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COGNITIVE MOTIVATIONS AND SENSATION SEEKING AS LONG-TERM PREDICTORS OF DRINKING PROBLEMS

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The development of comprehensive theories regarding the determinants of vulnerability toward drinking problems depends in part on longitudinal evidence linking psychosocial precursors to clinically-relevant problem consequences. In an investigation of some of the more promising psychosocial precursors of problem vulnerability, we evaluated the long-term predictive effects of adolescent cognitive motivations for alcohol use and sensation seeking on a wide variety of adult drinking-problem consequences including driving while intoxicated (DWI). Results indicated that the Cognitive Motivation factor was a significant, independent, nine-year predictor of a factor of Drinking-Problem Consequences. Over this same period, certain cognitive motivation and sensation seeking indicators independently predicted DWI, and the Sensation Seeking factor independently predicted Cognitive Motivation and Alcohol Use factors. The significant, independent effects on problem-drinking variables demonstrated that psychosocial vulnerability appeared across a range of consumption levels. These findings have important implications for counseling practices and the identification of teenagers of high-risk for drinking problems and DWI in later adulthood.

Anticipated effects and motivations for drinking may have critical importance in generating, understanding, and possible treatments of alcohol abuse (e.g., Goldman, Brown, & Christiansen, 1987; Marlatt & Gordon, 1985). Anticipated behavioral outcomes form an essential component of cognitive theories of personality (e.g., Mischel, 1973) and

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have been operationally defined in different ways, for example, as expectancy (Christiansen, Smith, Roehling, & Goldman, 1989; Leigh, 1989; Stacy, Widaman, & Marlatt, 1990), perceived function (Jessor & Jessor, 1977), and cognitive motivation (Newcomb, Chou, Bentler, & Huba, 1988). A growing number of studies has documented that this class of construct is a significant *prospective* predictor of drinking behavior, even when the predictive effects of previous consumption have been controlled statistically (e.g., Christiansen et al., 1989; Newcomb et al., 1988; Stacy, Widaman, & Marlatt, 1990). Given the generally acknowledged clinical and theoretical relevance of these cognitive anticipation constructs, further research is needed to establish more specific causal patterns, temporal limits of prediction, and range of clinically relevant dependent variables predicted by these constructs.

One neglected area of research on problem drinking and alcohol abuse is the comparison of cognitive anticipation constructs with other personality constructs as longitudinal predictors of drinking consequences. In a cross-sectional analysis of a wide variety of personality correlates of drinking problems in adulthood (Stacy, Newcomb, & Bentler, 1991b), a cognitive anticipation construct (cognitive motivation; Newcomb et al., 1988) was one of the two consistently significant predictors of drinking problems and alcohol consumption. The other strong predictor was *sensation seeking* (e.g., Zuckerman, 1979). Although cognitive motivation was generally a better cross-sectional predictor of drinking problems than was sensation seeking, sensation seeking nonetheless contributed significant, independent prediction to both alcohol consumption and problem consequences. Other studies have also shown that sensation seeking is a significant correlate of alcohol behaviors (e.g., Schwarz, Burkhardt, & Green, 1978; Zuckerman, 1979). However, longitudinal research is necessary to test more rigorously the simultaneous, independent importance of these two constructs in the prediction of drinking problems. As outlined later, this research has important implications for interventions designed to counsel teenagers of high-risk for adult-onset drinking problems.

COGNITIVE MOTIVATIONS AND PROBLEM DRINKING CONSEQUENCES

Although constructs representing cognitive anticipations for positive outcomes from drinking have been found to predict problem drinking in previous prospective research (Christiansen et al., 1989; Stacy et al., 1991a), previous longitudinal studies have not investigated the possi-

bility that these cognitions may *differentially* predict different types of clinically relevant problem consequences. Differential prediction is possible because indicators of specific drinking problems may diverge somewhat from one another in their origins, as suggested by studies in other domains of alcohol research. For example, genetic or family risk of alcoholism has been found to predict certain symptoms of problem drinking more frequently than other symptoms (Goodwin, 1988). The investigation of differential prediction, whether by expectancies or genetic risk, may shed light on the processes underlying problem drinking. In the case of drinking-related expectancies, differential prediction could occur in several ways. For example, strong anticipations of positive outcomes from drinking may represent a tendency to use alcohol in particular ways or situations that lead to problems in one's social or family life but not in work-related activities. In addition, expectancies about specific types of outcomes may be more predictive of some problems than others, because although the individual may use alcohol in an attempt to enhance a particular outcome (e.g., social rewards), over the long-run this behavior may exacerbate the very problem it was meant to ameliorate. This could occur because use of alcohol for its perceived functional utility in a particular domain may discourage the learning and use of more efficacious, and less debilitating methods of attaining the same goal. Practically, the study of different types of drinking problems predicted by cognitive anticipations in longitudinal research may provide information that facilitates prognostic assessment and identification of high-risk individuals. That is, assessment of cognitive anticipations may lead to more reliable estimation of the types of drinking problems to which a given individual is vulnerable.

