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Processes Linking Adolescent Problems to Substance-Use Problems in Late Young Adulthood*

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ABSTRACT. Objective: The current study explores three avenues in early young adulthood through which adolescent problems may be linked to later substance use problems: problematic substance use, failure to assume adult roles and responsibilities, and exposure to pro-drug social influences. Method: Participants (N = 1,986; 49% female) filled out surveys at ages 18, 23 and 29. Participants were 67% white, 9% black, 10% Hispanic and 8% Asian. Deviance, poor mental health, substance use, alcohol and other drug (AOD) problems, and school dropout were measured at age 18. AOD problems were also measured at age 23, as were role changes (e.g., marriage) and pro-drug social influences (e.g., friends use drugs). Indicators of substance abuse and dependence were measured at age 29. Demographics and family history of AOD were covariates. Results: Reporting more deviant behavior and heavier drinking at age 18 was associated with a higher likelihood of abuse and dependence at age 29. Alcohol use and pro-drug social influences at age 23 appeared to mediate the effects of adolescent substance use; lack of role assumption did not. The effect of poor mental health at age 18 was not mediated by any set of variables but instead appeared to directly predict dependence at age 29. Conclusions: Findings highlight the importance of early young adult drinking and substance-using peers in continuing patterns of heavy substance use developed during adolescence and also underscore the long-term impact of poor mental health during adolescence on substance use problems in late young adulthood. (*J. Stud. Alcohol* 66: 766-775, 2005)

APPROXIMATELY 25% OF U.S. ADULTS suffer from alcohol abuse or dependence, and 12% are either drug abusers or drug dependent (e.g., Chassin et al., 1999; Kessler et al., 1994; e.g., Kushner et al., 1999). The societal costs include decreased productivity (Mark et al., 2001; Mullahy and Sindelar, 1992) and diminished mental (D'Amico et al., 2005; Degenhardt and Hall, 2003) and physical health (Adams, 2002; Cherpitel, 1991). Although the majority of people have reduced their substance use by the mid-20s (Chen and Kandel, 1995; Gotham et al., 1997), many young adults continue to use substances at significant levels (e.g., Schulenberg et al., 1995) and may go on to develop substance-use disorders (SUDs) in adulthood.

Several studies have linked SUDs in early young adulthood to adolescent problems, such as early substance use, minor law breaking and poor mental health (e.g., Clapper et al., 1995; von Sydow et al., 2002; Zimmermann et al., 2003). Yet not all high-risk youth develop SUDs. A better understanding of the link between youth risk factors and SUDs in adulthood would allow for development of better prevention programming efforts during the teen and early

young adult years. With effective interventions, some of the personal, social and economic costs associated with substance abuse and dependence could be deterred. The current study explores three avenues through which adolescent problems may be linked to later SUDs: continuing or problematic substance use in early young adulthood, failure to assume adult responsibilities in early young adulthood and exposure to pro-drug social influences in early young adulthood.

We go beyond most prior work by examining how behaviors during adolescence and early young adulthood impact abuse and dependence at the end of young adulthood (age 29). Because those who still abuse substances by older young adulthood are at high risk for continued abuse (Brook et al., 2002; Windle and Welch, 1995), it is important to identify what predicts abuse and dependence at this age. Although SUDs are relatively common during the college years and often dissipate before the age of 30 (Schulenberg and Maggs, 2002), SUDs present at the end of the transition to full adulthood, in the late 20s and early 30s, pose a substantial risk of continuing through later life (Helzer et al., 1991).

Prior work has shown that adolescent problem behavior and mental health status predict problem use of alcohol or drugs during the period of emerging adulthood (e.g., Clapper et al., 1995; e.g., Duncan et al., 1997; Lewinsohn et al., 1999; Zimmermann et al., 2003). Specifically, deviant behavior in early adolescence is associated with more sub-

stance use-related problems in late adolescence (Stice et al., 1998), and youth who report intoxication before age 16, engage in fighting or have been arrested are more likely to abuse alcohol or be dependent on it at age 23 (Clapper et al., 1995). In addition, adolescent cigarette smoking increases the risk of developing a diagnosis of alcohol, cannabis or hard drug abuse or dependence by age 24 (Lewinsohn et al., 1999), and use of other illicit drugs predicts cannabis dependence at age 24 (von Sydow et al., 2002). Finally, school dropout is strongly associated with increased levels of alcohol-related problems for individuals in their mid-30s (Muthén and Muthén, 2000). Most of these studies linked adolescent substance use and deviance with substance problems in the early 20s (e.g., Lewinsohn et al., 1999; von Sydow et al., 2002). However, because deviant behaviors such as rule breaking, truancy and minor theft tend to be associated with behaviors such as substance use in early young adulthood (Clapper et al., 1995; von Sydow et al., 2002), we also expect an association between adolescent problem behaviors and SUDs in late young adulthood.

