized the delinquency outcome measure, differentiating adolescents who were non-delinquent or who committed minor forms of delinquency (scores of 1 or 2) versus those participating in moderate or serious types of acts (scores of 3 or 4). Prior to executing these analyses, the central predictors were centered by creating deviation scores (Aiken & West, 1991). Interaction terms were created by multiplying predictors after they were centered. For each of the four primary predictors (overt aggression, covert ASB, noncompliance, and peer status), two simultaneous covariates were entered at the initial step of all regression equations: age of the child and diagnostic status (ADHD vs. comparison). Interaction terms (Predictor × Diagnostic Status) were entered after each of the main effect predictors. The odds ratios (OR) reflect predictor–criterion associations with all preceding variables statistically controlled. As a supplemental analysis, we examined the Relative Improvement Over Chance of each main predictor with the delinquency severity outcome, utilizing the same dichotomization procedures outlined previously. Relative Improvement Over Chance has been recommended as an appropriate index of association while statistically controlling for variance attributable to chance (Farrington & Loeber, 1989). Note that when we conducted linear, observed least squares regression analyses, preserving the original metric of our ordinal outcome measure (1 to 4), we found identical patterns of results; these findings are available from the authors. The results of the logistic regression analyses are summarized in Table 4.

**Covariates.** We placed a binary variable (1 = ADHD status, 0 = comparison status) in each predictive equation. Because of (a) the significant association between child’s age and the primary outcome measure and (b) the reliable relation between age and the onset and pattern of ASB (Moffitt, 1993), we entered age as a covariate in all regression equations. In addition, although VIQ consistently correlated with all the predictors and our single outcome, it is quite possible that statistically controlling for this variable may constitute “over-control” in an investigation featuring youth with ADHD (Barkley, 1998). Lower verbal intelligence is a frequent concomitant feature of children with exter-

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic status</td>
<td>.31</td>
<td>.29</td>
</tr>
<tr>
<td>Peer status (social preference)</td>
<td>1.60</td>
<td>1.72</td>
</tr>
<tr>
<td>Peer status interaction term</td>
<td>.67</td>
<td>3.49</td>
</tr>
<tr>
<td>Noncompliance</td>
<td>16.6**</td>
<td>4.16</td>
</tr>
<tr>
<td>Noncompliance interaction term</td>
<td>.02</td>
<td>8.15</td>
</tr>
<tr>
<td>Overt aggression</td>
<td>5.5</td>
<td>39.58</td>
</tr>
<tr>
<td>Overt aggression interaction term</td>
<td>.03</td>
<td>.58</td>
</tr>
<tr>
<td>Covert ASB</td>
<td>2.37**</td>
<td>.29</td>
</tr>
<tr>
<td>Covert ASB interaction term</td>
<td>.22*</td>
<td>.58</td>
</tr>
</tbody>
</table>

Note: OR = odds ratio; SE = standard error; ASB = antisocial behavior. Predictors are centered.

*p < .01. **p < .00.
nalizing disorders (Moffitt & Lynam, 1994), and removing its influence may misrepresent predictive relations among variables. However, we executed all primary analyses both with and without control of VIQ. Other potential covariates (measures of internalizing behaviors and academic achievement at baseline; the number of measures unavailable for delinquency severity ratings due to missing data) were negligibly related to the delinquency severity outcome score; we report findings with and without their inclusion.

Given inconsistency in the literature linking childhood ADHD with subsequent ASB, we analyzed data to ascertain whether ADHD was uniquely related to adolescent delinquency severity over and above the simultaneous influences of overt aggression, noncompliance, covert ASB, and peer status. Overall, these latter four primary predictors accounted for 26% of the variance in delinquency severity, \( F(4, 139) = 11.65, p < .00 \), but diagnostic status was not significantly related after controlling for these predictors (OR = 0.31 in logistic model, \( p = .68 \)).

After entering age and diagnostic group status followed by the other main effects, overt aggression was marginally predictive (although not statistically significant) of delinquency severity (OR = 5.5, \( df = 1, p = .06 \)). The Overt Aggression \( \times \) Diagnostic Group interaction was also nonsignificantly related to delinquency severity (OR = .03, \( df = 1, p = .90 \)). In contrast, covert ASB showed a significant main effect (OR = 2.37, \( df = 1, p < .00 \)), and its interaction with diagnostic status was also significant (OR = .22, \( df = 1, p < .01 \)). When the covert ASB–delinquency severity association was examined in the diagnostic groups separately, the findings suggested, contrary to our hypothesis, a significantly stronger relation in the comparison group (OR = 9.9, \( df = 1, p < .01 \)) than in the ADHD group (OR = 1.14, \( df = 1, p = .37 \)). An identical pattern of findings emerged from analyses that included statistical control of VIQ, internalizing psychopathology, and academic achievement. In these analyses, there was a main effect for covert ASB (OR = 2.52, \( df = 1, p < .00 \)), as well as a significant interaction with diagnostic status (OR = .20, \( df = 1, p < .01 \)). Post hoc tests revealed that the predictive relation was once again driven by the comparison group (OR = 7.38, \( df = 1, p < .02 \)) relative to the ADHD group (OR = 1.15, \( df = 1, p = .36 \)). In terms of the main effect of covert ASB, its Relative Improvement Over Chance for predicting delinquency severity at follow-up was .34, meaning that the addition of covert ASB enhanced the prediction of the delinquency severity classification by 34% over predictions expected by chance.

