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Early-onset Conduct Problems: Predictions from daring temperament and risk taking behavior

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Abstract

Objective—Given its considerable public health significance, identifying predictors of early expressions of conduct problems is a priority. We examined the predictive validity of daring, a key dimension of temperament, and the Balloon Analog Risk Task (BART), a laboratory-based measure of risk taking behavior, with respect to two-year change in parent, teacher-, and youth self-reported oppositional defiant disorder (ODD), conduct disorder (CD), and antisocial behavior.

Method—At baseline, 150 ethnically diverse 6- to 10-year old ($M=7.8$, $SD=1.1$; 69.3% male) youth with ($n=82$) and without ($n=68$) DSM-IV ADHD completed the BART whereas parents rated youth temperament (i.e., daring); parents and teachers also independently rated youth ODD and CD symptoms. Approximately 2 years later, multi-informant ratings of youth ODD, CD, and antisocial behavior were gathered from rating scales and interviews.

Results—Whereas risk taking on the BART was unrelated to conduct problems, individual differences in daring prospectively predicted multi-informant rated conduct problems, independent of baseline risk taking, conduct problems, and ADHD diagnostic status.

Conclusion—Early differences in the propensity to show positive socio-emotional responses to risky or novel experiences uniquely predicted escalating conduct problems in childhood, even with control of other potent clinical correlates. We consider the role of temperament in the origins and development of significant conduct problems from childhood to adolescence, including possible explanatory mechanisms underlying these predictions.

Keywords

risk taking; daring; temperament; early-onset conduct problems; oppositional defiant disorder; conduct disorder

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Compliance with Ethical Standards

Conflict of interest

Sunhye Bai and Steve Lee declare that they have no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Childhood conduct problems prospectively predict diverse negative adolescent and adult outcomes including elevated criminal activity, substance problems, suicidal ideation/ attempts, as well as risky health behaviors (Miller, Malone, & Dodge, 2010; Odgers et al., 2008). For example, oppositional defiant disorder (ODD) and conduct disorder (CD) each predict the development of young adult antisocial personality disorder (Burke, Waldman, & Lahey, 2010; Lahey, Loeber, Burke, & Applegate, 2005). In particular, early-onset conduct problems (i.e., prior to age 10) are highly stable and intractable to intervention (American Psychiatric Association, 2013; Barker & Maughan, 2009; Odgers et al., 2008). Given their prediction of clinically significant outcomes and sensitivity to unique causal risk factors relative to later-onset conduct problems (Frick & Dickens, 2006), identifying precursors of early-onset conduct problems is a priority. Crucially, risk factors for conduct problems represent logical targets for intervention and prevention.

There is substantial evidence that early-onset conduct problems are particularly sensitive to individual differences in temperament relative to later-onset conduct problems (Harden, Quinn, & Tucker-Drob, 2012; Loeber, Burke, Lahey, Winters, & Zera, 2000). The developmental propensity model suggests that three independent dimensions of temperament – daring, negative emotionality, and prosociality – underlie conduct problems (Lahey & Waldman, 2003). The current study tested the unique contribution and validity of daring, relative to an in vivo measure of risk taking behavior, in the prediction of early-onset conduct problems.

Defined as a tendency to have positive socio-emotional responses to risky or novel experiences, *daring* disposition is an early indicator of enduring traits such as sensation seeking, novelty seeking, and behavioral disinhibition (Lahey & Waldman, 2003; Russo et al., 1993). Childhood daring positively predicted ODD/CD symptoms and substance problems whereas it inversely predicted anxiety disorder symptoms, independent of negative emotionality and prosociality (Castellanos-Ryan, Rubia, & Conrod, 2011; Hampson, Andrews, & Barckley, 2008; Lahey et al., 2008). Moreover, among adults, analogous traits such as sensation seeking and novelty seeking moderated the efficacy of treatment for substance use such that higher sensation seeking predicted worse response to intervention (Feldstein Ewing, LaChance, Bryan, & Hutchison, 2009). *Risk taking*, which describes behaviors that bring about immediate reward, despite their potential for undesirable outcomes, is related to but separable from daring (Boyer, 2006; Lejuez et al., 2002; Romer, 2010). Risk taking behavior in the laboratory was positively associated with ADHD symptoms in children (Drechsler, Rizzo, & Steinhausen, 2008), as well as real-world risk taking (e.g., substance use) in adolescents (Lejuez et al., 2002). Likewise, youth with more externalizing symptoms (i.e., conduct disorder and ADHD) showed more risk taking in laboratory tasks (Daugherty & Quay, 1991; Humphreys & Lee, 2011). Although daring and risk taking behavior are associated with conduct problems, it is unclear if they each independently predict prospective change in early-onset conduct problems. This study evaluated the incremental and predictive validity of individual differences in daring temperament and risk taking behavior in childhood with respect to two-year growth in early-onset conduct problems. Although trait daring in children was operationalized recently (Lahey & Waldman 2003), our hypotheses were informed by earlier studies on sensation seeking.

