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A Model of School Problems, Academic Failure, Alcohol Initiation, and the Relationship to Adult Heroin Injection

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Abstract

The current study uses structural equation modeling to investigate factors associated with alcohol initiation and injection heroin use. Baseline data from the NEURO-HIV Epidemiologic Study in Baltimore, Maryland, were used. Participants were 404 injection heroin users ($M_{\text{age}} = 32.72$) with a history of regular injection in their lifetime. Latent variables were created for self-reported school problems and academic failure. The final model indicated that greater school problems were associated with earlier alcohol initiation ($\beta = -0.22, p < .001$) and earlier alcohol initiation was associated with greater frequency of recent heroin use ($\beta = -0.12, p < .05$). Academic failure was directly related to greater frequency of recent heroin injection ($\beta = 0.15, p < .01$). The results expand research investigating the relationship between adolescent behavior and illicit drug use in adulthood.

Keywords

alcohol initiation; heroin injection; structural equation modeling; adolescent behavior

Injection drug use (IDU) continues to be a major public health concern in many inner-city neighborhoods throughout the United States such as Baltimore, Maryland, with upwards of one third of new HIV infections still being attributed to IDU (Center for Disease Control and Prevention [CDC], 2007). While there are a multitude of studies examining risk behaviors associated with IDU, much of the focus has been placed on demographic and social factors, which may have precipitated the behavior in adulthood. The gap in the literature is likely due, at least in part, to the relative absence of longitudinal studies beginning with participation in childhood that ultimately contain a sufficient number of heroin injectors in

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Declaration of Interest

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adulthood. As a result, one method is to identify developmental risk factors of greater injection frequency in adulthood derived from retrospective self-report data. In doing so, early onset of alcohol use represents a plausible risk factor of particular note, given the broad base of research documenting the myriad of negative outcomes associated with it. Further, two additional risk factors also shown to predict a range of adverse outcomes include behavioral problems as evidenced in school problems and academic failure. The significance of the current study findings is conceptualized in terms of an outcome associated with high risk and rarely considered in the literature.

Illicit drug use in adulthood likely evolves out of the complex interactions between physical, cognitive, environmental, and psychosocial influences (Fergusson, Boden, & Horwood, 2008; Fothergill, Ensminger, Green, Robertson, & Juon, 2009; Sherman et al., 2005). Many studies have explored developmental trajectories of substance abuse and dependence in adulthood by identifying markers of risk in adolescence. In particular, the stage-environment fit hypothesis describes maladaptive behavior during this period as a product of the mismatch between the developing needs of the adolescent and the corresponding response to these changes in their social environment (Eccles et al., 1993; Gutman & Eccles, 2007; Salmela-Aro & Tuominen-Soini, 2010; Wang, Dishion, Stormshak, & Willet, 2011). In other words, environments that recognize changes in adolescent behavior and respond to these changes create opportunities for positive outcomes to occur. Conversely, environments that fail to respond to these changes create the potential for difficulties such as substance use to arise. Fortunately, Ellickson, Tucker, Klein, and McGuigan (2001) noted that problematic behavior during adolescence is often visible, thus creating the potential for intervention and modification. Behavior in school is a valuable mechanism by which to evaluate problematic behavior, especially as illustrated through school problems and academic competence.

Research supports the theory that markers of risk for substance use in adolescence often occur in school (Bachman et al., 2008; Bogart, Collins, Ellickson, & Klein, 2006; Crosnoe, 2006; Friedman, Bransfield, & Kreisher, 1994; Merline, Jager, & Schulenberg, 2008; Schulenberg et al., 2005) and that educational success is a protective factor against negative outcomes in adulthood (Bachman et al., 2008; Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004; Schulenberg, Bachman, O'Malley, & Johnston, 1994; Topitzes, Godes, Mersky, Ceglarek, & Reynolds, 2009). However, few studies have examined the association between problems that occur in school along with academic failure, alcohol initiation, and IDU. As problems in school may reduce the probability for educational success and, subsequently, reduce protective factors in adulthood, fully exploring this relationship is of vital importance. The current study seeks to explore school-related factors that may contribute to the initiation of alcohol use and how this is related to injection heroin use in adulthood among a sample of heavy, illicit substance users.

School Problems, Academic Failure, and Substance Use in Adolescence

Some studies have demonstrated a strong link between high-school dropout, opioid use, and IDU. For example, Fuller et al. (2002, 2005) found that high-school dropout was predictive of adolescent injection initiation and having recently transitioned to IDU in young adulthood. In addition, compared with high-school graduates, dropouts are significantly

more likely to have injected drugs, both recently (Obot & Anthony, 1999; Obot, Hubbard, & Anthony, 1999) and in their lifetime (Obot & Anthony, 2000). Also, adults with opioid use disorders often report low academic achievement (Gandhi, Kavanagh, & Jaffe, 2006). Studies of this nature frequently quantify academic achievement as high-school graduation. However, markers of poor academic performance that precede dropout may be better variables to explore as this occurs while the individual is still connected to school and interventions that promote academic success are viable as opposed to after the connection to school is lost through dropout. The current study seeks to address this concern by using self-reported grades in the last year of school as a marker for academic achievement rather than high-school graduation. This may be useful to prevention efforts as it is an indicator of behavior prior to school dropout; therefore, utilizing this measure allows for an examination of a portion of the population that has gone largely overlooked in the previous literature.

