

## Predicting Heavy Alcohol Use Among Adolescents

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A prospective, school-based study of alcohol use in a multiethnic sample of 3,675 adolescents found that family factors, other drug use, psychosocial-behavioral factors, and ethnic status are important discriminators of adolescents who are heavy alcohol users when compared with those who are experimental or moderate users. Implications for prevention and intervention are discussed.

For several decades, researchers have explored both the prevalence and the etiology of adolescent alcohol use, concluding that prevalence is high among middle and high school students in the United States (Johnston, O'Malley, & Bachman, 1991, 1994, 2001) and that alcohol use is regarded by many researchers to be statistically normative (Windle, 1999). Apart from documenting prevalence and demographic variability, early research focused on risk factor analysis to identify cross-sectional, multivariate correlates of adolescent alcohol use and other problem behaviors (Merrill, Kleber, Schwartz, Liu, & Lewis, 1999). Also, efforts have been directed toward the testing of models that hypothesize proximal and distal effects involving mediated and moderated causal paths that connect risk and protective factors to alcohol use (Baer & Bray, 1999; Bray, Getz, & Baer, 2000; Donovan, Jessor, & Costa, 1991; Huba & Bentler, 1982; Zucker, Fitzgerald, & Moses, 1995).

Another important conceptual focus has been the qualitative distinction among stages of alcohol use, such as initiation, experimentation, regular use, heavy use, and binge drinking (Kandel, 1975,

1980; Windle, 1996). Various typologies or stage-process models of alcohol involvement have been used by researchers without the emergence of a strong consensus that one particular model has greatest utility for all research purposes. Knupfer (1989) suggested an eight-stage model ranging from lifelong abstainer to frequent drunk. Werch and DiClemente (1994) offered a five-stage motivational model ranging from precontemplation (seriously thinking about initiating) to maintenance (continuing usage). Windle (1996) advocated a five-stage model ranging from abstainers to problem drinkers. Many adolescents use alcohol experimentally, sometimes frequently and sometimes consuming multiple drinks per occasion, without engaging in other problem behaviors or experiencing immediate negative consequences. Windle (1996) suggested it is theoretically and empirically important to distinguish between heavy drinkers and those who drink heavily *and* have experienced personal or social problems associated with drinking. Such distinctions have important implications for both understanding the multivariate etiology of adolescent alcohol involvement and the design of prevention/intervention programs.

Much research has been either purposely or inadvertently directed toward the earlier stages of initiation and experimentation (Reifman, Barnes, Dintcheff, Farrell, & Uhteg, 1998). Unintentional emphasis on initiation can arise because alcohol use distributions are usually skewed toward the low end of the scale, especially among samples of young adolescents. In addition, use of regression analytic techniques with continuous dependent variables can obscure the distinction between qualitatively different developmental stages of use or abuse of alcohol. For these reasons, more attention should be given to identifying predictors of heavy use and problem-related use of alcohol among ad-

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olescents (Knupfer, 1989; Windle, 1999). This shift in focus is warranted because of the greater deleterious health, behavioral, and social consequences of heavy or abusive adolescent alcohol use, as opposed to experimentation, and because of the differential implications for the design of prevention and intervention programs.

### Psychosocial, Developmental Model of Adolescent Alcohol Use

Previous research has demonstrated the utility of conceptualizing elements of the individuation process, stress, and peer alcohol usage as potential mediators of the relationship between risk or protective family processes and adolescent alcohol usage (Baer & Bray, 1999; Bell, Forthun, & Sun, 2000). These findings are consistent among adolescents across gender and racial/ethnic background, that is, non-Hispanic White, African American, and Mexican American (Bray, Getz, & Baer, 2000). The possibility that these constructs are mediators in the prediction of heavy alcohol use is the focus of this article. Distal, family process-related constructs that are known to be predictors of adolescent alcohol usage include family conflict, parental alcohol use, quality of communication with parents, and parental monitoring (Bray, Adams, Getz, & Baer, 2001; Dishion & McMahon, 1998; Duncan, Duncan, & Hops, 1996; Duncan, Tildesley, Duncan, & Hops, 1995). However, these constructs impact adolescent alcohol use, in part, indirectly through their effect on the individuation process, use of other substances, expression of other deviant behavior, stress, and peer alcohol use, which, in turn, directly impact heavy alcohol use. Additionally, familial processes may function as risk or protective factors, either by driving adolescents from a distasteful familial environment toward alcohol-using peer groups or by providing a nurturing environment facilitative of healthy attachment to the family as individuation progresses. Stress, use of other substances, deviant behavior, and peer alcohol usage are typically strong and stable predictors of adolescents' alcohol usage (Donovan et al., 1991; Zucker, Boyd, & Howard, 1994).

For example, family conflict and parental use of alcohol frequently predict adolescent alcohol use. First, family conflict is potentially indicative not only of a noxious family environment for the adolescent but also of parents who are often too distracted to communicate effectively with their

children or to monitor adequately their children's activities. Under such circumstances, adolescents are more likely to experience stress, to engage in avoidance coping by using alcohol or other substances, and to associate with alcohol-using peers (Baer & Bray, 1999). Second, higher alcohol use by mothers reflects the potential for their children to role model a dysfunctional coping strategy when family conflict or stress occurs and to have alcohol more readily available for their own use. Alternatively, an adolescent whose mother monitors his or her behavior and has open and high-quality communication with him or her is less likely to use alcohol (Bray et al., 2001; Dishion & McMahon, 1998; Duncan et al., 1995). It is unclear whether these variables discriminate both heavy use from experimental/moderate use and nonuse from experimental/moderate use.

Psychosocial-behavioral constructs of stress, peer alcohol use, and deviant behavior are stable, positive predictors of adolescent alcohol use and partially mediate the impact of family factors on adolescent drinking (see Figure 1). Such mediation has been demonstrated for stress and for peer use of alcohol (Baer & Bray, 1999; Bray et al., 2000). Deviant behavior (a strong, positive correlate of stress, peer alcohol use, and individual adolescents' use) should function similarly. Again, it is expected that these variables operate as risk factors, but their discriminatory strength is not clear with regard to the distinction between heavy versus experimental/moderate use and nonuse versus experimental/moderate use.

