

Predicting Problem Drinking: A Test of an Interactive Social Learning Model

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This study tested a social learning model and explored the direct and interactive relationships between personality and environment in predicting problem alcohol use. We used longitudinal data from a nonclinical sample of males and females first tested in adolescence and followed into young adulthood. Hierarchical regression analyses were used to test main effects and interaction models. The cross-sectional data supported an interactive social learning model. Both personality and environment variables significantly predicted problem drinking. Two interactions between heavy drinking peer groups and personality variables were significant. Contrary to our hypothesis, the direction of the interaction was negative. In contrast, the longitudinal analyses did not provide strong support for our interactive model. Personality variables were significant predictors longitudinally, but in only one analysis did an environment variable significantly predict problem drinking. Furthermore, none of the interactions was significant predictors over time. Overall, the findings suggest that social learning models based on the interaction of personality and environmental influences may be more appropriate for predicting concurrent, as opposed to future problems, and that future research should include person-environment interactions. In addition, cultural tolerance of heavy drinking may be an important determinant of the role of psychological vulnerability in the development of problem drinking.

Key Words: Problem Drinking, Personality, Environment, Interactions.

DESPITE APPARENT declines in overall levels of alcohol consumption during the last 10 years in the United States, recent data suggest that alcohol abuse persists as a major social problem. For example, while past year, month, and daily use rates have declined, estimates of problem drinking and alcoholism from national surveys over the past 25 years have remained relatively constant, indicating that approximately 6 to 10% of the general adult population is estimated to be "problem drinkers," "heavy drinkers," or alcoholics.¹⁻⁶ Recent estimates place the number of alcohol abusers at around 8 to 12 million.⁷

Research focusing on the etiology of alcohol abuse has grown extensively over the last decade, but at present it is characterized largely by undisciplined work. Recently, however, many theorists across disciplines are coming to

common ground in their belief that the development of problem alcohol (and other drug) use involves the meeting of "vulnerable personalities" with social groups that meet the emotional needs of the personality, while teaching and positively reinforcing substance use as a coping mechanism. This interactive "social learning" model, however, is more theorized than shown. That is, only two studies to our knowledge have empirically tested *interactions* between personality and environment in predicting substance use behaviors.^{8,9} The present study explicitly explores the direct and interactive relationships between personality and environment in predicting problem alcohol use.

SOCIAL LEARNING THEORY

Social learning theorizing, in its many formulations, has combined ideas from classic sociological and psychological thinking. Its roots lie in the differential associations research of Sutherland,¹⁰ and the respective operant conditioning and self-efficacy works of Skinner¹¹ and Bandura.¹² Over time, different aspects of social learning theory have been embraced and enhanced by researchers in the study of deviance and substance use, and presently it is perhaps more appropriate to refer to social learning as *a set of theories*. The accumulation of models has created some confusion in the literature, as the label "social learning theory" has been claimed simultaneously by substantively different theoretical positions. There seems to be two main interpretations of social learning theory—one centering mainly on the issues of modeling, differential associations, and reinforcements, and the other combining these social network-related variables with the concept of personal predispositions. In the substance use literature, the former interpretation is most associated with the work of Akers.^{13,14} The latter interpretation is exemplified by numerous incarnations of environment/person theories of deviance and substance use, and is less tied to one theorist; however, it could be argued that many share a common theoretical base in the work of Bandura.¹²

The Akers model is well represented in the empirical substance use literature.¹⁴⁻¹⁷ The second major interpretation, hereto referred as the "interactive social learning model," has not seen many empirical tests of the full model. The research informing this latter theory has largely come from two separate areas: sociological research investigating social reinforcers (i.e., the Akers approach) and psycholog-

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ical research investigating issues of proneness to substance abuse. The study presented herein is an explicit test of an interactive social learning theory, because it brings together in one analysis the study of personality proneness and social reinforcers to predict problem alcohol use. The term "interactive social learning model" is used to differentiate social learning theories that include the concept of personal predisposition from those that do not.^{18,19}

In perhaps the first interactive social learning theory of alcoholism, Trice²⁰ maintained that alcohol addiction is a product of: "1) *Prone personalities* who imbibe regularly in 2) *drinking groups* that reflect the functional value of alcohol in a complex society, but which exercise 3) widely varying norms about what is deviant drinking behavior—a social ambivalence. As a result there are 4) weak social controls, since a deviant drinker in one group can readily move to a set of drinking companions with more tolerant norms. Finally, cultural values stressing the importance of self-control justify 5) a pattern of segregation of those who regularly become intoxicated" (p. 2). [emphasis added]

Trice's theory can easily be interpreted as a social learning theory, because it is clear that he believed that the interaction between the prone personality, the social environment (drinking group), and the substance (alcohol) produces alcoholism. He maintained that personality issues alone do not produce the addiction and that only through involvement with a social drinking group does the proneness turn into alcoholism. Further, Trice's emphasis on the role of drinking groups is especially relevant to an interactive social learning model, for it is in these groups that the individual observes drinking behavior, models it, and is positively reinforced. Trice stated that repeated exposure to a drinking group, "tends to satisfy the emotional needs of the ready personality, to bring about certain emotional rewards for him, and thereby fix the use of alcohol as his main adjustment technique" (p. 49).

In a more updated interactive social learning theory of substance use, Peele²¹ offered an "addiction formula," which is made up of interactions between concepts of "individual traits and needs," "values and outlook," "social milieu," and the "nature of experience" (p. 130). The formula supports the idea of personality characteristics, combining with "objects" of addiction (e.g., drugs, alcohol), and social environments in fostering addiction. Further examples of interactive theories include developmental models by Zucker and Noll,²² Huba and Bentler,²³ and White et al.,²⁴ which combine issues of personality, cognition, and parental/peer influences (among others) as contributors to adolescent problem drinking. Their models specifically address the belief expressed by many that there is not one causal pathway to drinking and other substance use problems, but rather there are many possible routes. These models allow for wide combinations of sociocultural, personal, familial, and biological factors in producing problem use behaviors (as well they specify reciprocal causal relationships among variables).

