Prospective effects of adolescent indicators of behavioral disinhibition on DSM-IV alcohol, tobacco, and illicit drug dependence in young adulthood

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HIGHLIGHTS

- Predictive effects of Behavioral Disinhibition indicators varied by substance.
- ADHD subscales were positive associated with illicit drug dependence.
- Conduct disorder and novelty seeking predict future drug problems.
- The strongest predictor of future drug problems was novelty seeking.
- Adolescent substance use mediates psychopathology effects on future drug problems.

ARTICLE INFO

ABSTRACT

Objective: To identify robust predictors of drug dependence.

Methods: This longitudinal study included 2361 male and female twins from an ongoing longitudinal study at the Center for Antisocial Drug Dependence (CADD) at the University of Colorado Boulder and Denver campuses. Twins were recruited for the CADD project while they were between the ages of 12 and 18. Participants in the current study were on average approximately 15 years of age during the first wave of assessment and approximately 20 years of age at the second wave of assessment. The average time between assessments was five years. A structured interview was administered at each assessment to determine patterns of substance use and Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; Fourth Edition) attention deficit hyperactivity disorder (ADHD), conduct disorder (CD), and drug dependence symptoms. Cloninger's Tridimensional Personality Questionnaire was also used to assess novelty seeking tendencies (NS). At the second wave of assessment, DSM-IV dependence symptoms were reassessed using the same interview. Path analyses were used to examine direct and indirect mechanisms linking psychopathology and drug outcomes.

Results: Adolescent substance use, CD, and NS predicted young adult substance dependence, whereas the predictive effects of ADHD were few and inconsistent. Furthermore, CD and NS effects were partially mediated by adolescent substance use.

Conclusions: Adolescent conduct problems, novelty seeking, and drug use are important indices of future drug problems. The strongest predictor was novelty seeking.

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1. Introduction

Difficulty in inhibition of behavioral impulses results in an increased risk for the development of substance use and substance use disorders (SUD; consisting of DSM-IV abuse or dependence) (American Psychiatric Association, 2000). Individuals diagnosed with conduct disorder (CD) or attention problems (i.e., deficits in attention or hyperactivity–impulsivity — as defined by DSM-IV ADHD) are more likely to use substances during adolescence and develop a SUD during young adulthood (Charach, Yeung, Climans, & Lillie, 2011). Likewise, high novelty seeking (NS; a tendency for high levels of exploratory behavior, novel experiences, and immediate rewards), low harm avoidance, and low reward dependence tendencies have been associated with the development

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of SUD (Wills, Vaccaro, & McNamara, 1994). Further, early use of alcohol, tobacco, and illicit drugs increases the likelihood of future drug problems (Grant & Dawson, 1997).

A growing number of studies (Iacono, Malone, & McGue, 2008) indicate that ADHD, CD, and NS frequently co-occur and that the covariance among these traits can be best explained by an underlying latent trait referred to as Behavioral Disinhibition (BD; i.e., "the inability to inhibit behavior despite its social undesirability, and cascade of familial, educational, psychological, and legal consequences") (Young, Stallings, Corley, Krauter, & Hewitt, 2000). The high comorbidity among these disorders has prompted the need for more studies that can clarify the relationship between early assessments of ADHD, CD, NS, and SU and future drug problems. For instance, several reports have suggested that CD mediates the association between the inattention and hyperactivity subscales of ADHD and young adult drug problems (Brook, Duan, Zhang, Cohen, & Brook, 2008; Disney, Elkins, McGue, & Iacono, 1999; Fergusson, Horwood, & Ridder, 2007). Of these studies, those that have managed to adjust for the co-occurrence of CD and ADHD have concluded that ADHD effects could be attributed to the fact that CD was not accounted for in the model. Still, it remains unclear if any or all of these associations are due to their direct relationship with substance dependence or with the early stages of substance initiation and use.