Risk taking behavior and sensation seeking are only modestly and positively correlated, especially among adolescents and young adults (Lauriola, Panno, Levin, & Lejuez, 2014). Whereas sensation seeking or daring reflects an enduring and pervasive macro-level disposition, in vivo risk taking may reflect situationally specific micro-level behaviors (Lahey & Waldman, 2003; Russo et al., 1993; Sharma, Markon & Clark, 2014). Laboratory paradigms, such as the Balloon Analogue Risk Task (BART), are sensitive to individual differences in reward sensitivity/punishment and cognitive ability (Dean, Sugar, Hellemann, & London, 2011; Humphreys & Lee, 2011; Humphreys, Lee, & Tottenham, 2013), whereas daring (a parent-report measure) reflects an emotion-laden disposition (Sharma et al., 2014). Although sensation seeking and real-life risk taking increase synchronously from childhood to adolescence (Steinberg et al., 2008), and both are associated with conduct problems, it is unclear if trait daring and risk taking behavior uniquely predict conduct problems. Their simultaneous evaluation will conservatively test their validity and potentially inform if they constitute separate targets for intervention.

Individual differences in daring and related traits are typically assessed through rating scales and interviews with youth and parents. However, laboratory paradigms are essential because they minimize respondent bias and estimate situationally specific behaviors (Frick & Loney, 2000), such as covert antisocial behavior (i.e., stealing) (Hinshaw, Simmel, & Heller, 1995) and impulsivity (Dougherty et al., 2003). In vivo behavioral assessment also uniquely predicted delinquency, over and above baseline ADHD, aggression and peer status (Lee & Hinshaw, 2004). Moreover, rating scales often include items/language that explicitly overlap with symptoms of psychopathology, thus inflating their putative association (Martel, 2009). The Child and Adolescent Disposition Scale (CADS) was designed to specifically assesses daring, negative emotionality and prosociality having conservatively excluded items that are clear synonyms or antonyms of mental disorder symptoms (Lahey & Waldman, 2003; Lahey et al., 2008). Although daring from the CADS was cross-sectionally associated with CD in 6 to 17 year-old youth (Lahey et al., 2008; Lahey, Rathouz, Applegate, Tackett, & Waldman, 2010; Taylor, Allan, Mikolajewski, & Hart, 2013; Waldman et al., 2011), construct validity requires accounting for other risk factors (e.g., childhood ADHD; Waschbusch, 2002). In particular, the association of early individual differences in daring specifically with respect to early-onset conduct problems, a key consideration given their unique risk factors (e.g., heritability; Moffitt, 2006), constitutes a strong test of its predictive validity. Thus, prospective studies of daring must carefully attend to these methodological and developmental considerations.

The Balloon-Analogue Risk Task (BART) is a laboratory-based decision-making task that yields individual differences in youth risk taking behavior and sensitivity to reward and punishment (Humphreys & Lee, 2011; Lejuez et al., 2007). Participants successively pump up thirty balloons to earn points, and each balloon explodes at a variable number of pumps, wherein all points are lost when a balloon explodes. The average number of pumps across unexploded balloons estimates risk taking behavior (Lejuez et al., 2007). Although the BART is positively correlated with real life risky health behaviors (e.g., substance use) (Lejuez et al., 2007; Lejuez, Aklin, Zvolensky, & Pedulla, 2003; MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2010), few studies have tested the predictive validity of the BART with respect to youth conduct problems (Centifanti & Modecki, 2013; Crowley,

Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006). Humphreys and Lee (2011) reported that children with comorbid ADHD and ODD exhibited more risk taking on the BART relative youth with ADHD only and non-disordered comparison youth. The current study is well-positioned to test prospective association between BART and early-onset conduct problems, with control of daring, ADHD, and baseline conduct problems. With evidence of incremental predictions, intervention-induced reductions in risk taking behavior may decrease the burden associated with significant child conduct problems.

Using an ethnically diverse sample of 150 children with ($n=82$) and without ($n=68$) ADHD followed prospectively for two years, we collected multi-method (i.e., laboratory analogue, rating scales) and multi-informant (i.e., parent, youth, teacher) measures of conduct problems (i.e., antisocial behavior, ODD and CD symptoms). Specifically, we examined daring and risk taking behavior on the BART as independent predictors of two-year change in separate youth-, parent- and teacher-rated conduct problems. We hypothesized that baseline daring and risk taking would each uniquely predict growth in multi-dimensional measures of conduct problems, independent of initial childhood ADHD status and conduct problems.