EMPIRICAL SUPPORT FOR SOCIAL LEARNING MODELS

Akers et al.²⁵ tested social learning models in samples of adolescents and elderly persons,²⁶ and found that alcohol use by significant others, beliefs about alcohol, and reinforcers of alcohol use were all significant in explaining drinking behavior. More specifically, they found that differential associations were the best predictor for adolescent and elderly drinking. The second best predictor for adolescents was their beliefs about alcohol, and differential reinforcements were the second best predictor for elderly drinking.

Mirroring the findings of Akers and colleagues,^{25,26} Johnson¹⁶ found that differential associations, as opposed to attitudes about use, reinforcements, and punishments, had the strongest relationship to continued alcohol use. Similarly, White and colleagues¹⁷ found that differential association variables (including friends' use and friends' tolerance of use) were the most significant predictors of adolescent alcohol (and other drug) use. Biddle et al.²⁷ and Hartford²⁸ also found that alcohol use in later adolescence was most influenced by peer drinking, whereas young adolescents' onset of drinking was more related to parental drinking.

Studies of tavern cultures provide further evidence that peer and drinking groups influence adult drinking patterns. Taverns affect drinking patterns by providing a tolerant atmosphere where drinking is reinforced and positive attitudes about alcohol are the norm.^{29–32} Whereas data are equivocal, the majority of research supports the idea that group size is one determinant of drinking behavior.^{32–34} In general, the research on peer influence and drinking groups finds evidence of social networks of users who teach and reinforce substance use, while providing emotional support and ego satisfaction. Social reinforcement, however, is not sufficient to explain the development of substance abuse. Rather, as argued by interactive social learning theory, a "ready" personality must mix with a reinforcing social network for the proneness to grow into problem substance use.

PERSONALITY PRONENESS AND SUBSTANCE USE

Many researchers have supported the idea of a "prone-ness" to addiction. Khantzian³⁵ described a self-medication hypothesis of addictive disorders. He summarized clinical observations and psychiatric diagnostic findings of substance dependent individuals that suggested that these individuals are predisposed to addiction, because they suffer from "painful affect states and related psychiatric disorders" (p. 1259). Hatterer,³⁶ while expressing doubts about the existence of a singular addictive personality type, claimed that certain genetic, cultural, and personality-related factors can collectively contribute to create addictive vulnerability. Reviews by Zucker and Lisansky Gombert³⁷ and Sutker and Allain³⁸ identified a number of common psychological traits that precede drinking and other drug

problems, including childhood antisocial behavior, aggressiveness, heightened activity, arousability, anxiety, and depression. A more recent review of the psychological alcohol literature³⁹ cited several common personality characteristics and/or behavioral dispositions in adolescence that consistently predict later alcohol problems. Among the most commonly found traits or constructs were unconventional-ity, low ego-control, sensation seeking, impulsivity, aggression, and inability to delay gratification (see pp. 47–49).

Peele²¹ has argued that the fact that the “same individuals become addicted to many things, either simultaneously, sequentially, or alternatively” (p. 16) provides the strongest proof for a predisposing personality for addiction. He also noted studies of alcoholics⁴⁰ and heroin addicts⁴¹ that have shown that recovering persons often become compulsively attached to other things such as food or prayer. The empirical research on personality proneness has often failed to simultaneously consider environmental variables, and some exceptions are summarized herein.

RESEARCH INVESTIGATING PERSONALITY/ENVIRONMENT ASSOCIATIONS AND INTERACTIONS

Bates and Labouvie⁸ investigated the influence of “person–environment constellations” on the development of adolescent high-risk trajectories of drug use. They found that constellations made up of deviant differential associations, disinhibition, impulsivity, and poor parental control increased the probability of involvement in a high-risk drug use trajectory. They primarily reported additive associations, and their results support the notion that personality and environment variables combine to produce problem substance use. Earlier work from these authors⁴² investigated a “goodness-of-fit” model between personality needs and environmental situations in fostering problem substance use, and found that a “mismatch” between high levels of need for social support and the lack of these needs being met in the environment predicted increased problem use.

In another study, Brook et al.⁴³ found that personal and environmental factors combine to predict increased levels of substance use. Specifically, friends’ substance use and childhood aggression combined to predict the transition from moderate to heavy alcohol and marijuana use. These researchers found a significant interaction effect between these variables as well; low childhood aggression interacted with low peer substance use to protect against heavy substance use. Studying interactions among personal variables and substance use, Rogosch et al.⁴⁴ found an interaction between family history of alcoholism and personality constructs. In their study, high levels of dispositional self-awareness attenuated (or buffered) the relationship between family history of alcoholism and alcohol consumption. In contrast, high levels of personality risk (as indicated by high levels of aggressiveness and impulsivity) magnified the effects of family history on alcohol consumption and social consequences of drinking.

Stacy et al.⁴⁵ examined interactions among an array of personality variables and alcohol use in predicting alcohol problems and drunk driving. Most interactions involving the measures of sensation seeking, depressive tendency, social conformity, hostility, and cognitive motivation were significant (although small in size) across gender and the two dependent variables. In later research, these same authors⁹ tested interactions between social influences on drug use (as measured by perceived proportion of friends who use) and certain personality constructs that were hypothesized to either buffer or magnify the effect of the social influences on substance use. In this study, as well as their earlier study, they did not test an overall interaction model, but rather they tested numerous separate models. A measure of “liberalism” was found to buffer the effect of social influence on marijuana and cocaine use (i.e., as liberalism increased, the predictive ability of social influence on drug use decreased). As well, a measure of “self-acceptance” buffered the effect of social influence on “hard drug” use. In this case, high levels of self-acceptance were protective against the effects of social influence, and persons with low self-acceptance were more susceptible to social influence. Lastly, a measure of “extroversion” was found to increase the predictive effect of social influence on cocaine use; extroverted, as compared with introverted, individuals were more likely to respond to peer influences.

Stacy et al.’s⁹ study is one of the few testing personality–environment interactions, and is the closest in design to the interactive social learning model tested herein. The presence of significant interactions between personality and differential associations in their research provides perhaps the only previous empirical support for a model like the one explored in the present study. In a meaningful difference from the model tested herein, Stacy et al. theorized that the personality variables moderated the social influence measures, whereas in this study we model the differential associations variables as moderators of the personality constructs.