High-school dropout can be conceptualized as a cumulative experience of misbehavior, school-related problems, dissatisfaction with school, and poor academic competence (Newcomb et al., 2002). However important the role high-school dropout may play in the progression to adult substance use, only a handful of studies have investigated the relationship between school-related problems observable while an individual is still in school and substance use in adulthood. Of note, Drapela (2006) found that disruptive school behavior had a direct effect on drug use and that school problems were an antecedent to school dropout. In addition, problems that adolescents had in school had as much of an effect on current drug use as did deviant peers, social bonds, negative environments, demographics, prior drug use, and prior antisocial behavior. Similarly, in a longitudinal study of African Americans investigating the effects of early education indicators on later substance use, Fothergill et al. (2008) found that suspension, skipping school in adolescence, and not having a high-school diploma put individuals at greater risk for adult problem drug use. As such, school-related problems may be a key indicator of substance use in adolescence and one that persists after leaving school. However, in a thorough review of the literature, no studies have tested the relationship between these factors and IDU in adulthood, particularly among heavy drug users.

Adolescent Alcohol Initiation and Illicit Drug Use

Alcohol is the most commonly misused drug during adolescence, followed closely by tobacco and marijuana (Johnston, O'Malley, Bachman, & Schulenberg, 2009). Despite this, much of the extant literature has focused specifically on the impact of adolescent marijuana use on current IDU (Ellickson, D'Amico, Collins, & Klein, 2005; Fuller et al., 2001), while the role of adolescent alcohol initiation in later illicit drug use has gone largely overlooked (Sintov, Kendler, Walsh, Patterson, & Prescott, 2009). In a review of the literature, only one study indicated that early age of alcohol use was associated with later IDU (Corsi, Winch, Kwaitkowski, & Booth, 2007) and one study indicated that the age of first alcohol use was significantly younger for injection drug users compared with non-injection drug users (Sherman et al., 2005). In addition, research has suggested that early onset of alcohol-related disorders may predict the use of heavier drugs (Golub & Johnson, 2001; Merrill, Kleber, Schwartz, Liu, & Lewis, 1999) as well as alcohol abuse/dependence or other drug dependence (Chen, Storr, & Anthony, 2009; Dawson, Goldstein, Chou, Ruan, & Grant,

2008; Grant, 1998; Grant & Dawson, 1997; Grant, Stinson, & Harford, 2001; King & Chassin, 2007) later in life.

In a study of individuals in treatment who met the diagnostic criteria for alcohol dependence, Sintov and her colleagues (2009) found that early cigarette, alcohol, and other drug use were associated with increased risk for drug dependence later in life. Similar studies have found that among those who experience early onset of alcohol use, approximately 25% and 11% meet diagnostic criteria for alcohol abuse and dependence, respectively, later in life (Behrendt, Wittchen, Hofler, Lieb, & Beesdo, 2009). Though the literature has hinted at the potential of the early onset of alcohol use to predict later illicit drug use, it has not explicitly explored this relationship beyond alcohol to include recent IDU. Given the prevalence of alcohol misuse among adolescents, this appears to be a critical oversight in the literature.

The present study seeks to extend the literature on factors contributing to IDU among heavy, illicit drug users by retrospectively examining the relationships between school problems and academic failure with alcohol initiation and recent IDU. The theoretical underpinnings of the hypothesized structural model was based on a review of the literature investigating risk factors associated with substance use in adolescence and IDU among adults (Figure 1). It was hypothesized that school problems and academic failure would be related to each other and that these latent variables would be associated with participants' age of alcohol initiation. It was also expected that participants' age of alcohol initiation would be related to their frequency of recent injection heroin use.

METHOD

Study Design

Data for this study were obtained from the baseline assessment of the NEURO-HIV Epidemiologic Study. This study was designed to examine neuropsychological and social-behavioral risk factors of HIV, hepatitis A, hepatitis B, and hepatitis C among both injection and noninjection drug users in Baltimore, Maryland. This study was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health in 2001 and has received annual renewals. The design of this study is cross sectional. Participants completed the HIV-Risk Behavior Inventory, a detailed behavioral assessment of drug use and sexual practices. In order to be eligible for participation in the parent study, participants had to be between the ages of 15 and 50 years old and had to report use of noninjection and/or injection drugs in the past 6 months. Recruitment strategies for participation included advertisements in local papers, street outreach, and referrals from local service agencies. Participants provided written informed consent and completed a face-to-face HIV-risk behavior interview. In addition, participants completed a battery of neuropsychological tests that measured executive functioning and estimated general intelligence. Blood and urine samples were obtained to test for the presence of drugs and sexually transmitted diseases (STDs). Participants were remunerated \$45 for the baseline assessment.