As also described in Table 4, noncompliance significantly predicted delinquency severity (OR = 16.6, \( df = 1, p < .00 \)), but the corresponding interaction term was not significant (OR = .02, \( df = 1, p = .18 \)). The results from the logistic regressions with the VIQ, internalizing behavior, and academic achievement covariates were similar (main effect OR = 4.43, \( df = 1, p < .01 \) and interaction OR = .00, \( df = 1, p = .28 \)). Finally, peer status was not significantly predictive of delinquency severity (OR = 1.6, \( df = 1, p = .44 \)), and its interaction with diagnostic status was also not significant (OR = 62, \( df = 1, p = .61 \)).

**Discussion**

Results from an ethnically diverse and rigorously assessed group of preadolescent boys with and without ADHD suggest several key findings regarding childhood precursors of adolescent delinquency severity. First, our logistic regressions indicate that childhood ADHD was not predictive of adolescent delinquency severity once several crucial indicators of overt and covert ASB and noncompliance from childhood were statistically controlled. Thus, the predictive power of ADHD status to adolescent delinquency disappeared when key indexes of childhood externalizing behavior related to ADHD were taken into account. Second, whereas both noncompliance and covert ASB were independently associated with the severity of adolescent delinquency, overt aggression did not make independent contributions with control of these other externalizing behaviors. Third, our measure of social preference did not independently predict delinquency severity with control of externalizing behavior. Fourth, counter to our hypotheses, covert ASB in childhood was a stronger predictor of delinquency severity in the comparison boys than in the ADHD sample.

With respect to the prediction from childhood ADHD, we first note that we performed an extremely stringent test, given our careful statistical control of several externalizing behavioral patterns and peer status. Indeed, ADHD is clearly associated with externalizing behavior and with peer rejection (Hinshaw & Melnick, 1995); once these correlates were controlled, ADHD status no longer predicted to adolescent delinquency severity. Our findings are consistent with a recent review (Lahey et al., 2000), which suggested that childhood ADHD is not an independent predictor of delinquency when baseline ASB is controlled. However, future investigations should disaggregate the constituent symptom clusters of ADHD to ascertain whether a particular dimension, rather than the diagnosis per se, individually predicts future delinquency. These dimensions may also be uniquely related to certain subtypes of delinquency.

The findings for early noncompliance and early covert ASB suggest that the covert or clandestine endpoint of the continuum of externalizing behavior should not be overlooked in the study of precursors of delinquency. These indicators were, in fact, more predictive than was overt aggression per se. Covert ASB
and noncompliance, particularly when manifested early in development and coupled with other disruptive behavior, may be part of a larger constellation of antisocial tendencies (temperamental variables such as sensation seeking) that is linked to later severe delinquency (Loeber et al., 1993). The relatively higher base rates of noncompliance may also enhance its predictive strength. However, although early noncompliance and covert ASB were significant predictors of adolescent delinquency severity, the prediction was not perfect. These results resonate with an important theme in developmental psychopathology (Cicchetti & Rogosch, 1996). That is, variables such as covert ASB and noncompliance may yield group differences (severe vs. nondelinquents), but accurately predicting group membership remains far from perfect. Indeed, an enduring challenge for the field will be to establish cross-time predictive models that offer precision and specificity in identifying children at risk for poor outcomes.

Given the ambiguous results from past investigations of the independent role of the quality of peer relationships in predicting later psychopathology (Coie et al., 1992; Laird et al., 2001), we examined whether a global measure of peer regard provided an independent contribution to the prediction of adolescent delinquency severity. Although peer status did not independently predict delinquency, our stringent control of several dimensions of childhood externalizing behavior and the unique nature of our sample may have contributed to the negative finding. That is, the large proportion of ADHD versus comparison children at our summer programs (approximately 60:40 ratios) may have indirectly mitigated the predictive strength of negative peer regard. In particular, Hinshaw and Melnick (1995) found that the boys with ADHD were slightly more lenient than comparison boys with respect to their sociometric appraisals. In more representative samples, the sociometric profile of children with ADHD may be more negative because typically developing children are apt to view the disruptive behaviors as particularly deviant. Such circumstances are conducive for the continuity of maladaptive behavior over time (Coe & Dodge, 1998; Coie et al., 1995).