Method

Participants

Participants were 150 6 to 10 year-old ($M=7.8$, $SD=1.1$) youths (69.3% male) with ($n=82$) and without ($n=68$) DSM-IV ADHD, at baseline (i.e., Wave 1); they were 7 to 13 years old ($M=9.6$, $SD=1.3$) when they completed their follow-up assessment two years later (i.e., Wave 2). The sample was ethnically diverse: 49.3% were Caucasian, 22.0% bi-racial, 10.0% Hispanic, 4.7% African-American, 2.7% Asian, and 2.7% other. Participants were recruited from a large metropolitan city in the Western United States through advertisements at local elementary schools, mailings to pediatric clinics, presentations to self-help groups, and referrals from local health care providers. We oversampled young children with ADHD given its central role in accelerating early-onset conduct problems (Hinshaw, Lahey & Hart, 1993). ADHD diagnostic procedures are described in greater detail elsewhere (Shemmassian & Lee, 2015).

Eligible youth were required to live with at least one biological parent at least half the time, have a Full Scale IQ of at least 70 ($M=107.2$, $SD=15.4$), and English fluency. To enhance generalizability, ADHD probands were allowed to be diagnosed with other common comorbid conditions (e.g., anxiety, ODD); however, exclusionary criteria for all participants consisted of an autism spectrum, seizure, or other neurological disorder, or any other medical condition that would prevent their full participation in the study. ADHD probands and non-ADHD comparison youths were comparable with respect to age, sex, and race-ethnicity (see Table 1).

Procedures

Wave 1—Interested participants were initially assessed through a telephone screener. Eligible families were mailed rating scales and invited to the research laboratory for in-

person assessments. After obtaining parent consent and youth assent, parents completed a structured diagnostic interview and rating scales about child psychopathology and family functioning whereas youths completed standardized tests of academic achievement, computer-based behavioral tasks, and self-report measures of socio-emotional functioning. Each child's primary teacher was mailed parallel rating scales of child behavior to complete. If a youth was typically medicated, we asked parents and teachers to complete rating scales and interviews based on the child's unmedicated behavior.

Wave 2—Approximately two years after their Wave 1 assessment, families were contacted to participate in a laboratory-based follow-up assessment. Wave 2 assessment procedures were very similar to Wave 1 and focused on child psychopathology, parenting, and family functioning (e.g., structured diagnostic interviews and rating scales). As with Wave 1, each child's primary teacher at Wave 2 was mailed parallel rating scales of child behavior. We examined whether retention, conservatively defined as the proportion of youth with *complete* Wave 2 data for the current study differed from the original Wave 1 participants. 74.3% of the overall sample in Wave 1 had complete data in Wave 2 and there were no significant differences with respect to age ($t(77.4)=0.97, p=.33$), sex ($\chi^2(1)=0.45, p=.50$), race-ethnicity ($\chi^2(1)=1.39, p=.24$), as well as the number of Wave 1 parent- and teacher-rated ODD and CD symptoms ($t(69.4)=-1.16, p=.25$ and $t(88.0)=-1.50, p=.21$, respectively), between those who did and did not participate in the follow-up assessment. However, relative to non-ADHD comparison youth, Wave 1 ADHD probands were more likely to have complete data at Wave 2 ($\chi^2(1)=4.61, p=0.03$). The Institutional Review Board (IRB) approved all study procedures at Waves 1 and 2.

Measures

Balloon Analogue Risk Task (BART; Lejuez et al., 2002, 2007)—At Wave 1, youth completed the BART, a computer-administered analogue of risk taking behavior in the laboratory. Each child was presented a series of 30 balloons (i.e., trials) and instructed that balloon pumps would earn points that could be used to obtain small prizes and toys. However, the balloons exploded at an unknown and variable number of pumps. If a balloon exploded, all the points the participant accumulated for that particular trial were lost. Alternatively, the participant could stop pumping at any point during a trial, “save” the points accrued, and advance to the next trial. Initially, children clicked a mouse for each pump but eventually this was replaced wherein each child could conveniently type the exact number of pumps desired. Because the number of pumps was constrained by the number of balloons that exploded across the 30 trials, we used the average number of pumps across the balloons that did not explode (“average adjusted pumps”) (Lejuez et al., 2002, 2007). The BART is a well-validated measure with high internal consistency and external validity in relation to real life risky behaviors (e.g., substance use) (Lejuez et al., 2002, 2007), and ADHD and ODD (Humphreys & Lee, 2011).