Mental health research has shown that psychiatric distress is associated with meeting criteria for an alcohol use disorder (Jackson and Sher, 2003), with mental disorders at age 15 leading to elevated risk of cannabis use at age 18 (McGee et al., 2000) and anxiety disorders during adolescence predictive of onset and course of alcohol disorders in early young adulthood (Zimmermann et al., 2003). Thus, we might also expect a relationship between adolescent mental health problems and SUDs in adulthood. We know of no other study that has examined, in conjunction, adolescent deviance, substance use and mental-health problems as predictors of substance-use problems in adulthood.

One process linking adolescent problems with late young adulthood SUDs might be continued or escalated use of substances during early young adulthood. Emerging work on trajectories of alcohol, cigarettes and marijuana (e.g., Brown et al., 2001; Ellickson et al., 2004; Orlando et al., 2004; Schulenberg et al., 1995; Tucker et al., 2005) indicates that patterns of substance use vary over time and that that there are distinct groups of early and problem users: some discontinue or substantially reduce use during adolescence or later young adulthood; others have fairly stable patterns over time; and still others escalate use between adolescence and young adulthood. It is therefore important to ask whether adult SUDs are a function of continuing use from adolescence into adulthood or instead are products of other young adult problems (e.g., inability to make role transitions) that develop as a consequence of adolescent substance use. Only one study has linked adolescent and early young adult substance use to potential problematic substance use in late young adulthood (Brook et al., 2002); however, this study did not examine the potential mediating role that continued substance use in early young adulthood may have on later substance problems in late young adulthood. Young adults who have experienced mental-health or conduct problems early in life may also be at risk through this same process, engaging in high levels or problematic patterns of substance use when they leave their parents' home, which continues into later adulthood.

A second process that may explain the development of SUDs in late young adulthood may be failure to assume adult roles among high-risk adolescents. For example, adolescent alcohol and drug use may interfere with normative tasks of development (Baumrind and Moselle, 1985; Newcomb and Bentler, 1988), which may decrease the likelihood that youth undertake adult roles (Yamaguchi and Kandel, 1987). Although no study has tested whether failure to assume adult roles explains associations between adolescent problems and later SUDs, research has shown that marriage reduces the risk of drug and alcohol dependence in late young adulthood (Grant, 1996; Grant, 1997) and that entrance into the work force is associated with decreased drinking by age 27 (Gotham et al., 1997). In addition, youth who complete college report less marijuana use compared to those who do not (Aitken et al., 2000). Because they are less likely to make these types of transitions (e.g., Brown et al., 2001; Ensminger and Juon, 1998), it may be that adolescent substance users are more likely to develop SUDs during late young adulthood.

Finally, problematic social influences in early adulthood may also provide a link between problems in adolescence and SUDs in adulthood. Many youths who use alcohol or drugs are likely to have friends who use substances (Hopfer et al., 2003; Hussong and Hicks, 2003) and evidence indicates that association with peers who smoke, drink heavily or have alcohol-related problems prospectively predicts young adult smoking, alcohol use and problems (Andrews et al., 2002; Chassin et al., 2002). By extension, association with substance users in early adulthood may predict SUDs in later young adulthood and may be responsible for links between adolescent use and these disorders.

A secondary goal of this paper was to explore whether different adolescent factors and young adult processes are associated with substance abuse versus substance dependence. Schuckit and Smith (2001) addressed this question for alcohol and found that most predictors were associated with both alcohol abuse and dependence; however, having dependent family members only predicted dependence. Another longitudinal study found different adolescent predictors for cannabis abuse versus dependence at age 24: male gender and attitudes predicted abuse, whereas prior drug abuse, family trauma, indicators of mental instability and deprived socioeconomic status predicted dependence (von Sydow et al., 2002). To our knowledge, however, no one has examined factors during both adolescence and early young adulthood to test whether they contribute differently to substance abuse and dependence in late young adulthood.

The current study addresses these gaps in the literature. Using prospective data collected from participants at ages 18 and 23, we examined the impact of factors measured during both adolescence and early young adulthood on substance use outcomes at age 29. To illuminate the processes through which adolescent drug use and behavioral and mental health problems may influence such outcomes, we examined the degree to which substance use, failure to assume adult roles and exposure to pro-drug social influences during young adulthood mediated any association between adolescent problems and later abuse or dependence. We hypothesized that the impact of adolescent problems would be mediated, at least in part, by each of these later behaviors and experiences. We also assessed whether different antecedents predicted substance abuse versus dependence.

Method

Participants and procedure

Data came from youths who participated in the original field trial for Project ALERT, a drug prevention program targeting middle school students (Ellickson and Bell, 1990). Thirty control and treatment schools from California and Oregon were chosen to capture a diverse range of school and community environments, including urban, suburban and rural areas. Nine of the schools had a minority population of 50% or more and 18 schools drew from neighborhoods with household incomes below the median for their state. Of the 6,527 seventh grade students who completed baseline surveys, 1,986 filled out follow-up surveys at each of the three time points, age 18 (wave 7), age 23 (wave 8) and age 29 (wave 9), and are the focus of this paper. The analysis sample was 49% female, 67% white, 9% black, 10% Hispanic, 8% Asian and 4% other race or ethnicity. The mean (SD) age at each assessment period was 18.13 (0.54), 23.5 (0.57) and 29.44 (0.68).

