Predictive Validity of Childhood Oppositional Defiant Disorder and Conduct Disorder: Implications for the DSM–V
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Predictive Validity of Childhood Oppositional Defiant Disorder and Conduct Disorder: Implications for the DSM–V

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Data are presented from 3 studies of children and adolescents to evaluate the predictive validity of childhood oppositional defiant disorder (ODD) and conduct disorder (CD) as defined in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM–IV; American Psychiatric Association, 1994) and the International Classification of Diseases, Version 10 (ICD-10; World Health Organization, 1992). The present analyses strongly support the predictive validity of these diagnoses by showing that they predict both future psychopathology and enduring functional impairment. Furthermore, the present findings generally support the hierarchical developmental hypothesis in DSM–IV that some children with ODD progress to childhood-onset CD, and some youth with CD progress to antisocial personality disorder (APD). Nonetheless, they reveal that CD does not always co-occur with ODD, particularly during adolescence. Importantly, the present findings suggest that ICD-10 diagnostic criteria for ODD, which treat CD symptoms as ODD symptoms when diagnostic criteria for CD are not met, identify more functionally impaired children than the more restrictive DSM–IV definition of ODD. Filling this “hole” in the DSM–IV criteria for ODD should be a priority for the DSM–V. In addition, the present findings suggest that although the psychopathic trait of interpersonal callousness in childhood independently predicts future APD, these findings do not confirm the hypothesis that callousness distinguishes a subset of children with CD with an elevated risk for APD.

Keywords: oppositional defiant disorder, conduct disorder, antisocial personality disorder, interpersonal callousness

Since the publication of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM–IV; American Psychiatric Association, 1994), the emerging empirical evidence has provided strong support for the DSM–IV’s taxonomic model of attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD). Both exploratory and confirmatory factor analyses have consistently shown that the symptoms of ODD and CD, and the inattention and hyperactivity-impulsivity dimensions of ADHD, load onto separate factors (for a review, see Loeber, Burke, & Pardini, 2009). Consistent with the grouping of these disorders under the rubric of “Attention-Deficit and Disruptive Behavior Disorders” in the DSM–IV, however, these four dimensions of symptoms are highly correlated with one another (Lahey et al., 2008).

Nonetheless, there remain a number of significant unresolved issues that need to be empirically addressed before the the DSM–V Task Force concludes its review and possible revisions of diagnostic criteria for ODD and CD (Moffitt et al., 2008). In the present article we report analyses of data from three samples to address three of these issues.

1. Hierarchical developmental relations among disorders. The DSM–IV hypothesized a developmental pathway from ODD to CD to antisocial personality disorder (APD). These developmental relations are hypothesized to be hierarchical, with only some children with ODD progressing to CD and only some youth with CD progressing to APD (Lahey & Loeber, 1994; Lahey, Loeber, Burke, & Applegate, 2005; Loeber, Burke, et al., 2000; Loeber, Lahey, & Thomas, 1991; Moffitt et al., 2008). Indeed, in the DSM–IV, when criteria for CD are met, the diagnosis of ODD cannot also be assigned because it is assumed to always be present. Furthermore, the diagnosis of APD cannot be given unless there is evidence that the individual exhibited significant CD behaviors before age 15.

Because the extent to which a diagnosis predicts a later, more serious diagnosis is a fundamental aspect of predictive validity, it is important to know whether ODD, CD, and APD are, in fact, nested developmentally. The limited new evidence emerging since 1994 from longitudinal studies is consistent with the hypothesis that childhood ODD is a developmental precursor to CD, given that ODD usually has an earlier onset and a greater prevalence, and children with ODD are at increased risk for developing CD (Burke, Loeber, & Birmaher, 2002; Lahey & Loeber, 1994; Lavigne et al.,...
2001; Loeber, Burke, et al., 2000). Similarly, there is recent evidence confirming the hypothesis that child and adolescent CD as defined in the DSM–IV is a developmental precursor to APD (Lahey et al., 2005; Loeber, Burke, & Lahey, 2002).

The DSM–IV assumes that ODD is always present in youth who meet diagnostic criteria for CD. Previous studies suggest that the extent to which ODD is always present in youth who meet diagnostic criteria for CD appears to vary with the type of sample. Although the proportion of children with CD who meet or have ever met criteria for ODD tends to be high in clinic samples, it is common to identify youth who meet criteria for CD in samples representative of the general population who do not also exhibit ODD (see Burke, in press). This discrepancy in findings may reflect two kinds of sampling biases. First, consistent with the concept of Berkson’s (1946) bias, there is evidence that children and adolescents who receive clinical services are more likely to meet criteria for multiple mental disorders than children and adolescents identified in population-based samples who have not received clinical services (Goodman et al., 1997). Indeed, there is evidence that comorbid ODD could particularly lead to clinic referral because a diagnosis of ODD, but not CD, has been found to be associated with caregiver strain (Bussing, Gary, et al., 2003; Bussing, Zima, et al., 2003), and similarly is associated with involvement in mental health treatment during the prior year (Bussing, Zima, et al., 2003). Thus, clinic samples may be more likely to include higher rates of children with CD who also have met criteria for ODD because parents are motivated to seek clinical services. Nonetheless, it is important to determine how common ODD is among children who meet criteria for CD even in clinic samples to evaluate this hierarchical diagnostic rule. We report the results of analyses of this association using a longitudinal clinic sample to assess the nesting of the diagnosis of ODD within CD.

Second, there is evidence that children and adolescents who meet criteria for CD with later ages of onset are less likely to receive mental health services (Lahey et al., 1999). This is important because there is strong evidence that youth who follow different developmental trajectories of antisocial behavior exhibit different childhood characteristics, including substantially greater oppositional behavior among youth with childhood-onset antisocial behavior (Lahey et al., 2006; Moffitt, Caspi, Harrington, & Milne, 2002). Thus, the DSM–IV presumption that ODD is always present when criteria for CD are met is unlikely to be literally correct, but may be generally accurate in clinical settings. In the present article, we report new data from a 13-year longitudinal study on the extent to which clinic-referred children with CD concurrently meet criteria for ODD.