Figure 1 represents the hypothesized set of relationships wherein the impact of various family factors on heavy alcohol use is partially mediated by elements of individuation, stress, marijuana use, deviance, and peer alcohol use. This figure is intended as a heuristic model, not as a formal path diagram to which partial regression coefficients are assigned.

The present study entails longitudinal prediction of alcohol use among three groups of adolescents: those who have never used alcohol (i.e., never users), those who have just begun to use alcohol or are experimenting with it (i.e., initiators-moderate experimenters), and those who consume heavily on occasions of alcohol use (i.e., heavy users). Four research questions are the focus of this investigation. First, do previously discovered robust predictors of adolescent alcohol usage in general function equally well as predictors of alcohol initiation or experimentation and of heavier alcohol usage?

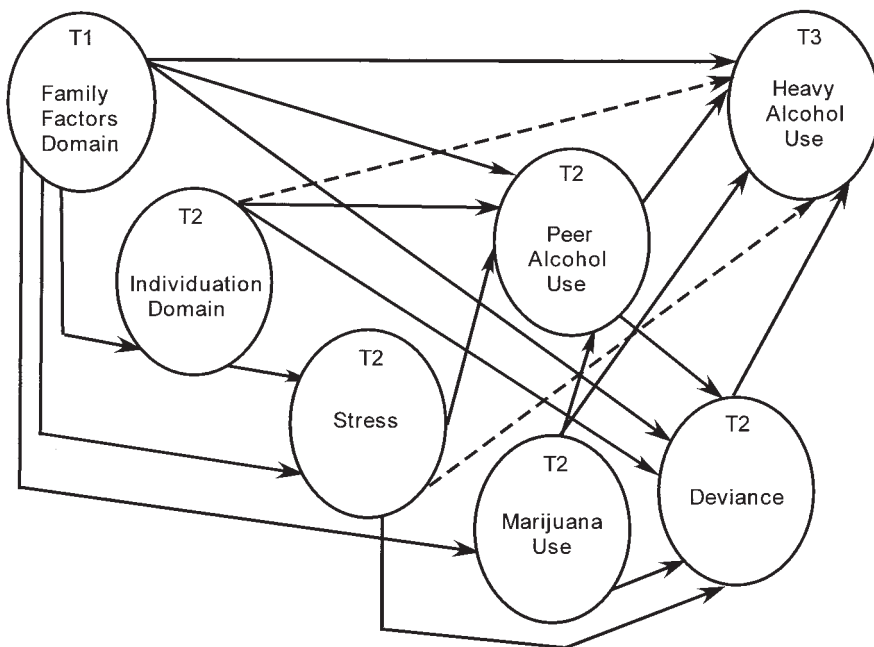


Figure 1. Heavy alcohol use among adolescents as a function of family factors partially mediated by individuation, prior marijuana use, stress, peer alcohol use, and deviance. Dashed line paths dropped to nonsignificance after mediators entered the equation. T = time.

Second, are there unique predictors of heavier alcohol usage? Third, do intrapersonal developmental and interpersonal psychosocial factors mediate partially or completely the relationship between more distal family processes and heavy alcohol use among adolescents? Fourth, can it be demonstrated that robust risk and/or protective factors interact synergistically such that negative consequences of risk are buffered or mitigated (Rutter, 1985)? Alternatively, can it be demonstrated that two co-occurring protective factors produce a strong preventive effect because one has potentiated the action of the other (Brook, Brook, Gordon, Whiteman, & Cohen, 1990)?

Method

Participants

The sample for this study was selected from among 4,088 middle school-aged students who participated in a survey conducted annually in a cohort sequential design in a large southwestern urban area over a period of 3 years (for a detailed description of the original study, see Baer & Bray, 1999). The 3,675 students who compose the study sample that we analyzed for this report were those who participated in all three waves of

measurement and whose alcohol consumption either remained the same or increased during the 3-year period. We imposed this restriction to eliminate the ambiguity associated with the alcohol status of claimed quitters or consumption reducers. Mirroring the full longitudinal sample (Baer & Bray, 1999), 49% of the 3,675-student subset were male, 61% were members of intact families, and 39% were non-Hispanic White, 26% were African American, and 35% were Mexican American.

Instruments

Demographic factors were the student's gender, race/ethnicity (non-Hispanic White, African American, and Mexican American), age, and grade level; the mother's level of education; and the family structure (intact vs. nonintact).

Heavy alcohol use was measured in Year 3 by a single five-point-scale item assessing the average quantity of alcohol beverages consumed (i.e., beer, wine, and liquor combined) during the previous month on an average occasion of use (1 = nothing, I never drink, 5 = six or more drinks). This measure was then recoded as a tri-chotomy, such that three drinks or more indicated heavy use, less than one to two drinks reflected experimental or moderate use, and nothing, I never drink reflected abstinence. The percentages of subjects in each

category of the trimetric code were 28%, 46%, and 26%, respectively.<sup>1</sup>

*Family process and parental alcohol behavior* were assessed with measures of family conflict, mother's monitoring, communication with mother, and mother's alcohol use. For all measures, higher mean scores indicated more of the particular variable. The family conflict measure was composed of nine 5-point Likert items drawn from the Family Environment Scale (Moos & Moos, 1981), which indicates openly expressed anger and aggression among family members. The internal consistency (Cronbach's alpha) for this measure was .94 for the study sample, with 2-month test-retest reliability of .85 (Moos & Moos, 1981).

*Parental monitoring* was assessed with a scale composed of seven 5-point Likert items that were drawn from the adolescent version of the Assessment of Child Monitoring Scale (Hetherington & Clingempeel, 1992). This scale measures the extent to which the mother is aware of the child's activities and friends, and it has been validated through factor analysis. It significantly correlates with observations of parent-child interactions on similar dimensions, and its test-retest reliabilities have ranged from .68 to .81. The Cronbach's alpha value for our study sample was .81.

*Communication with mother* was measured by ten 5-point Likert items from the Barnes and Olson (1982) Parent-Adolescent Communication Scale. This scale assesses positive aspects of parent-adolescent communication, including the free exchange of emotional and factual information, and has a 4-week test-retest reliability of .78. The Cronbach's alpha value for our study sample was .93.

