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Longitudinal Relations Among Negative Affect, Substance Use and Peer Deviance During the Transition from Middle to Late Adolescence

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Abstract

The transition from middle to late adolescence brings challenges that increase risk for emotional, behavioral, and social problems. The nature of the associations among these types of problems is poorly understood. This National Institute on Drug Abuse-funded study examined longitudinal relations among negative affect, substance use, and peer deviance from ages 16 to 18 years. Multiwave youth and parent questionnaire data collected from 429 6thgraders (222 girls) and their families residing in the rural Midwestern United States and recruited in 1993 were analyzed via structural equation modeling. Consistent with the self-medication hypothesis, negative affect statistically predicted increased substance use over time. Implications for theory and prevention are discussed and the study's limitations are noted.

Keywords

Negative Affect; Substance Use; Peer Deviance; Adolescence; Longitudinal

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The transition from middle to late adolescence is characterized by complex changes related to biological, psychological, and social functioning. For example, it is during this time that many teens experience enhanced freedoms and mobility as they individuate from their families of origin and prepare for the interpersonal, educational, and vocational demands of early adulthood. As is typical in role transitions (Stuart & Robertson, 2003), new challenges during this developmental period increase teens' risk for a host of emotional and behavioral problems. In particular, indicators of negative affect, such as depression and hopelessness, typically increase dramatically throughout the teen years (Costello et al., 2002), especially among girls (Hankin et al., 1998). Moreover, substance use onset often occurs in middle adolescence, with a steady rise in the frequency of substance use extending throughout late adolescence (Johnston, O'Malley, & Bachman, 2002). In the United States and many other developed countries, alcohol drinking and cigarette smoking are the most common forms of substance use among late adolescent boys and girls (Hibell, Anderson, & Bjarnasson, 2004; Johnston, O'Malley, & Bachman, 2006), and many teens are involved with both of these substances (Jackson, Sher, Cooper, & Wood, 2002); use of alcohol and cigarettes is

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associated with increased mortality and morbidity (Institute of Medicine, 2004; Mathers, Toumbourou, Catalano, Williams, & Patton, 2006). Importantly, the increasing influence of peers can be a contributing factor to emotional and behavioral problems faced in late adolescence, as numerous studies have documented the adverse correlates and consequences of deviant peer associations (e.g., Dishion, Patterson, & Griesler, 1994; Li, Barrera, Hops, & Fisher, 2002).

Rather than being isolated problems, there is evidence that adolescent negative affect, substance use, and peer deviance are interrelated (Elliott, Huizinga, & Menard, 1989). However, the precise nature of the relationships is unclear and research findings examining predictive effects among these variables have been mixed (as reviewed below). In part, progress in this area of research has been hampered by limitations in previous studies, including (a) a lack of clear theoretical guidance, (b) poor specificity in the developmental period of adolescence that is under investigation, and (c) an overreliance on cross-sectional data. In addition, many studies have been based on clinical or high-risk samples of teens. To address these limitations, the current study draws on multiwave panel data collected from a sample of adolescents from the rural Midwestern United States to test theoretically hypothesized longitudinal relations among negative affect, substance use, and peer deviance during the transition from middle to late adolescence.

Conceptual Framework

The conceptual framework guiding this research is illustrated in Figure 1. In conjunction with the discussion below, this framework outlines hypothesized links among study variables. The self-medication hypothesis suggests that individuals use substances to alleviate their symptoms of dysphoria (Khantzian, 1985). Thus, in its basic form, the self-medication hypothesis suggests that there should be a positive effect of earlier negative affect on later substance, as represented by path b in Figure 1. As discussed later, recent research has begun to examine the critical conditions under which self-medication processes do and do not operate (Hussong, Galloway, & Feagans, 2005;Hussong, Hicks, Levy, & Curran, 2001); here, it is expected that negative affect in middle adolescence will lead to increased substance use in late adolescence.

It is possible, however, that a causal effect goes in the opposite direction: from substance use to negative affect. This possibility is consistent with the impaired functioning hypothesis (Newcomb & Bentler, 1988), which highlights the adverse consequences, including negative affect, that can result from substance involvement. For example, animal and human studies have shown that the pharmacological effects of both alcohol (Koob & Le Moal, 2001) and nicotine (Pomerleau & Pomerleau, 1984) may alter the brain's reward system; these effects, as well as the drug experience itself, can increase the likelihood of negative affect. Alternatively, adolescent substance use may compromise the successful completion of critical developmental tasks related to functioning in school, family, and peer contexts (Baumrind & Moselle, 1985), which, in turn, could increase risk for negative affect. For example, substance use could negatively impact an adolescent's school performance, which could, in turn, increase the likelihood of the adolescent experiencing feelings of hopelessness, worthlessness, and sadness. Regardless of the specific mechanism, the impaired functioning hypothesis suggests that substance use in middle adolescence will lead to increased negative affect in late adolescence (path c in Figure 1).

