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Predictors of Adolescent Functioning in Girls with Attention-deficit/Hyperactivity Disorder (ADHD): The Role of Childhood ADHD, Conduct Problems, and Peer Status

Abstract

Predictors of adolescent functioning were studied in an ethnically diverse sample of girls with attention-deficit/hyperactivity disorder (ADHD) (*n* = 140) and age- and ethnicity-matched comparison girls (*n* = 88) who participated in naturalistic summer programs during childhood. Over a five-year follow-up (sample retention = 92%; age range = 11.3–18.2 years), conduct problems were predicted by hyperactivity-impulsivity (HI) symptoms and noncompliance (NC). Academic achievement was predicted only by inattention symptoms, whereas school suspensions/expulsions were predicted by inattention symptoms (ADHD sample only), NC, and negative peer status. Substance use was predicted by NC and HI symptoms. Internalizing problems were predicted by HI symptoms, noncompliance, and covert antisocial behavior. Finally, initial peer status was the only significant predictor of later negative social preference.

Keywords

attention-deficit/hyperactivity disorder (ADHD); girls; prospective follow-up; longitudinal; predictors; adolescence

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There is overwhelming evidence that children with attention-deficit/hyperactivity disorder (ADHD) experience more maladjustment than typically developing youth. Evidence for concurrent and prospective impairment includes substandard academic achievement, poor peer relationships, family disruption, accidental injuries, and high comorbidity with other psychiatric disorders (Barkley, Fischer, Smallish, & Fletcher, 2002; Hinshaw, 2002; Lahey et al., 2004). Although the literature is marked by an absence of research on female samples, a recent prospective study of girls with and without ADHD revealed that early ADHD was linked consistently and strongly to elevated symptomatology and impairment in adolescence, largely independent of demographics, IQ, or comorbidities (Hinshaw, Owens, Sami, & Fargeon, in press). Our objective here is to extend this work by examining conceptually relevant and, in many instances, objectively measured predictor variables during childhood (e.g., overt and covert aggression; peer relationships) in terms of their independent predictions to adolescent functioning. Indeed, based on parallel work with boys diagnosed with ADHD (Lee & Hinshaw, 2004), it may well be the case that childhood ADHD is associated with adolescent problems largely through its association with comorbidities and impairments.

As just indicated, the paucity of data on girls' follow-up status means that the male literature provides examples of relevant predictors. In addition, although limited data exist on girls with ADHD, there are several follow-up studies of girls with externalizing behaviors. The review of Pajer (1998) revealed that outcomes of girls with conduct problems were more diverse than those of boys and included internalizing disorders, marital problems, and suicidality. Therefore, longitudinal studies of outcomes for girls with ADHD must include multiple domains because of their potential for multifinal developmental trajectories (Cicchetti & Rogosch, 1996).

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What are the most important outcome domains, and which predictors may be relevant for each? First, conduct problems and antisocial behavior comprise an essential outcome. In boys with ADHD, the presence of conduct problems predicts persistent antisocial behavior (ASB) (Hinshaw, Lahey, & Hart, 1993; Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). Further, noncompliance (NC) and covert ASB outweighed early ADHD in predicting later delinquency in boys (Lee & Hinshaw, 2004). Peer rejection also predicts negative outcomes in boys. Some studies have shown that peer status, independent of aggression, predicts antisocial outcomes (Coie, Lochman, Terry, & Hyman, 1992; Nelson & Dishion, 2004). However, other studies have reported that negative peer regard in childhood is a marker for other behaviors that are the primary, independent predictors (Lee & Hinshaw, 2004; Woodward & Fergusson, 1999).

In addition to antisocial outcomes, academic problems are a frequent consequence of ADHD (Fischer, Barkley, Edelbrock, & Smallish, 1990; Lahey et al., 2004). The association between aggression and underachievement in childhood is largely accounted for by the overlap of ADHD with conduct problems (Hinshaw, 1992), suggesting that links between ADHD and low academic achievement are highly specific. Still, the majority of the literature pertains to boys and needs to be tested in girls. It is also unclear which underlying dimension of ADHD is most strongly related to academic problems: Inattention/disorganization or hyperactivity/impulsivity (American Psychiatric Association, 2000). Thus, we contrast inattention versus hyperactivity dimensions as predictors of measures of school functioning in adolescence.

A third important outcome to consider in girls with ADHD is substance use. Although some experimentation with substances may be normative during adolescence, non-normative use may presage serious delinquency (Loeber et al., 1998). Recently, Molina and Pelham (2003) reported that ADHD was independently associated with later substance use (controlling for aggression); but replication is needed, particularly in a female sample. Furthermore, whereas temperamental factors associated with ADHD (e.g., deficits in response inhibition or harm avoidance) may influence substance abuse (Willis & Dishion, 2004), conduct problems may be the primary predictor of such substance use, with ADHD and peer status influencing substance use indirectly through their overlap with aggression (Armstrong & Costello, 2002).

A fourth important outcome is the development of internalizing symptoms. In boys with ADHD, higher rates of later internalizing symptoms than in comparison samples have not been consistently reported (Fischer, Barkley, Smallish, & Fletcher, 2002; Hinshaw, 2002; Mannuzza et al., 1991). However, given the large increase in anxiety and depression in adolescence for girls in general (Lewinsohn et al., 1993), it may be that girls with ADHD show particularly high risk for their emergence, due in part to the negative peer status and conduct problems associated with ADHD (see, for example, Pajer, 1998).

Finally, ADHD is associated with negative peer status (Hinshaw & Melnick, 1995), but the vast majority of the longitudinal literature pertains to boys. Peer rejection shows significant continuity (Coie & Dodge, 1983); therefore, problems in the later social relationships of children with ADHD may therefore reflect problems associated with peer rejection in childhood.