METHODS

Design

Data to be used in this study were gathered as part of the Rutgers Health and Human Development Project, a prospective longitudinal study that began in 1979. The study began with a sample of 1380 New Jersey adolescents located through a random telephone survey and has followed them into young adulthood. To date, three retests, with the subjects returning every 3 years for the first two retests, and after 7 years for the third, have been complete (for details on design and subject recruitment, see Pandina et al.⁴⁶). The time 1 (T1) to time 4 (T4) year follow-up rate was 91% ($n = 1257$). In these analyses, we used data from each of the three retests: time 2 (T2), time 3 (T3), and T4.

The original sample was largely White (89%), slightly higher than New Jersey’s proportion (83%) as measured by the 1981 U.S. Census, and closely mirrored the state’s religious and socioeconomic makeup. Self-selection does not seem to have diminished representativeness, and reliability and validity analyses support this assertion.⁴⁷ The sample is most representative of American adolescents growing up in working- and middle-class suburban environments.⁴⁸ Data collected from those who

dropped out (ages 15 and 18 at T1) suggest that there are no problematic differences in alcohol quantity and frequency measures between the retained subjects and those lost through attrition.⁴⁸

Measures

Data for the present study come from self-reports. Self-report data are often used to study deviant behavior.^{49,50} The potential validity problems due to deliberate falsification of information, error in recall, and measurement effects seem to be minimal with the use of professional interviewers, short recall times, and assurances of confidentiality.⁵⁰

Problem Alcohol and Drug Use. The Problem Alcohol Use scale consists of 36 possible negative consequences (e.g., “had withdrawal symptoms” and “passed out or fainted suddenly”); the full scale is listed in the Appendix; Cronbach α 's are: T2 = 0.93, T3 = 0.93, and T4 = 0.93. The use of negative consequences as a measure of “problem drinking” or “problem drug use” is relatively common in the literature.^{45,47,51,52}

Intrapersonal Variables. Whereas Trice believed that proneness to alcoholism involved an “independence-dependence” conflict (among men only), we have chosen not to explore this part of his theory in light of more modern conceptions of personality proneness. Therefore, we include four personality constructs consistently found to be related to alcohol and drug problems: disinhibition, experience seeking, depressive tendencies, and hostility. The measure of disinhibition is derived from Zuckerman's⁵³ Sensation Seeking scale. This is an eight-item, forced-choice scale (e.g., “I like ‘wild’ uninhibited parties” and “a person should have considerable sexual experience before marriage”). The measure of experience seeking is also from Zuckerman's Sensation Seeking scale and is an 8-item scale (e.g., “I would like to take off on a trip with no preplanned or definite routes” and “I like to explore a strange city or section of town by myself, even if it means getting lost”). The Zuckerman scales are widely used in the alcohol and drug use literature, and numerous studies have found increased levels of substance use/problem use to be associated with higher levels of disinhibition and experience seeking.^{8,45,54,55}

The measures of depressive tendencies and hostility are subscales of the SCL-90-R.⁵⁶ The measure of depression comes from 10-item scale (e.g., “thoughts of ending your life,” “feeling no interest in things,” and “feelings of worthlessness”). The measure of hostility comes from a 10-item scale (e.g., “outbursts that you could not control”; “having urges to beat, injure, or harm someone”; and “feeling easily annoyed or irritated”). The SCL-90-R has highly validity and reliability in clinical and general population samples.⁵⁷ Previous research has often found high levels of depression and hostility, as measured by the SCL-90, to be significant predictors of substance abuse problems and increased levels of drinking and drug use.^{43,45,59–61}

Social Environment Variables. In operationalizing the environmental variables, we incorporate Trice's²⁰ concept of “heavy” drinking groups into a model with the more traditional social learning concept of “motivation.” Two sets of indicators are used to operationalize environmental influences as follows: (1) the proportion of the subject's friends who are problem alcohol users (differential associations), and (2) the subject's level of motivation to use alcohol with friends.

The first set of indicators is made up of a 5-item scale from the subject's evaluation of his/her friends' alcohol use (e.g., “how many of your friends sought treatment for an alcohol problem?” and “how many of your friends have been in trouble with the police for something they did while drinking?”). To operationalize Trice's²⁰ notion of “alcoholic” or heavy using groups, we focus on items indicating *problem* substance use rather than following the more traditional differential associations approach of using measures of the proportion of friends who simply *use*. Cronbach α 's for the problem-using group scales are: T2 = 0.81 and T3 = 0.75.

The second set of environmental indicators is made up of 3-item scale measuring the subject's motivations to drink with peers or significant others (e.g., “my most important reasons for drinking alcohol are: (1) it's just something my friends and I do when we get together, (2) my friends expect me to, and (3) my boyfriend/girlfriend or husband/wife expects me to”). Cronbach α 's for this scale are: T2 = 0.95 and T3 = 0.84. The

problem use measures, as well as three independent variables (friends' problem use, hostility, and depression), were logged due to skewness. Correlations among all variables are listed in the Appendix.

Analysis

Hierarchical regression analyses were used to investigate both a main effects and interaction model of personality/environment predictors of problem alcohol use. Both cross-sectional and longitudinal relationships among variables were explored as follows: T3 dependent variables were regressed on T2 and T3 independent variables; and likewise, T4 dependent variables were regressed on T3 and T3 independent variables. In the longitudinal analysis, prior alcohol problems were controlled for via the inclusion of a score of problem use from the earlier time wave (i.e., problem alcohol use from T2 was included in the model for T3 problem use, and problem alcohol from T3 was included in the model for T4 problem use). The hierarchical regression analyses followed a two-step procedure. The main effects model was entered in the first step: four personality constructs, two social network measures, and gender. Two-way interaction terms were entered in the second step. Each of the four personality variables was entered separately in a two-way interaction term, with the problem-using group (differential associations) measure as the moderator variable. Whereas others have investigated moderating relationships by performing separate regressions involving only the variables specified in the interactions,^{9,45} we have taken the more conservative approach of testing for moderator effects over and above a full model, including variables not specified in any interactions. The significant interactions found under these circumstances can be viewed as more valid because they have faced a tougher test for “survival.”

The final sample consisted of subject who had been present at all four time periods of data collection ($n = 120$). Not all of these subjects were included in each analysis, however. Data were missing on some variables in the analysis: the T2/T2–T3 analyses were missing 45 cases and the T3/T3–T4 analyses were missing 14 cases. This small number of subject loss, ~1 to 2% of the total sample, does not pose a significant problem relative to the validity and generalizability of the findings. Most importantly, the n 's for each series of regressions are the same.