Child and Adolescent Disposition Scale (CADS) – Daring Dimension (Lahey et al., 2008)—The CADS is a 29-item parent interview of individual differences in three facets of youth disposition: daring, negative emotionality, and prosociality. The CADS was explicitly designed to rigorously and conservatively measure temperament for use in studies

of psychopathology. This interview was administered at Wave 1 to parents, who rated their children from 1 (*not at all*) to 4 (*very much*) in response to each question. We used the daring subscale consisting of 5 items: is he/she brave; is he/she daring and adventurous; does he/she like doing things that are risky and dangerous; does he/she like rough games and sports; does he/she like things that are exciting and loud. Ratings were summed, and scale scores ranged from 5 to 20. The CADS is psychometrically sound, including high test-retest reliability and external validity in relation to multiple dimensions of psychopathology (Lahey et al., 2008). In the current study, daring had a Cronbach's alpha of .79.

Self-Reported Antisocial Behavior (SRA; Loeber, Stouthamer-Loeber, Kammen, & Farrington, 1989)—At Wave 2, we administered the SRA, a developmentally sensitive 32-item interview of youth antisocial behavior. Items differentially reflected aggression (e.g., “hit, slapped, or shoved one of your parents”), covert behaviors (e.g., “stolen or tried to steal a bicycle or skateboard”), delinquency (e.g., “skipped school without an excuse”), and substance use (e.g., “drunk any beer”). Responses ranged from 0 (*never*) to 3 (*more often*) and a total sum was calculated; however, 3 items (i.e., use of glue, tobacco and marijuana) were excluded because they were not endorsed in the entire sample ($range=0$ to 87). The SRA demonstrated concurrent and predictive validity with respect to official records of arrests and convictions (Farrington, Loeber, Stouthamer-Loeber, & Van Kammen, 1996; Loeber et al., 1989). The internal consistency was satisfactory at .73.

Disruptive Behavior Disorder Rating Scale (DBD; Pelham, Gnagy, Greenslade, & Milich, 1992)—Parents and teachers completed identical versions of the DBD at Wave 1 and at Wave 2. Items directly assessed DSM-IV symptoms of ADHD, ODD, and CD and were rated on a scale ranging from 0 (*not at all*) to 3 (*very much*). At each wave, for each reporter, we separately summed and analyzed scores based on the 8 ODD and 15 CD symptoms in DSM-IV, resulting in four different outcome variables across two independent reporters. The ranges of scores were 0 to 24 for ODD and 0 to 45 for CD. The DBD shows strong psychometric properties, including high internal consistency and positive predictive power, especially for ODD (Pelham et al., 1992). At Wave 2, Cronbach's alphas for ODD and CD were .83 and .54 according to parent ratings and .88 and .92 according to teacher ratings, respectively.

Data Analysis

To review, we simultaneously evaluated the predictive validity of individual differences in risk taking behavior (i.e., BART) versus daring (i.e., CADS) with respect to youth-, parent-, and teacher-rated conduct problems from a two-year prospective follow-up. Wave 2 outcomes consisted of five separate measures: youth self-reported antisocial behavior, parent-rated ODD and CD symptoms from the DBD; and teacher-rated ODD and CD symptoms from the DBD. With respect to covariates, we controlled for child sex (female=0, male=1) and age. Also, given its association with risk taking behavior, daring and conduct problems (Humphreys & Lee, 2011; Mannuzza, Klein, Abikoff, & Iii, 2004), and to improve the specificity of observed associations, we controlled for baseline DSM-IV ADHD diagnostic status (i.e., non-ADHD comparison=0, ADHD=1), which was assessed through

Diagnostic Interview Schedule for Children – Fourth Edition (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), a computer-administered structured diagnostic parent interview. Finally, we controlled for Wave 1 levels of Wave 2 outcomes (e.g., controlled for Wave 1 ODD in predictions of Wave 2 ODD). However, in predictions of Wave 2 youth self-reported antisocial behavior, we controlled for Wave 1 CD symptoms from the DBD given that youth self-reported antisocial behavior was not obtained at Wave 1. Age, risk taking behavior (i.e., average adjusted pumps on BART), and daring were mean-centered. Analyses consisted of negative binomial or Poisson regression to account for non-normality and over-dispersed outcomes. We also present incidence rate ratios (i.e., ratio of the rate of symptom increase), which were derived by exponentiating the unstandardized coefficients, to describe the unique association of Wave 1 daring and risk taking behavior with each Wave 2 conduct problem outcome, independent of baseline conduct problems, ADHD diagnostic status, as well as age and sex. All analyses were completed in Stata version 13.1.