The major alternative to the types of specific effects just summarized is a predictive effect of a general factor of cognitive anticipations or expectancies on a general factor of problem consequences. In this latter perspective, specific positive expectancies are merely indicators of the same predisposition toward drinking for goal attainment (Stacy, Widaman, & Marlatt, 1990), and specific problem consequences are merely different manifestations of the same general problem. It is also possible that these latter, general effects and the aforementioned specific effects occur simultaneously. Although the simultaneous investigation of general and specific (unique) effects regarding expectancies and drinking problems has been advocated or attempted in several previous reports (e.g., Goldman, Brown, Christiansen, & Smith, 1991; Stacy et al., 1991b), previous research addressing this issue has not been prospective in design.

SENSATION SEEKING

The construct of sensation seeking has been used to explain a wide variety of behaviors (e.g., Zuckerman, 1983, 1984), including use of alcohol and other drugs (for review, see Zuckerman, 1979). Most research on sensation seeking has emphasized the genetic origins of the trait, as well as the biological mediators of the trait's effects on other psychological traits and on behavior (for reviews, see Zuckerman, 1979, 1984). However, previous longitudinal research has not compared the predictive utility of sensation seeking to that of cognitive motivation or expectancy. In addition, previous research has not examined the possible role sensation seeking may play in the prediction of cognitive anticipation constructs. This predictive effect is plausible, if one assumes that sensation seeking tendencies have cognitive manifestations involving anticipated behavioral outcomes. For example, persons higher in sensation seeking may develop greater cognitive motivations for the potentially positive outcomes involved in sensation seeking activities, such as alcohol use.

It is also possible that cognitive motivations regarding a particular behavior, such as alcohol use, may generalize over time to a wide variety of sensation seeking activities and raise scores on measures of sensation seeking. This type of generalization may occur through the process of mediated stimulus generalization, as outlined by Rotter (1954; also see Stacy et al., 1991a). However, on the basis of previous research regarding the biological substrates of sensation seeking (e.g., Zuckerman, 1984) and the hypothesized heritability of this trait (Fulker, Eysenck, & Zuckerman, 1980), one might expect that sensation seeking would not be affected by cognitive motivation. One goal of this longitudinal investigation of sensation seeking and cognitive motivation (for alcohol) is to test the two possible, alternative predictive directions involving these constructs. In addition, we examine the predictive effects of adolescent sensation seeking on a wide range of adult drinking problems. The investigation of differential effects of sensation seeking on a range of problem consequences of alcohol has important theoretical and practical implications, analogous to the implications regarding the differential effects of general versus specific cognitive motivations on alcohol problems. For example, the predictive effects of sensation seeking can be usefully construed both in terms of a common factor and its subscales (Zuckerman, 1979), and some problem consequences from drinking (e.g., DWI) may be more uniquely consistent with a sensation seeking predisposition than other problem consequences (e.g., physical problems).

OVERVIEW

In earlier studies (Newcomb et al., 1988; Stacy et al., 1991a), we investigated the longitudinal prediction of general drug use by cognitive motivation for alcohol and marijuana use. However, the longitudinal investigation of sensation seeking and specific types of problem-drinking consequences either was not possible in that prospective work, because the measures were not available, or was well beyond the scope of the earlier work. The theoretical and applied importance of these constructs warrants a separate evaluation. The present study assesses the theoretical constructs summarized earlier, as well as a wide range of drinking consequences and problems, including physical, social, work-related, legal, and driving-related problems. Subsequently, we evaluate a longitudinal structural model that investigates the substantive issues we have outlined. In this model, we conduct a simultaneous analysis of both general factors and specific subscales representing the constructs of interest.