The stake in conformity hypothesis, which is illustrated by path d in Figure 1, suggests that negative affect promotes peer deviance. Because negative affect can make it difficult to establish and maintain positive relationships with conventional peers (e.g., Kaplan, 1975,1980;Kaslow, Brown, & Mee, 1994), teens who struggle with emotional problems may lose their “stake” in prosocial socialization and seek out deviant peer associations (Damphousse & Kaplan, 1998). Thus, according to this perspective, negative affect in middle adolescence will lead to increased peer deviance in late adolescence (path d in Figure 1).

Peer deviance may lead to increased substance involvement among teens (path e in Figure 1), possibly through a socialization process in which deviant behavior is acquired and reinforced through peer interactions (Kandel, 1978;Oetting & Beauvais, 1987). Peer deviance also may increase risk for negative affect (path f in Figure 1) through a process that has been termed the “cumulative continuity of disadvantage” (Caspi, Bem, & Elder, 1989), in which the negative personal and social consequences of a deviant lifestyle accumulate over time, progressively limiting future opportunities for healthy development. Failure to succeed in conventional activities may engender negative affect (cf. Capaldi & Stoolmiller, 1999).

Finally, according to the peer selection hypothesis (Kandel, 1978), adolescent substance use leads to increased peer deviance over time (path g in Figure 1). Rather than learn deviant behavior from their peers, teens may seek out and choose to spend time associating with like-minded friends, that is, friends who are engaged in and promote deviant behaviors. Note that the hypotheses depicted in Figure 1 are not necessarily competing. Instead, they are potentially compatible theoretical expectations. Furthermore, because contemporary theory and research increasingly have called attention to the complex, dynamic nature of human behavior and biopsychosocial processes (Buscema, 1998; Cicchetti & Rogosch, 2002; Grossi & Buscema, 2006), these hypotheses represent initial but important steps in defining and understanding processes involved in the development of negative affect, substance use, and peer deviance among teens.

Longitudinal Relations Among Negative Affect, Substance Use, and Peer Deviance

Studies examining the self-medication hypothesis among teenagers have produced mixed findings. On the one hand, certain research has indicated that indicators of negative affect may increase risk for adolescent substance use (Henry et al., 1993; Wills, Sandy, Shinar, & Yaeger, 1999). For example, isolating an earlier period of adolescent development than the one in the current study, Wills and his colleagues (1999) found that negative affect among participants at age 12 years positively predicted substance use among those same participants three years later, at age 15 years. On the other hand, additional studies have reported no effect of negative affect on substance involvement (Hansell & White, 1991; Kumpulainen & Roine, 2002). Instead, some studies have revealed that substance use may increase symptoms of negative affect, such as psychological distress and depression, throughout late adolescence (Hansell & White, 1991) and even into young adulthood (Brook, Cohen, & Brook, 1998); these findings are consistent with the impaired functioning hypothesis.

In general, few investigators have examined links between indicators of negative affect and peer deviance among teens. In an important exception to this trend, Damphousse and Kaplan (1998) reported that feelings of alienation induced by psychological distress predicted deviant peer associations among adolescent participants in their longitudinal study, a finding that is consistent with the stake in conformity hypothesis. These authors also reported results that were consistent with a cumulative continuity of disadvantage process in that deviant peer associations were associated with a range of adverse consequences that led to increased psychological distress (cf. Capaldi & Stoolmiller, 1999). Given the paucity of research examining associations among these variables, additional studies are warranted.

More commonly, investigators have examined links between peer deviance and adolescent substance use in tests of peer socialization and selection processes. In this regard, studies of adolescents have demonstrated that peer deviance may statistically predict increased substance use (Damphousse & Kaplan, 1998; Li et al., 2002), substance use may statistically predict increased peer deviance (Reed & Rountree, 1997), and these variables may mutually predict one another in a reciprocal causation process (Curran, Stice, & Chassin, 1997).

In sum, although investigators have begun to examine longitudinal relations among negative affect, substance use, and peer deviance in adolescents over time, findings are mixed. Little research has examined these variables simultaneously. In addition, many studies have included cohorts with a wide age range, which makes it more difficult to isolate processes that may be specific to a certain period of adolescent development. For these reasons, further research is needed.

Overview of the Current Study

In the current study, panel data were analyzed using structural equation modeling (SEM) to simultaneously test the hypotheses depicted in Figure 1 during the transition from middle to late adolescence. The nature of these associations may differ for boys and girls (Marmorstein & Iacono, 2003;Whitmore et al., 1997). For example, Henry et al. (1993) found that depressive symptoms, as an indicator of negative affect, positively predicted substance use among adolescent boys but not among adolescent girls. Thus, multiple-group analyses were conducted to test for gender moderation of the hypothesized relations.