Study Participants

Table 1 includes a summary of participant characteristics, academic history, and injection heroin use. The study sample included 404 adults residing in Baltimore with a mean age of 32.72 ($SD = 7.78$). Sixty-one percent of participants were White, 58% were male, and 49% had a high-school diploma or equivalent. Previous studies have used the Shipley Institute of Living Scale (SILS) to estimate general intelligence using the age-adjusted standard score for the combined vocabulary and abstraction score (Bolla, Funderburk, & Cadet, 2000). This measure of general intelligence in the study population indicated a mean score of 97.55 ($SD = 11.22$), consistent with what is found in the general population (Lezak, 2004; Zachary, 1991). All study participants reported having injected heroin in their lifetime, 79% reported injected heroin in the past 6 months, and 72% reported injected heroin in the month prior to the assessment. The majority of participants (84%) reported a history of regular injection heroin use or a period of at least 3 months of injection episodes on a daily or near-daily basis in their lifetime. The mean years of regular injection was 5.89 ($SD = 6.51$), with a mean age of 23.34 ($SD = 6.56$) for the first injection episode. This population was selected as research has suggested that heroin addiction may be a lifelong condition (Hser, Hoffman, Grella, & Anglin, 2001).

Measures

School Problems—Participants responded “yes” or “no” to four survey items used in a scale of school problems. “Did you have any of these problems during your last school year”: “Were you sent to the principal?”; “Were your parents called for a family conference?”; “Were you suspended?”; and “Were you expelled?” (Cronbach’s alpha: 0.842).

Academic Failure—Four survey items were used in a scale of academic failure. “During your last year in school, describe the grades that you received in each of these subjects”: “Reading or English,” “Science,” “Social Studies,” and “Math or arithmetic” (Cronbach’s alpha: 0.814). Response options were 1 = “A,” 2 = “B,” 3 = “C,” 4 = “D,” and 5 = “F.” A higher score on this scale indicates greater academic failure.

Alcohol Initiation—Participants responded to one item that assessed alcohol initiation: “How old were you when you first used alcohol?” Participants responded in age in years. The mean age of alcohol initiation in the sample was 13.46 years ($SD = 3.62$).

Frequency of Recent Heroin Use—Participants responded to one item that assessed frequency of recent injection heroin use: “In the past 30 days, how many days did you inject heroin?” Participant responses ranged from “0 days” to “30 days.” Participants reported injecting heroin for an average of 16.54 ($SD = 13.62$) days in the month prior to the assessment.

Demographics—Study demographics included age, sex, and race/ethnicity.

Analytical Strategy

A model building approach was used in the data analyses in the current study. Study analyses utilized structural equation modeling (SEM) in Mplus, version 6.0 (Muthen & Muthen, 1998–2010), to assess the role of school problems and academic failure in alcohol initiation and frequency of recent injection heroin use in adulthood. In order to accomplish this aim, the analyses proceeded through several steps. First, measurement models were created to evaluate the relationships between the observed variables and the latent variables. Exploratory factor analyses were conducted to determine the appropriate factor structure for the items comprising each latent variable. Second, a confirmatory factor analysis (CFA) was conducted to determine the factor structure fit of the measurement model. All available data from the baseline assessment were used for the measurement models. The final measurement model (Model 5; $n = 399$) had less than 1% missing data. Parameter estimation was calculated using weighted least squares mean and variance adjusted (WLSMV) procedure. WLSMV estimation is a method used with categorical and/or ordinal variables in Mplus that uses pairwise deletion to handle missing data (Muthen & Muthen, 1998–2010).

Measurement of fit models was assessed with three goodness-of-fit indices: comparative fit index (CFI), Tucker-Lewis fit index (TLI), and root mean square error of approximation (RMSEA). The CFI and TLI describe the fit of the hypothesized model compared with the null model assuming zero covariance among variables and provide a measure of complete covariation in the data (Byrne, 2010). Both the CFI and the TLI range in value from 0 to 1.00 and values that are close to 0.95 are representative of a model that fits the data well (Hu & Bentler, 1998). The RMSEA is recognized as one of the most informative criteria in structural modeling and takes into account the error of approximation in the population and is sensitive to the number of estimated parameters in the model. Values ≤ 0.05 indicate a close approximate fit, values that range between 0.05 and 0.08 indicate a reasonable fit, and values ≥ 0.10 indicate a poor fit (Byrne, 2010).

The third analysis tested the full structural model specifying the relationship between the two latent variables, alcohol initiation, and frequency of recent injection heroin use. Model fit was assessed using CFI, TLI, and RMSEA. The final model was based on a sample size of 404; 388 participants had complete data, representing less than 4% missing from the full sample. The decision not to stratify by sex and/or ethnicity was made to maximize sample size for the analyses. Applying the models proposed here to samples stratified by sex and/or race is reserved for future research.