METHOD

SUBJECTS AND PROCEDURE

The respondents were 584 participants in an ongoing longitudinal investigation of drug-use etiology and consequences (e.g., Newcomb & Bentler, 1988). Extensive information about sample characteristics, attrition analyses, and procedures have been presented in a number of earlier reports (Newcomb, 1992; Stacy et al., 1991b). The sample was about 64% White and 71% female, with a mean age of 17.95 at Wave 3 (T1 for this study) and 26.95 at Wave 6 (T2 for this study). Briefly, subjects were initially recruited in 1976 from 11 junior high schools in Los Angeles county and were subsequently followed-up, primarily through repeated mailings, six times over a 12-year period. Schools from lower socioeconomic areas were somewhat oversampled, to obtain rough comparability with the county as a whole (Newcomb, 1992). Essential measures for the present study (sensation seeking, cognitive motivations) were obtained only in the third and sixth data collections and were separated by nine years. Measures were obtained with a confidential, self-administered questionnaire.

In an analysis of subject attrition over the entire 12-year period of our study, we contrasted the group of subjects who dropped out of the study with the retained sample. We computed point-biserial correla-

tions between group status (retained versus dropped-out subjects) and a set of relevant variables measured in 1976 (13 different drug and alcohol measures and 25 personality tests). Using a Bonferroni procedure to adjust for multiple simultaneous comparisons, not one of these 38 variables significantly correlated with group status. The average, absolute point-biserial correlation for these 38 tests was .03, whereas the average squared correlation was less than .002. The largest difference accounted for less than 1% of the variance between groups. These analyses indicated that very little of the attrition rate between 1976 and 1988 was due to self-selection based on drug use or personality traits. In a step-wise multiple regression analysis, which selected the seven best predictors of attrition from the entire set of 38 variables, only 3% of the variance in attrition could be accounted for. Those who continued in the study reported more agility, less attractiveness, more generosity, more intelligence, less invulnerability, less orderliness, and more trustful qualities in 1976 than those who did not continue in the study. Not one of the 13 drug and alcohol use measures entered the equation as a significant predictor.

MEASURES

In most instances, several measures of each construct were summed to form indicators (subscales), either based on previous published findings or on the content of items. These indicators were then used to reflect latent variables of their respective constructs, as described below.

Sensation Seeking. Sensation seeking was assessed with four 4-item subscales of Zuckerman's scale, slightly modified for this research to avoid predictor-criterion confounding by excluding mention of alcohol or drug use. The four different subscales were:

experience seeking (e.g., "I would like to explore strange places"),
thrill and adventure seeking (e.g., "I would like to try parachute jumping"),
disinhibition (e.g., "I like wild parties"),
boredom susceptibility (e.g., "I get restless when I spend too much time at home").

Each item asked respondents to indicate how often they felt in the way listed, ranging from *never* (1) to *always* (5). Each of these subscales has an adequate degree of reliability, based on the findings of an earlier

report (Huba, Newcomb, & Bentler, 1981). This construct was assessed at both waves of measurement.

Cognitive Motivation. Cognitive Motivation was a latent construct representing anticipated outcomes of drinking that was measured at both waves of assessment with four subscales that were developed in previous research (Newcomb et al., 1988):

reduction of negative affect (e.g., "get rid of anxiety or tension"),
enhancement of positive affect (e.g., "enjoy what I'm doing more"),
social cohesion (e.g., "feel good around people"),
addiction (e.g., "feel bad when I don't use it").

Each of these subscales was composed of the sum of from 3 to 5 items. Subjects indicated if they have or would drink alcohol for each of the reasons listed, scored on a three-point scale of *no* (1), *not sure* (2), and *yes* (3). The reliability of these subscales is adequate, using the statistical significance of item loadings as a criterion (Newcomb et al., 1988).

Alcohol Use. Alcohol use was measured at both waves with four items which formed a latent variable: three separate frequency items for beer, wine, and liquor, and one general quantity item. Frequency items assessed how often subjects drank particular beverages in the last six months on seven-point scales ranging from "never" to "more than once a day." The nine-point quantity item asked how many drinks were consumed on an average day in the last six months, ranging from "did not drink" to "more than six." In previous research, these items loaded moderately well on the same general factor of alcohol use, indicating an acceptable degree of reliability (Stacy et al., 1991b). Other research has indicated that similar self-report alcohol use items show an acceptable degree of convergent validity with independent measures of alcohol use (Stacy, Widaman, Hays, & DiMatteo, 1985).