Several important methodological limitations deserve note. First, whereas this investigation is enhanced by its prospective design, the lengthy time between baseline and follow-up (5 years, and in some cases more) is problematic for establishing trajectories, which require repeated assessments over time (Tremblay, 2000). Other investigators (Frick & Loney, 1999) suggest that the length of time between assessments is negatively related to the stability estimates of externalizing behavior over time. Second, as with any prospective study that does not specifically address generative mechanisms (e.g., mediators), we cannot assume that common outcomes (e.g., severely delinquent) necessarily reflect identical processes. This point is true both between and within the diagnostic groups. Third, we also recommend that future prospective studies not only compare probands and control groups but also other psychiatric comparison groups, which might enhance perspectives on causal pathways. Fourth, although we did statistically covary for the influence of age on delinquency severity, the “right-censored” nature of our baseline sample may mask important developmental themes. Children who were younger at baseline (6 or 7 years of age) were less likely to have entered the risk period of adolescence at the follow-up relative to their older camp counterparts. Given that age is one of the most reliable correlates of delinquency, samples with different distributions of this variable may yield different results. For example, stability coefficients of externalizing behaviors over time are moderated by the age of the sample (Frick & Loney, 1999).

In addition, given the important distinction between experimental and statistical control, alternative methodologies to contrasting aggression and peer regard may be enhanced by identifying subgroups of children. Bierman and Wargo (1995) compared correlates of aggressive-only, aggressive and rejected, rejected nonaggressive, and typically developing children and found that both aggressive and rejected children were the most impaired. Also, whereas sampling of youth with ADHD appears to be viable for studying aggression and delinquency given the role of ADHD in fueling an early onset of externalizing conditions (Hinshaw & Lee, 2003), the clinic-referred nature of our participants may indicate linkages between domains that are not generalizable. There are important differences between clinical and nonclinical samples, with clinic-referred children exhibiting more extreme psychopathology (Goodman et al., 1997).

We note that our use of a single outcome measure appraising delinquency severity from multiple informants may in fact disproportionately reflect covert ASB and status offenses given that adolescent delinquency is largely driven by a substantial increase in the number of status offenders (truancy; violation of curfews; Moffitt & Caspi, 2001). Because our outcome measure did not appraise delinquency severity separately for overt ASB (physical aggression, assault) and covert ASB acts (stealing, truancy), our predictions from baseline measures may reflect prediction to nonviolent offenses rather than overt behaviors. Given the conceptual and empirical evidence for distinct overt and covert ASB and differences in correlation patterns, ASB measures should reflect these important subtypes. Also, our target group was ascertained using DSM–III–R criteria; however, published studies have reliably shown that the vast majority (nearly 98%) of children diagnosed with ADHD using DSM–III–R symptom criteria also satisfy the diagnostic criteria for
the ADHD combined subtype of the Diagnostic and Statistical Manual of Mental Disorders (4th ed. [DSM–IV], American Psychiatric Association, 1994; Lahey et al., 1994). Finally, the developmental course (including ASB) of ADHD in girls is virtually unknown. It is unclear whether the lower base rates of physical aggression among girls would predict later delinquency; however, negative outcomes are more widely dispersed among girls relative to boys, signaling greater multifinality (Hinshaw & Lee, 2003).

In sum, our findings suggest childhood (ages 6 to 12) noncompliance (oppositionality, defiance, excessive irritability) and covert ASB may be particularly important for the development of delinquency in adolescence. Although early overt aggression and peer status did not make independent contributions, the unique characteristics of this investigation (sample, age range, follow-up period) may partly explain these nonsignificant findings. We suggest that prospective follow-up studies of children with ADHD be continued with repeated assessments given important changes in the ADHD profile over time (type of ASB, onset/desistance). Second, multidimensional measures of outcome are necessary given that changes in behavior over time may in fact be part of the same underlying traits (heterotypic continuity). Finally, tests of moderation and mediation (Kraemer, Stice, Kazdin, Offord, & Tsuang, M. T. (1994). Diagnostic accuracy of the Child Behavior Checklist scales for attention-deficit hyperactivity disorder: A receiver-operating characteristic analysis. Journal of Consulting and Clinical Psychology, 62, 1017–1025.

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DELINEQUENCY AMONG BOYS WITH AND WITHOUT ADHD


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