To adjust for sample attrition, we used logistic regression to obtain predicted probabilities of returning a survey at age 18, at age 23 and at age 29 based on information taken from the baseline survey (wave 1) in seventh grade (e.g., gender, drug use, delinquency, drug-related attitudes and family structure) and created weights that were the inverse of those probabilities. Attriters were more likely to be black and male, to do poorly in school and to have used cigarettes and marijuana by Grade 7. However, the weighted sample closely approximates the original baseline sample on these characteristics, removing 90% or more of the known bias from attrition (Ellickson et al., 1997). Such weights have also been shown to perform better in removing bias than other methods, such as tracking students or sample selection modeling (McGuigan et al., 1997).

Youths who consented to participate in the follow-up surveys completed mailed questionnaires at ages 18, 23 and

age 29. Steps were taken to ensure confidentiality, such as preventing non-research personnel from seeing responses, identifying surveys by number and informing participants, both in writing and verbally during phone contacts, that the survey was voluntary, that information they provided was subject to strict confidentiality procedures and that they could refuse to participate at any time. Depending on the year of data collection, participants received between $15 and $30 for returning the survey.

Missing value imputation

Most participants at each wave completed the entire survey; however, there was a small amount of missing data for most variables (1%-6%). To avoid the substantial loss of data that can occur in regressions requiring complete information for each of the included variables, we used least squares regression imputation on continuous predictors and logistic regression imputation on dichotomous predictors (Little, 1992). We did not impute race/ethnicity or either of the outcome variables.

Measures

Demographics, deviance, poor mental health and school dropout were measured at age 18. Substance use and problems were measured at ages 18 and 23. Family history of alcohol or drug problems, adult roles and responsibilities and pro-drug social influence variables were measured at age 23. Substance abuse and dependence were measured at age 29.

Demographic variables. Demographic variables included gender, race/ethnicity and age at baseline. Participants were considered to have a family history of substance problems if they reported that any of their relatives ever had an alcohol problem or a drug problem.

Problem behaviors and poor mental health. Deviance ($\alpha = .86$) was the average of 26 past-year items (e.g., skipped school, been involved in gang fights). Items were coded from 0 (not at all) to 5 (20 or more times). For *school dropout,* youths who indicated that they were not currently enrolled in school at wave 7 and had not graduated or received a high school diploma by age 18 were categorized as dropping out of school. We derived measures of *alcohol, cigarette* and *marijuana use* from items that assessed both participants' quantity of use (number per day of standard drinks [can of beer, glass of wine or shot of distilled spirits], cigarettes, and times used marijuana) and frequency of use (number of days using each substance) in the past 30 days. *Hard drug use* indicated use of illicit drugs other than marijuana (e.g., LSD, cocaine, downers, heroin) and was a dichotomous variable reflecting any past-year use. For alcohol and other drug (AOD) problems at age 18, we standardized and then averaged 13 items

reflecting the number of times (from 0 to 20 or more) in the past-year participants had experienced specific problems because of their alcohol or marijuana use ($\alpha = .86$). Five items were repeated for each substance, including missed school or work, did something they later felt sorry for, got into trouble at school or home, had trouble concentrating on what they were doing, got arrested or held at a police station. Three items were asked for alcohol only, including passed out, felt really sick, got into a physical fight. At age 23, the AOD problems measure included 20 items ($\alpha = .88$). Participants were asked 10 questions for alcohol that were repeated for "drugs not including alcohol, tobacco or drugs prescribed by a doctor" (as opposed to only marijuana). The "trouble at school or home" consequence was changed to "trouble at school or work"; "trouble concentrating" was omitted; and the following were added: got into a traffic accident, were criticized by friends and had difficulty with your spouse or live-in partner. Items were standardized and averaged. *Mental health* status (e.g., been a very nervous person, felt depressed, felt calm and peaceful; $\alpha = .83$) was measured with the well-validated Mental Health Inventory-5 (MHI-5; Stewart et al., 1992).

Adult roles and responsibilities. Adult roles and responsibilities included marriage, whether or not participants were living with a partner (cohabiting), parenthood (e.g., financial responsibility for children), work status and educational attainment (eighth grade or less [1] to Ph.D., M.D., J.D. or advanced degree [11]).

Pro-drug social influences. At age 23, participants were asked separately about use of three substances by members of their social networks. Responses were averaged using a 4-point scale (1 = never; 4 = often) to indicate *how often their best friend* used substances (smoked cigarettes, drank alcohol or used marijuana; $\alpha = .60$) and *how often their spouse or live-in partner* used substances (smoked cigarettes, drank alcohol or used marijuana; $\alpha = .71$). In the latter case, we accounted for participants without a spouse or partner by including a flag in our regression equation.