As a final consideration, relationships among negative affect, substance use, and peer deviance may be better explained by background characteristics. As one of several considerations in the establishment of causality (Hill, 1965), putative causal links between a risk factor (e.g., negative affect) and an outcome (e.g., substance use) may actually reflect a noncausal association due to common “third variable” predictors, such as early substance use and impulsivity. To illustrate, although substance involvement is prevalent and, therefore, statistically normative in late adolescence, onset of substance use in early adolescence is nonnormative, at least in the United States where this study was conducted, and may reflect a general propensity for deviance and related problems (Donovan & Jessor, 1985). Early onset alcohol (Hingson, Heeren, & Winter, 2006; Institute of Medicine, 2004) and tobacco (Chassin, Presson, Pitts, & Sherman, 2000) use increases risk for further substance involvement, including the development of substance use disorders, and diminishes psychosocial functioning in family, school, and peer contexts. Impulsivity is characterized by impatience, inattention, and thrill-seeking (Buss & Plomin, 1975), and is correlated with substance use (e.g., Acton, 2003), negative affect (e.g., Lengua, West, & Sandler, 1998), and peer deviance (e.g., Barnow et al., 2004). For the current analyses, indicators of early adolescent substance use and impulsivity, as well as a measure of parent educational attainment, which has been shown to be associated with missingness from this longitudinal study, were included as covariates.

METHODS

Sample

Data were derived from Project Family (Spoth & Redmond, 2002), a panel study of rural sixth-graders and their families, some of whom participated in brief universal substance use preventive interventions1. In the Fall of 1993, 883 families with sixth-grade children in rural communities of a Midwestern state in the United States were invited to participate in the study. Forty-nine percent (N = 429) of invited families completed the baseline (Wave 1) assessment. A prospective participation factor survey documented the representativeness of the sample with respect to a range of sociodemographic characteristics (Spoth, Redmond, Kahn, & Shin, 1997).

Initially, the average age of children was 11 years; the average age of mothers and fathers was 37 and 40 years, respectively. Fifty-two percent (n = 222) of target children were girls. Families had an average of 3 children in 1993, and most were dual-parent in structure (86%). The majority of mothers (61%) and fathers (58%) reported having some post-high school education. When the study began, the median annual household income was $32,000. Most of the participants were White (> 95%), a reflection of the rural Midwestern region of the United States in which the study was conducted. Background characteristics of the sample at baseline are summarized in Table 1.

With background covariates measured at age 11 years, the current study used age 16 and age 18 assessments of substance use, negative affect, and peer deviance to isolate the developmental transition from middle to late adolescence. Sixty-nine percent (n = 295) of teens participated at age 16 and 71% of teens participated at age 18. Extensive attrition analyses have been conducted, comparing assessment dropouts versus completers across a range of sociodemographic characteristics and psychosocial variables, and minimal differences have been revealed. However, there is consistent evidence that families with parents who report higher compared to those who report lower educational attainment are more likely to stay in the study (Spoth, Redmond, & Shin, 1998).

Procedure

Families interested in participating were contacted by a project staff member to schedule a home visit. Project staff were individuals with a background in social science who represented a mix of age and gender groups, and were predominantly White. Families then received information describing the assessments and the program components of the prevention trial and a packet of initial questionnaires to be completed individually by the parent(s) and the target children in the home. At the in-home visit, families completed additional assessments (baseline - Age 11 years) conducted via written questionnaires. Assessments took 60-80 minutes to complete and included information about family demographics, parent-child interactions, parenting practices, finances, parent work experiences, and child school experiences, as well as information about parent and child involvement in substance use and delinquency/crime. Prior to data collection, all families were informed that they were under no obligation to participate, that they could withdraw at any time, and that they may be randomly assigned to participate in a brief parent- and teen-training program. Participants were compensated $10/hour for their study involvement. Approximately 9 months later, similar procedures were used to collect follow-up information (Age 12 years). Such procedures also were used to collected data at follow-up assessments roughly 21 (Age 13 years), 33 (Age 14 years), 51 (Age 16 years), and 75 (Age 18 years) months after the baseline assessment, when students were in the 7th, 8th, 10th, and 12th grades, respectively. At each assessment, informed consent was obtained from participants and assent was obtained from adolescents; individuals were assured that their responses would remain confidential. All study procedures were approved by the human subjects review committees at Iowa State University and the University of Washington.

[1]Note that the current analyses were based on data from two conditions of a larger prevention trial conducted at Iowa State University (ISU): the control condition and a Preparing for the Drug Free Years (PDFY) condition. PDFY (currently called Guiding Good Choices) is a universal substance use prevention program developed at the University of Washington (UW). Data from these two conditions were available to the UW investigative team, which conducted the analyses, via an agreement from investigators at ISU. The larger trial includes an additional intervention condition, the Iowa Strengthening Families Program (ISFP) condition, that is based on work conducted solely at ISU; for this reason, data from families in the ISFP condition were not available to the UW team and are not included here.