In all, the absence of a large literature on the prospective follow-up of girls with ADHD means that hypotheses for the present sample must be based to a large extent on (a) follow-up investigations of boys with ADHD (Mannuzza & Klein, 1999); and (b) current thinking about the multifinal outcomes that emerge for girls with conduct problems (Pajer, 1998; see review in Hinshaw & Blachman, 2005). We therefore hypothesize that, in this large and well-characterized female sample, ascertained during the elementary-school years and followed prospectively five years later, childhood ADHD (and inattention in particular) will predict low

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academic achievement but that early aggression will provide the strongest predictions to diverse measures of adolescent functioning (e.g., externalizing and internalizing symptoms, substance use, and school behavior problems). We also expect that initial peer status will independently predict only later social preference, given that its associations with negative outcomes in prior reports are largely a product of its overlap with ADHD and aggression. Note that for all outcomes (except ADHD symptom dimensions), we test interactions between predictors and childhood ADHD diagnostic status to ascertain whether predictions are stronger in the ADHD or control group. That is, because the covariation of ADHD and aggression is almost entirely explained by shared genetic influences (Nadder, Rutter, Silberg, Maes, & Eaves, 2002), negative outcomes associated with early aggression should be stronger in children with ADHD, given their common etiology. Furthermore, previous research showed that authoritative parenting predicted peer status more strongly in boys with ADHD than in comparison boys (Hinshaw, Zupan, Simmel, Nigg, & Melnick, 1997) whereas covert ASB predicted adolescent delinquency severity more strongly in comparison males than in boys with ADHD (Lee & Hinshaw, 2004).

Method

Participants and Procedures

The sample of 140 girls with ADHD was recruited through mailings to and referrals from mental health centers, physician offices, and local schools. Presentations were given at meetings of local self-help groups and advertisements were placed in local newspapers. Probands were not required to have a previous diagnosis of ADHD. Comparison girls (n = 88) were recruited from fliers sent to local libraries, community centers, and listings in specific sections of newspapers that advertised summer programs for children.

The initial screening procedure for childhood ascertainment was multi-gated. The first phase comprised a telephone screening. At the second phase, involving the mailed rating scales to adult informants, inclusion criteria for probands required above-threshold scores on two empirically established measures and cutoff scores: (a) the Swanson, Nolan, and Pelham (SNAP) Parent Inattention and Teacher Inattention questionnaire (Swanson, 1992) with at least 5 of the 9 inattention symptoms endorsing impairment (items were rated at the level of 2 (“pretty much”) or 3 (“very much”) on 0–3 metric); and (b) CBCL and TRF Attention problems narrow band scores (Achenbach, 1991a; 1991b) that surpass the empirically established cutoff of T = 60 (Chen, Faraone, Biederman, & Tsuang, 1994). Parents of children with a prior diagnosis of ADHD and who were actively treated with medication provided ratings based on unmedicated behaviors (as did the majority of teachers). As in the Multimodal Treatment Study of Children with ADHD (Hinshaw et al., 1997), parents and teachers received an instruction sheet asking them to rate the girl's behavior during periods of time in which she was not receiving medication for ADHD. For structured interviews regarding symptomatology, interviewers similarly asked parents to select times during which the girl was not actively medicated.

Exclusion criteria included (a) borderline cognitive ability (Full Scale IQ < 70), (b) neurological disorders or psychosis, (c) autism or other pervasive developmental disorders, and (d) other medical and/or physical conditions that prevented participation in all summer camp activities. This sample reflects the ethnic and socioeconomic diversity of the San Francisco Bay Area. Of the 228 female participants, 53% were Caucasian, 27% were African-American, 11% were Latina, and 9% were Asian-American (see Table 1 for diagnostic group comparisons).

Families were invited to campus for a rigorous assessment, which included child IQ testing and a structured diagnostic interview using the Diagnostic Interview Schedule for Children, Parent Version (4th edition) (DISC-IV; Shaffer et al., 2000). Inclusion criteria required a

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diagnosis of ADHD-Combined or Predominantly Inattentive type, based on unmedicated behavior with an onset prior to age 7. Comparison girls could not have an ADHD diagnosis.

Because of the limited data on girls with ADHD, it is difficult to compare patterns of comorbidity gathered from the DISC-IV in this sample with any previous standard. Among the girls with the combined type of ADHD ($n = 93$), 71% ($n = 66$) and 26% ($n = 24$) met criteria for ODD and CD, respectively. Comorbidity was also high for girls with the Inattentive type of ADHD ($n = 47$): 47% ($n = 22$) and 11% ($n = 5$) were comorbid for ODD and CD, respectively.

Each girl participated in one of three summer research programs (see Hinshaw, 2002, for details). Each program was five weeks and conducted at a nearby school. Prior to each camp, and following mailed questionnaires to parents and teachers, all families came to campus for informed consent and assent procedures and extensive assessments of child and family functioning. The summer programs were designed to blend structure and naturalism. Girls were grouped into three classrooms based on their age, with each class composed of 25–26 girls. All classes and interactions were monitored daily, thus yielding objective measures of externalizing (physical/verbal aggression; NC) and internalizing behavior (social isolation; withdrawal). A laboratory measure of covert ASB (property destruction and theft) was administered to all children during the last week of each program. Peer sociometrics were gathered at the end of the first, third, and fifth week. Note that ADHD and comparison families did not differ at baseline on ethnicity, family structure, maternal education, and total family income (see Hinshaw, 2002). All families participated free of charge after giving full written consent.

As described in Hinshaw (2002), although about half of the ADHD sample was being treated with stimulant medications prior to the summer programs, most of the relevant caregivers agreed to their daughters' participation without medication. For the remaining families, we performed a single-blind medication trial during the summer programs, such that on approximately half of the days, the girls received no medication. All data reported herein reflect unmedicated behavior patterns.