Hypotheses

Past social learning research has consistently found measures of differential associations to be among the strongest predictors of alcohol use.^{16,25,26,62,63} Therefore, we hypothesized that differential associations (friends' problem use) would be the strongest predictor. Furthermore, we expected disinhibition to be the strongest personality predictor because of the wealth of findings in the literature of its relationship to problem substance use measures.^{8,45,64,65}

In terms of the moderator effects, we hypothesized that the measures of disinhibition and experience seeking would produce the most significant interaction effects (with the differential association variable). We thought that the social network might be more likely to bring to fruition the personality characteristics that dealt more with freeing inhibitions, “letting one's hair down” and trying new things. The size of the interaction effects was expected to be relatively small⁶⁶ (i.e., approximately a 1% variance increase over the main effects model). We hypothesized that the regression coefficients of the significant interaction terms (personality-differential associations) would be positive. In other words, we postulated that the presence of a problem drinking group would strengthen the predictive ability of the personality variable—very much in line with Trice's²⁰ theoretical perspective.

RESULTS

The results of the hierarchical analyses for problem alcohol use at T2 (the T2 cross-sectional analysis) and T2–T3 (the longitudinal analysis from T2 to T3) are summarized in

Table 1. Main and Interaction Effects for Problem Alcohol Use at T2 and T2–T3

Predictor variables	T2			T2–T3		
	R ²	b	β	R ²	b	β
Step 1	0.448***			0.299***		
Friends' Problem Use		1.69	0.42***		0.06	0.02
Motivations		0.14	0.26***		-0.01	-0.03
Disinhibition		0.10	0.17***		0.09	0.17***
Experience Seeking		0.04	0.05*	-0.01	-0.01	
Hostility		0.30	0.08***		0.08	0.02
Depression		0.16	0.04		-0.05	-0.01
Gender		0.08	0.03		0.22	0.10**
T2 alcohol problems (Control)		NA	NA		0.39	0.43***
	R ² Δ			R ² Δ		
Step 2						
DIS*FPU	0.006**	-0.15	-0.08***	0.000	0.01	0.01
EXP*FPU	0.004*	-1.15	-0.07**	0.000	-0.03	-0.02
HOS*FPU	0.000	-1.18	-0.02	0.000	-0.24	-0.02
DEP*FPU	0.000	-1.25	-0.02	0.000	-0.37	-0.03

Note: *n* = 1153. DIS, Disinhibition; EXP, Experience Seeking; HOS, Hostility; DEP, Depression; FPU, Friends' Problem Use; NA, not available.
p values are as follows: * *p* < 0.05; ** *p* < 0.01; *** *p* < 0.001.

Table 1. Beginning with the T2 cross-sectional analysis, the seven-variable additive model explained 45% of the variance in problem alcohol use (adjusted R²). An examination of the β-weights reveals that 5 of the 7 variables were significant: friends' problem use, motivations, disinhibition, experience seeking, and hostility. These results indicate that individuals who used for social reasons, whose friends were problem users, who were highly disinhibited, hostile, and were experienced seekers were more likely to report problem alcohol use. As expected, the differential associations variable was the strongest predictor overall (β = 0.42), and disinhibition was the strongest personality predictor (β = 0.17). Gender and depression were not significant. Overall, the model produced results consistent with the hypothesized social learning theory: a cluster of personal and environmental influences combined to predict relatively well a measure of problem alcohol use.

The same model tested longitudinally on T3 problem drinking behavior lost predictive power. Including a score of the subject's T2 problem drinking behaviors as a control, the model explained 30% of the variance. As expected, the strongest predictor was the control (β = 0.43), and only two other variables were significant: disinhibition (β = 0.17) and gender (β = 0.10). These results indicate that males, persons with prior drug problems, and highly disinhibited individuals at T2 were more likely to report problem alcohol use at T3. That the differential associations measure lost significance going from cross-sectional to longitudinal analyses suggests that past substance use-related network involvements, when levels of past alcohol problems are controlled, do not predict present behaviors. Interestingly, the measure of disinhibition remained significant in the longitudinal model, and retained its relative strength as a

predictor (*b* at T2 = 0.10, *b* = 0.09). Gender became a significant predictor in the longitudinal model.

In general, these findings indicate that the hypothesized social learning model of problem use is not strongly longitudinally. An examination of the stability coefficients of the predictors from T2 to T3 indicate that each of the predictors is low to moderately stable (0.26 to 0.55), suggesting that significant change is occurring among levels of predictors over time (Table 2). Hence, one cannot expect the model to strongly predict subsequent problem use behaviors. The measure of disinhibition was the most stable variable (0.55) and was the only variable to remain significant from the cross-sectional to the longitudinal analyses.

Table 1 also reports of the tests for the two-way interactions. In the T2 cross-sectional analyses, 2 of the 4 interactions tested were significant: "disinhibition*friends' problem use" and "experience seeking*friends' problem use." The former was the slightly stronger of the two, with an R² increase of 0.6% (β = -0.08) as opposed to the 0.4% increase (β = -0.07) attributable to the latter. Whereas the presence of personality–environment interactions lends support for an interactive social learning model of problem use behaviors; the directions of both interactions, contrary to our hypothesis, were negative. We had expected positive directions for all interactions, which would indicate that, as the proportion of friends who are problem users increases, the predictive ability of the personality measure increases. However, these negative signs indicate that as the proportion of problem-using friends increases, the predictive power of the personality measure decreases.

The results from the further probing of these interactions are depicted in Figs. 1 and 2. Following the recommendations of Jaccard et al.⁶⁷ and Aiken and West,⁶⁸ we centered the variables used in the interaction terms (before all regression analyses) and investigated the "simple" slopes of the regression of problem alcohol use on the personality variables at different levels of the moderator variable (friend's problem use). Three levels of the moderator variable were used: one standard deviation below the mean (SDB), the mean (M), and one standard deviation above the mean (SDA). As would be expected from the negative sign of the original interaction, the predictive ability of the personality measures went down as the value of the moderator went up. For example, with the differential association (moderator) variable at SDB, *b* of disinhibition =

Table 2. Stability Coefficients for Predictors, T2–T3

Predictor	Stability coefficient
Disinhibition	0.55
Experience Seeking	0.52
Hostility	0.37
Depression	0.47
Friends' Problem Alcohol Use	0.40
Motivation	0.29

Note: Stabilities were not run for the predictors from T3 to T4, because many predictors (disinhibition, experience seeking, and friends' problem use) were either not measured at T4, or were measured with different scales at T4 than at earlier times.