RESULTS

Preliminary bivariate correlations were conducted between participant characteristics indicating several significant findings that laid the framework for the hypothesized structural model. A summary of intercorrelations can be found in Table 2. Significant associations among participant demographics including sex, race, age, and last grade in school were considered as covariates for testing in post hoc analysis. Several noteworthy associations between variables of interest were found. First, age of first heroin injection was positively associated with alcohol initiation age ($r = 0.18$, $p < .001$), and second, frequency of recent heroin use was negatively related to alcohol initiation age ($r = -0.14$, $p < .01$). These two

findings are of critical importance for the hypothesized model presented here. Previous studies have used frequency of drug use as an indicator of abuse and dependence tendencies (Titus, Godley, & White, 2006). As found here, earlier alcohol initiation, and not earlier heroin injection, was related to frequency of heroin injection in adulthood. As such, early alcohol initiation may be a better indicator for injection heroin abuse/dependence than the initiation of heroin injection itself.

Measurement Models

Four measurement models were fit to determine the latent factor structure for school problems and academic failure items. Table 3 shows the standardized factor loadings and the fit statistics for each model.

School Problems—Model 1 describes the fit of four items for this latent variable and did not represent a good fit (CFI = 0.997, TLI = 0.990, RMSEA = 0.115). The item with the lowest factor loading was removed (“Were you expelled?”; Cronbach’s alpha: 0.862). Model 2 represents the latent factor “school problems” and best described the covariation among three items reported by participants (CFI = 1.000, TLI = 1.000, RMSEA < 0.001).

Academic Failure—Model 3 describes the fit of four items for this latent variable and did not represent a good fit (CFI = 0.996, TLI = 0.989, RMSEA = 0.119). The item with the lowest factor loading was removed (“Math or arithmetic”; Cronbach’s alpha: 0.861). Model 4 represents the latent factor “academic failure” and best described the covariation among the three items reported by participants (CFI = 1.000, TLI = 1.000, RMSEA < 0.001).

Confirmatory Factor Analysis—Model 5 illustrates the final CFA for “school problems” and “academic failure.” This model represents a reasonable fit to the data (CFI = 0.996, TLI = 0.993, RMSEA 0.072) and was retained for use in the structural equation model.

Structural Model

Bivariate correlations revealed significant relationships between the latent variables and the manifest variables of interest. School problems showed a significant positive association with academic failure ($r = 0.31, p < .001$) and a significant negative association with alcohol initiation ($r = -0.23, p < .001$). Academic failure showed a significant positive association with frequency of recent heroin use ($r = 0.16, p < .001$). A complete summary of all in tercorrelations of study constructs can be seen in Table 4.

The hypothesized structural equation model can be seen in Figure 1. This model revealed a negative association between school problems and alcohol initiation ($\beta = -0.22, p < .001$). Alcohol initiation was negatively associated with frequency of recent heroin use ($\beta = -0.18, p < .05$). Academic failure was not significantly associated with alcohol initiation ($\beta = -0.05, p > .01$). “School problems” was significantly positively related to academic failure ($\beta = 0.31, p < .001$). This model represents a close approximate fit to the data (CFI = 0.996, TLI = 0.993, RMSEA = 0.052).

Due to the significant relationship between academic failure and frequency of recent heroin use found in the bivariate correlation, another model was fit against the data adding a direct effect of academic failure on frequency of recent heroin use. Figure 2 illustrates the final structural equation model, representing a slightly better fit to the data ($CFI = 0.998$, $TLI = 0.996$, $RMSEA = 0.041$) than the hypothesized model. In this model, “school problems” was negatively associated with alcohol initiation ($\beta = -0.22$, $p < .001$) and alcohol initiation was negatively associated with frequency of recent heroin use ($\beta = -0.12$, $p < .05$). The association between academic failure and alcohol initiation is not significant ($\beta = -0.03$, $p > .01$); however, there is a significant direct effect of academic failure on frequency of recent heroin use ($\beta = 0.15$, $p < .01$). “School problems” was significantly positively related to academic failure ($\beta = 0.31$, $p < .001$).

A third, alternate model was tested adding a direct effect of school problems on frequency of recent heroin use. The path from school problems to frequency of recent heroin use was not significant ($\beta = -0.02$, $p > .01$). This alternate model also represented a good fit to the data ($CFI = 0.996$, $TLI = 0.993$, $RMSEA = 0.054$), but not better fit than the final model represented in Figure 2. A summary of the fit statistics for the CFA, the hypothesized model, the final model, and the alternate model can be found in Table 5.

Post hoc analyses were conducted in order to adjust for age, sex, and race in the final model illustrated in Figure 2. The variables age, sex, and race were added as covariates to the manifest variable, i.e., frequency of recent heroin use. This adjusted model did maintain a reasonable fit to the data ($CFI = 0.988$, $TLI = 0.984$, $RMSEA = 0.062$); however, the only significant standardized path that remained was the association of school problems with alcohol initiation age ($\beta = -0.20$, $p < .001$). The paths from alcohol initiation to frequency of recent heroin use and from academic failure to frequency of recent heroin use were in a similar direction from the unadjusted model, but did not reach significance. The reduction in path significance is most likely due to sample size, and future studies should aim to test this model in larger samples of injection drug users.