During the school year between 4 and 5 years after their initial involvement, families were invited to participate in our follow-up protocol via two on-campus sessions (Hinshaw et al., in press). Parents provided full written consent for, and adolescents assented to, all procedures. Prior to the visits, parents and two secondary school teachers completed paper-and-pencil measures about each participant's behavior. Each visit lasted 3–4 hours, with separate parent and child assessments. Parents completed structured interviews and psychopathology ratings while their daughters completed tests of neuropsychological functioning and academic achievement and self-reports of psychopathology. Parent-adolescent interactions were also videotaped. Of the 228 original participants, 209 were assessed (92%), with an age range from 11.3–18.2 years ($M = 14.1$). The participants appear representative of the full sample (Hinshaw et al., in press). Both the summer programs and the follow-up studies received full Institutional Review Board approval from the U.C. Berkeley Committee for the Protection of Human Subjects.

To test for differential attrition, we compared the 19 girls who did not participate with the 209 who did. Chi-square and independent sample *t*-tests showed no significant differences between the two groups of girls on baseline variables: diagnostic status (ADHD vs. comparison), $\chi^2(1, N = 228) = .43$, $p = .51$, social preference, $t(226) = -1.9$, $p = .06$, overt aggression, $t(226) = -1.1$, $p = .28$, noncompliance, $t(226) = -.22$, $p = .83$, covert ASB, $t(211) = .64$, $p = .52$, Full Scale IQ, $t(224) = -.80$, $p = .43$, maternal education level, $t(226) = -.23$, $p = .82$, family income $t(217) = -1.82$, $p = .09$, age $t(226) = .58$, $p = .56$, and ethnicity $\chi^2(1, N = 228) = 2.1$, $p = .71$.

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Baseline Measures

ADHD symptoms—We evaluated ADHD symptom dimensions of inattention and hyperactivity/impulsivity (HI) with the parent/teacher SNAP rating scale (Swanson, 1992). To use multiple informants, we followed Molina and Pelham (2003) by taking the higher score from the parent or teacher rating. To obtain symptom counts, we followed the convention that scores of 2 (pretty much) and 3 (very much) signify symptom presence, whereas scores of 0 (not at all) and 1 (just a little) are counted as absent (see Hinshaw et al., 1997). Inattention symptoms from parent and teacher ratings were correlated with $r(226) = .79$; for HI, $r(226) = .66$. Cronbach alphas were .79 and .88 for HI and inattention, respectively. The SNAP has received extensive validation regarding the diagnosis of ADHD (Swanson, 1992) and as an indictor of treatment response (Swanson et al., 2001).

Aggression and noncompliance—Microanalytic observations of social interactions were conducted by trained undergraduate observers in teams of four rotated throughout camp periods. During individual 1 hour playground periods/classroom activities, observers coded behaviors from the "sideline." Using randomized rosters of girls' names and blind to their diagnostic and medication status, raters followed audiotaped commands from headphones. Three-second "find" commands were followed by 5-second "observe" and 3- second "record" intervals. Behaviors were placed in 1 of 6 mutually exclusive categories (NC, verbal or physical aggression, social isolation, compliant, and prosocial). NC was conceptualized and measured separately from verbal and physical aggression. Behaviors included annoying, intrusive, and norm-violation acts but did not involve verbal threats or taunts and physical contact with another individual. Verbal aggression included swearing or explicit verbal threats/insults. Physical aggression was acts directed towards others resulting in physical contact, including kicking, hitting, and shoving. Percentage of agreement among raters for these two categories is: NC = .70 and physical/verbal aggression = .60 (Hinshaw, 2002). This system has received extensive validation in terms of known-groups validity (Hinshaw et al., 1995), as an indicator of medication response (Hinshaw et al., 1989), as a predictor of initial sociometric impressions (Erhardt & Hinshaw, 1994), and as a criterion measure for the effects of parenting behavior (Anderson et al., 1994).

Laboratory measure of covert ASB—During the final week of each summer camp, girls participated in a laboratory measure of covert ASB (Hinshaw, Simmel, & Heller, 1995). Children were instructed to work independently on a worksheet without adult supervision. Temptations, in the form of money and desirable small toys were available and some girls destroyed property (e.g., writing on walls with permanent markers). We estimated stealing (0–5) by adding the amount of money stolen ($0, $1 or $2) and the number of toys taken (0–3). Property destruction ranged from 0 (no damage) to 3 (major damage; e.g., writing on furniture). In prior research, covert ASB scores were shown to differentiate male ADHD and comparison samples; showed test re-test reliabilities of $r(20) = .41$, $p = .06$ for stealing and $r(20) = .59$, $p < .01$ for property destruction over consecutive days (comparison boys only); and, importantly, they predicted severity of delinquency five years later (Hinshaw, Heller, & McHale, 1992; Hinshaw, Simmel, & Heller, 1995; Lee & Hinshaw, 2004).

Peer sociometrics—At the end of the first, middle, and last week of each summer camp, all participants were asked to nominate three classmates with whom she would most and least like to be friends (Blachman & Hinshaw, 2002). Each confidential interview was conducted away from the camp activities. Picture boards with identical head-and-shoulders photos of classmates were available to children to improve the nomination process. To account for minor differences in the number of children in classrooms and across summers, we created a peer regard measure by subtracting the total number of negative nominations from positive nominations and then dividing by the number of children in the classroom. Psychometrics

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reveal stability across the 5-week programs: $r(228) = .51$ for positive nominations and $r(228) = .85$ for negative nominations. This procedure has distinguished ADHD and comparison children (Blachman & Hinshaw, 2002) and uncovered medication effects (Whalen et al., 1989).

Follow-up Measures in Adolescence

Computerized Diagnostic Interview Schedule for Children – Parent/Youth— (DISC-IV, Shaffer et al., 2000). The computerized DISC provides symptom counts and diagnoses using DSM-IV criteria based on parent and youth reports with built-in impairment criteria. In a sample of 84 parents and 82 children (ages 9 to 17; $M = 12.6$ years), one-year test-retest kappas for the youth interview was $k = .51$ for ODD, $k = .65$ for CD, $k = .92$ for major depression, and $k = .25$ to .68 for anxiety disorders (M kappa = .46) (Shaffer et al., 2000). Kappas for the parent interview for the same modules were $k = .54$ (ODD), $k = .43$ (CD), $k = .66$ (major depression), and ranged from .54 to .96 for anxiety disorders (M kappa = .68). For conduct problems, we summed symptoms of ODD and CD from the parent and youth interviews (coefficient alpha = .58). Internalizing symptoms reflected separation anxiety, generalized anxiety, social phobia, agoraphobia, panic disorder, and major depression from parent and youth interviews (coefficient alpha = .47). Substance dependence symptoms were similarly derived (alpha = .74). In a sample of 369 youth in a residential treatment facility, ODD and CD diagnoses yielded from the youth C-DISC were associated with independent measures of aggression and ASB (Friman, Handwerk, Smith, Larzelere, Lucas, & Shaffer, 2000). Similarly, the C-DISC was the core diagnostic measure in the Multimodal Treatment Study of ADHD (MTA Cooperative Group, 1999).