Measures

Substance use—Substance use at ages 16 and 18 years was measured as a latent variable indicated by self-reported frequency of cigarette smoking and alcohol use. Adolescents were asked to report "During the past 12 months, how often did you smoke cigarettes?" on a scale ranging from (1) "not at all" to (7) "About two packs a day" (M = 1.63, SD = 1.14 for age 16; M = 2.01, SD = 1.45 for age 18). Teens also indicated their frequency of alcohol use during the past 12 months on a scale ranging from (0) "not at all" to (6) "about every day" (M = 2.04, SD = 1.26 for age 16; M = 2.81, SD = 1.58 for age 18).

Negative affect—Negative affect at ages 16 and 18 years was measured as a latent variable indicated by self-reported depressed mood, low self-esteem, and hopelessness. Depressed mood was the average of 8 items (e.g., "I am unhappy, sad, or depressed") from the Child-Behavior Checklist-Youth Self-Report (CBCL-YSR, Achenbach, 1991) assessed on a 3-point scale ranging from (0) "Not true" to (2) "Very or often true" (M = .29, SD = .36 at age 16; M = .27, SD = .34 at age 18). Alpha reliability was .85 at age 16 and .84 at age 18. Low self-esteem was measured with 10 items adapted from the Rosenberg (1979) Self-esteem Scale using a 5-point Likert scale ranging from (1) "Strongly agree" to (5) "Strongly disagree" (M = 2.05, SD = .69 for age 16; M = 1.91, SD = .61 for age 18). All items were coded in the direction of low self-esteem. Alpha reliability was .91 at age 16 and .89 at age 18. Hopelessness was a single item that asked teens "Have you felt that the future looks hopeful and promising?" on a scale ranging from (1) "All of the time" to (6) "None of the time" (M = 2.48, SD = 1.17 for age 16; M = 2.30, SD = 1.06 for age 18).

Peer deviance—Peer deviance at ages 16 and 18 years was measured as a latent variable indicated by self-reported deviant peer associations and peer pressure. Deviant peer associations was the sum of 6 items asking teens to indicate how many of their close friends engaged in delinquent behaviors, such as vandalism and theft, in the past year. Response options ranged from (1) "None of them" to (5) "All of them" (M = 8.39, SD = 3.41 for age 16; M = 8.81, SD = 3.23 for age 18). Alpha reliability was .88 at age 16 and .81 at age 18. Responses to 2 items on a scale ranging from (1) "Often" to (4) "Never" were reverse coded and summed to compute a peer-pressure scale (M = 3.23, SD = 1.61 for age 16; M = 3.25, SD = 1.60 for age 18). Teens were asked how often their friends try to get them to "Do things at school" and to "Do something else" that can get them into trouble. Alpha reliability was .89 at age 16 and .90 at age 18.

Age 11 Covariates—Mothers and fathers indicated the highest grade of schooling that they had completed. These reports were standardized and summed into a measure of parent educational attainment. Adolescent-reported early-onset substance use was a dichotomous variable that indexed use (coded 1; 8%) or non-use (coded 0; 92%) of any of the following substances at age 11 years: cigarettes, smokeless tobacco, alcohol, marijuana, inhalants, and other illicit drugs. Responses to 13 self- and parent-report items (e.g., "Child loses temper during disagreements") drawn from the CBCL-YSR and the Revised Problem Behavior Checklist (Quay & Peterson, 1983) were standardized and averaged to compute an adolescent impulsivity scale (α = .64). Finally, gender was coded 1 for males and 0 for females.

Analysis

The data were analyzed via SEM in Mplus 4.0 (Muthén & Muthén, 2006) using MLR estimation, which provides chi-square fit statistics and standard errors for parameter estimates that are robust to nonnormality. To evaluate model fit, we examined the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). Current guidelines suggest that a CFI of close to .95 or greater and a RMSEA of close to .06

or less indicate acceptable model fit (Hu & Bentler, 1999). Analyses incorporated maximum likelihood missing data estimation, which yields more efficient and less biased parameter estimates than traditional missing data methods (Schafer & Graham, 2002). With advanced missing data estimation, the structural equation models were based on the full sample of 429 participants.