Of the 150 children with parent-reported data, 50 and 80 children were missing Wave 1 and Wave 2 teacher ratings, respectively. However, children with missing Wave 1 or Wave 2 teacher DBD data did not differ significantly from those with available data with respect to age ($t(96.6)=1.15, p=.25$), sex ($\chi^2(1)=2.15, p=.14$), race-ethnicity ($\chi^2(1)=1.83, p=.18$), ADHD status ($\chi^2(1)=0.43, p=.51$), or Wave 2 parent-report of ODD ($t(94.7)=0.41, p=.68$), or CD ($t(77.5)=1.22, p=.22$) symptoms. We implemented multiple imputation procedures for missing Wave 1 teacher DBD data using ten iterations of Markov Chain Monte Carlo in SAS PROC MI (White, Royston & Wood, 2011; Shemmassian & Lee, 2015). Imputed scores were summed to obtain subscale scores, averaged across the 10 iterations, and used in the subsequent imputation of missing Wave 2 teacher DBD data. For missing Wave 2 teacher ratings of ODD and CD symptoms, we utilized multiple imputation once again using ten sequential iterations based on chained poisson regression equations. Wave 1 daring, risk taking behavior, child age, sex, ADHD status, and parent and teacher ratings of ODD and CD symptoms from the DBD, as well as Wave 2 parent ratings of ADHD, ODD and CD symptoms were included as predictors in the imputation of missing Wave 2 teacher DBD data.

Results

Table 2 displays the zero-order correlation matrix for Wave 1 risk taking behavior and daring, Wave 1 and Wave 2 parent- and teacher-rated ODD and CD symptoms, and Wave 2 youth self-reported antisocial behaviors. Wave 1 risk taking behavior (BART) and daring (CADS) were not significantly correlated, suggesting their separability. Wave 1 risk taking behavior from the BART was modestly correlated with parent-rated Wave 2 ODD symptoms from the DBD ($r=.21$) and Wave 2 youth self-reported antisocial behavior ($r=.20$). Daring was concurrently and prospectively correlated with ODD and CD symptoms across multiple measures, with correlation coefficients ranging from .21 to .32. Finally, as expected, there was significant continuity in the parent ratings of ODD and CD symptoms across the two time points and across measures. However, teacher ratings of youth behaviors were less consistent across the two-year follow-up, partially reflecting that different teachers participated at each assessment.

Predictions of Wave 2 Youth Self-reported Antisocial Behavior (SRA)

To review, we tested the incremental contribution of individual differences in Wave 1 risk taking behavior (i.e., BART) and daring (i.e., CADS) with respect to separate youth self-, parent- and teacher-rated conduct problems gathered two years later (i.e., Wave 2). Controlling for age, sex, as well as Wave 1 conduct problems and ADHD diagnostic status, Wave 1 daring positively predicted Wave 2 youth self-reported antisocial behavior ($IRR=1.10$, $SE=.03$, $z=3.15$, $p=.001$, $95\% CI[1.04, 1.17]$) whereas Wave 1 risk taking behavior did so only marginally ($IRR=1.01$, $SE=.01$, $z=1.75$, $p=.096$, $95\% CI[1.00, 1.02]$). That is, Wave 2 antisocial behavior increased by 10% with one unit increase in Wave 1 daring, whereas it increased only 1% for a one unit increase in Wave 1 risk taking behavior.

Predictions of Wave 2 Parent-Rated ODD and CD Symptoms

Next, we similarly tested Wave 1 daring and risk taking behavior as prospective predictors of parent-rated Wave 2 ODD and CD symptoms, once again controlling for age, sex, as well as Wave 1 ADHD status and Wave 1 ODD/CD. As summarized in Table 3, daring positively predicted Wave 2 parent-rated ODD symptoms on the DBD ($IRR=1.04$, $p=.007$) whereas Wave 1 risk taking behavior did not ($IRR=1.00$, $p=.366$). Neither Wave 1 daring nor Wave 1 risk taking behavior significantly predicted parent-rated CD symptoms ($IRR=1.05$, $p=.152$; $IRR=1.00$, $p=.809$, respectively).

Teacher Ratings of ODD and CD Symptoms

Using the same data analytic models described above, we examined predictors of Wave 2 teacher-rated ODD and CD symptoms, as described in Table 3. Wave 1 daring significantly predicted the number of Wave 2 teacher-rated ODD and CD symptoms ($IRR=1.07$, $p=.002$ and $IRR=1.13$, $p=.040$, respectively) whereas Wave 1 risk taking behavior did not ($IRR=1.00$, $p=.676$ and $IRR=1.00$, $p=.774$, respectively). That is, Wave 1 daring predicted growth in teacher-rated ODD and CD symptoms, even with control of Wave 1 risk taking behavior and other critical demographic and clinical correlates.