2. Predictive validity of ODD. As noted by Moffitt et al. (2008), predictive validity is a sine qua non for diagnostic criteria for mental disorders that are applied to children and adolescents. That is, although functional impairment and distress that is concurrently associated with mental disorders may provide sufficient justification for treatment, it is essential that diagnostic criteria used with children predict future adaptive and maladaptive outcomes to improve treatment planning and prognosis. Although considerable existing research supports the predictive validity of ODD and CD (Moffitt et al., 2008), more remains to be learned about the predictive validity of ODD. In particular, it is not yet clear that ODD is associated with future adverse outcomes if it does not lead to CD, which is the case for many children with ODD. That is, is ODD a challenging and impairing condition during childhood, but not one associated with lasting dysfunction in those children with ODD who do not develop CD? To better understand the predictive validity of childhood ODD, we compare both the persistence of ODD symptoms and functional impairment of children with ODD who do and do not ever meet criteria for CD over a 13-year period.

Furthermore, there remains a controversy as to the role of ADHD in the prediction of CD after accounting for ODD (Lahey, McBurnett, & Loeber, 2000; Lahey et al., 2009; Mannuzza, Klein, Abikoff, & Moulton, 2004; Mannuzza et al., 1991). Some theorists hypothesize that ADHD is a direct developmental precursor to CD and APD (Mannuzza et al., 2004), whereas others suggest that apparent links between ADHD and later antisocial behavior have been observed due to the failure to account fully for the presence of childhood ODD (Lahey et al., 2000). For example, in a clinic sample of boys using DSM-based clinical interview measures from ages 7 to 17, annual increases in CD symptoms were predicted by ODD and not ADHD, but ADHD predicted increases in ODD over time (Burke, Loeber, Lahey, & Rathouz, 2005). Nonetheless, there is evidence that early oppositional behaviors do not predict later conduct problems when early conduct problems are controlled (Lahey et al., 2009). These data were not based on DSM–IV symptom lists, but raise concerns about the importance of ODD as a developmental precursor to later CD that must be addressed using DSM–IV criteria. In the present article, questions regarding childhood ADHD and ODD as precursors to CD are addressed using data from a longitudinal study that has followed children who met criteria for ADHD at 4–6 years and demographically matched comparison children. We test the hypothesis that ODD in Year 1 is a developmental precursor to new cases of CD over the next 12 years, even when subthreshold symptoms of CD in Year 1 are controlled, but ADHD is not an independent predictor of future CD.

Perhaps the most important unresolved question regarding the DSM–IV model of ODD and CD is whether the International Classification of Diseases, Version 10 (ICD-10; World Health Organization, 1992) definition of ODD is more valid in the ICD-10 than in the DSM–IV. In the DSM–IV, children can have up to three symptoms of ODD and two symptoms of CD and not meet criteria for either ODD or CD. In the ICD-10, which takes a developmental approach to ODD and CD, both symptoms of ODD and CD are considered in making the diagnosis of ODD when criteria for CD are not met; thus, these children would meet criteria for ODD. Rowe, Maughan, Costello, and Angold (2005) found the prevalence of DSM–IV ODD to be 3.9%, whereas the prevalence of ICD-10 ODD was 5.4%. Moreover, children who met criteria for ICD-10 ODD but not DSM–IV ODD were found to show levels of impairment and comorbidity equal to children who met DSM–IV criteria for ODD (Rowe et al., 2005).

In this article, we compare the validity of the ICD-10 and DSM–IV definitions of ODD in both a longitudinal study of clinic-referred children and controls and a large representative sample of twins (Lahey et al., 2008). We test the hypothesis that ICD-10 ODD identifies children with impairing disruptive behavior problems who do not meet criteria for either ODD or CD in the DSM–IV.
Loeber, & Lahey, 2003). Although CD is the best predictor of APD, CD is defined solely by discrete antisocial behaviors and not by the personality characteristics that are part of the definition of APD (Burke, 2007). Therefore, there is great interest in the potential role of personality features in childhood in predicting later APD. For example, a construct measuring callous and unemotional traits has been found to predict CD and other psychopathology (Rowe et al., in press), as well as predicting a more severe and aggressive pattern of later conduct problems (Frick, Cornell, Barry, Bodin, & Dane, 2003). Adolescent interpersonal callousness (IC; Burke, Loeber, & Lahey, 2007) and adolescent psychopathy (Lynam, Caspi, Moffitt, Loeber, & Southamer-Loeber, 2007) predict psychopathy in young adults. However, IC was not found to predict future delinquency after accounting for existing conduct problems in two of three cohorts of the Pittsburgh Youth Study (Pardini, Obradović, & Loeber, 2006). Similarly, in a large population-based sample, controlling for concurrent CD rendered the prediction from callous and unemotional traits to other disorders nonsignificant (Rowe et al., in press). To provide evidence relevant to the proposal to use callousness as a subtyping dimension for CD in the DSM–IV, we test the hypothesis that IC improves the prediction of APD in the clinic-referred Developmental Trends Study (DTS; Loeber, Green, Lahey, Frick, & McBurnett, 2000) sample.

Method

Growing Up With ADHD Study (GUWAS)

Participants. In the GUWAS (Lahey et al., 2007; Lee, Lahey, Owens, & Hinshaw, 2008), two cohorts of 3.8– to 7.0-year-old children were recruited in consecutive years at two sites, Chicago and Pittsburgh. Participants all lived with their biological mothers, and half initially met DSM–IV diagnostic criteria for ADHD. In Chicago, children with ADHD were recruited from a university child psychiatry clinic. In Pittsburgh, 42% of the children with ADHD were recruited from a university child psychiatry clinic, and 58% were recruited through advertisements, but no differences were found between recruitment methods. Five potential participants were excluded because of pervasive developmental disorder, mental retardation, or seizure disorder. Comparison children were recruited from similar schools and neighborhoods as probands and approximately matched probands on sex, ethnicity, and age. They had never been referred for mental health problems but were not excluded if they met criteria for a disorder other than ADHD. Of 310 eligible participants, 259 parents gave consent and participated. The present analyses are based on approximately annual structured diagnostic assessments conducted during Years 1–4, 6–9, and 12–13. Assessments were not conducted during Years 5, 10, and 11 due to insufficient funding.