Project Family incorporated a preventive intervention within it during the early years of the project (see Footnote). Two steps were taken to determine the appropriateness of the current data for conducting covariance structure analyses (i.e., SEM) to examine etiological processes. First, a multiple-group model that constrained to equality across conditions all 153 covariances among the 18 observed variables was compared with a multiple-group model that freely estimated across conditions all of those covariances. Note that the unconstrained model had zero degrees of freedom and a chi-square value of zero. Results from this highly conservative test showed that the fully constrained model fit significantly worse than that of the perfectly fitting unconstrained model based on a chi-square difference test, χ^2 (153, N = 429) = 199.43, $p < .05$, even though alternative fit indices for the fully constrained model displayed acceptable values (CFI = .97; RMSEA = .04). Examination of modification indices revealed that only three covariances were somewhat different across conditions: the association between age 18 low self-esteem and age 18 cigarette smoking ($b_{control} = .22$; $b_{experimental} = .08$), the association between age 18 low self-esteem and age 18 hopelessness ($b_{control} = .32$; $b_{experimental} = .45$), and the association between age 16 hopelessness and gender ($b_{control} = .07$; $b_{experimental} = -.06$). Releasing these three constraints resulted in a model that displayed acceptable fit statistics and that did not fit significantly worse than the perfectly fitting unconstrained model, χ^2 (150, N = 429) = 176.73, $p > .05$; CFI = .98; RMSEA = .03). These results suggest that the vast majority of associations among variables were the same across experimental conditions. Second, correlation and regression analyses showed that a variable indexing intervention status was not related to the variables of interest in the current study and that including a program variable indexing experimental versus control group status did not alter the pattern of findings reported below. For these reasons, analyses proceeded with the full, pooled sample.

RESULTS

To investigate possible gender differences in the hypothesized relations, the model depicted in Figure 2 was compared for boys and girls using multiple-group SEM. Results showed no differences in either the factor structure or predictive associations among latent variables; only one difference in estimated covariate effects was observed: the positive link between age 11 impulsivity and age 16 peer deviance was stronger for boys than girls (a summary of results is available on request). Given the presence of very few differences across gender groups, analyses were conducted on the total sample, including gender as a covariate.

Before discussing results from the final SEM, we note that an initial confirmatory factor analysis (CFA) was conducted to examine the measurement model and the basic associations among variables. All correlations among the 6 latent variables and the 4 covariates were estimated. Also, correlations between measurement errors of the same variable measured over time were estimated to account for possible method effects and other stable sources of systematic variation in the repeated measurements. The fit between the data and the CFA model was acceptable, χ^2 (91, N = 429) = 169.37, $p < .05$, CFI = .93, RMSEA = .05. Factor loadings were positive and statistically significant, ranging from .56 to .90 (see Table 2). Longitudinal constraints were placed on the (unstandardized) factor loadings to ensure that the latent outcomes were measured consistently over time. Prior analyses indicated that these constraints did not significantly reduce the fit of the model when compared to that of a model that allowed factor loadings to vary over time.

Correlations from the CFA are reported in Table 3. All but 3 of the correlations among latent variables were positive and statistically significant. Age 16 negative affect was unrelated to age 18 peer deviance. Both age 16 peer deviance and age 16 substance use were unrelated to age 18 negative affect.

To test hypothesized predictive relations among variables, the structural model in Figure 2 was estimated. Although not depicted in the figure, each latent variable was regressed on the 4 exogenous covariates, which were allowed to covary. The fit between the data and the structural model was acceptable, χ^2 (91, N = 429) = 172.67, $p < .05$, CFI = .93, RMSEA = .05. Statistically significant path estimates are reported in Figure 2. A full report of all parameter estimates is available on request. Each outcome was relatively stable. There was only one statistically significant predictor of change among the latent outcomes. Controlling for prior substance use, there was a positive estimated effect of age 16 negative affect on age 18 substance use, indicating that negative affect was associated with increased substance use over time.

Estimated effects of the covariates on the latent outcomes are reported in Table 4. As expected, boys were more likely to report peer deviance in adolescence, at ages 16 and 18. Unexpectedly, male gender had a significant negative association with substance use at age 16, indicating that girls had greater risk for substance use than boys at this time point. Interestingly, impulsivity was a significant positive predictor of age 16 negative affect. Early substance use had a significant positive association with substance use at age 16, but did not predict change in substance use at age 18. Finally, parent educational attainment was associated with lower substance use at age 16 and predicted decreased substance use at age 18.

Residual correlations among negative affect, peer deviance, and substance use at age 16 were positive and statistically significant. At age 18, significant positive residual correlations were observed between negative affect and peer deviance and between peer deviance and substance use. Including estimated stability effects, the model in Figure 2 accounted for an estimated 53% of the variance in age 18 negative affect, 35% of the variance in age 18 peer deviance, and 80% of the variance in age 18 substance use.