*Mother's perceived use of alcohol* was measured with a single 5-point item designed to assess the subject's perception of his or her mother's drinking, ranging from *not at all* (1) to *every day* (5).

*Individuation/behavioral mediating factors* were assessed with measures of five constructs within the domain of individuation and one measure of marijuana use. Separation, Peer-Related Individuation (Levine, Green, & Millon, 1986), Intergenerational Individuation (Bray, Williamson, & Malone, 1984), Peer Trust (Armsden & Greenberg, 1987), and Parents' Facilitation of Independence (Kenny, 1987) each capture different aspects of the individuation process. Items on these scales factor distinctly from each other, and the respective factors they constitute are not highly correlated with each other. Higher mean scores on each measure indicated more of the construct.

*Separation* was measured by nine items from the Steinberg and Silverberg (1986) Emotional Autonomy Scale. These items were the majority of those Steinberg and Silverberg designated as indicative of nondependence on parents and of parental deidealization. As noted by Ryan and Lynch (1989), the type of autonomy characterized by these subscales might indicate some degree of alienation from parents and a lack of confidence in parental support and acceptance. The type of independence that develops in such a context has been characterized as emotional separation or detachment. This modality of individuation, although it is functional in some respects, is correlated with the use of

alcohol and other substances, delinquency, and other problem behaviors. In contrast to separation, modalities of individuation that have healthier consequences are represented by the four other constructs we used. The entire Emotional Autonomy Scale has been validated and shown to be reliable (Steinberg & Silverberg, 1986). The Cronbach's alpha value for the separation scale was .93 in our study sample.

*Intergenerational individuation* is a component of the Personal Authority in the Family System Questionnaire (Bray & Harvey, 1992; Bray et al., 1984) and is designed to measure the extent to which adolescents and young adults develop a sense of autonomy and self-determination while remaining emotionally connected to their parents. In this context, individuation involves taking responsibility for oneself and not being controlled or impaired by one's par-

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<sup>1</sup>Some researchers (Hays & Ellickson, 1996; Russell, Welte, & Barnes, 1991) have suggested that global alcohol use items (combining beer, wine, and liquor) and measures addressing either frequency or quantity of use, but not both, are less valid and/or reliable than measures that combine frequency and quantity and that assess separately beer, wine, and liquor consumption. Others (Windle, 1996) have highlighted the importance of qualitative distinctions involving the mode of drinking (e.g., bingeing) or its consequences (e.g., feeling drunk). For this reason, we constructed a second, more complex indicator of heavy use. We computed a general frequency indicator by summing the scores of three beverage-specific (beer, wine, and liquor), 6-point Likert items; we adjusted this sum to weight for the multiple ways a particular sum could be achieved at the low end of the resulting 16-point indicator of frequency. Then, we used scores on this frequency indicator to adjust subjects' assignment to usage categories on the original quantity-based trichotomy as follows. Heavy users were defined as participants who consumed 3 or more drinks at one time within the past month *and* scored 8 or above on the frequency indicator. Experimental/moderate users were defined as subjects who consumed 1 or more drinks at one time within the past month *but* scored between 3 and 7 on the frequency indicator. Noninitiators/noncurrent users were defined as subjects who claimed they never drank *and* who scored 3 or less (never initiated or no consumption within the past month) on the frequency indicator. The effect of this procedure was to more stringently define heavy use, thus lowering the percentage of subjects so designated from 26% to 14%. Percentages in each category of the quantity-based measure were as follows: never drink (28%), less than 1 to 2 drinks per occasion (46%), and 3 to 20 drinks per occasion (26%). Percentages in each category of the frequency by quantity indicator were as follows: none (29%), experimental/moderate usage (58%), and heavy (14%). The two approaches to defining heavy alcohol usage produced essentially the same results—which is not surprising because the two measures were very highly correlated ( $r = .89$ ). Therefore, the presentation of data uses only the more parsimonious, quantity-based measure.

ents. This construct was measured by seven 5-point Likert items. Two-week test–retest reliability for the Personal Authority in the Family System Questionnaire is .75 (Bray & Harvey, 1992). The Cronbach's alpha value for our study sample was .78.

*Parents' facilitation of independence* was measured with five of the eight items from Kenny's (1987) Parental Relationship Questionnaire. This scale indicates the extent to which the adolescent feels that his or her parents approve of and facilitate his or her independent behavior and decision making. The Cronbach's alpha value for our study sample was .82.

*Peer trust* was measured by 9 of the 10 items from the Inventory of Parent and Peer Attachment (Armsden & Greenberg, 1987). This scale assesses the extent to which the student feels that his or her friends are accepting, respectful, and reliable confidants. The Cronbach's alpha value for our study sample was .93.

*Peer-related individuation* was measured by nine items from the Healthy Separation scale, which was drawn from the Separation-Individuation Test of Adolescence (Levine et al., 1986). This scale assesses the extent to which adolescents are sure of themselves and are interpersonally at ease with peers. The Cronbach's alpha value for our study sample was .77.

*Other substance use* (quantity of marijuana consumed) was measured with a single 5-point item ranging from 1 (*none*) to 4 (*more than two joints for myself*) on an occasion of use within the previous year. Measured during the 2nd year of the study, this item is a marker for previous use of other drugs and is a direct correlate of a subject's alcohol usage ( $r = .23$ ). *Psychosocial/behavioral mediating factors* of stress, peer alcohol use, and deviant behavior are posited as direct, positive predictors of adolescent alcohol use and as mediators of the impact of family-related behavioral factors and of individuation-related behavioral factors. Higher mean scores on each scale indicated more of the construct.

*Stress* was measured with 13 items from Coddington's (1972) Life Events Scale for Children. This 5-point Likert scale was structured to assess not only whether a stressful event had occurred but also how much the occurrence bothered the respondent (Baer, Garnezy, McLaughlin, Pokorny, & Wernick, 1987). The Cronbach's alpha value was .76 for our study sample.