1.1. Associations between measures of BD and substance problems

Population-based studies suggest a more than chance association between adolescent measures of BD and the development of future substance problems (Disney et al., 1999; Elkins, King, McGue, & Iacono, 2006; Elkins, McGue, & Iacono, 2007; Grekin, Sher, & Wood, 2006; Jenkins et al., 2011; Zucker, 2008); however, most studies are not prospective in nature and fail to account for the shared liability among adolescent ADHD, CD, NS, substance use, and substance problems (i.e., DSM-IV abuse or dependence) (Lee, Humphreys, Flory, Liu, & Glass, 2011). At the time of this study, we reviewed the literature and identified two longitudinal studies that examined the effect of both childhood/adolescent ADHD and CD on young adult (i.e., 30 > age > 18) SUDs and a third study that also included personality traits. In their study of 506 boys in the Pittsburgh Youth Study, Pardini, White, & Stouthamer-Loeber (2007) examined the effects of early adolescent ADHD, CD, anxiety, and depression on young adult alcohol use disorders. The authors concluded that while controlling for the comorbidity among all the adolescent psychopathologies, CD was related to young adult alcohol use disorder symptoms but ADHD was not. Furthermore, there was no interaction between ADHD and CD. Similar findings were obtained by Fergusson et al. (2007), who used a 25-year longitudinal study of a New Zealand birth cohort to examine the link between CD and attention problems and young adult substance use, abuse, and dependence. In a separate study, Tarter, Kirisci, Feske, & Vanyukov (2007) used a sample of males assessed during adolescence and young adulthood to identify pathways linking childhood hyperactivity to young adult substance use disorder. Tarter and colleagues discovered that childhood hyperactivity is a "diathesis for externalizing disturbances" at young adulthood. Furthermore, the link between childhood hyperactivity and young adult SUDs was mediated by both neuroticism and conduct problems, thus suggesting that NS and CD carry a much greater risk than ADHD.

1.2. Deriving robust estimates of effects in the context of adolescent drug use

Despite the growing number of studies linking childhood/adolescent psychopathology and personality with adult drug outcomes, it is not known whether any of the patterns of association described above are robust longitudinal effects, as most studies have failed to account for the joint effects of adolescent substance use (a robust predictor of future drug problems) (Grant & Dawson, 1997; Guy, Smith, & Bentler, 1994),

which has been shown to be elevated among teens with externalizing problems (August et al., 2006). In order to obtain robust estimates of effect between each of these early traits and young adult drug outcome, it is necessary to analyze longitudinal studies that have assessed all of these traits using a multivariate regression framework. A multivariate framework provides the opportunity to explore two fundamental research questions linking early assessments of ADHD, CD, and NS with future drug problems. Specifically, (1) are adolescents with a history of ADHD or CD problems or an exuberance for novelty at increased risk for future drug problems, and (2) are those risk estimates, specifically related to the drug problems themselves, or are they driven by their association with other behaviors, especially drug use, which on its own is capable of mimicking the characteristics of ADHD, CD, and NS because it causes neurocognitive (e.g., decreased memory, attention and speeded information processing, and executive functioning) and brain matter volume deficits (e.g., hippocampal, prefrontal cortex, and white matter volume) in the developing brain (Squeglia, Jacobus, & Tapert, 2009). For example, Squeglia, Spadoni, Infante, Myers, and Tapert (2009) showed that moderate to heavy alcohol use and high levels of hangover symptoms were associated with reduced sustained attention in males and reduced visuospatial task performance (e.g., visuospatial memory) in females. Overall, studies examining the effects of ADHD, CD, and NS on future drug problems need to account for (1) shared variance between the traits, and (2) the effects of adolescent drug use, as it can produce neural abnormalities that can perpetuate behavioral disadvantages that increase the risk for drug use/problems.

1.3. Purpose of the current study

The purpose of this study was to address the ambiguity surrounding the predictive role of BD indicators, especially since only a few prospective studies have considered their joint effects and underlying comorbidity with early/adolescent substance use. We hypothesized that early externalizing psychopathology (i.e., ADHD and CD symptomatology) and novelty seeking tendencies are indicators of future drug dependence problems, over and above the effects of early adolescent substance use. In addition to direct processes, we further hypothesized that conduct and attention problems and novelty seeking influence the liability to drug dependence by also influencing the level of drug use during adolescence (i.e., indirect mechanisms).

2. Materials and methods

2.1. Participants

The sample consisted of 2361 individual members of a twin pair (46% male) who were drawn from the Center for Antisocial Drug Dependence (CADD) Study, an ongoing study at the University of Colorado. The twins utilized in the CADD originate from two community-based twin samples at the University of Colorado that are part of the much larger Colorado Twin Registry based at the Institute for Behavioral Genetics at the University of Colorado at Boulder. The two samples consist of the Longitudinal Twin Study (LTS) sample and the Community Twin Sample (CTS). The CTS sample was open to all twins born in the state of Colorado between 1979 and 1990, and additional in-migrating twins in the same age range ascertained through Colorado school districts. The LTS included twins born in Colorado between 1984 and 1990 who were initially tested prior to age 2 and who were followed longitudinally (Rhea, Gross, Haberstick, & Corley, 2006, 2013); inclusion in this sample depended on location and early twin and family characteristics. Twins from both samples were recruited into the CADD while they were between the ages of 12 and 18 years of age. Due to the longitudinal nature of the study, subjects from the LTS and CTS are currently enrolled in five-year follow-ups of the original baseline assessment. Data for the current study were drawn from the first and second waves of the CADD study. At the end of data collection for Wave 2 during the year