Dependence. This measure was based on Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV, American Psychiatric Association, 1994) criteria and assessed use of alcohol and drugs (other than those that a doctor told you to take, e.g., prescribed drugs). Similar to DSM-IV criteria, participants who endorsed three or more items were included in the dependence group; items asked whether during the last 12 months the participants (1) had to use a lot more AOD than before to get the same effect (yes or no), (2) experienced withdrawal symptoms when they went without using AOD (yes or no), (3) used more AOD than they intended (not at all, 1 time, 2-5 times, 6-9 times, 10 or more times), (4) tried to cut down use of AOD but could not (yes or no), (5) spent most or all of the day getting AOD, using AOD or recovering from the effects of AOD (not at all, 1 day, 2-5 days, 6-9 days, 10 or

more days), (6) gave up activities like sports, work, school or being with friends or relatives in order to use AOD (yes or no) and (7) had a medical, psychological or emotional problem caused or worsened by AOD use (yes or no).

Abuse. Substance abuse was based on DSM-IV criteria and indicated a maladaptive pattern of substance use leading to clinically significant impairment or distress within a 12-month period. Participants were asked how many times the following things happened to them because of drinking alcohol or using drugs in the past 12 months: missed work, did something you were later sorry for, got into a physical fight, got into trouble at work, got arrested or held at a police station, got into a traffic accident, were criticized by your friends or had difficulties with your spouse or your live-in partner. Two additional items asked how many times in the past month participants missed work, arrived late or left work early because of alcohol (or drug) use. Participants who reported the same consequence three or more times or who reported that two or more different consequences occurred two to four times were included in the abuse group. Reports of missed work in both the past year and past month were counted as only one consequence.

Because the abuse and dependence categories were not based on a diagnostic interview, participants cannot be considered to have received a diagnosis. Hence, we use the terms abuse or dependence *groups* (as opposed to *diagnoses*). Although it is likely that there is considerable overlap between these groups and a clinical diagnosis, we could not confirm this with the data available to us. Similar to DSM-IV criteria, those classified in the dependent group could not also be classified in the abuse group; thus the two sample groups are mutually exclusive. At age 29, 13.3% of the weighted sample were in the abuse group and 12.4% were in the dependent group. Rates are comparable to other research examining abuse and dependence for this age group (e.g., Chassin et al., 1999; e.g., Kessler et al., 1994; Kushner et al., 1999; Lewinsohn et al., 1999).

Analyses

We conducted bivariate tests and four multinomial logistic regressions (MLR). MLR is appropriate for modeling outcome variables with two or more nominal categories. Our models compared the risk of being in the substance abuse group or being in the dependence group relative to not being in either group. We report relative risk ratios (RRRs), which are the probability of abuse or dependence for those with the predictor, compared to those without it.

Model 1 focused on variables measured during adolescence (age 18) and included demographics, substance use and related problems, deviance, poor mental health and school dropout. This model also included family history of substance problems because we considered it to be an indicator of likely genetic vulnerability, and for many youths

this factor was already present in adolescence. We tested mediation using the method described by Baron and Kenny (1986). We first ran the model without the hypothesized mediating variables and examined the RRRs for each individual adolescent predictor variable (Model 1). For this model, we also tested whether adolescent problem behaviors were significant as a group, predicting adult problems independently of demographic factors, using an Adjusted Wald Test (AWT). Based on theories suggesting that substance use, roles and responsibilities, and social influence at age 23 may mediate the association between problem behavior at age 18 and later substance problems at age 29, we then separately and sequentially added groups of age 23 hypothesized mediators to Model 1. Each model tested a different block of variables to see if it added to the prediction of adult problems independent of adolescent problems. Model 2 added variables for substance use and related problems at age 23. Model 3 added adult roles and responsibilities (e.g., marriage, employment at age 23), and Model 4 added pro-drug social influences at age 23. To reduce family-wise error associated with multiple tests of the same hypothesis, we examined the significance of each set of these conceptually related factors as a block, using an adjusted Wald test. Finally, we regressed each of the age 23 hypothesized mediators on our adolescent predictor variables. Evidence of mediation would be present if (1) categorization in the substance abuse or dependence group at age 29 was significantly associated with the adolescent predictor variables in Model 1, (2) the age 23 mediating variables were significantly associated with the adolescent predictor variables in Models 2-4, and (3) the effect of the adolescent predictor variables became smaller when the age 23 mediating variables were entered into the model. The significance of probable mediating effects was confirmed by Sobel (1982) tests.

Results

Bivariate relationships

Using MLR, we first examined the bivariate relationships between abuse and dependence at age 29 and each of the independent variables (see Table 1). Most variables were related to either abuse or dependence, except for age, full-time employment and parenthood. All variables related to abuse were also related to dependence; however, several variables were related to dependence but not abuse. Being Asian and having more education were associated with a lower likelihood of being in the dependent group at age 29, whereas poor mental health, a family history of substance problems, dropping out of school at age 18, using cigarettes at ages 18 and 23, cohabiting at age 23 and being around a partner who used drugs were all risk factors for being in the dependent (but not abuse) group.