Discussion

There is replicated evidence that daring and risk taking are associated with conduct problems and antisocial behavior, but few studies have evaluated their unique or incremental prediction with respect to early-onset conduct problems. This is particularly relevant given that early-onset conduct problems are etiologically distinct, including in its neuropsychological correlates and genetic influences, relative to later-onset conduct problems (McCabe, Hough, Wood & Yeh, 2001). Using data from a two-year prospective follow-up study of 150 school-age children (ages 6 to 10) with and without ADHD, we simultaneously evaluated daring and risk taking behavior as independent predictors of separate youth-, parent- and teacher-rated conduct problems (i.e., ODD, CD, antisocial behavior). Even with control of Wave 1 risk taking, baseline conduct problems, ADHD diagnostic status, as well as other key demographic covariates, individual differences in Wave 1 daring consistently predicted two-year growth in multi-informant rated conduct problems. Specifically, Wave 1 daring positively predicted youth self-reported antisocial behavior, parent- and teacher-rated ODD symptoms, as well as teacher-rated CD symptoms

at Wave 2. Alternatively, Wave 1 risk taking behavior from the BART did not significantly increment predictions of parent and teacher reports of ODD and CD symptoms, beyond daring and other baseline covariates. These preliminary findings suggest that individual differences in daring, even relatively early in development, predicted escalations in different forms of conduct problems, across multiple informants, controlling for performance on an in vivo assessment of risk taking behavior and other correlates of conduct problems.

Consistent with extant research, daring prospectively predicted two-year growth in parent-, youth-, and teacher-rated conduct problems, with control of baseline ADHD diagnostic status, risk taking behavior, and initial conduct problems. Although daring and related traits (e.g., sensation seeking, novelty seeking, behavioral disinhibition) were cross-sectionally associated with conduct problems (Lahey et al., 2008, 2010; Taylor et al., 2013; Waldman et al., 2011), few studies have examined their predictive validity in early childhood. The current study found that daring uniquely predicted early expressions of conduct problems, consistent with a previous finding where daring in middle childhood predicted adolescent antisocial behavior, over and above baseline externalizing problems, in boys from low income families (Trentacosta, Hyde, Shaw, & Cheong, 2009). Although previous evidence is based mostly on adolescence, when conduct problems and real-world risk taking are most prevalent (Steinberg et al., 2008), identification of antecedents to early-onset conduct problems is a priority because these youth are often treatment resistant, account for the vast majority of violent crime, and show persistent impairment into adulthood (Barker & Maughan, 2009; Odgers et al., 2008). Upon further replication and extension, a disposition of daring early in development may usefully identify children at risk for emergent conduct problems. To further improve the specificity of intervention targets, future research must rigorously assess the additive and multiplicative influences of other child traits, including prosociality and negative emotionality (Lahey & Waldman, 2003). Moreover, identifying moderators and mediating pathways underlying predictions of escalating conduct problems from early temperament should be prioritized. For example, elevated daring was more strongly predictive of antisocial behavior in adolescents who lived in dangerous neighborhoods than those who lived in safer communities (Trentacosta et al., 2009). Developing interactive models of risk and resilience, as well as their underlying causal mechanisms, will improve the specificity of existing prevention and intervention efforts.

Unlike previous studies, individual differences in childhood risk taking behavior from the BART was unrelated to change in conduct problem across two years, over and above daring, baseline symptoms and ADHD diagnostic status. Whereas risk taking from the BART predict ecologically valid criteria (e.g., substance use, risky behavior) (Lejuez et al., 2007; MacPherson et al., 2010), its association with child psychopathology is not well known. A previous cross-sectional study found that youth with ODD or comorbid ODD and ADHD exhibited more risk taking (i.e., more pumps on the BART) than ADHD only or non-disordered comparison youth (Humphreys & Lee, 2011). Likewise, a clinical sample of adolescents with conduct and substance problems displayed more risk taking behaviors on the BART than non-disordered youth (Crowley et al., 2006). Consistent with these past findings, we observed significant bivariate correlations between risk taking behaviors at Wave 1, parent ratings of ODD symptoms at Wave 1, and parent reported ODD symptoms and youth self-reported antisocial behaviors at Wave 2. However, risk taking on the BART

was uncorrelated with daring in this sample despite past evidence of a modest correlation that increases with age (Collado, Felton, MacPherson, & Lejuez, 2014; Lauriola et al., 2014).