Measures. Beginning with the initial assessment when the children were 4–6 years old, approximately annual assessments were conducted by trained lay interviewers. The Diagnostic Interview Schedule for Children (DISC; Shaffer, Fisher, Piacentini, Schwab-Stone, & Wicks, 1993) was administered to mothers in each assessment. Information was obtained from mothers on DSM–IV diagnostic criteria for a range of disorders, including symptoms of ADHD, ODD, and CD symptoms during the last 12 months (Lahey et al., 1998). In addition, the DISC was administered to the youth in Years 6–13 to query DSM–IV diagnostic criteria for CD and internalizing disorders. In each assessment, the child’s primary teacher completed the DSM–IV version of the Disruptive Behavior Disorder Rating Scale (Pelham, Gnagy, Greenslade, & Milich, 1992) by mail. Following standard procedures, teacher-reported ADHD symptoms rated “pretty much” or “very much” were scored as present. Symptoms of CD were considered to be present if reported by either the parent or the youth using the simple “or” rule as in the DSM–IV field trials (Lahey et al., 1994). Because both parent and youth reports of CD symptoms account for independent variance in functional impairment (E. L. Hart, Lahey, Loeber, & Hanson, 1994), the combination of parent and youth reports provides the most valid measure of CD symptoms.

In each assessment, the nonclinician version of the Children’s Global Assessment Scale (CGAS; Setterberg, Bird, & Gould, 1992) was used to obtain ratings of the child’s lowest level of overall functioning during the past 6 months. CGAS ratings were collected independently from the mother and interviewer who administered the DISC to the mother. In each assessment, the child’s primary or English teacher estimated the proportion of the child’s classmates who like, dislike, and ignore the child on three separate 5-point scales each year (Dishion, 1990). A social preference score was created by subtracting dislike ratings from like ratings. These scores were reversed to yield a negative social preference score with approximately Poisson distributions in each year.

Sample 2: Tennessee Twin Study (TTS)

Participants. The TTS sample is representative of all 6- to 17-year-old twins who were born in Tennessee and living in one of the state’s five metropolitan statistical areas in 2001 (Lahey et al., 2008). These include the 28 urban, suburban, and rural counties surrounding Nashville, Memphis, Knoxville, Chattanooga, and Bristol. A random sample of families with twins was selected and stratified on the age of the twins, proportional to the population of 35 geographic subareas. Ninety percent of families were located and screened, with 2,646 families being eligible. Twins were eligible if (a) both twins coresided with the adult caretaker at least half of the time during the past 6 months, (b) both twins and the caretaker spoke English, and (c) the twins were 6–17 years old. Only 12 families were ineligible because of language. Interviews were completed with 2,063 adult caretakers (91% biological mothers, 8% biological fathers). The response rate for caretaker interviews was 70%; when the caretaker was interviewed, 98% of the twin pairs were interviewed. Consistent with the population of Tennessee in 2001, caretakers classified 72% of the twin pairs as non-Hispanic White, 23% as African American, 2% as Hispanic, and 3% as other race/ethnic groups. Youth were excluded from the TTS if they had a diagnosis of psychosis or autism. This resulted in 2,023 twin pairs (4,046 youth). The TTS consists of approximately equal numbers of monozygotic (MZ; \( n = 752 \) pairs; 51% female pairs), same-sex dizygotic (DZ; \( n = 670 \) pairs; 51% female pairs), and mixed-sex DZ pairs (\( n = 601 \) pairs).

Measures. Adult caretakers and youth were interviewed separately using the Child and Adolescent Psychopathology Scale (CAPS; Lahey et al., 2008). Interviewers read each CAPS item aloud to the respondent from a laptop computer and entered
responses. The CAPS covers all DSM–IV and ICD-10 symptoms of ADHD, ODD, CD, major depression (MDD), generalized anxiety disorder, separation anxiety disorder, agoraphobia, social phobia, specific phobia, and obsessive-compulsive disorder (OCD). The CAPS was developed by primary investigator Lahey with National Institute of Mental Health funding to create a structured diagnostic interview that yields both categorical diagnoses and continuous ratings of dimensions of child and adolescent psychopathology. CAPS items covering DSM–IV symptoms were based on the “stem questions” of the DISC–IV (Shaffer et al., 1996), modified from “yes or no” questions to fit a 4-point response scale, where 1 = not at all, 2 = just a little, 3 = pretty much, and 4 = very much. Respondents were asked to respond by thinking about how well each item described the youth’s emotion or behavior, how often it occurred, and how serious it was during the last 12 months. Algorithms based on relations with DISC categorical diagnoses allow categorical diagnoses to be made on the basis of the CAPS.

The optimal informants on mental disorders in children and adolescents are different at different ages and for different disorders. Children < 9 years have been found to be unreliable informants on all types of symptoms in structured interviews, but 9-to-17-year-old youth can report reliable and valid information on CD and internalizing symptoms. (Jensen et al., 1999). In a separate large population-based sample of 4- to 17-year-olds (Lahey et al., 2004), a subset of participants (290 adult caretakers and 196 youth) stratified by age and numbers of symptoms was selected for a second interview 7–14 days later. Test–retest intraclass correlations for unit-weighted mean ratings of the symptoms of each DSM–IV disorder using the CAPS ranged from .65 to .89 caretaker reports and from .62 to .83 for youth reports of symptoms. Robust correlations with measures of functional impairment provide strong external validation of the CAPS (Lahey et al., 2004).

Sample 3: The DTS

Participants. Participants in the DTS were 177 boys recruited in 1987 from clinics in Pittsburgh, Pennsylvania and in Athens and Atlanta, Georgia. Boys had to be living with at least one biological parent and were excluded if they had a history of mental retardation or psychosis, inpatient psychiatric treatment within the last 6 months, or could not discontinue taking psychotropic medication for 2 days prior to their scheduled assessment. Further details regarding participant recruitment can be found in Loeber, Green, et al., 2000.

Participants in the DTS were 7–12 years of age at the beginning of the study, and were followed up with parent and child assessments until the age of 17. These interviews were conducted on an annual basis, except in Year 5, due to a funding cut. Young adult follow-up interviews were conducted with the youth alone at 18, 19, and 24 years of age. Retention rates for the childhood through adolescent data collection ranged from a high of 100% in Year 2 to 87.1% in Year 10, with an average across all years of 93.4%. There were 164 participants (93%) who completed at least one young adult follow-up interview at 18, 19, or 24 years of age; with 162 assessed at age 18, 153 assessed at age 19, and 143 assessed at age 24. The sample was composed of non-Hispanic White (70%) and African American boys (30%).