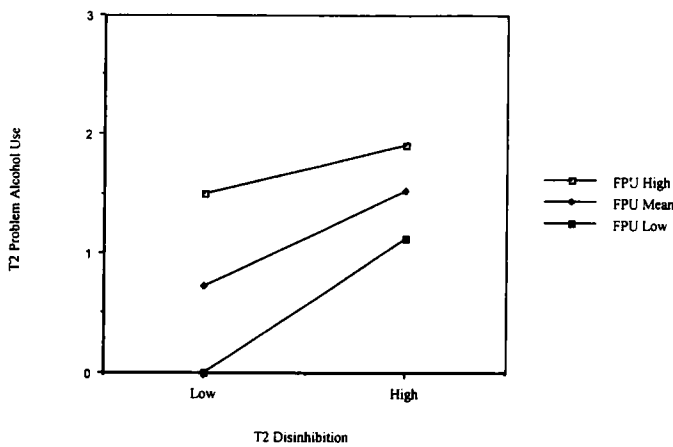


Fig. 1. Note: Range of (logged) T2 program alcohol use = 0 to 4.2. Values shown are 0 to 3 for clarity of slope depiction.

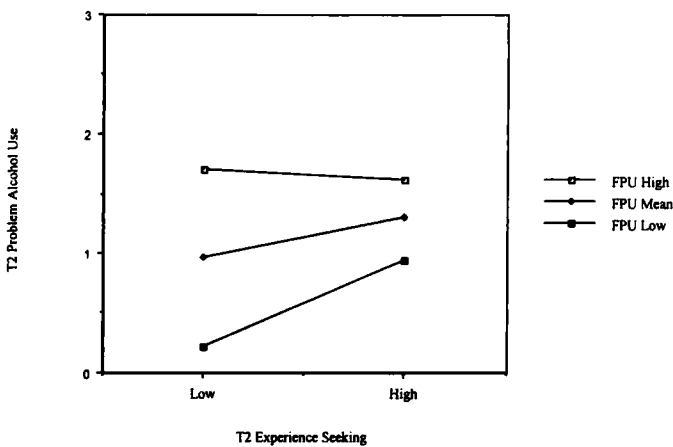


Fig. 2. Note: Range of (logged) T2 program alcohol use = 0 to 4.2. Values shown are 0 to 3 for clarity of slope depiction.

0.145; with the moderator at M, $b = 0.097$; and with the moderator at SDA, $b = 0.049$ (all $p < 0.001$). For the experience seeking interaction, with the moderator at SDB, $b = 0.085$ ($p < 0.01$); with the moderator at M, $b = 0.038$ ($p < .05$); and with the moderator at SDA, $b = 0.009$ (NS). These findings explicitly show the nature of the interactions—the falling levels of b show the predictive ability of the personality variable decreases as the proportion of problem using friends increases. In other words, the influence of disinhibition and experience seeking on problem alcohol use is strongest when the subjects do not have problem-using friends, and is weakest when the subjects have a high proportion of problem-using friends. None of the T2–T3 longitudinal two-way interactions significant.

The results from the hierarchical regression analyses for T3 (T3 cross-sectional analysis) and T3–T4 (T3 to T4 longitudinal analysis) are summarized in Table 3. Starting with the T3 cross-sectional data, the seven-variable model explained 46% of the variance in problem alcohol use. Five of the variables were significant: friends' problem use ($\beta = 0.38$), motivations to use with peers and significant others ($\beta = 0.21$), disinhibition ($\beta = 0.29$), experience seeking ($\beta =$

Table 3. Main and Interaction Effects for Problem Alcohol Use at T3 and T3–T4

Predictor variables	T3			T3–T4		
	R^2	b	β	R^2	b	β
Step 1	0.463***			0.350***		
Friends' Problem Use		1.45	0.38***	0.17	0.04	
Motivations		0.16	0.21***	0.06	0.08***	
Disinhibition		0.14	0.29***	0.08	0.16***	
Experience Seeking		0.03	0.06*	0.01	0.01	
Hostility		-0.07	-0.02	0.01	0.00	
Depression		0.40	0.11***	0.36	0.10**	
Gender		0.07	0.03	0.34	0.15***	
T3 alcohol problems (Control)		NA	NA	0.35	0.35***	
	$R^2\Delta$			$R^2\Delta$		
Step 2						
DIS*FPU	0.002*	-0.07	-0.04*	0.000	0.02	0.01
EXP*FPU	0.000	-0.05	-0.02	0.001	0.09	0.04
HOS*FPU	0.000	-0.33	-0.03	0.000	-0.11	-0.01
DEP*FPU	0.000	-0.17	-0.01	0.000	0.15	0.01

Note: $n = 1186$. DIS, Disinhibition; EXP, Experience Seeking; HOS, Hostility; DEP, Depression; FPU, Friends' Problem Use; NA, not available. p values are as follows: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

= 0.06), and depression ($\beta = 0.11$). Thus, those who used more with friends, had problem-using friends, and were disinhibited, depressed, and experience seekers more likely to report alcohol problems. These results closely mirror those of the T2 cross-sectional model. Friends' problems use was again the strongest predictor, and disinhibition was the strongest personality variable. The T3 motivations measure was again significant. In addition, the experience-seeking measure was weak, but significant for both cross-sectional analyses. The main difference in the results is found in the SCL-90 measures. For T2, the measure of hostility was significant and the measure of depression was not. At T3, these are reserved. Both offer very small contributions, however. As before, gender was not significant. In general, the T3 cross-sectional data indicate strong support for a social learning model of problem use behaviors.