School Functioning—We feature two measures of school functioning. First, we utilized the Wechsler Individual Achievement Test-Screener (WIAT; Wechsler, 1992). Reading and Math subtests are normed against a representative sample of American youth. Test-retest stability over a period of 12–52 days (median 17 days) in a sample of 367 5- to 17- year old youth ranged from .87 to .92 for Reading and .74 to .92 for Math (Wechsler, 1992). Second, we asked caregivers to indicate family status information, as well as services received by the child and family, on a year-by-year basis from the summer program through the follow-up period (see Hinshaw et al., in press). We focus, however, on the number of suspensions/expulsions between the summer camp and the follow-up assessment, recorded on a year-by-year grid.

Children's Depression Inventory—(CDI; Kovacs, 1992). This 27-item, self-report measure yields a total score and five separate factor scores. Test-retest reliabilities ranged from .50 to .67 for the six week interval and .56 to .77 for a 1 month interval in separate samples of 1,266 school children and 134 clinically diagnosed children (age range from 10–15 years old) (Kovacs, 1992). The CDI has been validated with adolescent girls by differentiating diagnostic groups (e.g., depressed vs. aggressive youth) (Liss, Phares, & Liljequist, 2001). We use the total score, which had a coefficient alpha of .80 in the current sample.

Dishion Social Preference Scale—(Dishion, 1990). This is a 3-item (5-point metric) teacher-completed measure of peer acceptance, rejection, and being ignored. Using a sample of over 200 boys from the Oregon Youth Study, Dishion (1990) showed that peer sociometric status at age 10 was associated with social preference two years later. In the same sample at age 12, social preference correlated with ASB, depression, and deviant peer association (.60, .30, and .51, respectively). We estimated negative social preference by subtracting the reject from the accept rating and then reverse scoring it. This approach was sensitive to diagnostic group differences in a sample of 255 preschool children with and without ADHD (ages 4–6 at baseline and assessed annually for four years) (Lahey et al., 2004). Specifically, ADHD was

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associated with higher levels of negative social preference than age- and ethnicity-matched comparison children.

Substance Use Questionnaire—(Molina & Pelham, 2003). The SUQ is a structured interview adapted from the Health Interview Questionnaire (Jessor, Donovan, & Costa, 1989). The SUQ includes lifetime exposure and frequency questions. Among 250 children with and without ADHD (Molina & Pelham, 2003), kappas for 2-week test-retest reliability for "ever trying" substances averaged .84, ranging from .70 (cigarettes) to .91 (marijuana). For categorical variables, psychometrics were as follows: $r(155) = .90$, kappa = .90 for "ever had a drink?"; $r(100) = .94$, kappa = .93 for "ever been drunk?"; $r(99) = .89$, kappa = .44 for "frequency of 5 or more drinks." Molina and Pelham (2003) found that inattention symptoms predicted substance use five years later using the SUQ. Given the age of our sample ($M = 14$ years) and low base rates of some substance use indicators, we supplemented the parent-reported DISC substance dependence measures by scoring the SUQ for the number of different substances used, given its differentiation of girls with and without abuse histories (Bailey & McCloskey, 2005).

Results

Data Analytic Plan

To test the independent contribution of our predictors (inattention and HI dimensions, NC, overt aggression, covert ASB, and social preference) to the five domains of adolescent outcome (conduct problems, school functioning as indexed by academic achievement and the number of suspensions/expulsions, substance use, internalizing problems, and negative social preference), we performed hierarchical linear regressions, entering first a block of covariates (age and family income) followed by pre-ordered predictors. Although Verbal IQ (VIQ) deficits are associated with ADHD (Cohen's $d = .95$ between probands and comparisons in our sample), controlling VIQ may result in over-control (Barkley, 1998), thereby diminishing the "true" impact of ADHD and its associated features. Results were virtually identical with and without VIQ in the models; thus, we report results without VIQ controlled. Predictors were centered using the sample mean and each predictor was entered last to test the significance of the variance explained in the outcome with control of all covariates and other predictors. After all main effects, predictor × diagnostic group interactions were entered at the final step.

Zero-Order Correlations

Correlations among predictors are presented in Table 3. Although some of the predictors are moderately correlated (e.g., overt aggression and noncompliance are correlated at $r = .57$ and HI and peer status at $r = -.51$), the magnitude of the associations does not suggest redundancy. Their overlap, however, requires simultaneous control of the other predictors.

Hierarchical Regression Analyses Predicting Adolescent Outcomes

The results of the hierarchical regression analyses predicting conduct problems in adolescence are presented in Table 4. HI significantly predicted conduct problems ($R^2 = .03$, $\beta = .29$, $p < .03$) after controlling for all covariates and all other predictors, but inattention did not ($R^2 = .00$, $\beta = .02$, $p = .86$). NC also independently predicted conduct problems ($R^2 = .03$, $\beta = .24$, $p < .02$) but overt aggression, covert ASB, and peer status did not. None of the interactions between predictors and group status was significant.