DISCUSSION

The current study used SEM to examine the relationships between school problems, academic failure, alcohol initiation, and frequency of recent heroin use among a sample of heavy injection drug users. Consistent with expectations, a significant correlation was observed between school problems and academic failure. There were three significant correlations of particular interest: school problems with alcohol initiation, alcohol initiation with frequency of recent injection heroin use, and academic failure with frequency of recent injection heroin use. Somewhat unexpectedly, school problems were associated with an earlier initiation age for alcohol, while academic failure was not. However, academic failure was related to greater frequency of recent heroin use. In addition, earlier alcohol initiation was also associated with greater frequency of recent heroin use. Taken together, these findings suggest that efforts to curtail early alcohol initiation and later IDU should identify at-risk adolescents through the display of either school-related problems or academic difficulties.

The paths in the final structural equation model (Figure 2) show several interesting significant associations. First, the latent variable “school problems” was associated with earlier alcohol initiation and earlier alcohol initiation was associated with greater frequency of injection heroin use. The path illustrating the relationship between alcohol initiation and frequency of recent injection heroin use suggests that delaying alcohol initiation in adolescence may reduce the association with injection heroin use in adulthood. Second, greater academic failure in participants’ last year of school was directly related to greater frequency of recent injection heroin use. This is significant in that studies have noted that low academic competence is associated with delinquency and drug use; in addition, these are variables that commonly precede an individual dropping out of school (Newcomb et al., 2002). In fact, Ellickson et al. (2001) found that among 7th graders, those who engaged in more delinquent behaviors and earned poorer grades were more likely to be high-risk drinkers in 12th grade. In addition, others have found that as drinking increased among high-school students, the risk of failing in at least one subject increased as well (López-Frías et al., 2001). Of course, it is not known whether doing poorly in school leads to alcohol consumption or consuming alcohol is a method of coping in response to academic incompetence. Either way, academic competency and maladaptive behaviors that are visible within the school context are variables that can be noted for early intervention before dropout from school occurs.

There are several potential explanations for the findings presented here. First, using a developmental model, research has suggested that early exposure to substance use equates to a longer duration of risk (Degenhardt et al., 2009). Some have identified early adolescence as a critical period for substance exposure, as this developmental time frame is filled with social and cognitive changes as well as peer influences. Increased exposure to substance use allows for modeling and reinforcement to occur; likewise, behavior is then shaped by experiences and consequences of substance use among peers (Sobeck, Abbey, Agius, Clinton, & Harrison, 2000; Yu & Williford, 1992). Second, substance use in adolescence may evolve out of a mismatch between the psychosocial needs of the adolescent and their environment, or the stage-environment fit hypothesis (Eccles et al., 1993). This theory suggests that negative behaviors exhibited by adolescents, such as substance use and delinquency, may result from a poor fit in the school environment. Eccles and colleagues (1993) emphasized that a good fit between the psychosocial needs of the adolescent and the school/educational environment is important for optimal development during this period.

The current study findings are consistent with previous research that has investigated the relationship between school misbehavior and adolescent substance use (Bryant, Schulenberg, O’Malley, Bachman, & Johnston, 2003). Early noncompliance as indicated by school problems should be considered warning signs for substance use in adolescents as these may be considered manifestations of a poor stage-environment fit. Although these indicators may not be at disordered levels (i.e., conduct disorder), interventions that target students who develop school problems along with other significant risk factors provide an opportunity for intervention. Conversely, a good stage-environment fit may be protective of problematic behaviors; for example, school connectedness (Wang, Matthew, Bellamy, & James, 2005) and academic achievement (Kostelecky, 2005) have been associated with less substance use in adolescence. A focus on problems that occur in school prior to dropout is

particularly important due to the fact that failure to complete high school is another noteworthy factor contributing to IDU in young adulthood (Fuller et al., 2002, 2005; Sherman et al., 2005). Though the current study represents an important step in further understanding the potentially critical role of the relationship between academic concerns and alcohol initiation, a greater understanding of context for school-related variables would be a key area of focus for future studies to address in an effort to understand the association between these variables. For example, performance problems may have been related to household disruption, which would be different from problems due to lack of motivation. Future research should explore this issue further.

As alcohol is currently the most commonly used substance among adolescents in the United States (Johnston et al., 2009), interventions that target indicators of school-related problems and the relationship to alcohol initiation are particularly relevant. Of particular interest here are factors that are observed while the individual was still enrolled in school. Once dropout occurs, these individuals become more difficult to reach, interventions may be less likely to occur, and substance use has the potential to escalate. Several studies have shown that school-level norms, school climate, and attitudes about substance use are protective against the developmental trajectory of drug use (Kumar, O'Malley, Johnston, Schulenberg, & Bachman, 2002; LaRusso, Romer, & Selman, 2008) and should be incorporated into prevention programs within schools (Fearnow-Kenney, Hansen, & McNeal, 2002) during the high-school years (White et al., 2006). Due to high dropout rates among minority and low-income students (NCES, 2010) and the fact that failure to complete high school is associated with a multitude of problems in young adulthood, identifying adolescents at-risk for substance use when they are still connected to school makes school-based targeted interventions practical and may even help to prevent school dropout.