DISCUSSION

In this study, age 16 negative affect was a positive statistical predictor of age 18 substance use, controlling for prior substance use. Although the estimated effect was not large in magnitude, this finding is consistent with certain prior research (e.g., Wills et al., 1999) and with the self-medication hypothesis (Khantzian, 1985), which suggests that some individuals may turn to substance use to escape from or cope with their symptoms of negative affect. Other studies have not supported the self-medication hypothesis among teens (Hansell & White, 1991; Kumpulainen & Roine, 2002). A few considerations may help explain this discrepancy in findings. A number of studies have been based on either clinic-referred or high-risk samples of adolescents, whereas the current study examined data collected from a normative sample of rural teens. Moreover, this study isolated the developmental transition from middle to late adolescence, a period in the lifespan when problems, such as negative affect and substance use, typically increase and predictive relations may strengthen. Thus, variations in study characteristics, such as the samples targeted (e.g., general population teens, clinic-referred teens) and the developmental periods covered (e.g., late adolescence, young adulthood) may help explain differences in findings within the literature, and a careful consideration of these characteristics may begin to elucidate for whom and under what conditions hypothesized effects are observed.

Cross-lagged correlations among latent variables from the CFA were consistent with hypothesized associations, with only a few exceptions. However, under the more stringent test of the structural model, only the link between earlier negative affect and later substance use remained statistically significant. Age 16 negative affect was unrelated to age 18 peer deviance in the CFA and did not predict change in peer deviance over time in the SEM. Furthermore, age 16 peer deviance was unrelated to age 18 negative affect, lending little support to theoretical frameworks that causally link these outcomes. Interestingly, the correlation between the residuals of the negative affect and peer deviance latent variables at age 18 remained statistically significant after accounting for estimated effects of the age 16 latent variables and the covariates. It is possible that hypothesized processes linking these variables operate on either a shorter (e.g., stake in conformity) or longer (e.g., cumulative continuity of disadvantage) time lag than the two-year interval examined in the current analyses.

Age 16 substance use also was unrelated to age 18 negative affect. This, combined with the finding that early substance use did not influence negative affect at either age 16 or age 18, runs contrary to expectations derived from the impaired functioning hypothesis with regard to negative affect as an outcome. Heavier substance use, involvement with harder drugs, or sustained substance use may be more likely to engender negative affect among teens. Alternatively, the adverse consequences of substance use for psychological functioning may emerge later in development, for example, in young adulthood.

Somewhat surprisingly, there was little evidence for peer socialization and peer selection with respect to substance use in the SEM analysis, despite the presence of significant associations among peer deviance and substance use in the CFA analysis. It is possible that substance-related socialization and selection processes play a stronger role in development during early adolescence, when opportunities for deviant peer involvement and substance use typically begin to increase. On a methodological note, it is important to reiterate that the model depicted in Figure 2 represents a somewhat stringent test in that both stability effects and covariate effects are accounted for in the analysis. For example, stability effects estimated over a time lag of more than two years likely would be weaker than those observed in the current study, thereby leaving a larger proportion of variance remaining that could be explained by other predictors. Note also that the correlation between the residuals of the peer deviance and substance use latent variables at age 18 was statistically significant.

Covariate Effects

There were several estimated effects of the covariates on the primary variables in this study. For example, early substance use at age 11 was associated with a higher level of substance use at age 16; however, early substance use did not predicted increased substance use from age 16 to age 18. Increased substance involvement during the transition from middle to late adolescence appears to be driven more by proximal factors, such as negative affect in middle adolescence, than by distal indicators of early substance use. Of course, early onset substance use is not benign (Institute of Medicine, 2004); for example, it increases the likelihood of substance involvement in middle adolescence, which in turn increases the likelihood of substance involvement in late adolescence, due to the relative stability of substance use over this time period.

Although male gender was associated with peer deviance in expected ways, it was negatively related to substance use in middle adolescence, indicating that boys were less likely than girls to use substances at age 16. This is inconsistent with much prior research, which has shown either elevated substance use among boys compared to girls (e.g., in substance misuse; Ellickson, Tucker, Klein, & McGuigan, 2001) or no gender differences in adolescent substance involvement (e.g., in substance initiation; Barnes, Welte, & Dintcheff, 1993). There appears to be an enhancement effect in our multivariate prediction model in that the correlation between gender and age 16 substance use was not statistically significant in the CFA model. For these reasons, we hesitate to offer substantive conclusions about this finding. Prior project analyses have revealed the importance of parent educational attainment in this sample (Spoth et al., 1997), which was further indicated by estimated predictive effects of this variable on substance use at ages 16 and 18 in the current analysis. Finally, it is noteworthy that impulsivity was a significant positive predictor of negative affect at age 16. Although Lengua et al. (1998) reported significant correlations between indicators of impulsivity and negative affect among children of divorced parents, they found no predictive relationships between these variables when controlling for the independent effects of other dimensions of temperament, such as task orientation and negative emotionality. Such a test was beyond the scope of the current study, therefore further research is indicated.