Problem-Drinking Consequences. The construct of problem-drinking consequences was measured with 29 items covering a wide range of personal, physical, social, and work-related negative consequences from drinking. These items were combined into three subscales of social (17 items), work-related (4 items), and physical/personal (8 items) problems and were used to represent a latent factor. Drinking-problem items were assessed only at the second wave of measurement, during adulthood; most of the types of problems assessed in this study are not likely to occur frequently in adolescence, and a highly skewed measure of these problems during that age period would have been of limited usefulness. Although it is possible that an extensive measurement in adolescence of problems particularly focused on adolescent

drinking (White & Labouvie, 1989) would have been useful, it is also possible that the most frequently reported adolescent drinking problems by White and Labouvie, such as "causing embarrassment," "fighting or acting bad," or "neglecting one's responsibilities," are not highly predictive of adult drinking problems. More severe problems, most indicative of alcohol dependence, were relatively infrequent in the adolescent data reported by White and Labouvie. In a descriptive analysis of the levels of problem drinking in the data from the present study, Newcomb (1992) found that our measures of drinking problems in adulthood yielded a DSM-III-R classification of alcohol dependence of 13% of the present respondents, comparable to national estimates of problem drinking in adulthood. Nearly 90% of the present sample reported drinking alcohol in the last six months, further suggesting that relevant levels of alcohol use and abuse were assessed.

Drinking-problem items were assessed on three-point scales indicating how often in the past year the problem occurred from drinking alcohol and ranged from "never" to "more than once." Examples of items on the social, physical/personal, and work-related subscales, respectively, are "hurt your relationships with your friends or family," "had problems with physical health," and "missed work." It should be noted that psychological and emotional problems, such as guilt and negative emotional feelings, were represented to some extent in the subscale of physical/personal problems. Although these subscales of problem consequences do not exhaust all the possible negative consequences from drinking, they do represent at least a minimal sample of these consequences. In addition, previous research found that each of these scales loaded significantly and at least moderately on the same common factor (Stacy et al., 1991b), and similar scales of negative consequences have shown an adequate degree of convergent validity (Stacy et al., 1985).

Driving While Intoxicated. Driving while intoxicated (DWI) was measured with two different scales, which were assessed only at the second wave of measurement. One scale (DWI behavior) was comprised of a single seven-point item that measured the number of times in the last six-months the respondent "drove a car while drunk," on a scale that ranged from "never" to "six or more times." This scale is similar to DWI items having strong reliability in previous research (Johnson & White, 1989). The second scale of DWI arrest was the sum of eight items that assessed whether the respondent had been arrested or convicted for DWI for each of the previous four years from 1984 to 1987. There was one item for each arrest and one for conviction in each year that were scored dichotomously as yes or no. For example,

subjects indicated whether they were arrested for DWI in 1984 on one item and indicated if they were convicted of DWI in 1984 on a separate item. The eight items were summed to form a single scale, because of the very low frequency of responses for any given year.

The two DWI scales (DWI behavior and DWI arrest) were used as separate, measured variable constructs in the modeling procedures reported below. These scales were included as separate variables and were not used to reflect a latent factor (for discussion, see Stacy et al., 1991b), primarily because the variance on the DWI arrest scale was much smaller than the variance on the DWI behavior scale. Even though we have considered the DWI arrest scale problematic for a variety of reasons, such as extreme departure from normality (Stacy et al., 1991b), this measure was retained because of its high degree of relevance to alcohol-abuse. The retention of this variable in the model did not compromise the estimation of parameters involving other variables and constructs.

ANALYTICAL PROCEDURE

Each of the subscales outlined above were used as indicators of their respective factors in latent variable structural equation models (e.g., Bentler, 1990). One advantage of these procedures is that both general longitudinal effects, from factor-to-factor, and more specific longitudinal effects (e.g., from indicator residual-to-indicator, and factor-to-indicator) can be evaluated simultaneously for statistical significance. Specific effects include, for example, the prediction of a factor by the residual, or unique component, of an indicator. In common factor measurement theory (e.g., Rummel, 1970), the residual of an indicator includes both random error variance and specific variance that does not share variance with the common factor. Associations of this specific component of variance with other factors or indicators in the model may imply either systematic method effects (e.g., Stacy et al., 1985) or substantive, theoretically meaningful effects. Many constructs, such as sensation seeking and intelligence, are thought to have substantive effects through both a general factor, in which breadth of prediction may be enhanced, and through unique components of specific indicators or subscales, which may predict some phenomena better than the common factor. For example, the disinhibition subscale of sensation seeking and verbal subscales of intelligence predict some phenomena better than do common factors on which these subscales load, but general factors of intelligence and sensation seeking predict a wider variety of dependent variables.