*Perceived peer alcohol use* was assessed as the sum of two 5-point items adapted from Jessor and Jessor (1977). One item asked about the alcohol consumption of "close friends"; the other asked about consumption among "kids you know that are your age." Possible scores on the resulting measure ranged from 2 to 10.

*Deviant behavior* was measured during the 2nd year of the study as the average of 16 five-point scale items drawn from Jessor and Jessor's (1977) longitudinal study of adolescent problem behavior. The scale assesses the extent to which the student has engaged in antisocial or norm-violating behavior within the previous year. The Cronbach's

alpha value for this scale is .83; the value for our study sample was .93.

### Measurement Development

Because the measures described above were primarily developed for non-Hispanic White samples of adolescents, their reliability or external validity for our study could be questioned. To make measures more comparable across attributes of gender and ethnicity, we subjected them to item response theory (IRT) analysis (Thissen, 1991) and to confirmatory factor analysis. We used IRT methodology to develop comparable scales for each ethnic group by modifying or deleting some items that did not function equally well across all racial/ethnic and gender categories. In addition, we established a response range of one to five for items of any scale that originally had been coded with fewer than five ordinal attributes (Hulin, Drasgow, & Parsons, 1983) to increase the potential information range of each scale. Comparability among ethnic groups was improved as a result of this analysis. Specifically, these procedures allowed the conclusion that the information value provided by these scales did not vary substantively across ethnic groups or between boys and girls.

### Procedures

Sixth-, seventh-, and eighth-grade students from five school districts were surveyed in a classroom setting once each year for 3 years. One school district required active parental consent; the other four districts allowed passive consent—that is, parents gave consent by not precluding the participation of their child after receiving a letter announcing the survey date and purpose. Before administering the survey, one of our project staff members read a protocol to the students, explaining our purpose and indicating that participation was voluntary. To preserve confidentiality, our staff conducted the survey and answered any questions that the students had, thereby avoiding contact between the classroom teacher and the students during the period.

### Data Analysis

The four research questions were addressed in the context of hierarchic discriminant function analysis.<sup>2</sup> Guided by the causal implications depicted in the psychosocial, develop-

<sup>2</sup>Given that our dependent variable was dichotomous and our predictor variables were either dichotomous or treatable as continuous, an alternative statistical approach could be logistic regression. Because clear superiority of one technique over the other was not apparent in this instance, we replicated the two-group, hierarchic entry analytic procedure using logistic regression. Results were substantively similar to those using discriminant function analysis. Here we report only the discriminant function analysis findings.

mental heuristic model (see Figure 1), we entered variables sequentially in four blocks. Those within each block were forced into the equation rather than allowed to drop out as a result of not achieving an arbitrary level of statistical significance. Each block contained six demographic variables: sex, age, dummy codes for African American and Mexican American ethnic status, intact family, and mother's education level. These variables constituted the first block for two related reasons. First, the research questions involve the possible effects on heavy alcohol use of family factors, individuation/behavioral factors, and psychosocial-behavioral mediators when we control for or partial out the effects of gender, race/ethnicity, family structure, and parental education (a proxy for family socioeconomic status [SES]). Second, because racial/ethnic status is usually correlated with family structure and SES, any analysis using racial/ethnic status as a predictor should include family structure and some measure of SES to minimize the possibility that a significant relationship involving racial/ethnic status will be interpreted spuriously as causal.

The first block contained the demographic variables only. The second block contained family-related behavioral factors: family conflict, mother's alcohol use, mother's monitoring, and communication with mother; these were measured during the 1st year of the study. The third block added the indicators of individuation: separation, intergenerational individuation, peer trust, parental facilitation of independence, and peer-related individuation; these were measured during the 2nd year of the study. Marijuana use was also included in the third block as a marker for previous illicit drug use. The fourth block added the hypothesized psychosocial and behavioral mediators, stress, peer alcohol use, and deviance, which were all measured during the 2nd year. The alcohol usage group status was based on the measurements made during the 3rd year. In this way, we exploited the longitudinal nature of the sample by matching our analytic procedure to the implied causal logic of the heuristic model (see Figure 1), which distinguishes between the impact of more distal family factors and the mediating potential of more proximal, relational, or behavioral variables (particularly those involving various dimensions of the individuation process), and the psychosocial and peer-related or behavioral alcohol involvement variables.

To explore the first two research questions involving the relative strengths of predictors, we conducted two analyses—one comparing the heavy use group with the experimental/moderate use group, and the other comparing the experimental/moderate use group with the abstention group. To explore the third question, regarding hypothesized mediator effects, we compared parameter magnitudes and levels of significance of the variables entered sequentially in the four blocks. If the variables intervening in the paths linking the family factor variables to heavy alcohol use (see Figure 1) were to *wholly* mediate the linkage, we expected that those family factor variables that significantly discriminated heavy from experimental/moderate alcohol use before a mediator was entered into the equation would become nonsignificant after entry. If the intervening variables *par-*

*tially* mediated the linkage, we expected the parameter magnitudes of the family factor variables that were initially significant to drop substantially after the mediators entered the equation yet remain statistically significant.

Finally, we addressed our fourth hypothesis, that synergistic effects might emerge with regard to the combining of a risk and a protective variable (buffering), the combining of two protective factors, or the combining of two risk factors. We combined the strongest risk factor discriminating heavy alcohol use (peer alcohol use) with the strongest inverse discriminator (mother's monitoring) to test the buffering hypothesis. A second test involved the combining of a second inverse discriminator (African American ethnic status) with peer alcohol use. We tested protective factor synergism by combining African American ethnic status with mother's monitoring. We also tested risk factor synergism by combining separation with peer alcohol use and with deviant behavior. For each test, we entered the interaction term into a trimmed model from which previously nonsignificant variables had been eliminated. The interaction term was entered last, after its components and covariates had been entered.