Measures. A modified version of the DISC (Costello, Edelbrock, Dulcan, Kalas, & Klaric, 1987) was developed on the basis of DSM–III–R criteria (Loeber et al., 1989). Parallel versions for parents, children, and teachers were administered at each assessment to assess symptoms of CD, ODD, and ADHD. In the present analyses, both parent and child reports were used, combined at the symptom level using an either/or strategy, so that a positive symptom endorsement from either the parent or the child was considered to denote the presence of that symptom.

Although the DISC assessed DSM–III–R symptoms, we were able to create CD constructs using criteria similar to the DSM–IV. The primary distinction is the addition of “often bullies, threatens or intimidates others” and “often stays out at night despite parental prohibitions,” which we had within our parent report for all phases. For child report, we also had “bullying” for all phases. However, we queried “stay out late” with children in only the first and second assessment waves. Finally, the DSM–IV specifies “lying to con,” whereas the DSM–IV included “lying” without any qualification. Our assessment did not include the specification of “lying to con” at any phase.

IC. Parents and teachers completed an extended version of the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983) annually through assessments at age 17. This was modified to include 88 items regarding delinquent and covert antisocial behaviors (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). Eight items from these measures regarding manipulative, sneaky behavior and an absence of guilt were summed to create separate parent and teacher constructs of IC behaviors. The development of this construct and its psychometric properties are described in more detail elsewhere (Burke et al., 2007; Pardini et al., 2006). Across the 10 waves of the present data set, the internal consistency reliability alpha for the construct ranged from .87 to .93. The extent to which this measure is correlated with related constructs, such as callous unemotional (CU) traits (e.g., Frick et al., 2003) and childhood psychopathy (e.g., Lynam et al., 2007) is not well established, although parent-rated IC has been shown to correlate with the interpersonal/affective factor of the Child Psychopathy Scale (r = .78; Pardini & Loeber, 2008). CU items tap largely overlapping items, although CU also includes affectively oriented items, and psychopathy includes impulsive, irresponsible, and antisocial behavior (see Loeber, Burke, & Pardini, 2009, for further discussion).

APD. At 18, 19, and 24 years of age, participants were assessed using the Computerized Diagnostic Interview Schedule Revised (DIS; Robins & Helzer, 1988). The temporal stability of DIS-based measurement of APD has been shown to be good (rs = .60 and .58 for 6- and 12-month follow-up assessments; Vandiver & Sher, 1991). This included an assessment of DSM–III–R criteria for APD, whereas DSM–IV criteria for APD did not include items regarding ability to function as a responsible parent and sustaining a monogamous relationship for 1 year. Additionally, in DSM–IV, two items pertaining to inconsistent work behavior and failure to honor financial obligations were combined. DSM–IV APD scoring was developed by excluding DIS data on the two items that were dropped and defining the item on work behavior and financial obligations by combining items for these criteria. Because we wished to examine CD as an antecedent to APD, we did not require childhood CD to have been present to give the diagnosis of APD.
Preliminary analyses showed that the diagnosis of APD was not always stable across assessment waves in the DTS. Therefore, because APD is conceptualized as a chronic mental disorder, APD was conservatively considered to be present only if criteria were met in at least two of the three adult assessments at 18, 19, or 24 years. Of the 164 participants assessed at least once during adulthood, these scoring procedures led to five missing cases, or a total of 159 participants available for analyses predicting APD.

To validate this measure of APD based on at least two positive diagnoses, the association between our definition of APD and several external criterion variables related to the construct of APD was tested. Participants meeting criteria for APD in adulthood had, on average, twice as many criminal charges ($M = 6.35$ vs. $M = 2.5$) and approximately four times as many violent charges ($M = 0.92$ vs. $M = 0.23$) as other participants, according to official records (both differences significant at $p < .01$). Similarly, participants with APD were 2.6 times more likely than those without APD to report having been fired from a job ($p < .001$) and were 3.3 times as likely to report causing injury to a romantic partner ($p = .04$). They also had Psychopathy Checklist scores (Hart, Cox, & Hare, 1995) that were, on average, 2.3 times greater than those without APD ($p < .001$).

### Data analyses

In the GUWAS sample, all longitudinal data analyses were conducted using general estimating equations (GEEs; Zeger & Liang, 1986). GEEs account for the clustering of multiple repeated observations over time within each participant and allow the specification of a within-person correlation structure to account for correlations in the outcome variable over time. Given that GEEs were used within generalized linear models, the present analyses allow for non-normally distributed outcomes, such as count or dichotomous variables. In all of these analyses, an autoregressive correlation structure was specified.

For repeated measures of dichotomous outcome variables, binomial regression was specified in the present analyses. For continuous data, working distributions that approximate the data were specified on the basis of their empirical distributions. Specifically, when GEE was used with count variables in the GUWAS, a Poisson distribution was specified. Because population-averaged GEE regressions model the average value of the outcome for each subset of participants who share the same value of the predictor variable, and not the entire distribution of outcome values, they are less restricted by distributional assumptions than other approaches to longitudinal data analysis. The $z$ statistic was used in all statistical tests, which were based on the robust (“empirical”) standard error that adjusts for dispersion and minimizes the effect of incorrect specification of the within-person covariance structure.

GEE was also used for dichotomous and count outcomes in the cross-sectional analyses of the TTS data. In this case, the GEE was used to account for the clustering of participants within twin pairs. This allowed all individual twins to be included in the same analysis without violating the assumption of observational independence.

To examine the prediction of APD in adulthood from CD to IC through adolescence in the DTS, logistic regression models were conducted in which participants were clustered to account for correlated observations, which allow for all waves of predictors to be included in the model.