Implications

By targeting a specific period of adolescent development and testing for predictors of change over time, these findings contribute to a deeper understanding of the relationships among negative affect, substance use, and peer deviance. Moreover, moderation analyses revealed little evidence of gender differences in the predictive relations, which suggests that the basic processes under investigation are more similar than different for adolescent boys and girls.

The findings of this study may have implications for preventive intervention. For example, reducing symptoms of negative affect, such as depression, among teens may not only help manage those symptoms but may also help prevent later substance use (Compton, Burns, Egger, & Robertson, 2002). However, additional research is needed before more definitive prevention recommendations can be made. In particular, further investigations of the varying conditions under which the self-medication process might operate are needed (e.g., Hussong et al., 2001); other variables, such as social support and coping skills, might moderate the link between negative affect and substance use. In addition, studies that examine associations between negative affect and substance use on a shorter time scale (Hussong et al., 2005) promise to complement findings from longer term longitudinal studies, such as ours. To the extent that prevention recommendations do translate into practice (Spoth & Greenberg, 2005), studies such as ours, which provide moderate benefits to research participants at the time of the investigation (Kleinig & Einstein, 2006), may lead to larger public health benefits in the long run.

Strengths and Limitations

Strengths of this study include the theory-guided approach, prospective longitudinal design, rich assessment, and structural equation modeling analyses. A limitation concerns the nature of the sample; findings might not generalize to racially and ethnically diverse samples of teens or to samples of teens drawn from urban and suburban settings or from other cultural contexts. Also, assessments covered the lower end of the spectrum for negative affective states, therefore additional research examining more serious mood disorders in relation to substance use and peer deviance is needed. In addition, assessments were primarily based on adolescent self-reports for the current analyses. Finally, the current analyses addressed key expectations from several theoretical frameworks, but each framework includes a broader set of predictions that provide opportunities for further investigation. In particular, additional tests of moderating variables that reflect the various characteristics of individuals and the environments in which they live are needed to further examine the critical conditions under which hypothesized processes operate; such tests will help to further elucidate the complex and dynamic nature of human behavior (Buscema, 1998; Grossi & Buscema, 2006). Still, this study provided a stringent test of theoretical expectations regarding longitudinal relations among negative affect, substance use, and peer deviance, and findings enhance our understanding of the development of these problems among teens in late adolescence.

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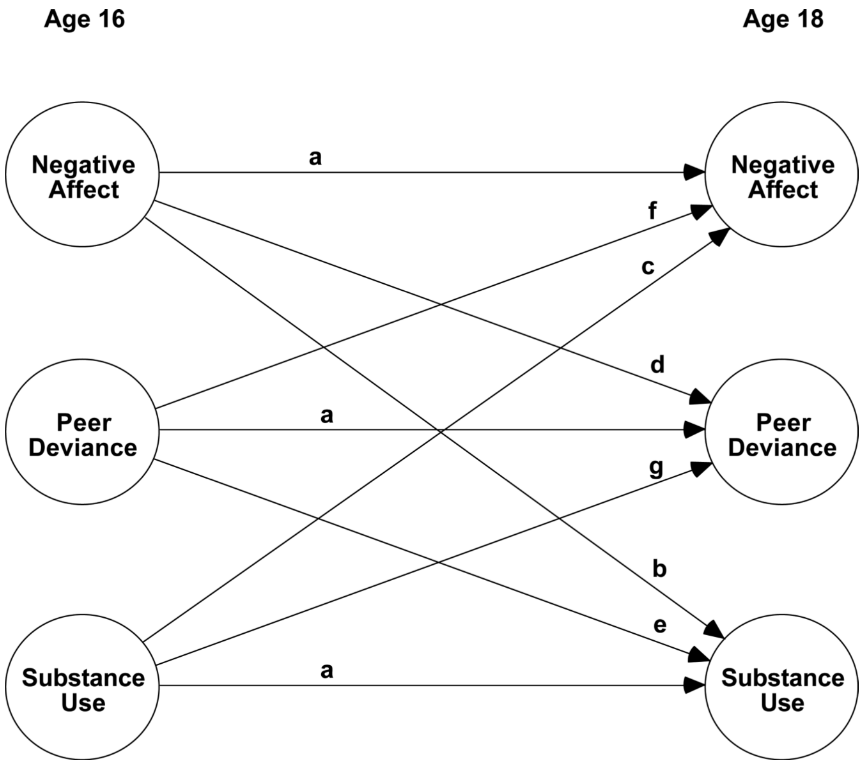

Figure 1.
Theoretical Model. Note. a = stability coefficient, b = self-medication, c = impaired functioning, d = stake in conformity, e = peer socialization, f = cumulative continuity of disadvantage, g = peer selection. All hypothesized relationships are positive.