## Results

The first exploratory hypothesis was that variables previously identified as either direct or inverse predictors of adolescent alcohol initiation also discriminate heavy use from experimental or moderate usage. Data addressing this hypothesis are presented in Table 1; here, 18 independent variables often associated with adolescent alcohol use are blocked into one of the four categories noted in the text previously: demographic factors, family process and parental alcohol behavioral factors, individuation/behavioral mediating factors, and psychosocial-behavioral mediating factors. The literature suggests that discriminators' correlations with the function (displayed in the structure matrix) constitute useful criteria for assessing their importance (Klecka, 1980; Tabachnick & Fidell, 1989). Discriminating variables with significant Wilks's lambda ( $p < .05$ ) and Rao's  $V$  values of .25 or greater were deemed worthy of attention. We regarded structure matrix parameters of .25 to .39 to be low, .40 to .59 to be moderate, and .60 and above to be strong.

Correlations between the discriminating variables and the canonical discriminant functions (shown in Table 1) in cell entries for the model containing all of the blocks of variables revealed that peer alcohol use was, by far, the strongest predictor and a risk factor for heavy use.

Risk factors identified as having moderate importance were deviant behavior and previous marijuana use; those identified as having low but notable im-

Table 1

*Structure Coefficients/Canonical Function Coefficients: Discrimination of Heavy Alcohol Users Compared With Experimental/Moderate Users*

Discriminating variables	Demog. factors only	Demog. + family factors	Demog. + family factors + individuation factors	Demog. + family factors + individuation factors + psychosocial mediators	$\Delta\chi^2$ (df) $p <$	Demog. + trimmed model
Demographic factors (T1)						
Sex (1 = male)	.39/.33***	.28/.23***	.14*	.13*		.14***
African American	-.59/-.69***	-.43/-.54***	-.35/-.44***	-.30/-.38***		-.30/-.38***
Mexican American				.13*		.14**
Intact family	/.22*					
Mother's education						
Age	.63/.67***	.45/.41***	.37/.30***	.32/.18***	140 (6) .001	.32/.19***
Family/behavioral factors (T1)						
Family conflict		.47/.30***	.38/.20***	.32/.15**		.33/.10*
Mother's monitoring		-.61/-.50***	-.50/-.30***	-.42/-.18***		-.43/-.14**
Communicate with mother		-.33/	.15*			
Mother's alcohol use		.33/.28***	.19***	.11*	116 (4) .001	.12*
Individuation/behavioral mediators (T2)						
Separation			.37/.23***	.32/		
Intergenerational individuation						
Peer trust						
Parents facilitate independence						
Individuation (peer)						
Marijuana use			.69/.55***	.59/.28***	115 (6) .001	.59/.30***
Psychosocial/behavioral mediators (T2)						
Stress						
Peer alcohol use				.73/.50***		.74/.51***
Deviant behavior				.58/.21***	127 (3) .001	.59/.20***

*Note.* Structure coefficients (to the left of the slash) are pooled within-groups correlations between discriminators and standardized canonical discriminant functions. Empty cells reflect parameters that had nonsignificant Rao's  $V$ s and correlation values less than .25. Signs are adjusted to reflect the direction of proportions or means relative to heavier alcohol use. Alcohol use types after listwise deletion of missing data: heavy ( $n = 661$ ), experimental/moderate ( $n = 1,179$ ), nonuse ( $n = 672$ ). Canonical function coefficients are to the right of the slash. All  $p$  values refer to Wilks's lambda. Demog. = demographic; T = time.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .005$ .

portance were separation and family conflict. Age was also a risk factor of low importance. Potentially important for understanding the role of previous marijuana use in alcohol initiation is the fact that the adolescents who reported never having used marijuana in the 2nd year had a 45% prevalence for alcohol use, whereas those who reported never having used alcohol had only a 1% prevalence for marijuana use. The protective factors that were inversely related to heavy use as compared with experimental/moderate use are mother's monitoring (moderate strength) and being African American (low strength).

Parameters to the left of the slash in the cells of Table 1 are not adjusted for multicollinearity among the predictors. Parameters to the right of the slash are standardized canonical discriminant function coefficients that are adjusted for the presence of other variables. The values in the fourth column indicate that, except for separation, the risk and protective factors noted above hold up as significant discriminators. The fifth column in Table 1 presents the  $F$  and  $p$  values for each block of variables that succeeded the first block. Significant standardized function coefficients are displayed to the right of the slash in the

fifth column. Their significance levels (based on Wilks's lambda) are indicated.

The second exploratory hypothesis involved the possibility that some significant discriminators of heavy alcohol users, as compared with experimental or moderate users, would not necessarily be reliable discriminators between nonusers and experimental/moderate users (i.e., initiation) of alcohol (see Tables 1 and 2). Three other comparative possibilities are that a particular variable discriminates (a) experimental/moderate use from nonuse (i.e., initiation) more reliably than heavy use, (b) heavy use and

initiation of use equally well, or (c) neither heavy use nor initiation of use. Table 3 displays structure matrix parameters in four columns representing these possibilities.

The second column in Table 3 indicates that family conflict, marijuana use, being older, and being non-Hispanic White discriminated heavy users more reliably than initiators of alcohol use. Greater peer alcohol use and deviance and more effective maternal monitoring discriminated heavy use and initiation equally well, as noted in the first column of Table 3. Better communication with mother, greater parental

Table 2

*Structure Coefficients/Canonical Function Coefficients: Discrimination of Alcohol Experimental/Moderate Users Compared With Never Users*

Discriminating variables	Demog. factors only	Demog. + family factors	Demog. + family factors + individuation factors	Demog. + family factors + individuation factors + psychosocial mediators	$\Delta\chi^2$ (df) $p <$	Demog. + trimmed model
Demographic factors (T1)						
Sex (1 = male)						
African American						
Mexican American						
Intact family	-.77/-.72***					
Mother's education						
Age	.66/.62**				140 (6) .001	
Family/behavioral factors (T1)						
Family conflict		.38/	.29/	.14*		
Mother's monitoring		-.63/-.42***	-.49/-.25***	-.36/		
Communicate with mother		-.57/.25	-.44/	.32/		
Mother's alcohol use		.75/.67***	.58/.48***	.43/.31***		.43/.32***
Individuation/behavioral mediators (T2)						
Separation			.72/.53***	.53/.16**		.54/.22***
Intergenerational individuation			-.38/			
Peer trust						
Parents facilitate independence			-.46/	-.34/		
Individuation (peer)						
Marijuana use			.40/.24***	.30/	115 (6) .001	
Psychosocial/behavioral mediators (T2)						
Stress				.39/		
Peer alcohol use				.81/.59***		.82/.61***
Deviant behavior				.64/.35***	127 (3) .001	.65/.39***

*Note.* Structure coefficients (to the left of the slash) are pooled within-groups correlations between discriminators and standardized canonical discriminant functions. Empty cells reflect parameters that had nonsignificant Rao's  $V$ s and correlation values less than .25. Signs are adjusted to reflect the direction of proportions or means relative to heavier alcohol use. Alcohol use types after listwise deletion of missing data: heavy ( $n = 661$ ), experimental/moderate ( $n = 1,179$ ), nonuse ( $n = 672$ ). Canonical function coefficients are to the right of the slash. All  $p$  values refer to Wilks's lambda. Demog. = demographic; T = time.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .005$ .