Results of analyses predicting standardized achievement scores in adolescence are also reported in Table 4. Inattention significantly predicted the composite index of academic achievement ($R^2 = .04$, $\beta = -.32$, $p < .01$) but HI did not ($R^2 = .00$, $\beta = -.05$, $p = .68$). Although the HI × group interaction term was significant ($R^2 = .03$, $\beta = .62$, $p < .01$), separate

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examinations of HI and achievement in the ADHD and control groups did not yield meaningful differences (ADHD: $R^2 = .00$, $\beta = .03$, $p = .77$; Comparison: $R^2 = .00$, $\beta = .06$, $p = .61$). However, this analysis may not be adequately powered to examine predictor-outcome models separately by diagnostic group, as would be suggested by the presence of a significant interaction. None of the other predictors was significant, and neither were any interaction terms.

The regression analyses for school suspensions/expulsions are provided in Table 5. NC and peer status were significant predictors ($R^2 = .09$, $\beta = .41$, $p < .00$ and $R^2 = .02$, $\beta = -.20$, $p < .05$, respectively) after controlling for covariates and all other predictors. Inattention did not have a main effect for suspensions and expulsions but there was a significant interaction with diagnostic group ($R^2 = .03$, $\beta = .21$, $p < .05$). Separate regressions for the ADHD and comparison group showed a modest relation in the ADHD group ($R^2 = .01$, $\beta = .12$, $p = .23$). Analyses could not be conducted for the comparison girls because all 16 children with a history of suspensions and expulsions were in the ADHD group. HI, NC, overt aggression, covert ASB, and their respective interaction terms with group membership were not significant.

The results of the regression analyses predicting negative social preference scores in adolescence are also provided in Table 5. HI and Inattention did not significantly predict negative social preference and none of the other externalizing predictors was independently associated with peer status. As expected, however, baseline peer status predicted the follow-up negative social preference score, even controlling for initial externalizing behavior and peer status ($R^2 = .07$, $\beta = -.36$, $p < .01$). Interaction terms were not significant, suggesting that predictor-outcome relations did not differ by diagnostic group.

The results of the hierarchical regression analyses predicting internalizing symptoms and depression are provided in Table 6. HI significantly predicted internalizing symptoms ($R^2 = .04$, $\beta = .36$, $p < .01$) but not the CDI ($R^2 = .01$, $\beta = .12$, $p < .40$). Inattention was unrelated to both emotional distress measures. NC significantly predicted internalizing symptoms ($R^2 = .02$, $\beta = .21$, $p < .05$) but not the CDI ($R^2 = .01$, $\beta = .12$, $p < .23$). Covert ASB also predicted the CDI ($R^2 = .05$, $\beta = .23$, $p < .01$) with a marginal effect for internalizing symptoms ($R^2 = .03$, $\beta = .20$, $p = .07$), whereas overt aggression, peer status, and their interactions with group membership did not yield significant predictions.

Table 7 summarizes the final set of regression analyses predicting substance use. Hi significantly predicted parent-reported substance dependence ($R^2 = .04$, $\beta = .34$, $p < .05$) but was unrelated to substance use variety ($R^2 = .01$, $\beta = .18$, $p = .18$). Inattention, overt aggression, and covert ASB did not significantly predict either substance-related outcome after controlling for covariates and other predictors. NC significantly predicted substance use variety ($R^2 = .02$, $\beta = .21$, $p < .05$). Finally, none of the interaction terms with group membership was significant.

Discussion

Given the paucity of prospective research on girls with ADHD, we tested several key hypotheses regarding the predictive strength of ADHD symptom dimensions, noncompliance (NC), overt aggression, covert ASB, and peer status on key domains of adolescent functioning in pre-adolescent girls followed prospectively 5 years later. We selected a broad spectrum of ecologically relevant outcomes including conduct problems, academic functioning, substance use, internalizing behavior, and negative social preference.

Consistent with recent interest in research on conduct problems in girls (Moffitt, Caspi, Rutter, & Silva, 2001), we contrasted HI and inattention as predictors of ASB. HI significantly predicted conduct problems, consistent with other findings that HI is more “externalizing” than inattention (that is, given its stronger association with aggression than inattention) (Daugherty & Quay, 1991) and that HI predicts ASB over time (Babinski, Hartsough, & Lambert, 1999).

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Recent work also suggests that HI in girls may actually represent the same underlying trait that is expressed as CD in boys (Hartung, Milich, Lynam, & Martin, 2002). We also emphasize that contrasting ADHD dimensions and aggression is important, given their overlap; but their interactive influences should not be overlooked, particularly in relation to an early onset trajectory of ASB. Early aggression, when coupled with ADHD, is typically accompanied by other problematic risk factors (e.g., negative peer regard, neuropsychological deficits) that collectively contribute to a persistent and treatment-resistant pattern of offending (Moffitt, 1990, 1993). Finally, NC predicted conduct problems whereas overt aggression, covert ASB, and social preference did not. The importance of NC in the origins of conduct problems mirrors our previous report using boys (Lee & Hinshaw, 2004), which revealed that NC independently predicted delinquency severity at a five-year follow-up.

Why might NC be an important predictor of conduct problems? First, higher base rates of NC than aggression during observational periods may have made NC more capable of explaining variance. At baseline, NC may have been a more developmentally sensitive measure of ASB. This may be particularly true for girls, who show lower rates of overt aggression than boys (Keenan & Shaw, 1997). NC is also the midpoint the overt-covert continuum, perhaps tapping both “sides” of ASB, including the separate risk factors associated with the overt and covert spectrum (e.g., overt aggression being more heritable than covert ASB) (Edelbrock, Plomin, Rende, & Thompson, 1995; Loeber & Schmaling, 1985; Loeber et al., 1993). NC may also mirror ODD as a precursor of later delinquency (Lahey, McBurnett, & Loeber, 2000).

Past research connecting conduct problems and academic achievement problems during childhood may have been misleading, given the overlap of aggressive behavior with ADHD and the independent contribution of early ADHD to underachievement (Hinshaw, 1992). As result, we hypothesized that externalizing behavior and peer status would not significantly predict adolescent underachievement with ADHD controlled. As with boys (Hinshaw, 1992), inattention significantly predicted academic achievement, whereas HI, externalizing behavior, and peer status did not. The predictive strength of inattention to academic problems, even with control of HI, diverse forms of ASB, and peer status, underscores impairments associated with this dimension in ADHD girls. Note that in the same sample of girls, Hinshaw et al. (in press) showed that a categorical diagnosis of ADHD in childhood is a specific predictor of adolescent achievement problems, over and above demographics, comorbidity, and even IQ. The current findings suggest that it was the inattention dimension that accounted for this relation.