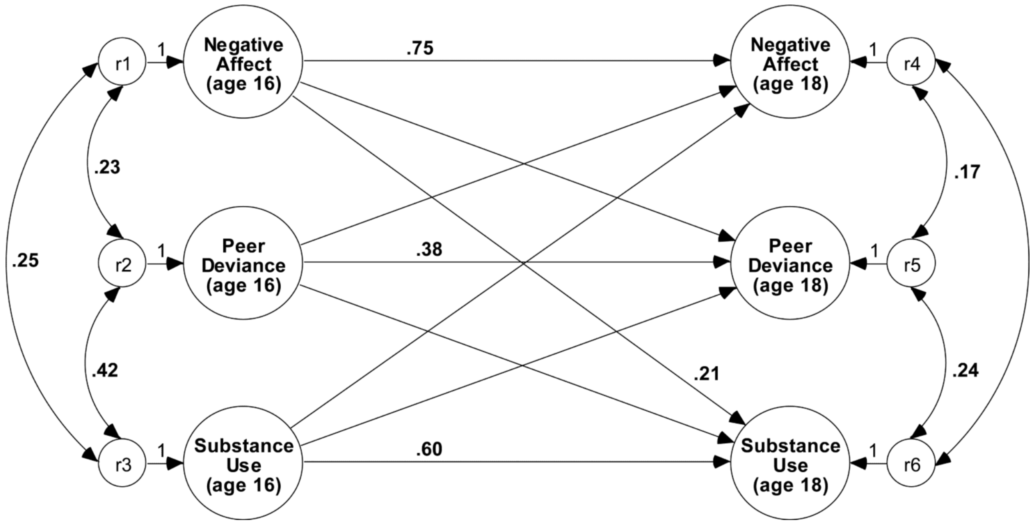

Figure 2.
Final Structural Model (statistically significant estimates reported). Covariates not depicted in the figure include: parent educational attainment, gender, early substance use, and impulsivity.

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Table 1

Background Characteristics of the Study Sample at Baseline

Variable	*M*	*SD*
Annual household income in 1993	38,045.81	38,844.66
Parent education (years)	13.41	1.84
Parent age (years)	37.98	5.27
Target child age (years)	11.35	.50
Number of children in family	2.99	1.53
Parent marital status (% dual parent)	.86	.35
Length of time in community (years)	15.62	12.58

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Table 2

Factor loadings from confirmatory factor analysis (^{r} = reference indicator)

Variable	***b***	***s.e.***	***β***
Negative affect (age 16)			
Depressed mood	1.00^r	-----	.64
Low self-esteem	2.49	.30	.85
Hopelessness	3.08	.34	.60
Negative affect (age 18)			
Depressed mood	1.00^r	-----	.65
Low self-esteem	2.49	.30	.90
Hopelessness	3.08	.34	.65
Peer deviance (age 16)			
Deviant peer associations	1.00^r	-----	.58
Peer pressure	.58	.14	.71
Peer deviance (age 18)			
Deviant peer associations	1.00^r	-----	.58
Peer pressure	.58	.14	.69
Substance use (age 16)			
Cigarette smoking	1.00^r	-----	.75
Alcohol use	.86	.15	.70
Substance use (age 18)			
Cigarette smoking	1.00^r	-----	.58
Alcohol use	.86	.15	.56

Table 3

Correlations among covariates and latent variables from the confirmatory factor analysis[a]

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Male gender (age 11)									
(2) Parent educational attainment (age 11)	.01								
(3) Impulsivity (age 11)	.08	-.13*							
(4) Early substance use (age 11)	.16**	-.07	.12*						
(5) Negative affect (age 16)	-.06	-.11	.26***	.05					
(6) Peer deviance (age 16)	.28**	-.09	.21	.16	.27**				
(7) Substance use (age 16)	-.09	-.18**	.14	.30**	.32**	.46*			
(8) Negative affect (age 18)	-.02	-.04	.17*	.03	.72***	.20	.17		
(9) Peer deviance (age 18)	.29***	-.03	.14	.14	.21	.54*	.36*	.31*	
(10) Substance use (age 18)	.01	-.35***	.17	.25**	.48***	.60**	.81***	.35**	.64**

[a] *p < .05. **p < .01. ***p < .001.

Table 4

Covariate effects from the model in Figure 2 (β's reported)[a]

	Outcome					
Covariate	**Negative Affect Age 16**	**Negative Affect Age 18**	**Peer Deviance Age 16**	**Peer Deviance Age 18**	**Substance Use Age 16**	**Substance Use Age 18**
Gender (Male)	-.09	.01	.25**	.21*	-.14*	.01
Parent Educational Attainment	-.07	.03	-.07	.05	-.14*	-.20**
Early Substance Use	.03	.01	.10	-.01	.30**	.01
Impulsivity	.25***	-.01	.17	.01	.10	-.05

[a] $*p < .05$. $**p < .01$. $***p < .001$.