Table 3

*Comparison of Predictors' Capacities to Discriminate Adolescent Heavy Users of Alcohol From Experimental/Moderate Users and Experimental/Moderate Users From Nonusers: Structure Matrix Correlations*

Discriminating variables	Predicts relatively equally	Predicts heavy use better	Predicts initiation better	Predicts neither
Demographic factors (T1)				
Sex (1 = male)				.20/.04
African American		-.30/-.05		
Mexican American				.06/.02
Intact family				-.06/-.16
Mother's education				-.12/-.00
Age		.32/.18		
Family/behavioral factors (T1)				
Family conflict		.32/.22		
Mother's monitoring	-.42/-.36			
Communication with mother			-.23/-.32	
Mother's use of alcohol			.23/.43	
Individuation/behavioral mediators (T2)				
Separation			.32/.53	
Intergenerational/individuation			-.07/-.28	
Peer trust				-.07/-.02
Parents facilitate independence			-.10/-.34	
Individuation (peer)				-.10/-.07
Marijuana use		.59/.30		
Psychosocial/behavioral mediators (T2)				
Stress			.24/.39	
Peer alcohol use	.73/.81			
Deviance	.58/.64			

*Note.* For the present purposes, to count as a substantive predictor, the correlation must be at least .25. Alcohol use types after listwise deletion of missing data: heavy ( $n = 661$ ), experimental/moderate ( $n = 1,179$ ), nonuse ( $n = 672$ ). Heavy users are to the left of the slash; experimental/moderate users are to the right. T = time.

facilitation of independence, and greater intergenerational individuation were more reliable inverse discriminators of initiation of alcohol use, whereas mother's frequent alcohol use, more stress, and greater separation predicted initiation moderately well and heavy use poorly. Peer trust and peer-related individuation predicted neither heavy use nor initiation of use; sex, intact family, and mother's education level, at least in the context of the other variables in the model, also did not predict heavy use or initiation of use.

Our third hypothesis was that measures of individuation, previous marijuana use, stress, peer alcohol use, and deviance mediate relations between family-related behavioral factors and heavy alcohol use. Tests of this hypothesis are reported in Table 1. Because this aspect of the analysis was theory driven, it was appropriate to use a hierarchic procedure in

which variables were entered sequentially in accordance with their location in the pathways represented in Figure 1.

Table 1 presents standardized canonical coefficient values, whose significance levels are shown to the right of the slash. Each entered block of measures explained significantly more variance at  $p < .001$ , as indicated by the data in the change in chi-square column of Table 1. The trimmed model (column six of Table 1), in which individually nonsignificant or low-parameter-magnitude measures were deleted from each block of discriminators, did not explain significantly less variance than the full model,  $\Delta\chi^2(7, N = 1,840) = 10.00, p < .10$ .

Assessing the mediating effect of each indicator of individuation, we found that greater separation from parents discriminated heavy alcohol use, even after the effects of family factor indicators were controlled

( $p < .001$ ). The other indicators within the domain of individuation were not significant. Furthermore, the parameter magnitudes for family conflict ( $p < .002$ ), mother's monitoring ( $p < .001$ ), and perceived maternal alcohol use ( $p < .001$ ) were consistent, weak-to-moderate discriminators of heavy use, which suggests that they have direct effects, as well as indirect ones, mediated by separation. Marijuana use was a strong behavioral predictor of heavy alcohol use after the family-related behavioral factors were controlled ( $p < .001$ ).

Entry of stress next and by itself into the model (not shown in Table 1) did not affect the parameter magnitudes for separation, mother's monitoring, or perceived maternal alcohol use. Stress was a significant predictor of heavy use (Wilk's  $\lambda = .82$ ,  $p < .001$ ) before deviance and perceived peer use were entered into the model.

Entry of greater perceived peer alcohol use and deviant behavior into the model resulted in a drop in parameter magnitudes for family conflict, mother's monitoring, perceived maternal alcohol use, and stress as discriminators of heavy alcohol use. Each of the former variables except for stress remained a significant discriminator ( $ps < .008$ ,  $.003$ , and  $.023$ , respectively) in the presence of peer use and deviance. This suggests that perceived greater use of alcohol by peers and deviant behavior partially mediated the impact of the family factors. We suggest this possibility cautiously, as there is no test of statistical significance for the differences in parameter magnitude across blocks. Furthermore, perceived peer use and deviance appeared to mediate completely the discriminating ability of separation and stress on heavy alcohol use, as they were no longer significant when peer use and deviant behavior were controlled. Marijuana use remained a discriminator of heavy use, though of lesser magnitude ( $p < .001$ ).

Although the demographic variables were not study foci, we note that being African American (compared with non-Hispanic White and Mexican American) remained a moderately strong protective factor against heavy alcohol use ( $p < .001$ ), even after all other variables of the model were controlled. Age, although it declined substantially in impact, remained a weak discriminator of heavy alcohol use.

Our fourth hypothesis was that risk and protective factors would interact with each other and produce synergistic outcomes. None of the interaction terms used to test these hypotheses were found to be statistically significant. Tests for interacting risk factors and for interacting protective factors also were not found to be significant.