### Results

#### Issue 1: Are There Hierarchical Developmental Relations Among ODD, CD, and APD?

Does childhood ODD predict later CD? Using data from the GUWAS sample, groups of children were created based on meeting DSM–IV diagnostic criteria for ADHD, both ADHD and ODD, or neither disorder in Year 1 (at 4–6 years of age). These analyses used data from the 184 children who were assessed through assessment Years 12 and/or 13 (Note: half of non-ADHD comparison children were dropped from the study before Year 12 for budgetary reasons), but not including 33 children who already met criteria for CD in Year 1. Figure 1 shows the percentage of children meeting criteria for CD within each group in each assessment year. In addition, four children with ODD in the absence of ADHD were not included in these analyses, but including them had essentially no effect on the results.

Longitudinal binomial regression in the GEE was used to test the extent to which Year 1 ADHD and ODD entered as simultaneous predictors predicted the prevalence of the diagnosis of CD over the next 12 years. Among children who did not already meet diagnostic criteria for CD in Year 1, both the diagnoses of ADHD ($\beta = 0.91, z = 2.09, p < .04$) and ODD ($\beta = 1.41, z = 4.51, p < .0001$) predicted meeting criteria for CD during Years 2–13, controlling methodological and demographic covariates. When the number of subthreshold CD symptoms in Year 1 were added as a third simultaneous predictor, however, Year 1 CD symptoms ($\beta = 0.90, z = 4.62, p < .0001$) and the diagnosis of ODD in Year 1 ($\beta = 0.97, z = 3.22, p < .002$) both predicted the prevalence of CD over the next 12 years, but the diagnosis of ADHD in Year 1 did not ($\beta = 0.64, z = 1.43, p = .15$). Thus, both ODD and subthreshold symptoms of CD independently predicted new (i.e., incident) cases of CD over the next 12 years in this sample.

It is important to examine further the developmental sequences of ODD and CD in the 19 of the 48 children who met criteria for ADHD but not ODD or CD in Year 1, but who later met criteria for CD at least once during Years 2–13. Among these 19 children, nine met criteria for ODD at least once before criteria for CD were met during Years 2–13, and six met criteria for ODD in the same year as criteria for CD were first met. Only four of these 19 children met criteria for CD without meeting criteria for ODD in an earlier year or in the same year.

**Early ODD and the early emergence of CD.** Because the GUWAS sample was ascertained at 4–6 years of age, it would be reasonable to assume that most children with CD in this sample would first meet criteria for CD during childhood. Consistent with this view, Figure 2 shows that 70.0% of the 86 children who ever met criteria for CD during Years 1–13 did so for the first time during the first 4 years of the study (spanning ages 4–9 years of age). Consistent with previous studies showing a link between early ODD behavior and early-onset conduct problems (Lahey et al., 1998, 2006), ordinal logistic regression showed that among children who met criteria for CD at least once during the study, there was a robust inverse relation between the year in which

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1 Additional details on these validation analyses are available from Jeffrey D. Burke upon request.
criteria for CD were first met and having met criteria for ODD in Year 1 (OR = 0.83, 95% CI = 0.74, 0.94). Whereas 71.4%–78.4% of youth who first met criteria for CD in Years 1–3 also met criteria for ODD in Year 1, that was true of only 30.0% of youth who first met criteria for CD in Year 8 or later.

Do children and adolescents who meet criteria for CD always meet criteria for ODD? As shown in Figure 3, analyses of data from the GUWAS sample reveal that children and adolescents who met criteria for CD in each wave were significantly more likely to meet criteria for ODD in the same wave than to not meet criteria for ODD (all χ² tests within each wave p < .0001). Nonetheless, the nesting of ODD within CD was not perfect in any wave. Furthermore, longitudinal binomial regression in GEE revealed that the frequency of cases of CD in which criteria for ODD were met sharply declined over assessment years (β = −0.20, z = −4.301, p < .0001), reaching particularly low levels in Years 12 and 13 when the youth were 16–18 years of age.

Is there a diagnostic hole in the DSM–IV definition of ODD? Valid diagnostic taxonomies must be comprehensive in the sense of identifying all impaired individuals who are in need of treatment. In the ICD-10 Research Diagnostic Criteria, ODD is defined by four or more symptoms from the combined list of both ODD and CD symptoms, but the diagnosis of ODD is given only if the individual does not meet criteria for CD. Does ICD-10 ODD identify additional impaired children and adolescents who are not diagnosed in DSM–IV as ODD? For example, are youth with three symptoms of ODD and two symptoms of CD (who would not receive a diagnosis of either ODD or CD in DSM–IV) significantly impaired? To be consistent with both DSM–IV and ICD-10 criteria, the diagnoses of DSM–IV and ICD-10 ODD were precluded in the present analyses of two samples if criteria for CD were met.

Using data from the GUWAS sample of 4- to 6-year-olds in Year 1, the ICD-10 criteria for ODD increased the prevalence of ODD in Year 1 (4–6 years) by 9/48 = 18.8% (see Table 1). Controlling methodological and demographic covariates, both interviewers and parents gave significantly and consistently lower CGAS ratings to children in both ODD groups over the next 12 years than children who did not meet either criteria for ODD: Parent CGAS for children who met only ICD-10 criteria (β = −0.16, z = −3.15, p < .002) and for children who met both ICD-10 and DSM–IV criteria (β = −0.17, z = −6.54, p < .0001); interviewer CGAS for children who met only ICD-10 criteria (β = −0.19, z = −3.37, p < .001) and for children who met both ICD-10 and DSM–IV criteria (β = −0.18, z = −6.89, p < .0001). Figure 4 shows the CGAS as rated by the interviewer and the parent at each assessment point in the GUWAS sample.

To further examine this issue, cross-sectional analyses were conducted using data on 4,048 twin children ages 6–17 years from representative TTS sample. In each member of the twin pairs, the ICD-10 definition of ODD identified 72%–79% more children and
adolescents with ODD in this sample (see Table 1). The two groups of children and adolescents who met criteria for ODD (according to ICD-10 only, or according to both ICD-10 and DSM–IV) were compared with children who met neither set of criteria for ODD on a measure of global impairment completed by mothers that combined impaired functioning with peers, with parents, with teachers, difficulties in completing homework or work at home, and difficulties in completing classroom academic work or work outside the home (Lahey et al., 2004). Figure 5 shows the mean global impairment score by diagnostic group. GEE was used to account for clustering within twin pairs to allow data on all twins to be analyzed in the same model. Controlling for age, sex, race/ethnicity, and family income, both the ICD-only group \( (\beta = 0.30, z = 8.43, p < .0001) \) and the ICD + DSM–IV group \( (\beta = 0.44, z = 15.87, p < .0001) \) exhibited significantly greater impairment than the ODD group. The both ICD + DSM–IV group \( (\beta = 0.14, z = 3.36, p < .001) \) exhibited slightly but significantly greater impairment than the ICD-only group.