The longitudinal model (T3–T4) explained 35% of the variance in problem alcohol use. The R^2 was lower for the longitudinal, compared with the cross-sectional analyses, similar to what was found in the T2 and T2–T3 analyses. Numerous other similarities to the earlier analyses exist: (1) friends' problem use became nonsignificant in the longitudinal model, as did experience seeking; (2) disinhibition remained significant, although smaller in effect (b for T3 = 0.14; b for T3–T4 = 0.08); (3) gender became significant ($\beta = 0.015$) in the longitudinal model; and (4) the control (subject's problem alcohol use at T3) became the most significant predictor ($\beta = 0.35$). One difference from the earlier alcohol analyses was that depression remained significant from the T3 to the T3–T4 analyses, and did not change much in effect (b for T3 = 0.11; b for T3–T4 = 0.10). Another difference was that the motivation variables remained significant, although smaller in effect. These re-

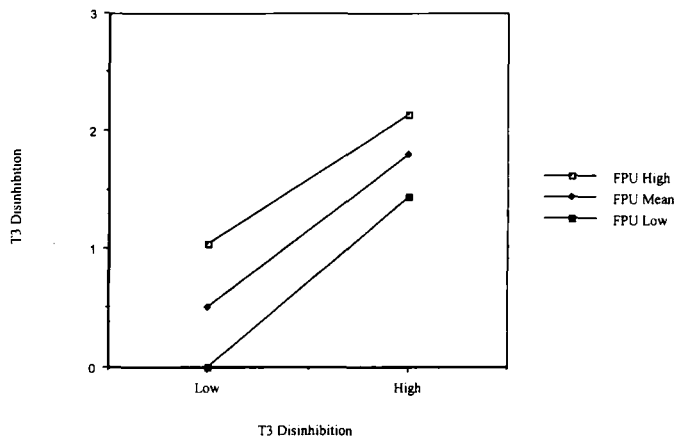


Fig. 3. Note: Range of (logged) T3 program alcohol use = 0 to 4.49. Values shown are 0 to 3 for clarity of slope depiction. FPU, Friends' Problem Use.

sults indicate that males, and those who used with friends, were highly disinhibited, and were depressed at T3 were more likely to report problems with alcohol at T4. Overall, the T3–T4 longitudinal model moderately supports social learning principles in that one environmental influence, motivation to use with peers and significant others, combined with two personality measures and gender to significantly predict later problem alcohol use.

In terms of significant interactions, the “disinhibition *friend’s problem use” term ($\beta = -0.04$) added a small amount of increased variance (0.2%) in the T3 cross-sectional analysis. This was the only significant two-way interaction in the T3 and T3–T4 analyses. This interaction, like those in the earlier analyses, was negative. Further probing of the interaction (Fig. 3) indicated that, as the level of the moderator (friends’ problem use) rose, the *b* of the disinhibition measure fell [*b* at SDB = 0.164; *b* at M = 0.143; *b* at SDA = 0.122 (all $p < 0.001$)]. In other words, as the proportion of problem-using friends increased, the predictive ability of disinhibition decreased. Note that the smaller differences between the slopes indicate that this interaction effect is the weakest of the three found. This finding, like the earlier interaction results, is contrary to our hypothesis.

DISCUSSION

This study investigated the much theorized and underresearched issue of personality–environment interactions in the development of problem alcohol use. The main effects model offers qualified support for a social learning theory of problem alcohol use. The main qualifier comes in the distinction between cross-sectional and longitudinal analyses—each of the cross-sectional analyses produced results strongly supporting a social learning theory, whereas the longitudinal data produced equivocal results at best. In the cross-sectional analyses, both environmental influence variables were significant and positively related to problem drinking, with friends’ problem use being the strongest

predictor. These findings replicate the results of numerous previous studies investigating the impact of environmental influences on drinking.^{16,17,23,26}

In each cross-sectional analysis, three personality measures were also significant (and positively related) predictors of problem use. Disinhibition and experience seeking were significant in each, whereas hostility was significant at T2 and depression was significant at T3. These findings mirror the results of numerous studies linking these four specific personality constructs with higher levels of alcohol (and/or drug) use and problems.^{8,54,61,64,65,69}

In contrast, the longitudinal analyses indicate only moderate support for the social learning model in one case (T3–T4), and no support in the other (T2–T3). For T2–T3, the only significant variable (other than gender and the control for prior problem use) was disinhibition. In the T3–T4 analyses, the motivations, disinhibition, and depression measures were significant (along with gender and the control), indicating some support for the notion that environmental and personal variables combine to predict problem use.

The results suggest that the combination of environmental and personality influences is strongly predictive only when occurring concurrently with problem use behaviors. This finding is reflected in the pattern of explained variance between the cross-sectional and longitudinal analyses. The cross-sectional models, respectively, explained 15% (T2) and 11% (T3) more variance in problem use outcomes than did the longitudinal models. The differences in R^2 seem to indicate that social learning predictors are not strong predictors of later behaviors. The main relationship they have with later problem use scores may be indirect through their influence on earlier problem use measures.

Relatedly, a number of social learning predictors “dropped out” of significance from the cross-sectional to longitudinal analyses. This difference, although not explicitly hypothesized a priori, is not surprising given (1) the relatively low stability coefficients of the predictors variables (from T2 to T3), and (2) the methodological properties of control variables. Beginning with the stabilities, the 3-year coefficients of the predictors from T2 to T3 were low to moderate (0.29 to 0.55), indicating that a significant number of the subjects were experiencing different social learning influences and different levels of personality proneness at T3 than at T2. Therefore, one might not expect many T2 independent variables to remain as significant predictors of T3 problem use measures. Although we were unable to perform T3–T4 stability coefficient analyses because several of the T3 measures were not repeated at T4, we would expect similar or lower stabilities for those predictors given that an even greater number of years had passed between data collections. The model may not necessarily be “unsupported” by the longitudinal data. Rather, it may simply show that the social learning model is essentially a concurrent one and is less suited for longitudinal prediction. It is also possible that the presence of control

variables also contributed to this loss of significance by “taking away” variance from the other predictors, decreasing their statistical significance, and perhaps masking their importance.