## Discussion

In this study we found that certain family factors, the separation dimension of individuation, psychosocial-behavioral factors, and ethnic status were important discriminators of adolescents who were heavy alcohol users when compared with those who were experimental or moderate users. In addition, results reveal that other factors from those same domains were much stronger discriminators of experimental or moderate users than of nonusers of alcohol. One family factor (mother's parental monitoring) and two psychosocial behavioral factors discriminated membership in these groups equally well. Finally, hypotheses regarding the mediation of the impact of family factors on alcohol usage by individuation and psychosocial-behavioral factors were supported.

### *Direct Discriminators of Heavy Alcohol Use*

Four robust and moderately strong predictors of heavy alcohol use among adolescents emerged: perceived peer alcohol use, race/ethnicity (i.e., being non-Hispanic White or Mexican American as opposed to African American), previous marijuana use, and age. Robust but weaker predictors were adolescent deviant behavior, mother's parental monitoring, mother's alcohol use, and family conflict. Of these weaker predictors, previous marijuana use and family conflict were persistent discriminators *only* of heavy use as opposed to experimental/moderate use. In the context of the other predictor variables, the weaker predictors were not substantively important discriminators of experimental/moderate use as opposed to nonuse. Furthermore, age and being non-Hispanic White or Mexican American were both direct predictors of heavy use but not of experimental/moderate use. These findings address the first and second hypotheses; findings here suggest that some well-established risk or protective factors are stronger or more reliable markers for current or future heavy alcohol use than they are for initiation of use.

Why should previous marijuana use and family conflict operate in this way? With regard to marijuana use, this variable may well be a proxy for some traits or processes that place adolescents at greater risk for heavy alcohol use, such as use of multiple drugs, early age of initiation to use of alcohol or other drugs, and deviance or antisocial behavior (Windle, 1996). The poor predictive capacity of marijuana use for initiation of alcohol use suggests that marijuana

was not a primary gateway drug among our sample, but alcohol apparently was. This interpretation is consistent with our finding regarding the prevalence of these two drugs during the 2nd year of the survey and with the findings of others (Kandel, 1975; Kandel, Yamaguchi, & Chen, 1992).

Family conflict, because of its persistence as a direct and significant predictor of heavy alcohol use (as opposed to experimental/moderate use) and its insignificance as a predictor of experimental/moderate use (as opposed to nonuse), seems to be important as a distal cause of long-term, deleterious, psychosocial consequences for adolescents (Blanton, Gibbons, Gerrard, Conger, & Smith, 1997; Bray et al., 2001). However, most of family conflict's discriminatory capacity is indirect—that is, mediated by stress, deviant behavior, and peer use of alcohol.

It is not surprising that age remained a discriminator of heavy alcohol use, given that the subjects who were 6th, 7th, and 8th graders at the time of the first survey were 8th, 9th, and 10th graders at the time of the third survey. That age did not discriminate initiators by the 3rd year may be due to the fact that those adolescents who are going to initiate alcohol use before age 18 will have done so by their freshman year of high school for reasons encompassed by the other variables in our analysis. For heavy users, however, being older might be a proxy for variables that were not encompassed by other variables in our analysis, such as holding a part- or full-time job. For adolescents, this variable may be a marker for several factors that are correlated with alcohol use, such as greater availability of disposable income, more contact with nonfamilial adults who drink, and earlier assumption of adult roles for which alcohol use is a right of passage.

Being African American was a protective factor against heavy alcohol use but not against initiation of use. This finding highlights the importance of considering race or ethnicity with regard to qualitatively different aspects of alcohol involvement. African American adolescents, for reasons other than those indicated by all of the other variables in our analysis, were less likely to be heavy alcohol users than were non-Hispanic White and Mexican American adolescents. However, they were not less likely to have initiated alcohol use. This finding lends a useful interpretive perspective to the results of studies that used continuous measures of alcohol use and discovered that African American adolescents use less alcohol or accelerate usage at a slower rate than non-Hispanic Whites or Mexican Americans. The fact that being African American persists as a moderately

strong inverse discriminator of heavy alcohol use suggests that there may be one or more protective elements of the family process that distinguish lower middle to middle class African American families as compared with non-Hispanic White and Mexican American families. Such variables, if controlled, should negate the predictive power of ethnicity. However, it is clear that measures in this study are not tapping the relevant construct. This is an important question for future research.

Other predictors of heavy alcohol use among adolescents also predicted the transition from nonuse to experimental/moderate use. A moderately strong risk factor was perceived peer alcohol use. Risk factors of lesser magnitude were deviant behavior and mother's alcohol use. A another protective factor was mother's monitoring. Collectively, these findings suggest that family processes or behaviors that are indicative of ineffective parenting encourage the initiation of alcohol use as well as acceleration to heavy use through involvement with alcohol-using peers. That these direct effects are not of high magnitude does not negate their importance, because, in the context of the heuristic model (see Figure 1), their effects are partially mediated by perceived peer alcohol use and deviant behavior.

### *Mediation of the Impact of Family Factors on Heavy Alcohol Use*

The impact of family conflict, mother's monitoring, and mother's alcohol use as discriminators of heavy alcohol use among adolescents was partially mediated by the separation modality of the individuation process and previous marijuana use. This is consistent with the hypothesis that the domain of individuation mediates the relation between family and behavioral factors and heavy alcohol use. However, only separation, which is the health-problematic modality of individuation from the family systems theoretical perspective (Bray et al., 2001), contributed to this process. The other, more positively oriented modalities of individuation were not significant discriminators. These findings suggest that the levels of risk factors are more important markers for heavy use than are levels of protective factors, at least when they compete linearly with each other for predictive dominance. It may be that poor parenting encourages emotional detachment on the part of adolescents, thereby making them more receptive to influence by deviant peers or more likely to actively seek out deviant peers as associates at a developmental stage known, in general, to be one of transition from lesser

to greater receptivity to peer influence. Continued positive attachment to parents and receptivity to parental influence are more likely in a family context characterized by constructive communication patterns and monitoring of adolescent behavior.