To determine whether the much greater percent difference in the number of identified cases of ODD using the ICD-10 and DSM–IV definitions in the TTS sample than in the GUWAS was due to the much greater number of older children and adolescents (6–17 vs. 4–6 years) at the time of the diagnosis of ODD in the TTS, or the greater proportion of females in the TTS (50% vs. 20%), the association of the prevalence of ICD-only cases of ODD with age and sex was tested in binomial regression in GEE. There was not a significant sex difference in the prevalence of cases of ODD diagnosed only in the ICD-10 \( (\beta = 0.25, z = 1.38, p = .17) \). There was a nonsignificant trend toward an association between age and the number of cases of ODD diagnosed only in the ICD-10 \( (\beta = -0.05, z = -1.84, p = .066) \), but the trend was in the opposite direction (i.e., more ICD-only cases at younger ages). Thus, the difference in the relative prevalence of the ICD-10-only cases in the TTS and GUWAS sample appears to be due to factors other than age or sex differences, such as differences in clinic and representative samples.

Does CD predict future APD? Forty-eight participants (30.2%) in the DTS met criteria for APD two or more times among the 159 who were assessed at least twice over ages 18, 19, and 24. Of those 159 young men, 109 had met criteria for CD at least once between ages 7 and 17, and 39.5% of those with CD went on to meet criteria for APD more than once \( (OR = 1.77, SE = 0.51, p = .001) \). Also of interest, 10% of young men who met criteria for APD never met criteria for CD \( (n = 5) \). All five had shown two symptoms of CD during at least one previous assessment, however. These findings are consistent with previous reports based on the age 18- and 19-year assessments in the DTS (Lahey et al., 2005; Loeber et al., 2002).

Table 1

<table>
<thead>
<tr>
<th>Not DSM–IV ODD</th>
<th>DSM–IV ODD</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUWAS</td>
<td>TTS (Twin 1)</td>
</tr>
<tr>
<td>Not ICD ODD</td>
<td>94</td>
</tr>
<tr>
<td>ICD ODD, but not DSM–IV ODD</td>
<td>9</td>
</tr>
<tr>
<td>ODD in both ICD and DSM–IV</td>
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</tr>
</tbody>
</table>

Note. ADHD = attention-deficit/hyperactivity disorder; DSM–IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition; ICD-10 = International Classification of Diseases, Version 10; ODD = oppositional defiant disorder.
Issue 2: Predictive Validity of ODD in Children Who Never Develop CD

The upper left panel of Figure 6 shows the course of ODD symptoms over Years 1–13 in the GUWAS sample among three groups of children: (a) children who met criteria for ODD in Year 1 (at 4–6 years of age) who met criteria for CD at least once during Years 1–13; (b) children who met criteria for ODD in Year 1 but never met criteria for CD during Years 1–13; and (c) children who did not meet criteria for ODD in Year 1 and never met criteria for CD during Years 1–13, included as the comparison group. Across groups, there was a decline in ODD symptoms during Years 2–13 ($\beta = -0.09, z = -10.26, p < .0001$). Over this time span, children with ODD in Year 1 who met criteria for CD in at least one wave ($\beta = 2.07, z = 13.78, p < .0001$) and children with ODD in Year 1 who never met criteria for CD ($\beta = 1.32, z = 6.20, p < .0001$) exhibited more ODD symptoms than comparison children. Children with ODD in Year 1 who never met criteria for CD exhibited fewer ODD symptoms during Years 2–13 than children with ODD in Year 1 who ever met criteria for CD ($\beta = -0.74, z = -4.36, p < .0001$). Furthermore, when the Group × Year interaction was added to the model, it was significant ($\beta = -0.09, z = -4.32, p < .0001$), indicating that children with ODD in Year 1 who never met criteria for CD showed more rapid improvement over Years 2–13 in ODD symptoms than children with ODD in Year 1 who met criteria for CD at least once.

To assess the predictive validity of ODD in the subgroup that never met criteria for CD, analyses of three measures of functional impairment during Years 2–13 were conducted, controlling time, age in Year 1, family income in Year 1, race/ethnicity, site, cohort, and the diagnosis of ADHD and the number of CD symptoms in Year 1. Log-linear regression did not reveal a significant change in negative classmate social preferences ratings by teachers over Years 2–13 across groups. The upper right panel of Figure 6 shows that both children with ODD in Year 1 who never met criteria for CD ($\beta = 0.47, z = 1.96, p < .05$) and children with ODD in Year 1 who met criteria for CD at least once ($\beta = 0.79, z = 3.46, p < .0001$) exhibited more impairment over Years 2–13 than children in the comparison group. For parent ratings from the Child Behavior Checklist, analyses of three measures of impairment did not reveal significant changes over Years 2–13 across groups (upper middle panel). The remaining panels show differences in ratings of impairment by teachers, parents, and interviewers over time among the same three groups (Growing Up with ADHD Study; Lahey et al., 2007). ODD = oppositional defiant disorder; CD = conduct disorder.
.0005) were given more negative social preference scores than comparison children. The difference between these two ODD groups was not significant at \( p < .05 (\beta = -.032, z = -1.70, p = .09) \), and when the interaction with time was added to the model, there was not a significant difference in the rate of decline in negative social preference scores over years between the two ODD groups (\( \beta = 0.00, z = 0.07, p = .94 \)).

Linear regression revealed that parent CGAS ratings improved over years across groups (\( \beta = 0.62, z = 5.49, p < .0001 \)). The lower left panel of Figure 6 shows that both children with ODD in Year 1 who never met criteria for CD (\( \beta = -5.08, z = -2.11, p < .05 \)) and children with ODD in Year 1 who met criteria for CD at least once (\( \beta = -13.94, z = -5.29, p < .0001 \)) were given lower CGAS ratings by interviewers than comparison children in Years 2–13. Children with ODD in Year 1 who never met criteria for CD received higher CGAS ratings than children with ODD in Year 1 who did meet criteria for CD (\( \beta = 8.85, z = 3.18, p < .005 \)), but when the interaction with time was added to the model, there was not a significant difference in the rate of decline in CGAS improvement over years between the two ODD groups (\( \beta = 0.62, z = 1.56, p = .12 \)).