The fact that the cross-sectional analyses supported our interactive model and the longitudinal analyses did not raise several confounding issues. For example, the direction of “causality” may be opposite to that predicted in our model. In other words, being a problem drinker may cause a person to become depressed or choose to associate with heavy drinkers. Similarly, the relationship may be spurious (i.e., there may be other variables that predict both problem drinking and the personality–environment variables included in this study). Cross-sectional data cannot rule out either of these alternative explanations. It is possible, however, that our model is correctly specified and that proximal environmental influences are simply more important than distal ones.²⁴ It has been demonstrated that peer effects are very important predictors of substance use and that peer groups change often in adolescence and even in young adulthood.⁴⁸ Furthermore, existing research confirms that both selection and socialization processes are determinants of peer group changes.^{48,70} Thus, peer effects may need to be contemporaneous for an effect to be found, which would account for their lack of main and interactive effects in the longitudinal analyses.

Other findings from the main effects analyses were inconsistent and harder to interpret. For example, gender was not significant in the cross-sectional data, but was significant in the longitudinal analyses. The coefficient was always positive, indicating that problem use was more likely among males than females, which is consistent with most research.^{71,72} That gender was significant longitudinally, but not cross-sectionally, remains puzzling; perhaps future cross-sectional-to-longitudinal comparisons can shed light on this issue.

In terms of interactions, whereas none of the terms in the longitudinal analyses was significant, 3 of the 8 possible interactions in the cross-sectional analyses were. Thus, these analyses provide moderate support for the notion that person–environment interactions may be important predictors of concurrent problem alcohol use. Again, these findings should be interpreted with caution, given the limitations of cross-sectional analyses described herein. Effect sizes were small, and a note of caution is necessary when interpreting the results. However, that the interactions added only small amounts of explained variance over the main effects models does not mean that they are theoretically unimportant. As discussed previously, increases in R^2 due to interaction effects in nonexperimental data are usually quite small—often ~1% variance increase. Stacey et al.⁹ argue that researchers should not compare the amounts of variance explained by main and interaction effects because of the issue of measurement error. As described by Busemeyer and Jones,⁷³ the increase in R^2 is directly re-

lated to the reliability of the interaction term. If measurement error exists in the variables used in the creation of the interaction term (as is always the case in nonexperimental research), the act of multiplying those variables also multiplies the impact of measurement error on the product term. Busemeyer and Jones⁷³ contend, “thus, the presence of measurement error in the predictor variables will drastically reduce the power to detect a significant contribution from the product term” (p. 559). It seems, then, that the statistical significance of an interaction effect may be a better indicator of its importance, rather than the increase in explained variance. In addition, the crucial part of an interaction effect is not necessarily the size of the R^2 increase, but the “movement” in the independent variable with the changes in the value of the moderator.

Perhaps the most interesting finding from the interactive analyses lies in the direction of the significant terms. The hypothesis, as guided by the Trice-inspired social learning theory, was that all significant interactions would be positive, indicating that the presence of problem-using friends would increase the predictive ability of the personality proneness constructs. However, each of the significant interactions was negative, indicating that the presence of a problem drinking group actually decreases the predictive ability of the personality proneness measures. Thus, the findings do not support the notion suggested by our interactive social learning theory that personality predispositions would be necessary in the development of alcoholism.

These results do, however, conform to earlier observations made by Jellinek⁷⁴ and Lemert⁷⁵ regarding drinking norms and psychological vulnerability. These researchers argued that, in cultures with a norm of low levels of daily drinking, high psychological vulnerability is necessary for a person to become alcoholic. Conversely, in cultures where higher levels of daily drinking are the norm, psychological vulnerability is *not* necessary for persons to become alcoholic. Robins et al.⁷⁶ also concluded from their longitudinal analysis of formerly deviant children that the higher rates of alcoholism among the Irish, compared with other ethnic groups and among men as compared with women, are due largely to exposure to heavy drinking patterns, not greater susceptibility. The findings of Robins et al.⁷⁶ are consistent with the work of Bales⁷⁷ and Snyder,⁷⁸ who studied Irish and Jewish drinking patterns and concluded that cultural drinking norms accounted for the difference in their respective rates of alcoholism. More recently, Skog,⁷⁹ in his discussion of a distribution theory of alcoholism, espoused the view that even people with low levels of “constitutional disposition” toward alcoholism may develop drinking problems “when exposed to a particularly wet environmental where alcohol is cheap, easy to come by, and frequently used by everybody” (p. 586). Overall, our data, as well as this earlier body of research, suggest that in contemporary American society, where drinking is a relatively common

occurrence, problem drinking can develop regardless of personality proneness. That is, anyone involved in a heavy drinking group who drinks heavily enough can become a problem drinker, regardless of psychological vulnerability. Personal vulnerability may be more necessary in the development of problem drug use because any use of illicit substances is not normative. Further research investigating person–environment relationships and interactions should be sensitive to the relative cultural acceptability of the substances in question.

Several limitations of the research affect the reliability and generalizability of the results. First, the sample is mostly White, and the results are not generalizable to non-Caucasians. As well, the sample is mostly metropolitan and from working- and middle-class backgrounds, and is not representative of rural dwellers and persons of the highest and lowest social classes. Furthermore, the recall times for the predictors and dependent variables often differed. For example, the SCL-90 and Zuckerman variables have essentially no recall times—they measure present personality states (the SCL-90 references the past 30 days). Likewise, the motivations variable was based on present conditions. The dependent measure of problem alcohol use across all times was based on a 3-year recall (friends' problem use mirrored this recall time). By default, the analyses treat the recall times as the same, and as a result some of the relationships found between variables may not exist.

Another potential problem is the time span between data gatherings. The span of 3 years between T2 and T3 and the 7 years between T3 and T4 may be too long to assess certain longitudinal relationships adequately. Although this time frame may be appropriate to gauge the predictive ability of earlier delinquent behavior on later drug problems, it may be too long to ascertain the longitudinal impact of, for example, personality predispositions on later drug problems because of the fluid nature of personality changes over time.⁸⁰ Furthermore, these data, while longitudinal, cannot eliminate all selection effects. One possibility pertinent to personality change over time is that subjects with similar personality traits may be clustering together in peer groups.⁸¹ For example, high sensation seekers may select friends who are also high sensation seekers, thus confounding the effects of personality with peer influences on drinking. The relevant correlations (see Appendix) between the personality and friends' problem drinking group variables in this study are not high (none above 0.33), but the influence of personality on peer group affiliation should be considered, and drinking among peers should be regarded as more than simple environmental exposure to alcohol.