### *Mediation of the Impact of Psychosocial/Behavioral Factors on Heavy Use*

That peer alcohol use and deviant behavior completely mediated the effect of separation on heavy alcohol use is not consistent with our hypothesis of partial mediation. That is, we expected both a direct and an indirect effect. This finding is open to at least two interpretations, one of which is substantive, and the other of which is methodological. Regarding the former, these findings highlight the importance of considering peer relations in trying to understand the etiology of adolescent alcohol use. It appears that heavy and moderate use, as well as the initiation of alcohol use, are practiced in a social context motivated by a quest for social support that will be sought from peers if not received from parents (Kaplan, 1980). Direct influences of separation and stress on heavy alcohol use that were not significant after the introduction of mediators (represented by the dashed paths in Figure 1) highlight the indirect impact of separation and stress on alcohol usage. Although the hypotheses tested in this study were not couched within a theoretical framework of self-regulation or adaptation (Carver & Scheier, 1982), the findings suggest the possible utility of linking the psychosocial–developmental perspective presented herein to that approach. For example, the paradigm suggested by Levanthal, Leventhal, and Cameron (2001) indicates that adolescent alcohol and other substance use is not a passive, one-dimensional process caused exclusively by social influences but rather is a subjective choice made by persons usefully conceptualized as dynamic, problem-solving actors. Separation and levels of stress experienced in the context of family processes, as indicated by our findings, might engender negative affect, motivating greater association with alcohol-using peers and more tolerance for deviant behavior in general and heavier alcohol use in particular.

### *Absence of Synergistic Effects*

Neither buffering effects nor risk factor synergism were found with regard to the discrimination of heavy alcohol use. It may be that an additive, multivariate model best accounts for the transition from

experimental/moderate alcohol use to heavy use. Conversely, flaws in the design of our study may account for our negative findings. Combining risk and buffering factors measured at different time points, as we did, may not be the most appropriate test of the buffering hypothesis. Furthermore, to test both the buffering hypothesis and the risk factor synergism hypothesis, we combined variables that were drawn from different construct domains thought to be related causally to each other. For example, by creating an interaction term that combined peer alcohol use with a correlated, potentially causal antecedent (i.e., mother's monitoring), we might have created a variable that confounded our analysis and mitigated against finding a significant interaction.

### *Implications for Prevention and Practice*

Many studies of adolescent alcohol use have documented multiple risk factors for adolescent involvement. Most have not, however, distinguished carefully between initiation that leads no further than experimentation or occasional use and heavy use that may or may not also involve ancillary psychosocial or behavioral problems. Prevention and intervention strategies may be more or less successful, depending on the extent to which they match the qualitative extent of alcohol involvement among the target adolescents. For example, heavy users are less likely than experimenters or moderate alcohol users to respond to programs that emphasize peer-pressure resistance skills (Windle, 1999), because the drinking behavior of heavy users is more likely to be internally motivated (e.g., avoidance coping) than is that of experimenters and moderate users. The findings suggest that non-Hispanic White and Mexican American adolescents who are older, who also use marijuana, and who have experienced higher levels of family conflict are more likely to be heavy alcohol users. Consequently, programs aimed at curbing or preventing heavy alcohol use should consider focusing on mitigating family conflict and adolescent multidrug use as well as on predictors of heavy use whose effects are largely mediated by peer use and deviant behavior. Examples of the latter are ineffective parenting (e.g., poor parental monitoring) and dysfunctional modalities of individuation (e.g., separation).

Some risk and preventive factors for adolescent alcohol use may be cost-effective targets for both prevention and intervention because they discriminate equally well between heavy alcohol use and initiation of use. The ones identified in this study are peer alcohol use, deviant behavior, and mother's

monitoring. Controlling adolescents' association with drug-using peers and participation in deviant behavior is crucial, because these variables are indicators of multiple dysfunctional processes that can be influenced by prevention efforts. For example, the typically strong magnitude of the parameter linking the perceived level of peer alcohol use to the adolescents' use reflects not only the stereotypic influence of peer pressure on initiation of alcohol use but also the self-selection of alcohol-using peers by those who have already initiated use. Helping adolescents to select peers whose attitudes and behaviors reinforce their own constructive intentions and behaviors while mitigating dysfunctional intentions and behaviors is crucial for effective prevention or intervention. For example, constructive monitoring is less likely to occur in the context of poor parent-adolescent communication, lack of parental warmth, intense family conflict, or parental alcohol or other drug involvement. The problems we have discussed each involve behavioral decisions on the part of parents and, consequently, are potential prevention or intervention targets.

### *Limitations and Conclusions*

The results of this study should be evaluated in light of several limitations. Relying exclusively on self-reports results in common method variance that might contribute to multicollinearity among the measures and, thus, could have influenced our findings. Although multicollinearity possibly occurred, it most likely had a low impact on the outcomes of our analysis for two reasons. First, if common method variance was high (assuming an equal common method effect across all measures) one would expect all mediator hypotheses to be supported or refuted equally. Our findings, however, indicate differential effects of mediators; some direct effects held up strongly after controls were introduced, whereas others did so weakly, and still others did not at all. Second, the mediator effects we observed are consistent with the theory-driven hypotheses depicted in Figure 1. The hierarchical entry procedure used in the discriminant function analysis was theory structured, not driven by stepwise inclusion that cued off statistical significance. Nevertheless, future research on heavy alcohol use should use multiple data-gathering methods from various family members for purposes of measure cross-validation.

A related limitation concerns the potential mismatch between the hypothetically ideal time frame

between measurements and the actual time frame. We made our measurements about 1 year apart, which is logistically convenient in a school-based study. Such a time frame might, however, be too broad to capture nuances in the etiology of alcohol use that are only detectable within a shorter period. When the time frame between measurements does not correspond to actual changes occurring in the measured variables, tests of valid hypotheses are less likely to be supported strongly by the results of analysis. Future research on adolescent heavy alcohol use should take the time frame between measurements into account.

Finally, this study highlights the need for conducting longitudinal research when investigating developmental and family processes and substance use that leads to problem drinking (Duncan et al., 1996, 1995). Longitudinal designs provide a means to better understand the sequence of influences on substance use. It is important that future research continue to examine the adolescent transition and evaluate the multiple perspectives of different family members and peers and how these processes may change during later adolescence and young adulthood.

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