Linear regression also showed that interviewer CGAS ratings improved over years across groups (\( \beta = 0.85, z = 4.13, p < .0001 \)). The lower right panel of Figure 6 shows that children with ODD in Year 1 who met criteria for CD at least once (\( \beta = -14.15, z = -5.66, p < .0001 \)), but not children with ODD in Year 1 who never met criteria for CD (\( \beta = -3.94, z = -1.69, p = .09 \)), were given lower CGAS ratings by interviewers than comparison children. Children with ODD in Year 1 who never met criteria for CD received higher interviewer CGAS ratings during Years 2–13 than children with ODD in Year 1 who did meet criteria for CD (\( \beta = 10.21, z = 3.88, p < .0001 \)). Furthermore, when the interaction with time was added to the model, children with ODD in Year 1 who never met criteria for CD were found to exhibit more rapid increases in CGAS scores over time than children who met with ODD who met criteria for CD at least once (\( \beta = 0.70, z = 2.26, p < .05 \)).

**Outcomes of CD**

### Issue 3: Role of Psychopathylike Characteristics in the Predictive Validity of CD

Analyses of the DTS data were conducted to assess the role of IC in predicting APD using logistic regression models with APD as the outcome, clustered on participants to allow for all waves of predictors to be included in the model. When tested in separate models, both parent-reported (OR = 1.09, 95% CI = 1.03, 1.16, \( p = .004 \)) and teacher-reported (OR = 1.11, 95% CI = 1.06, 1.16, \( p < .001 \)) IC predicted APD, and both remained significant when tested simultaneously in a joint model with age as a covariate. Including the diagnosis of CD (OR = 2.12, 95% CI = 1.30, 3.47, \( p = .003 \)) in the model rendered parent-reported IC nonsignificant (OR = 1.03, 95% CI = 0.96, 1.11, \( p = .38 \)), whereas teacher-reported IC remained significant (OR = 1.08, 95% CI = 1.03, 1.14, \( p = .002 \)). When other measures of psychopathy were tested for entry into the model, only a diagnosis of ODD (OR = 1.71, 95% CI = 1.05, 2.79, \( p = .03 \)) entered the model. Testing for interactions found that the interaction between CD and IC was significant (OR = 0.86, 95% CI = .80, 93, \( p < .001 \)) and rendered ODD nonsignificant (see Table 2). The interaction term indicated that when CD was present, the level of concurrent IC made no difference for the probability of APD in adulthood, whereas when a diagnosis of CD was absent, increasing IC led to an increasing probability of APD (see Figure 7). IC scores approximately 1.5 standard deviations above the mean and greater were associated with a probability of APD that was equal to CD. In fact, four of the five young men who met criteria for APD without ever meeting criteria for CD had IC scores in at least one year that were equal to or greater than 1.5 standard deviations above the mean IC score.

**Discussion**

The present analyses provide strong support for many aspects of the DSM-IV developmental model of ODD, CD, and APD but reveal important taxonomic problems, particularly regarding the more comprehensive coverage of the ICD-10 versus the DSM-IV ODD and the role of callous interpersonal behavior in regards to CD.

### Hierarchical Developmental Relations Among ODD, CD, and APD

In order to evaluate the predictive validity of ODD, CD, and APD, it is necessary to know whether they are related to one another developmentally in the hierarchical manner described in the DSM-IV.

**Is ODD in early childhood a developmental precursor to CD?** The present findings suggest that ODD is a robust predictor of at least early-onset CD. In the longitudinal GUWAS sample, the diagnosis of ODD at 4–6 years of age predicted incident cases of CD over the next 12 years, controlling for both the diagnosis of ADHD and the number of subthreshold CD symptoms at 4–6 years of age. Indeed, among children who did not meet criteria for ODD at 4–6 years but later met criteria for CD, diagnostic criteria were first met for ODD in a preceding wave or in the same wave as criteria were first met for CD in 79% of cases. Thus, criteria for ODD were met before or at about the same time as CD in nearly all cases. These findings are important because the GUWAS began when participating children were young enough to capture most of the developmental transition from ODD to childhood-onset CD. Nonetheless, such developmental relations remain hidden from us for the children who already met criteria for CD at 4–6 years of age.

<table>
<thead>
<tr>
<th>Odds ratio</th>
<th>SE</th>
<th>( p )</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-rated IC</td>
<td>1.15</td>
<td>0.03</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>CD</td>
<td>2.37</td>
<td>0.57</td>
<td>&lt;.001</td>
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<tr>
<td>CD × IC interaction</td>
<td>0.86</td>
<td>0.03</td>
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<tr>
<td>ODD</td>
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<td>0.40</td>
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<tr>
<td>Age</td>
<td>1.06</td>
<td>0.03</td>
<td>.04</td>
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</table>

*Note. IC = interpersonal callousness; CD = conduct disorder; ODD = oppositional defiant disorder.*
The present analyses of the GUWAS data also confirm previous findings (Lahey et al., 1998, 2006) that ODD in early childhood particularly predicts early-onset CD. This is important because early-onset antisocial behavior is linked to even more serious maladaptive social and health functioning than later-onset antisocial behavior (Moffitt, 2006; Odgers et al., 2007). This means, however, that the GUWAS sample can shed little light on the role of ODD in late-onset CD. Other studies suggest that late-onset CD may not be related to ODD (Lahey et al., 1998, 2006), but far more evidence is needed on this issue from prospective studies. Nonetheless, the predictive association between ODD and CD confirms one aspect of the DSM–IV hierarchical developmental model of antisocial behavior and strongly supports previous evidence that childhood ODD is a valid mental disorder partly because it predicts the future incidence of at least childhood-onset CD.