For an index of school behavior (suspensions/expulsions), we found that only girls with ADHD had histories of suspensions/expulsions during the transition from primary to secondary school and that both NC and peer status were independently associated with school behavior problems. Evidence for the independent predictive role of peer status and later adjustment is inconsistent (Nelson & Dishion, 2004; Lee & Hinshaw, 2004), but these findings suggest that examining ecologically valid outcomes may be crucial. For example, using school behavior problems (as reported by peers or teachers) minimizes the influence of shared method variance. Second, symptoms of ODD and CD refer to a narrow range of acts that do not account for the full range of ASB (e.g., relational aggression). And finally, suspensions/expulsions implicitly involve impairment whereas symptoms do not involve impairment per se (see Pelham, Fabiano, & Massetti, 2005 for a thoughtful discussion on the relevance of symptoms vs. impairment).

Because adolescent experimentation with substance use can be somewhat normative, we featured outcomes over and above simple use of substances. That is, we employed measures that assessed substance dependence and the variety of substances used. Contrary to Molina and Pelham (2003), we found that HI (and not inattention) predicted substance dependence symptoms. Such discrepancies reveal the link between ADHD and substance abuse is still

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unresolved. Potential explanations for these discrepant results include the selection of covariates (e.g., we controlled overt and covert ASB and peer status), sex-specific predictions, and the age range of participants. Note than NC also significantly predicted the number of different substances used, revealing its ubiquity as a predictor.

Internalizing symptoms are particularly relevant for adolescent girls, for whom pubertal onset marks the beginning of a rise in symptoms relative to boys (Lewinsohn et al., 1993). In this study, HI was the more relevant ADHD dimension in predicting this symptom domain. The most striking finding, however, was that covert ASB and NC predicted different aspects of emotional distress. Specifically, covert ASB was associated with self-reported depression and NC predicted internalizing symptoms. An association between externalizing behavior and later emotional problems in girls is not unexpected (Pajer, 1998). For example, Keenan and Shaw (1997) suggested that girls may be funneled toward internalizing problems after the age of 3–4 years given their advanced cognitive/language abilities and emotion regulation relative to boys.

After controlling for diverse forms of ASB and childhood social preference, HI and inattention did not significantly predict negative social preference in adolescence, nor did any other predictors except childhood peer status. This underscores the continuity of indicators of peer relationships over time (Coie & Dodge, 1983). However, we emphasize that positive peer regard may not be universally associated with successful development. For example, social preference in the context of association with deviant peers or siblings may accentuate negative outcomes (Stormshak, Comeau, & Shephard, 2004). Similarly, within low SES neighborhoods, delinquency may be *positively* correlated with social preference (Coie & Jacobs, 1993).

There are some important limitations to this study. First, the variance accounted for in adolescence for all outcome measures was under 10%. Therefore, although we identified precursors of various aspects of adjustment, most of the variance in these outcomes remains unexplained. Refining measurement by using person-centered approaches that identify subgroups of children (e.g., latent class analysis) and building transactional models that include translational research methods (e.g., genetic, pathophysiology) should improve predictions. Second, although the participants are ethnically and socioeconomically diverse, the sample was a combination of children with ADHD and a comparison group. Thus, the sample was not representative of either clinic-referred or community recruited children. Third, the few significant interactions may be a result of modest power and the difficulty of finding interactions in non-experimental research (McClelland & Judd, 1993). Fourth, two-occasion data help sort temporal ordering of variables but they do not allow for tests of mediation (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001); these will be possible with additional waves of data collection. Fifth, the age range of our participants did not allow for subgroup analyses within externalizing children (early- vs. adolescent-onset ASB). For example, at follow-up, some girls had not even entered adolescence, whereas others had more exposure to risk factors related to adolescent development (e.g., deviant male peers). Thus, different developmental patterns may not be readily detected given that developmental risk was not equitably distributed among the girls.

In conclusion, the current analyses suggest that early hyperactivity and NC are important predictors of adolescent functioning across a number of key domains, independent of their association with peer status and ADHD. Thus, multifinalilty appears pertinent for girls with early externalizing problems. We also emphasize that heterotypic continuity is particularly salient in this sample of girls, given that covert ASB and NC both significantly predicted different aspects of emotional distress. It has been suggested that internalizing outcomes (e.g., somaticization) of aggressive girls may be comparable to antisocial outcomes of aggressive boys (Lilienfeld, 1992). Intervention efforts, particularly early in development, are indicated

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given the functional deficits associated with externalizing behavior in girls. Finally, for future investigations, we recommend tests of moderation to specify risk-outcome relationships that include multiple levels of influence (e.g., callous-unemotional traits, genetic risk using measured genotypes). Tests of mediation are also essential to identify the underlying mechanisms governing these statistical associations (e.g., effective parenting, successful coping strategies). Collectively, these tests should provide key insights into the transactional nature of atypical development in girls with ADHD.