Despite the unique associations found in the current study, there are several limitations inherent in a cross-sectional design. First, it is important to note that IDU interacts with a wide range of psychosocial factors that occur embedded within a multilevel system of personal and environmental factors. The authors do not attest that the model explored here is the only explanation for how IDU may develop; instead, it is a distinct look at variables originated during adolescence that may contribute to this high-risk behavior. Future research should examine how substance abuse is impacted by a variety of other factors, such as individual resources and how these resources function in a range of contexts. In addition, while cross-sectional research is a vital tool in identifying areas for more in-depth study, the ability to make causal inferences must be reserved for studies of a longitudinal design. Second, the findings of the current study may not generalize to other populations such as those who are not in urban settings or otherwise differ from the present sample. Future research is needed to address this issue. Finally, this study uses retrospective data where there is great reliance on the self-report of drug use history, school problems, and grades participants' received while still enrolled in school. However, the self-report of drug use was appropriate for the current study as it provides information over longer periods of time and has been shown to be a reliable and valid method of obtaining drug use information (Darke, 1998). Although it is less than ideal to use retrospective data to create linear patterns of behavior, it is very difficult to accumulate large samples of injection drug users using prospective data from adolescence in "normal" samples. In addition, retrospective data have

been utilized in studies where SEM has been employed (King, King, Gudanowski, & Vreven, 1995; Matsunaga, 2011).

Notwithstanding these limitations, this study has several inherent strengths and it addresses a gap in the literature identifying early alcohol initiation as a risk factor for IDU. To be exact, this study is the first of its kind to investigate school-related factors as contributors to alcohol initiation during adolescence and IDU in adulthood among heavy, illicit drug users. Studies of this kind often occur in large-scale, national surveys, such as Monitoring the Future (Johnston et al., 2009) and the National Survey on Drug Use and Health, that investigate substance use either in school-based settings or in household surveys. Due to this design, the most at-risk and marginalized individuals are often missed in data collection due to absenteeism, attrition, and noncompliance (Bachman, Johnston, O'Malley, & Schulenberg, 2006). As a result, these methods may result in an underrepresentation of both school-related problems and illicit drug use.

Finally, this study serves as a platform for future, longitudinal research with a focus on school-related problems, alcohol initiation, and illicit drug use in adulthood. In addition, as frequency of recent heroin use was related to age (negatively), sex (males), and race/ethnicity (White) in this study sample, future research should analyze this model by sex and/or race to explore these relationships further. Ultimately, school problems and academic failure provide potential foreshadowing for harmful illicit drug use in adulthood; waiting for dropout as a marker for those at-risk for substance use puts psychologists, educators, social workers, and counselors behind the curve in prevention.

RÉSUMÉ

Représentation des problèmes à l'école, de l'échec scolaire, de l'initiation à l'alcool et lien avec l'injection d'héroïne chez l'adulte

La présente étude s'inspire de la modélisation *par* équation structurelle pour analyser les facteurs liés à l'initiation à l'alcool et à la consommation d'héroïne *par* injection. Nous avons utilisé les données de base issues de l'étude épidémiologique NEURO-HIV réalisée à Baltimore dans le Maryland. Le groupe de participants *était* composé de 404 consommateurs d'héroïne *par* injection ($M_{age} = 32.72$) ayant déjà utilisé régulièrement l'injection dans leur vie. Nous avons *créé* des variables latentes pour les problèmes à l'école et l'échec scolaire que les intéressés ont eux-mêmes signalés. D'après la représentation finale, les problèmes à l'école plus graves sont liés à l'initiation précoce à l'alcool ($\beta = -0.22, p < .001$) et l'initiation précoce à l'alcool est *liée* à une fréquence plus *élevée* de consommation récente d'héroïne ($\beta = -0.12, p < .05$). L'échec scolaire est directement *lié* à une fréquence plus *élevée* d'injection récente d'héroïne ($\beta = 0.15, p < .01$). Les résultats élargissent la recherche *qui analyse le lien entre le comportement des adolescents et la consommation illégale de drogues chez l'adulte*.

Mots-clés: initiation à l'alcool, injection d'héroïne, modélisation par équation structurelle, comportement des adolescents

RESUMEN

Modelo de problemas escolares, fracasos académicos, iniciación en el consumo de alcohol y la relación con la inyección de heroína en adultos

El estudio actual utiliza el modelo de ecuación estructural para investigar los factores vinculados con la iniciación en el consumo de alcohol y el uso de la inyección de heroína. Se utilizaron los datos basales obtenidos en el Estudio Epidemiológico NEURO-HIV realizado en Baltimore, Maryland. Los participantes fueron 404 usuarios de la inyección de heroína ($M_{edad} = 32.72$) con antecedentes de inyección regular durante toda su vida. Se crearon variables latentes para los problemas escolares y los fracasos académicos autoinformados. El modelo final indicó que los problemas escolares mayores estuvieron vinculados con la iniciación temprana en el consumo de alcohol ($\beta = -0.22, p < .001$) y la iniciación más temprana en el consumo de alcohol estuvo vinculada con el uso más frecuente de heroína en el último tiempo ($\beta = -0.12, p < .05$). El fracaso académico estuvo directamente relacionado con el uso más frecuente de la inyección de heroína en el último tiempo ($\beta = 0.15, p < .01$). Los resultados amplían la investigación que estudia la relación entre el comportamiento adolescente y el uso de drogas ilícitas en la edad adulta.