As an assessment tool, the BART is very distinct from the CADS. Whereas CADS assesses a broad range of behaviors through parent interview, the BART is a laboratory task designed to elicit specific behaviors. A risk taking measure that parallels the CADS in format and breadth may have offered a more analogous comparison between the two constructs in question. Furthermore, BART does not singularly reflect risk taking. The total or average number of pumps (traditional measure of risk taking) shows a quadratic association with the amount of rewards earned, such that both low and high number of pumps are associated with fewer rewards earned (Ashenhurs, Jentsch & Ray, 2011; Humphreys et al., 2013). Likewise, among adults, average number of pumps is positively correlated with IQ and age, and together, past research suggests that BART is sensitive to learning (Ashenhurst et al., 2011; Dean et al., 2011; Humphreys et al., 2013). Trial-by-trial examinations suggest that performance on BART depends on learning and sensitivity to reward and punishment. Thus, future studies should elucidate explanatory mechanisms that may underlie the relationship between daring, risk taking behavior and emergent conduct problems. Trajectories of risk taking behavior across trials or sensitivity to punishment or rewards during the computer task may demonstrate stronger predictive validity for conduct problems than aggregate risk taking, and more accurately represent possible behavioral or cognitive mediators that explain the prospective association between daring temperament and conduct problems.

We emphasize several limitations to the current study. Daring was assessed by parent interview only, and the majority of the parents were mothers. Thus, the association between daring and symptom severity may be inflated by shared method variance. Multiple informant ratings of child daring, including youth self-reports and father reports will provide a more objective rating of child disposition. Second, although participants were recruited from multiple sources, thus minimizing biases associated with clinic-referred samples (Goodman et al., 1997), the sample is neither epidemiological nor population-based. Future studies should examine how the prospective associations between daring and risk taking behavior and conduct problems differ by child sex and other demographic variables, in larger, epidemiological or population-based samples to better account for known demographic differences in conduct problems (Maughan, Rowe, Messer, Goodman & Meltzer, 2004) and to improve external validity.

We found that individual differences in daring in early childhood uniquely and prospectively predicts increases in youth self-, parent- and teacher- rated conduct problems above and beyond risk taking behavior, ADHD status and baseline symptom levels. Early expression of the dispositional trait of daring may prove critical to early intervention and prevention efforts related to early-onset conduct problems. This is particularly important, given the poor prognosis and treatment resistance associated with early expressions of conduct problems. Future research should examine mediating mechanisms that underlie the prospective associations between child traits and early onset conduct problems, such as sensitivity to reward and punishment, and peer affiliations, as well as the moderating effects of family,

school and neighborhood climates, to more precisely identify intervention targets to improve treatment.

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Table 1

Descriptive statistics of demographics, predictors, and symptoms of conduct problems at Wave 1 and Wave 2

| | ADHD N=82 M (SD) | Non-ADHD N=68 M (SD) | Total N=150 M (SD) | t/X² |
|--------------------------|---------------------------------|-------------------------------------|-----------------------------------|------------------------|
| <i>Demographics</i> | | | | |
| Age at baseline | 7.77 (1.15) | 7.86 (1.09) | 7.82 (1.12) | 0.41 |
| Age at follow up | 9.52 (1.27) | 9.60 (1.24) | 9.56 (1.25) | 0.35 |
| % Male | 76.83 | 60.29 | 69.33 | 4.78* |
| % Caucasian | 48.65 | 51.35 | 49.33 | 0.65 |
| Full Scale IQ | 103.82 (13.48) | 111.22 (16.36) | 107.18 (15.26) | 2.96** |
| <i>Wave 1 Predictors</i> | | | | |
| BART Avg. Adj. Pumps | 28.68 (14.96) | 26.35 (15.12) | 27.62 (15.03) | -0.94 |
| CADS Daring | 13.16 (3.63) | 12.66 (2.90) | 12.93 (3.32) | -0.91 |
| <i>Wave 1 Symptoms</i> | | | | |
| ODD-parent report | 8.01 (4.43) | 4.16 (3.79) | 6.27 (4.56) | -5.61*** |
| CD-parent report | 2.30 (2.58) | 0.85 (1.31) | 1.64 (2.21) | -4.17*** |
| <i>Wave 2 Symptoms</i> | | | | |
| ODD-parent report | 6.30 (4.21) | 3.01 (2.84) | 4.81 (4.00) | -5.47*** |
| CD-parent report | 1.22 (1.63) | 0.43 (0.83) | 0.86 (1.38) | -3.64*** |
| Youth SRA ^a | 5.03 (5.41) | 4.82 (5.04) | 4.94 (5.22) | -0.21 |

†
p < 0.10,*
p < 0.05,**
p < 0.01,***
p < 0.001^aYouth SRA was completed by 110 participants

ADHD=Attention-Deficit/Hyperactivity Disorder; ODD=Oppositional Defiant Disorder; CD=Conduct Disorder; SRA=Self-reported Antisocial Behavior.