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Table 1

Descriptive Statistics for ADHD and Comparison Groups at Baseline

Variable	Combined (n = 93) M (SD)	Inattentive (n = 47) M (SD)	Comparison (n = 88) M (SD)	p[1]
Demographic				
Age (months)	114.4 (20.2)	118 (20.2)	113.2 (19.8)	ns
Income[2]	6.1 (2.6)	6.3 (2.8)	6.7 (2.5)	ns
Maternal Education	4.7 (.96)	4.7 (.95)	4.9 (.99)	ns
Cognitive:				
WISC Verbal IQ	99.8 (13.5)[a]	101.1 (15.4)[a]	113.1 (12.6)[b]	<.01
WIAT Reading[3]	102.1 (14.6)[a]	101.1 (14.2)[a]	112 (12.6)[b]	<.01
Behavioral (Maternal Ratings):				
SNAP Inattention (0–27)	20.8 (5.0)[a]	21.6 (4.2)[a]	3.8 (3.4)[b]	<.01
SNAP H/I[4] (0–27)	18.9 (5.3)[a]	10.0 (5.1)[b]	2.3 (2.6)[c]	<.01
CBCL Internalizing	60.8 (10.3)[a]	60.2 (10.2)[a]	47.4 (11.2)[b]	<.01
CBCL Externalizing	68.7 (8.2)[a]	58.6 (11.0)[b]	45.9 (8.2)[c]	<.01

Note: WISC = Wechsler Intelligence Scale for Children, WIAT = Wechsler Individual Achievement Test, SNAP = Swanson, Nolan, and Pelham, CBCL = Child Behavior Checklist.

[1] Group differences were tested via one-way ANOVA. Means with different superscripts in a given row differ significantly, following Tukey post-hoc corrections.

[2] Continuous measure of family income.

[3] Reading achievement standard score.

[4] SNAP Hyperactivity/Impulsivity.

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Table 2

Differences between ADHD and Comparison Girls on Predictors and Outcomes

Variable	Combined (n = 93) M (SD)	Inattentive (n = 47) M (SD)	Comparison (n = 88) M (SD)	p[1]
ADHD predictors				
SNAP HI[2]	7.3 (2.0)[a]	3.6 (2.3)[b]	.28 (.71)[c]	<.00
SNAP Inattention[2]	7.9 (1.6)[a]	7.9 (1.4)[a]	.91 (1.9)[b]	<.00
Externalizing predictors:				
Observed noncompliance[2]	.15 (.09)[a]	.07 (.06)[b]	.04 (.04)[c]	<.00
Observed overt aggression[2]	.01 (.02)[a]	.005 (.01)[b]	.002 (.004)[b]	<.00
Covert ASB[2]	.19 (.45)[a]	.14 (.47)[a,b]	.02 (.15)[b]	<.01
Sociometric predictors:				
Social preference[2]	−.12 (.29)[a]	.001 (.16)[b]	.13 (.12)[c]	<.00
Conduct problems outcome[3]				
ODD + CD symptoms	16.3 (8.1)[a]	15.1 (5.7)[a]	10.5 (6.0)[b]	<.00
School functioning outcomes[4]:				
WIAT composite (Math/Reading)	−.77 (1.7)[a]	−.68 (1.8)[a]	1.1 (1.3)[b]	<.00
No. suspensions/expulsions	.26 (.57)[a]	.00 (.00)[b]	.00 (.00)[b]	<.00
Internalizing outcomes[5]:				
Internalizing symptoms	38.8 (18.5)[a]	34.1 (17)[a]	20.1 (14)[b]	<.00
CDI	7.8 (6.5)[a]	6.5 (4.0)[b]	5.3 (5.7)[b]	<.02
Peer status (teacher ratings)[7]:				
Neg. Social Pref.	2.7 (2.6)[a]	1.7 (1.6)[b]	.89 (1.3)[b]	<.00
Substance use outcomes[8]:				
Variety	.76 (1.5)	.90 (1.8)	.44 (.85)	ns
Dependence symptoms	.53 (2.4)	.05 (.31)	.02 (.22)	<.08

Note: SNAP = Swanson, Nolan, and Pelham Rating Scale; Covert ASB = Covert Antisocial Behavior; Conduct Problems Outcomes = Sum of Parent and Youth ODD and CD Symptoms; WIAT = Wechsler Individual Achievement Test; Internalizing symptoms = Sum of parent and youth internalizing symptoms; CDI = Child Depression Inventory; Neg. Social Pref. = Negative social preference; Variety = Number of different substances used; Dependence = Total number of symptoms of substance dependence from the DISC interview (parent).

[1] Group differences were tested via one-way ANOVA. Means with different superscripts in a given row differ significantly, following Tukey post-hoc corrections.

[2] Sample size for each of the predictors is 228 (with the exception of covert ASB = 213).

[3] Sample size is 204 for conduct problems outcome.

[4] Sample size for academic achievement and suspensions/expulsions is 204 and 202, respectively.

[5] Sample size for mood symptoms and CDI is 197 and 206, respectively.

[6] Sample size for teacher negative social preference is 152.

[7] Sample size for substance use variety and dependence symptoms is 205 and 207, respectively.

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Table 3

Intercorrelations among Predictors and Outcome Variables

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Noncompliance	--	.57**	.34**	−.45**	.58**	.46**	39**	−.27**	.40**	.21**	.37**	.38**	.15*	.07
2. Overt aggression	--	--	.09	−.46**	.41**	.31**	.25**	−.28**	.27**	−.01	.25**	.34**	−.02	.03
3. Covert ASB	--	--	--	−.13	.22**	.19**	.13	−.05	.23**	.22**	.20**	.11	−.09	−.04
4. Peer Status	--	--	--	--	−.51**	−.42**	−.22**	.30**	−.31**	−.16*	−.27**	−.50**	.12	.01
5. SNAP HI	--	--	--	--	--	.76**	.39**	−.39**	.37**	.19**	.52**	.36**	.14*	.19**
6. SNAP Inattention	--	--	--	--	--	--	.37**	−.46**	.27**	.17*	.46**	.27**	.16*	.11
7. Conduct Problems	--	--	--	--	--	--	--	−.22**	.29**	.38**	.55**	.26**	.46**	.38**
8. WIAT Achievement	--	--	--	--	--	--	--	--	−.21**	−.14	−.32**	−.14	−.19**	−.23**
9. Suspensions/Expulsions	--	--	--	--	--	--	--	--	--	.07	.30**	.22**	.06	.27**
10. CDI	--	--	--	--	--	--	--	--	--	--	.52**	.24**	.31**	.17*
11. Internalizing Symptoms	--	--	--	--	--	--	--	--	--	--	--	.25**	.26**	.19**
12. Neg. Social Pref.	--	--	--	--	--	--	--	--	--	--	--	--	−.03	.001
13. Substance Variety	--	--	--	--	--	--	--	--	--	--	--	--	--	.53**
14. Substance Dependence	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Note. Overt Aggression = Observed Physical + Verbal aggression; Covert ASB = Covert Antisocial Behavior (Stealing + Property Destruction); SNAP = Swanson, Nolan, and Pelham Rating Scale; HI = Hyperactivity-Impulsivity Symptoms; Conduct Problems = Sum of Parent and Youth ODD + CD Symptoms; WIAT Achievement = Composite of Wechsler Individual Achievement Math and Reading; CDI = Child Depression Inventory; Internalizing Symptoms = Sum of Parent and Youth Internalizing Disorder Symptoms; Neg. Social Pref. = Negative Social Preference; Substance Variety = Number of Different Substances Used; Substance Dependence = Number of Substance Use Dependence Symptoms.