Palabras clave: iniciación en el consumo de alcohol, inyección de heroína, modelo de ecuación estructural, comportamiento adolescente

Biographies

Dr. Rebecca C. Trenz, Ph.D., M.A., is currently a Visiting Assistant Professor at Mercy College, Dobbs Ferry, NY, USA. Prior to her current position, Dr. Trenz completed a postdoctoral fellowship in the Drug Dependence and Epidemiology Training Program at the Johns Hopkins School of Public Health. Dr. Trenz has two main areas of research: psychosocial factors associated with illicit drug use in adulthood and sex risk behavior among high-risk, substance-using populations. Her work includes manuscripts that identify factors associated with early substance use exposure and illicit drug use in adulthood. She is also interested in exploring the role of alcohol use in sex risk behavior and infectious disease among illicit drug users. Other research interests include perceptions of motivational climate, achievement goals, satisfaction, persistence, and performance in competitive learning environments. In addition, Dr. Trenz enjoys applying statistical techniques such as structural equation modeling and latent class analysis to large datasets to further address her research interests.

Dr. Paul Harrell, Ph.D., M.A., is a postdoctoral fellow at Johns Hopkins University School of Public Health, Baltimore, MD, USA. His current research involves drug dependence epidemiology with a focus on understanding mechanisms underlying patterns of polydrug

use. Other research interests include behavioral pharmacology and expectancies, particularly the “placebo effect.” He has over 10 years of experience conducting research with people, including adolescents/adults with mental and substance disorders. His experience includes all aspects of the research process: successful grant applications, participant recruitment, supervision of data collection, and successful manuscript submissions to *Drug and Alcohol Dependence*, *Psychopharmacology*, and *Journal of Substance Abuse Treatment*. His early research experience included work on a clinical trial of buprenorphine for opioid-dependent adolescents at Johns Hopkins School of Medicine. The results were published in *Journal of the American Medical Association (JAMA)*. In addition, his career involved research rotations at American University, the National Institute of Mental Health Section on Neuroimaging, and the National Institute on Drug Abuse. He finishes his fellowship in June of 2012 and plans on continuing work researching mind–body interrelations and cognitive/social factors that impact mental and/or behavioral health. He looks forward to accelerating his research productivity with the goal of improvements in all aspects of public health. He lives in Baltimore, MD.

Dr. Michael Scherer's, Ph.D., M.S., research interests in alcohol use among polysubstance users. He is particularly interested in how the role of social networks, cognitive abilities, and the personality factors that influence risk-taking behavior may be adapted or augmented to provide support in reducing the use of deleterious substances. In this endeavor, he completed a master's degree in Rehabilitation Counseling and a doctoral degree in Counseling Psychology. He is currently completing his postdoctoral training at the Johns Hopkins Bloomberg School of Public Health, after which he intends to continue to work in academia to further explore addictions and innovative new ways in which to approach their treatment.

Dr. Brent E. Mancha, Ph.D., M.H.S., is a Research Associate in the Department of Mental Health at the Johns Hopkins Bloomberg School of Public Health (JHSPH), Baltimore, MD, USA. He is currently Assistant Director of the Hubert H. Humphrey Fellowship Program at Johns Hopkins. He is a graduate of the Ph.D. program in the Department of Mental Health at JHSPH and an alumnus of the National Institute on Drug Abuse (NIDA) Drug Dependence Epidemiology Training (DDET) Program. During his first 2 years of doctoral study, he was a recipient of the NIMH Child Mental Health Services Training Program fellowship. While at Johns Hopkins, he has worked extensively with Dr. William W. Latimer. Dr. Mancha's research focuses on the epidemiology of alcohol and drug dependence, with a special interest in alcohol use during adolescence. His dissertation examined patterns of DSM-IV alcohol

problems among youths from the United States and Puerto Rico and utilized latent class analysis to examine different profiles of adolescent drinkers. Dr. Mancha coordinates the Johns Hopkins Humphrey Fellows Program and also works as part of a research team analyzing data, writing and publishing manuscripts, and preparing abstracts and presentations for scientific conferences.

Dr. William W. Latimer, Ph.D., M.P.H., is the Elizabeth Faulk Professor and Chair of the Department of Clinical and Health Psychology in the College of Public Health and Health Professions at the University of Florida, Gainesville, FL, USA. Dr. Latimer's research has been NIDA funded since 1995 and focuses on the epidemiology, prevention, and treatment of infectious disease and drug dependence, with a special focus on neurobehavioral risk factors of disease, treatment engagement, and outcome. Dr. Latimer's epidemiologic research focuses on neuropsychological and social-behavioral risk factors of HIV and other infectious diseases among drug-using populations in the United States, South Africa, and Russia. Dr. Latimer's HIV and drug prevention research focuses on evaluation of efficacy and effectiveness of interventions that coordinate cognitive-behavioral and family systems approaches. Dr. Latimer's drug treatment research also focuses on evaluating neurobehavioral and process factors influencing the efficacy and effectiveness of cognitive-behavioral, family systems, and 12-step approaches for adolescent and adult drug abuse. Since 2001, Dr. Latimer has conducted five R01 studies in Baltimore City, including randomized trial studies to test IFCBT efficacy to reduce HIV risk behavior and foster drug abstinence among adults with drug dependence and epidemiologic studies of HIV risk behavior among adult heroin and cocaine addicts.