Is ODD always concurrently present in children who meet criteria for CD? Analyses of GUWAS data indicated that the assumption of the DSM–IV that all children who meet criteria for CD also meet criteria for ODD at the same time is largely but not entirely correct during childhood, and is particularly at odds with the data during adolescence. The lower concurrent prevalence of ODD among adolescents with CD confirms one aspect of the DSM–IV hierarchical developmental model of antisocial behavior and strongly supports previous evidence that childhood ODD is a valid mental disorder partly because it predicts the future incidence of at least childhood-onset CD.

Figure 7. Interaction between conduct disorder and interpersonal callousness during adolescence in the prediction of antisocial personality disorder (APD) in adulthood in the Developmental Trends Study. The predicted probability for each observation is jittered in the figure to improve its visibility.

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with serious consequences that must be revisited by the DSM–V work groups and Task Force.

**Does CD predict APD?** The present analyses of the DTS elaborate on early assessments of the predictive association of childhood and adolescent CD with APD at ages 18 or 19 years (Lahey et al., 2005; Loeber et al., 2002). The present findings suggest that, when APD is defined as meeting diagnostic criteria for APD in at least two assessments over 18, 19, and 24 years, approximately one third of those with CD progress to APD. This is roughly consistent with the proportion of children who progress from ODD to CD in the DTS. For a small group, APD emerged in young adulthood without ever having met criteria for CD, although no youth in the DTS who met APD criteria in at least two assessments was completely absent of a history of CD symptoms. Recent evidence from a large population-based study are consistent, finding that CD measured in childhood or adolescence is the single strongest predictor of young adult APD among mental health disorders (Copeland, Shamahan, Costello, & Angold, 2009).

The present analyses of the DTS are the first to report on APD as an outcome of CD when APD was assessed repeatedly over a 6-year period. These results suggest on the whole that the hierarchical developmental model of ODD, CD, and APD assumed by the DSM–IV reflects the progression in antisocial behavior of some children. Two important caveats to this hierarchical model should be emphasized, however. First, the findings of the DTS are likely relevant only to early-onset CD and may not be relevant to later-onset CD. Second, it is clear that not all children with ODD will progress to CD and then to APD in young adulthood; indeed, the majority of children with ODD do not. Much remains to be learned from longitudinal studies about the development of disruptive and antisocial behavior, particularly using studies of population-based samples in addition to clinic samples.

**Predictive Validity of ODD Among Children Who Never Develop CD**

In the GUWAS sample, children who met diagnostic criteria for ODD in Year 1 (at 4–6 years of age) continued to exhibit substantial numbers of ODD symptoms and significant levels of functional impairment over many years, even though there was a general trend for symptoms and impairment to improve over the 12-year follow-up period. The long-term GUWAS longitudinal database affords a unique opportunity to determine whether ODD at 4–6 years exhibits predictive validity even in those children who never develop CD. Children with ODD in Year 1 who never met criteria for CD continued to exhibit atypical numbers of ODD symptoms for at least 6–7 years, even though they showed a more rapid decline in ODD symptoms than children diagnosed with ODD in Year 1 who did meet criteria for CD. Nonetheless, both ODD groups continued to exhibit substantial levels of functional impairment relative to comparison children over at least 6–7 years after the diagnosis. Thus, the diagnosis of ODD in young children has clear predictive validity both in the sense that ODD often precedes the more impairing disorder of CD and because even children with ODD who never meet criteria for CD continue to exhibit marked levels of functional impairment both at the time of diagnosis and for many years to come. It is encouraging that some children recover from early ODD, but they do so very gradually and continue to exhibit impairment over the long period in which they continue to exhibit symptoms.

**Does IC Improve the Prediction of APD Among Children With CD?**

Are children with CD who exhibit early psychopathylike characteristics more likely to meet diagnostic criteria for APD? In the DTS, teacher-reported IC from childhood through adolescence significantly predicted APD, along with CD and ODD diagnoses. As with the prediction of young adult psychopathy in the same sample (Burke et al., 2007), parent-reported IC was not significantly predictive after accounting for other covariates, notably CD, but teacher-reported IC was a significant independent predictor of future APD.

It is important to note that the significant interaction between IC and CD did not mean that children with CD who have higher levels of IC are at greater risk of developing APD. Rather, the significant interaction indicated that when CD was present, the level of IC made little difference in the probability of future APD. In contrast, when CD was absent, greater IC was associated with a greater risk for APD in young adulthood. The possibility that callous interpersonal traits should be used instead of age of onset as the basis for subtyping CD to reduce its heterogeneity is under consideration for the DSM–V. Our findings suggest that IC features do not improve the prediction of APD when CD is present, which does not support using IC as the basis for subtyping CD in the DSM–V to improve the prediction of APD.

The results of the present analyses are not all consistent with previous analyses from the DTS (Loeber et al., 2002), however, which found that callousness did distinguish those who went on to meet criteria for APD from those who did not over and above the presence of CD. Several key differences between the present analyses and the prior findings explain these differences. First and foremost, the previous analyses generated predictors by collapsing across all waves of predictors to conduct a simple logistic regression model. In contrast, the present analyses maintain all waves of data while accounting for clustering by participant, which allows for the evaluation of the relative strength of CD and callousness contemporaneously at each wave. The present analyses also included the additional assessment of APD at age 24, and required APD to be present over multiple assessments.

In addition, the prior analyses used an ad hoc measure of callousness rather than the somewhat more established construct used here. Thus, although the present findings do not support the option of using callousness to subtype CD, the overall evidence across studies with differing constructs and during differing developmental periods remains mixed.

**Limitations**

The longitudinal studies used in the present analyses have the advantage of covering large spans of development but were relatively small and not well powered statistically. Although a strong argument can be made for testing diagnostic criteria in the kinds of clinic samples for which the DSM–V is intended, these samples cannot be said to be representative of all clinic-referred children, but were selected to oversample children with ADHD (the GUWAS) or children with CD (the DTS). There are a few more
useful longitudinal studies of clinic samples that used DSM–IV criteria, but these limitations must be acknowledged. Furthermore, the fact that the DTS included only boys and the GUWAS included only a minority of girls is an important limitation of the present analyses. Fortunately, longitudinal studies of disruptive behavior disorders in girls are now available to test the generality of the present findings (e.g., Loebner, Hipwell, Battista, Sembower, & Stouthamer-Loebner, 2009; Odgers et al., 2008).

References


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