TABLE 1. Bivariate relationships between being in the abuse or dependent group at age 29, and characteristics at ages 18 and 23 (relative risk ratios)

Variable	Abuse group	Dependence group	% yes or mean (SD)
Demographics[a]			
Female	0.46‡	0.66*	49.28
Age	0.89	0.85	See *Participants and procedure* section in Method
Ethnicity[b]			
Black	0.80	0.95	9.52
Hispanic	0.78	1.39	10.34
Asian	0.65	0.34*	8.20
Other race	1.67	1.96	4.54
Family history	1.38	1.76†	34.81
Age 18 PB and MH			
Alcohol use	2.41‡	2.89‡	0.31 (0.58)
Cigarette use	1.02	1.11‡	1.40 (3.49)
Marijuana use	1.68*	2.70‡	0.11 (0.41)
Hard drug use	1.92*	3.78‡	20.59
AOD problems (>1)	2.92‡	3.53‡	52.61
Deviance	4.03‡	5.92‡	0.32 (0.39)
Poor mental health	1.03	1.38‡	2.40 (0.94)
School dropout	1.36	2.22‡	16.79
Age 23 substance use			
Alcohol use	2.36‡	2.63‡	0.53 (0.84)
Cigarette use	1.03	1.10‡	2.00 (4.41)
Marijuana use	1.98‡	3.37‡	0.17 (0.49)
Hard drug use	2.81‡	8.66‡	20.12
AOD problems (>1)	6.66‡	10.18‡	61.13
Age 23 roles			
Currently married	0.61*	0.67§	22.13
Cohabitating	1.22	1.68†	19.41
Working full time	1.23	0.98	49.25
Parenthood	1.01	0.90	25.16
Education	0.94	0.87†	19.87[c]
Age 23 social influence			
Closest friend use of drugs	2.02‡	2.53‡	2.24 (0.82)
Partner use of drugs	1.18	1.95‡	1.50 (0.74)

Notes: Based on a multinomial logit model that compares abuse and dependence groups to the nonabusing/nondependent group. PB = problem behavior; MH = mental health; AOD = alcohol and other drug. [a]Female and ethnicity reported from the baseline (wave 1) data; [b]compared with white; [c]% college graduate or higher.
§$p < .10$; *$p < .05$; †$p < .01$; ‡$p < .001$.

Multivariate models

Model 1 tested the relationship between adolescent behaviors and problems measured at age 18 and abuse and dependence measured at age 29, controlling for demographic variables. AWTs for the block of variables that included use of alcohol, cigarettes, marijuana and hard drugs, AOD problems, poor mental health, deviance, high school dropout, and family history of alcohol and drug use were significant for both abuse ($F = 5.39$, 8/22 df, $p < .001$) and dependence ($F = 8.79$, 8/22 df, $p < .001$). Being male, reporting more deviant behavior and heavier drinking at age 18 were associated with a higher likelihood of being in both groups at age 29 (see Table 2). Having more AOD problems at age 18 predicted being in the abuse group, whereas being young for one's cohort and having poor

TABLE 2. Multinomial logistic regression models predicting abuse (A) and dependent (D) groups at age 29 (relative risk ratios)

Variable	Model 1: Base Model A	Model 1: Base Model D	Model 2: Use at age 23 A	Model 2: Use at age 23 D	Model 3: Roles A	Model 3: Roles D	Model 4: Social Influence A	Model 4: Social Influence D
Demographics								
Female	0.50‡	0.70*	0.67*	1.01	0.48‡	0.74§	0.54‡	0.70*
Age	0.78	0.69*	0.82	0.75	0.77	0.69*	0.79	0.74§
Black	1.02	1.30	0.94	1.15	0.88	1.27	0.99	1.15
Hispanic	0.69	1.14	0.66	1.13	0.66	1.13	0.63§	1.07
Asian	0.78	0.43*	0.85	0.44§	0.80	0.43§	0.82	0.45§
Other race	1.56	1.88	1.63	1.45	1.46	1.80	1.47	1.65
Family history	1.33	1.35	1.30	1.10	1.31	1.34	1.26	1.28
Age 18 PB and MH								
Alcohol use	1.65†	1.64†	1.41§	1.40§	1.64†	1.60†	1.55†	1.58†
Cigarette use	0.97	1.02	0.97	1.02	0.97	1.02	0.96	1.01
Marijuana use	0.87	1.31	0.72	0.99	0.88	1.33	0.80	1.17
Hard drug use	0.86	1.20	0.74	0.80	0.85	1.17	0.76	1.03
AOD problems	1.82*	1.52§	1.72*	1.32	1.81*	1.51§	1.76*	1.42
Deviance	1.67*	2.22*	1.53	1.86	1.61§	2.24*	1.55	2.12*
Poor mental health	1.02	1.36‡	1.00	1.37†	1.02	1.36‡	1.01	1.36†
School dropout	1.44	1.44	1.31	1.19	1.27	1.33	1.40	1.38
Age 23 substance use								
Alcohol use	–	–	1.84‡	1.75‡	–	–	–	–
Cigarette use	–	–	0.98	1.00	–	–	–	–
Marijuana use	–	–	1.24	1.67*	–	–	–	–
Hard drug use	–	–	0.91	1.92*	–	–	–	–
AOD problems	–	–	2.78‡	3.33‡	–	–	–	–
Age 23 roles								
Married	–	–	–	–	0.57*	0.94	–	–
Cohabit	–	–	–	–	0.86	1.08	–	–
Work full time	–	–	–	–	1.17	0.89	–	–
Parenthood	–	–	–	–	1.46	0.72	–	–
Education	–	–	–	–	0.96	0.95	–	–
Age 23 social influence								
Closest friend use of drugs	–	–	–	–	–	–	1.77‡	1.72‡
Partner use of drugs	–	–	–	–	–	–	0.84	1.24