GLOSSARY

Academic failure

Grades received during the last year of high school

Alcohol initiation

Age at first alcohol consumption

Frequency of recent heroin use

Number of days heroin used in the past month

IDU

Injection drug use

School problems

Disciplinary problems encountered during the last year of school

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FIGURE 1. Hypothesized structural model depicting paths among school problems, academic failure, alcohol initiation, and frequency of recent heroin use measured at baseline.

FIGURE 2.

Final structural equation model depicting significant standardized pathways. Nonsignificant pathways are indicated by a dashed line. Path coefficients are shown by one-way arrows and correlations are shown by double-headed arrows (* $p < .05$; ** $p < .01$; *** $p < .001$).

TABLE 1.

Participant characteristics ($N = 404$)

Variable	<i>N</i>	%	<i>M</i>	<i>SD</i>	Median
Gender					
Male	236	58.4			
Female	168	41.6			
Race					
White	246	60.9			
Black	158	41.6			
Age			32.72	7.78	33.00
Last year of school			10.66	1.85	11.00
High-school graduate or greater	199	49.3			
Estimated IQ			97.55	11.22	98.00
Married	39	9.7			
Regular employment ^a	158	39.2			
Received public assistance ^a	173	42.9			
Homeless ^a	84	20.8			
Currently in drug treatment	111	27.8			
Academic problems					
Fail a class ^b	64	15.9			
Ever drop out	248	61.8			
Ever held back a grade	198	40.0			
Ever truant	201	49.8			
Sent to the principal ^b	216	53.5			
Family conference ^b	194	48.0			
Suspended ^b	206	51.0			
Expelled ^b	102	25.2			
Alcohol initiation age			13.50	3.62	13.50
Injection heroin use					

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Variable	N	%	M	SD	Median
Age at first injection episode			23.34	6.56	22.00
Injected in past 6 months	318	78.7			
Injected in past month	292	72.3			
Days injected past month			16.54	13.62	20.00
Injection episodes/day past month			1.98	2.01	2.00
Ever inject regularly ^c	335	83.5			
Years of regular injection			5.89	6.51	4.00

^aIndicates a time period of past 6 months.

^bIndicates last year of school.

^cRegular injection indicates a period of at least 3 months of daily or nearly daily use.

TABLE 2.

Intercorrelations of participant characteristics

	1	2	3	4	5	6	7
Male	-						
White	0.17***	-					
Age	0.03	0.47***	-				
Last grade in school	-0.02	0.17***	0.03	-			
Alcohol initiation age	0.08	0.15**	0.12*	0.14**	-		
Heroin injection initiation age	0.10*	0.11*	0.39***	0.10*	0.18***	-	
Frequency of recent heroin use	-0.22***	-0.46***	-0.37***	-0.13**	-0.14**	-0.01	-

* $p < .05$;

** $p < .01$;

*** $p < .001$.

TABLE 3.

Standardized, geomin-rotated factor loadings and fit statistics for the measurement models

Item	Model 1 <i>n</i> = 404	Model 2 <i>n</i> = 404	Model 3 <i>n</i> = 399	Model 4 <i>n</i> = 399	Model 5 <i>n</i> = 399
School problems					
Were you sent to the principal?	0.934	0.954			0.953
Were your parents called for a family conference?	0.912	0.922			0.927
Were you suspended?	0.962	0.930			0.927
Were you expelled?	0.827				
Academic failure					
Grade in English			0.739	0.733	0.745
Grade in science			0.899	0.880	0.880
Grade in social studies			0.928	0.950	0.944
Grade in math			0.488		
Fit indices					
CFI	0.997	1.000	0.996	1.000	0.996
TLI	0.990	1.000	0.989	1.000	0.993
RMSEA	0.115	0.000	0.119	0.000	0.072

TABLE 4.

Intercorrelation variables included in the structural equation model

	1	2	3	4
(1) Alcohol initiation age	-			
(2) Frequency of recent heroin use	-0.14 [*]	-		
(3) School problems	-0.23 [*]	0.07	-	
(4) Academic failure	-0.10	0.16 [*]	0.31 ^{**}	-

^{*}
 $p < .01$;

^{**}
 $p < .001$.

TABLE 5.

Fit statistics for the CFA and structural equation models

Model	<i>n</i>	<i>df</i>	χ^2	CFI	TLI	RMSEA
CFA	399	8	24.95**	1.00	1.00	0.07
Hypothesized model	388	18	38.02**	1.00	1.00	0.05
Final model	388	17	28.70*	1.00	1.00	0.04
Alternate model	388	16	34.66**	1.00	0.99	0.05

* $p < .05$;

** $p < .01$.