Lastly, and related to the final point above, the measurement error that can be introduced by (among other issues) self-reported data, has been multiplied in the creation of the interaction terms. This problem can lead to type II error in the estimation of parameters and in tests of signif-

icance.⁹ This problem may be related to the fact that relatively few of the interactions tested were significant. In addressing the problem of identifying significant person–environment interactions, Bates and Labouvie⁸ contend that our present measures of personality and environmental influences are relatively unsophisticated, and fail to untangle the environment's influence on personality and vice-versa. Because issues of personality and environment are confounded in present measures, Bates and Labouvie argue that identifying interactions among these variables (which are themselves combinations of personality and environmental data) is likely to be difficult.

In summary, some of the most important implications of this research have already been discussed above, namely: (1) social learning models based on the interactions and/or co-occurrence of personality and environmental influences may be more appropriate for predicting concurrent, as opposed to future, problem use due to instability of predictors over time; (2) the search for person–environment interactions is worthwhile and should be included in future search; and (3) future studies need to be sensitive to issues of cultural acceptability and tolerance of heavy use of the substance in question when assessing the impact of psychological vulnerability. In addition, future research should expand the base of personality measures investigated. In our desire for a compact and parsimonious social learning model, we kept the number of personality measures relatively small. Other salient and previously proven personality predictors, such as “impulsivity” and “low self-esteem,” should be included in future interactive models, as well as heritability variables, such as “extent of family alcoholism.” The work of Rogosch et al.,⁴⁴ which suggests that personality risk factors for drinking problems can moderate the relationship between family history of alcoholism and alcohol consumption, indicates that this type of analysis warrants increased attention.

Overall, the study suggests that the co-occurrence and interaction of personality predispositions and environmental influences are important in the prediction of problem alcohol use. Yet, we have found that personality proneness is more important when there are fewer environmental supports for heavy drinking. Thus, data suggest that there are multiple causes of alcohol problems and that both personal and environmental factors play a role and interact with each other. Future research would do well to explore further these types of relationships as we seek greater understanding of the complexities that characterize substance abuse behaviors.

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Table A1. Correlations for Alcohol Analyses T2 and T2-T3

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. T2 Problem Use	—											
2. Friends' Problem Use	.56	—										
3. Motivations	.41	.22	—									
4. Disinhibition	.40	.29	.27	—								
5. Experience Seeking	.27	.23	.23	.30	—							
6. Hostility	.23	.17	.05	.18	.12	—						
7. Depression	.16	.13	.03	.02	.08	.65	—					
8. Gender	.12	.09	.03	.26	.01	.02	-.14	—				
9. DIS*FPU	.06	.28	.00	.03	.04	.04	-.01	.03	—			
10. EXP*FPU	.06	.26	-.03	.03	.07	.06	.06	.02	.35	—		
11. HOS*FPU	.10	.26	-.04	.04	.06	.08	.03	.01	.25	.22	—	
12. DEP*FPU	.03	.15	-.05	-.01	.06	.03	.06	-.03	.00	.13	.67	—
13. T3 Problem Use	.51	.31	.20	.37	.16	.15	.06	.20	.05	.02	.04	-.02

Note: $n = 1153$. Decimals are omitted. Correlations ≥ 0.06 are significant at $p < 0.05$ (two-tailed). DIS, Disinhibition; EXP, Experience Seeking; HOS, Hostility; DEP, Depression; FPU, Friends' Problem Use.

Table A2. Correlations for Variables in Table 5.4, Alcohol Analyses T3 and T3-T4

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. T3 Problem Use	—											
2. Friends' Problem Use	.53	—										
3. Motivations	.39	.19	—									
4. Disinhibition	.51	.33	.33	—								
5. Experience Seeking	.26	.19	.14	.31	—							
6. Hostility	.17	.20	.02	.12	.03	—						
7. Depression	.11	.06	.00	-.01	.05	.64	—					
8. Gender	.19	.17	.09	.31	.04	.02	-.17	—				
9. DIS*FPU	.04	.29	-.10	-.03	-.04	.02	-.03	.02	—			
10. EXP*FPU	.01	.14	-.07	-.04	.01	.01	.06	-.01	.30	—		
11. HOS*FPU	.07	.22	.03	.01	.01	.19	.04	.05	.14	-.04	—	
12. DEP*FPU	.01	.09	.02	-.03	.04	.05	-.03	-.01	-.05	.06	.63	—
13. T4 Problem Use	.54	.34	.30	.44	.19	.16	.11	.27	.02	.04	.04	.01

Note: $n = 1186$. Decimals are omitted. Correlations ≥ 0.06 are significant at $p < 0.05$ (two-tailed). DIS, Disinhibition; EXP, Experience Seeking; HOS, Hostility; DEP, Depression; FPU, Friends' Problem Use.

APPENDIX

Problem Alcohol Scale

Within the last 3 years, how many times did the following things happen to you while drinking alcohol or because of your drinking alcohol?

0 = none

1 = 1-2 times

2 = 3-5 times

3 = 6 or more times

1. not able to do homework (or work assignments)
2. got into fights, acted bad, or did mean things
3. not remember things you said or did after a certain point
4. worried or felt guilty about using
5. missed out on other things because you spent too much
6. went to work or school drunk
7. caused shame or embarrassment
8. tossed down several drinks for fast or quick effect
9. neglected responsibilities
10. friends or neighbors avoided you
11. relatives avoided you
12. felt paranoid or uptight
13. felt you needed more than you used to
14. felt you needed less than you used to
15. wanted to stop but you couldn't
16. tired to control by changing pattern
17. had withdrawal symptoms
18. noticed a change in your personality
19. felt you had a problem
20. been in trouble with the police for having or using
21. spent a whole weekend using
22. had a drink before or instead of breakfast
23. lost a job
24. been in a treatment program
25. got hurt or had an accident
26. missed a day (or part of a day) of school or work
27. people told you about things you said or did that you can't remember
28. suddenly you found yourself in a place you couldn't remember getting to
29. passed out or fainted suddenly
30. been in trouble with the police for something you did while using
31. kept using when you promised yourself not to
32. sought advice about your using
33. felt physically or psychologically dependent
34. told by a physician to stop or cut down
35. hurt chances of getting ahead on your job
36. experienced a noticeable weight loss.

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