Notes: Based on a multinomial logit model that compares abuse and dependence groups to the nonabusing/nondependent group. The first coefficient is for the abuse group age 29 (A); the second coefficient is for the dependent group at age 29 (D). PB = problem behavior; MH = mental health; AOD = alcohol and other drug.
§$p < .10$; *$p < .05$; †$p < .01$; ‡$p < .001$.

mental health predicted being in the dependent group. Asians were less likely to be in the dependent group.

Model 2 assessed mediating and direct effects of substance use and problems at age 23 on SUDs at age 29 (Table 2). AWTs for this block of variables were significant for both abuse ($F = 11.02$, 5/25 df, $p < .001$) and dependence ($F = 20.45$, 5/25 df, $p < .001$). Within this group, alcohol use and AOD problems at age 23 predicted being in both groups at age 29. Marijuana and hard drug use at age 23 were associated with a higher likelihood of being in the dependent, but not the abuse, group. For both groups, deviance and alcohol use at age 18 were no longer significant. Thus, substance use and problems at age 23 may mediate the effects of adolescent substance use and problems on later SUDs. Being male and young for one's cohort also dropped out of the model for dependence.

To test further the potential mediating role of substance use and problems at age 23, we conducted logistic regres-

sions to separately predict alcohol, marijuana and hard drug use, and AOD problems at age 23 from the Model 1 variables. Three significant effects emerged: (1) alcohol use at age 18 predicted alcohol use at age 23 (b [SE] = .27 [.06], $p < .001$), (2) AOD problems at age 18 predicted AOD problems at age 23 ($b = .15$ [.07], $p < .05$), and (3) deviance at age 18 predicted hard drug use at age 23 ($b = .73$ [.30], $p < .05$). We used the Sobel test (1982) to determine whether effects of substance use, problems and deviance at age 18 on abuse and dependence at age 29 were reduced by accounting for substance use and problems at age 23. We found evidence that alcohol use at age 23 mediated the association between alcohol use at age 18 and abuse ($z = 3.33$, $p < .001$) and dependence ($z = 3.14$, $p < .01$) at age 29 (see Figure 1). We also found marginally significant evidence that AOD problems at age 23 mediated the association between AOD problems at age 18 and abuse at age 29 ($z = 1.89$, $p = .059$) and that hard drug use at age 23
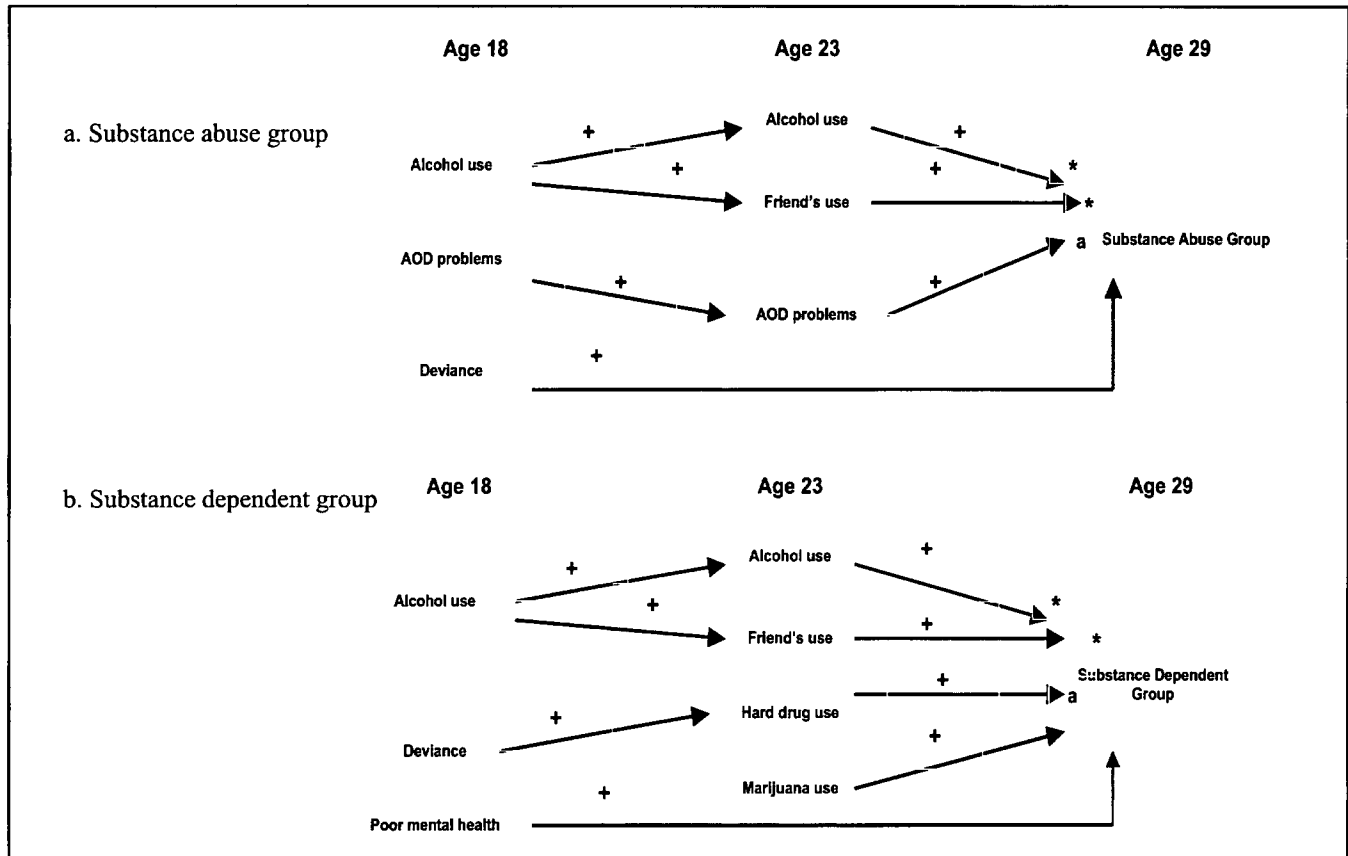
FIGURE 1. Results of models predicting substance abuse and dependence at age 29. Only significant paths are shown. AOD = alcohol and other drug. *mediated effect significant at $p < .05$; [a]mediated effect significant at $p < .10$.