Zero-order correlations between Wave 1 predictors, and conduct problem symptoms at Wave 1 and Wave 2

Table 2

| | M (SD) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------------------|---------------|-------|--------|--------|--------|--------|------|--------|-----|-------|-----|
| <i>Wave 1 Predictors</i> | | | | | | | | | | | |
| 1 BART Avg. Adj. Pumps | 27.49 (15.00) | | | | | | | | | | |
| 2 CADS Daring | 12.97 (3.35) | .12 | | | | | | | | | |
| <i>Wave 1 Symptoms</i> | | | | | | | | | | | |
| 3 ODD - parent report | 6.23 (4.55) | .26** | .24** | | | | | | | | |
| 4 CD - parent report | 1.62 (2.21) | .06 | .30*** | .65*** | | | | | | | |
| 5 ODD - teacher report | 3.94 (5.83) | .15 | .23* | .18† | .26** | | | | | | |
| 6 CD - teacher report | 1.20 (2.40) | .17† | .21* | .17† | .28* | .78*** | | | | | |
| <i>Wave 2 Symptoms</i> | | | | | | | | | | | |
| 7 ODD - parent report | 4.71 (3.88) | .21* | .32*** | .60*** | .33*** | .05 | .09 | | | | |
| 8 CD - parent report | 0.83 (1.36) | .03 | .25** | .36*** | .46*** | .03 | .09 | .61*** | | | |
| 9 ODD - teacher report | 2.86 (3.32) | .11 | .30* | .19 | -.04 | .20 | .31* | .20 | .05 | | |
| 10 CD - teacher report | 0.55 (1.08) | .05 | .24* | .14 | .11 | .12 | .11 | .12 | .17 | .33** | |
| 11 Youth SRA | 4.95 (5.20) | .20* | .30** | .24* | .02 | .23* | .11 | .29** | .06 | .38** | .02 |

† p < 0.10,

* p < 0.05,

** p < 0.01,

*** p < 0.001

ODD=Oppositional Defiant Disorder; CD=Conduct Disorder; SRA= Self-reported Antisocial Behavior.

Summary of regression analyses of Wave 1 daring and risk taking behavior predicting parents and teachers' reports of ODD and CD symptoms at Wave 2

Table 3

| Predictor | Parent reported symptoms ^a | | | | Teacher reported symptoms ^b | | | | |
|------------------------|---------------------------------------|-----|-------|-------|--|-----|-------|------|--------------|
| | IRR | SE | z | p | IRR | SE | t | p | 95% CI |
| ODD symptoms | | | | | | | | | |
| BART Avg. Adj. Pumps | 1.00 | .00 | 0.90 | .366 | 1.00 | .01 | 0.43 | .676 | [0.99, 1.02] |
| CADS Daring | 1.04 | .02 | 2.69 | .007 | 1.07 | .02 | 3.35 | .002 | [1.03, 1.12] |
| Wave 1 symptoms | 1.08 | .01 | 5.64 | <.001 | 1.04 | .02 | 2.37 | .034 | [1.00, 1.08] |
| ADHD (yes=1; no=0) | 1.47 | .18 | -0.74 | .002 | 0.63 | .15 | -3.56 | .001 | [0.49, 0.82] |
| Age | 0.96 | .05 | 0.16 | .458 | 1.19 | .28 | 1.35 | .202 | [0.90, 1.58] |
| Sex (male=1; female=0) | 1.02 | .12 | 3.14 | .872 | 1.50 | .08 | 2.19 | .038 | [1.02, 2.19] |
| Intercept | 2.08 | .28 | 5.33 | <.001 | 2.04 | .40 | 3.59 | .002 | [1.35, 3.08] |
| CD symptoms | | | | | | | | | |
| BART Avg. Adj. Pumps | 1.00 | .01 | 0.24 | .809 | 1.00 | .02 | -0.29 | .774 | [0.96, 1.03] |
| CADS Daring | 1.05 | .04 | 1.43 | .152 | 1.13 | .06 | 2.19 | .040 | [1.01, 1.26] |
| Wave 1 symptoms | 1.24 | .07 | 3.87 | <.001 | 0.99 | .07 | -0.14 | .890 | [0.84, 1.16] |
| ADHD (yes=1; no=0) | 1.88 | .50 | 0.13 | .016 | 1.40 | .16 | 0.77 | .451 | [0.56, 3.52] |
| Age | 1.01 | .11 | -0.13 | .898 | 0.85 | .89 | -0.92 | .370 | [0.58, 1.24] |
| Sex (male=1; female=0) | 0.97 | .24 | 2.40 | .899 | 1.34 | .61 | 0.43 | .672 | [0.32, 5.66] |
| Intercept | 0.34 | .09 | -3.91 | <.001 | 0.36 | .24 | -1.50 | .156 | [0.08, 1.56] |

^a n=150;

^b n=148

IRR= Incidence rate ratios; ODD=Oppositional Defiant Disorder; CD=Conduct Disorder