* $p < .05$

** $p < .01$

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Table 4

Summary of Hierarchical Regressions: Predicting Conduct Problems and Academic Achievement

Follow-Up Measures	ΔR^{2a}	β [b]	p[c]
Outcome Domain: Conduct Problems (ODD + CD Symptoms)			
1. Hyperactivity-Impulsivity Symptoms	.03	.29	<.05
2. Inattention Symptoms	.00	.02	ns
3. Overt Aggression	.01	.15	ns
4. Covert Antisocial Behavior	.01	.08	ns
5. Observed Noncompliance	.03	.24	<.05
6. Peer Status	.00	.07	ns
7. Substance Variety	.01	.18	ns
Outcome Domain: Reading and Math Achievement (Composite)			
1. Hyperactivity-Impulsivity Symptoms	.00	−.05	ns
2. Hyperactivity-Impulsivity × Group Interaction	.03	.62	<.01
3. Inattention Symptoms	.04	−.32	<.00
4. Overt Aggression	.01	−.15	ns
5. Covert Antisocial Behavior	.00	.01	ns
6. Observed Noncompliance	.00	.07	<.00
7. Peer Status	.01	.10	ns

[a] Change in R^2 associated with each predictor with control of all preceding variables.

[b] Beta reflects association with outcome with simultaneous control of previous variables.

[c] Significance level associated with predictor at final step, following entry of all main effects.

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Table 5

Summary of Hierarchical Regressions: Predicting Suspensions/Expulsions and Negative Social Preference

Follow-Up Measures	ΔR^{2a}	β [b]	p[c]
Outcome Domain: Number of Suspensions/Expulsions			
1. Hyperactivity-Impulsivity Symptoms	.00	.08	ns
2. Inattention Symptoms	.00	.00	ns
3. Inattention × Group Interaction	.03	.21	<.05
4. Overt Aggression	.00	−.03	ns
5. Covert Antisocial Behavior	.00	.06	ns
6. Observed Noncompliance	.09	.41	<.00
7. Peer Status	.02	−.20	<.05
Outcome Domain: Negative Social Preference			
1. Hyperactivity-Impulsivity Symptoms	.01	.18	ns
2. Inattention Symptoms	.00	−.02	ns
3. Overt Aggression	.00	.03	ns
4. Covert Antisocial Behavior	.00	−.04	ns
5. Observed Noncompliance	.01	.12	ns
6. Peer Status	.07	−.36	<.00

[a] Change in R^2 associated with each predictor with control of all preceding variables.

[b] Beta reflects association with outcome with simultaneous control of previous variables.

[c] Significance level associated with predictor at final step, following entry of all main effects.

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Table 6

Summary of Hierarchical Regressions: Predicting Internalizing Symptoms and Child Depression

Follow-Up Measures	ΔR^{2a}	β [b]	p[c]
Outcome Domain: Internalizing Symptoms			
1. Hyperactivity-Impulsivity Symptoms	.04	.36	<.00
2. Inattention Symptoms	.00	.09	ns
3. Overt Aggression	.01	.13	ns
4. Covert Antisocial Behavior	.03	.20	ns
5. Observed Noncompliance	.02	.19	<.05
6. Peer Status	.00	−.01	ns
Outcome Domain: Child Depression (CDI)[d]			
1. Hyperactivity-Impulsivity Symptoms	.01	.12	ns
2. Inattention Symptoms	.00	−.09	ns
3. Overt Aggression	.00	−.07	ns
4. Covert Antisocial Behavior	.08	.31	<.00
5. Observed Noncompliance	.00	.09	ns
6. Peer Status	.00	−.08	ns

[a] Change in R^2 associated with each predictor with control of all preceding variables.

[b] Beta reflects association with outcome with simultaneous control of previous variables.

[c] Significance level associated with predictor at final step, following entry of all main effects.

[d] Total score from the Child Depression Inventory (CDI)

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Table 7

Summary of Hierarchical Regressions: Predicting Substance Use Variety and Dependence

Follow-Up Measures	ΔR^{2a}	β [b]	p[c]
Outcome Domain: Substance Dependence Symptoms			
1. Hyperactivity-Impulsivity Symptoms	.04	.34	<.05
2. Inattention Symptoms	.01	−.15	ns
3. Overt Aggression	.00	.05	ns
4. Covert Antisocial Behavior	.00	−.03	ns
5. Observed Noncompliance	.01	.10	ns
6. Peer Status	.01	.13	ns
Outcome Domain: Number of Different Substances Used			
1. Hyperactivity-Impulsivity Symptoms	.01	.18	ns
2. Inattention Symptoms	.00	−.10	ns
3. Overt Aggression	.00	.00	ns
4. Covert Antisocial Behavior	.00	−.04	ns
5. Observed Noncompliance	.02	.21	<.05
6. Peer Status	.02	.18	ns

[a] Change in R^2 associated with each predictor with control of all preceding variables.

[b] Beta reflects association with outcome with simultaneous control of previous variables.

[c] Significance level associated with predictor at final step, following entry of all main effects.