mediated the association between deviance at age 18 and dependence at age 29 ($z = 1.78, p = .08$).

Model 3 added adult roles and responsibilities at age 23 to Model 1. AWTs for this block of variables were marginal for the abuse group ($F = 2.33$, 5/25 df, $p = .07$) and nonsignificant for the dependent group ($F = 0.30$, 5/25 df, $p = .91$). Although this relationship should be interpreted with caution given the marginal AWT, marriage at age 23 was negatively related to being in the abuse group at age 29. Nevertheless, adding marriage to the abuse model did not alter the coefficients for alcohol use or AOD problems and only modestly reduced that for deviance. Given that early deviance and marriage were unrelated, the mediational hypothesis for marriage was not supported.

Model 4 added pro-drug social influence variables to Model 1. AWTs for this set of variables were significant for both the abuse ($F = 8.71$, 3/27 df, $p < .001$) and dependence groups ($F = 11.00$, 3/27 df, $p < .001$). Being around friends who used drugs (e.g., alcohol, cigarettes and marijuana) at age 23 predicted being in both groups at age 29. As compared to Model 1, age was now only marginally related to being in the dependent group. Although still significant, the coefficient for alcohol use was reduced for

both groups. The coefficient for deviance was reduced for dependence and no longer significant for abuse, and the AOD problem coefficient was reduced for abuse and no longer significant for dependence. Analyses showed that alcohol use at age 18 was positively associated with being around friends who used substances at age 23 ($b = .15$ [.05], $p < .01$). Sobel tests indicated that being around friends who used substances at age 23 mediated the association between alcohol use at age 18 and being in both the abuse ($z = 2.44, p < .05$) and dependent groups ($z = 2.29, p < .05$) at age 29. Figure 1 summarizes the direct and mediated effects identified in the above analyses in graphic form.

Discussion

The current study extended past research by examining three avenues in early young adulthood (substance use, failure to assume adult roles and exposure to pro-drug social influences), which may link adolescent problems to substance use problems in later young adulthood. Bivariate relationships suggested that several risk and protective factors during adolescence and early young adulthood predicted being in the dependent group but not the abuse group.

Consistent with Schuckit's work (e.g., Schuckit and Smith, 2001), family history was associated with being in the dependent but not the abuse group. Similarly, school dropout, cohabiting, less education, poor mental health and a partner who uses drugs were all associated with dependence but not abuse. Thus, youths with more initial risk factors had a greater likelihood of being in the dependent group. Use of each drug examined and AOD problems at ages 18 and 23 were associated with both abuse and dependence (except age 18 cigarette use, which did not predict abuse). This confirmed our hypothesis that substance use at both time points predicted abuse and dependence in late young adulthood.

Multivariate analysis explored these associations more thoroughly. Our base model revealed that three adolescent problems were associated with abuse and dependence at age 29: alcohol use, AOD problems and deviant behavior. Although several of the same predictors were associated with both the abuse and dependence indicators, there were some differences. Poor mental health predicted being in the dependent but not the abuse group, suggesting differences in the influence of internalized problems on these two disorders.

Mediation tests illuminated the processes through which early problems might affect later substance use problems. Results indicated that youths who drank heavily during the teen years were more likely to continue this pattern into early young adulthood and subsequently to meet our criteria for abuse or dependence in late young adulthood. In addition, youths who experienced AOD problems at age 18 and age 23 were more likely to be categorized as substance abusers at age 29. Although the mediated effect for AOD problems was only marginal for dependence, the Sobel test is known to be conservative (MacKinnon et al., 2002). This mediation suggests that continued use during early young adulthood contributes to subsequent problems in late young adulthood. Pro-drug social influence during early young adulthood also mediated the association between adolescent alcohol use and abuse and dependence at age 29, suggesting that teens who use alcohol more heavily develop disorders in part because they are more likely to associate with substance-using peers in young adulthood. These findings indicate that prevention efforts based on countering peer influence and providing normative feedback (e.g., Borsari and Carey, 2000; D'Amico and Fromme, 2002) may be particularly relevant for these youths. More information about peer and partner use of specific substances might help identify which substances were more influential (e.g., alcohol, cigarettes or marijuana) in predicting abuse or dependence in late young adulthood.

We found no support for the hypothesis that substance use or deviance might be related to adult substance use through their adverse effect on role assumption. Although marriage was the only role change that protected young adults against later problems at age 29, it did not mediate the effects of earlier substance use or deviant behavior. Hence, the effect of marriage on later abuse appears to be independent of its relationship with adolescent patterns of problem behavior.

We were also unable to pinpoint the process by which adolescent deviance affects substance use problems during late young adulthood. Although adding young adult substance use, role assumption or social influences to the base model did reduce the strength of deviance as a predictor, only hard drug use appeared to mediate the early deviance/ later dependence relationship and that effect was marginal. Further research is needed to provide evidence that hard drug use does or does not play a mediating role in the development of substance dependence.

Finally, our results indicated that poor mental health has a significant direct relationship with dependence at age 29. This underscores the potential long-term impact that poor mental health during adolescence may have on subsequent substance use problems in late young adulthood. The lack of mediation via any of the processes assessed indicates that it is not continued or escalating use, difficulties with role assumption or problematic social influences that explain this relationship. The relationship may instead be direct, with internalized problems creating a reliance on alcohol or drugs to navigate daily life. That we can identify this risk as early as adolescence is promising. Unfortunately, most teens do not voluntarily seek help for mental health problems (e.g., Offer et al., 1991) because of lack of knowledge of the availability of programs (Balch, 1998) or fears about confidentiality and embarrassment (Ackard and Neumark-Sztainer, 2001). Thus, our findings stress the importance of making mental health services more accessible to this age group, as this may help prevent some of the social and economic costs associated with substance dependence in late young adulthood.

Our findings clarify how problem behaviors during these two developmental periods can impact a young adult's future and underscore the need for programs designed to reach teens and young adults who use substances regularly and experience problems (Larimer et al., 1998). Interventions focused on normative feedback and skills training have been successful with high school students who abuse substances, with teens substantially decreasing their alcohol use, drunk driving episodes (D'Amico and Fromme, 2002) and hard drug use (Sussman et al., 2002; Sussman et al., 1998) after receiving these interventions. Other successful prevention programs have utilized a social norms or harm reduction approach to decrease heavy substance use during early young adulthood (Borsari and Carey, 2000; Larimer and Cronce, 2002; Perkins, 2003). Thus, prevention efforts aimed at decreasing heavier use during these transitional periods may diminish the likelihood of developing substance abuse or dependence in late young adulthood.

Limitations of this study include our reliance on self-reported substance use and problems, the geographical confinement of the original sample to California and Oregon areas and substantial sample attrition over the 11-year period. We took steps to mitigate these limitations. First, we utilized procedures to decrease under-reporting of alcohol and other drug use, finding that use rates in this sample were highly accurate when subjected to internal reliability checks and externally validated against saliva test results (Reinisch et al., 1991). To increase the original sample's generalizability, we selected participants from communities that were ethnically diverse and represented a wide range of socioeconomic statuses. Estimates of drug use and related problem behaviors in both this and other studies have paralleled those for national samples (Ellickson et al., 1996; Ellickson et al., 1997). Our use of sample weights reduced over 90% of the attrition bias with respect to gender, ethnicity, baseline grades and baseline substance use. Nevertheless, to the extent that the weights failed to account for other differences between attriters and nonattriters, nonrandom study attrition may reduce the generalizability of the results. We also note that we lacked information on the stability of the abuse and dependence groups over time and that our abuse and dependence indicators were measured for a combination of substance types and were based on questionnaire data, not a diagnostic interview. Hence we were unable to draw conclusions about clinical disorder or to examine whether adolescent and young adult variables differentially predict alcohol versus drug abuse or dependence.

Despite these limitations, our findings provide a significant contribution to the literature on predictors of substance abuse and dependence. They highlight the importance of two behaviors of early young adults, ongoing substance use and association with substance using peers, in escalating patterns of heavy substance use developed during adolescence into late young adult disorders. They also underscore the long-term association of poor mental health during adolescence with substance use problems in late young adulthood. Results emphasize the importance of creating multifaceted prevention approaches to target alcohol and drug use during both of these important developmental periods.

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