To the extent that method effects do not appear to account for specific effects, substantive interpretations of specific effects may be reasonable. In the present study, there are a number of instances in which indicators and their general factors may diverge in patterns of association with other constructs. However, one problem with the investigation of specific effects in an already large multivariate model is that specific effects may be significant by chance alone. Thus, although we investigate a number of specific effects in the present study, we interpret these effects with caution and emphasize only the highly significant effects. In addition, we analyze a supplementary model in which only highly significant specific effects are estimated, to ensure that the significance of paths from factor-to-factor remain robust regardless of the model. This practice helps ensure that the relatively more confirmatory aspects of the structural model, based on paths from factor-to-factor, are not contingent on the relatively more exploratory aspects of the analysis, in which specific effects are evaluated for statistical significance.

Our SEM analyses were conducted with the EQS program (Bentler, 1989) to simultaneously evaluate both specific effects and general effects of concern to the issues outlined in the introduction. Because males and females showed minimal differences in patterns of correlations in previous research on drinking problems, alcohol use, sensation seeking, and cognitive motivations (Stacy et al., 1991b), we used the total sample of subjects in the SEM analysis. This strategy is preferred when the sample size must be maximized for the analysis of large multivariate models.

RESULTS

CONFIRMATORY FACTOR ANALYSIS MEASUREMENT MODEL

A preliminary confirmatory factor analysis (CFA) model was first estimated to evaluate hypothesized factor loadings, factor intercorrelations, and the fit of the model to the data. Because indicators of several constructs were assessed at both times (Sensation Seeking, Cognitive Motivation, Alcohol Use), covariances were allowed between residual variables of repeated measures (e.g., beer frequency at time 1 and time 2; see Jöreskog, 1979). This initial CFA model yielded fit values of .90 for the nonnormed fit index (NNFI; Bentler, 1989), .92 for the comparative fit index (CFI; Bentler, 1990), and 2.78 for the χ^2/df ratio. On the

basis of Lagrange Multiplier (LM) model modification indices (Chou & Bentler, 1990), 24 additional correlations between residual variables of indicators were added to the initial CFA model to derive the final CFA model. The final CFA model fit the data well (NNFI = .96; CFI = .97; $\chi^2/df = 1.77$). The magnitudes of correlations among constructs as well as the factor loadings in this model differed only minimally from those obtained in the initial CFA model. Factor loadings from the final CFA model are provided in Figure 1.

EVALUATION OF STRUCTURAL EQUATION PATH MODELS

The statistical significance of regression paths in the SEM's was evaluated using critical ratios and hierarchical model tests. Our sequence of model construction began with a relatively saturated model, in which all paths from adolescent factors to adult factors were estimated. Correlations were allowed within-time among all constructs in adolescence and all construct residuals in adulthood. Additional, specific longitudinal paths (e.g., paths from indicator residual-to-indicator and from factor-to-indicator) were added if they were found to be significant according to the LM test (Chou & Bentler, 1990). Once all significant ($p < .05$) paths were added, nonsignificant paths were removed on the basis of the Wald test (Chou & Bentler, 1990). Both general effect (i.e., factor-to-factor) and specific effect (e.g., indicator residual-to-indicator, and factor-to-indicator) paths were evaluated in these procedures. In addition to this structural model, a supplementary model was evaluated in which only highly significant ($p < .01$) specific paths were estimated. Because the presence or absence of general (factor-to-factor) paths reaching the $p < .05$ criterion of significance in this supplementary model was identical to the pattern of significant general paths in the full model, only the full ("final") model is described below. However, our interpretations in the Discussion emphasize only the highly significant ($p < .01$) specific paths.

The final structural model derived with these procedures fit the data adequately (NNFI = .97; CFI = .98; $\chi^2/df = 1.58$), and provided a somewhat better fit than did the supplementary model (NNFI = .96; CFI = .97; $\chi^2/df = 1.69$). Figure 2 primarily depicts the portions of the final model representing general effect paths among general factors, as enclosed by ovals (e.g., Cognitive Motivation, Problem-Drinking Consequences). This figure also includes the two DWI variables used as single-indicator constructs (depicted within rectangles). Paths from adolescent factors to the two DWI variables, though technically not

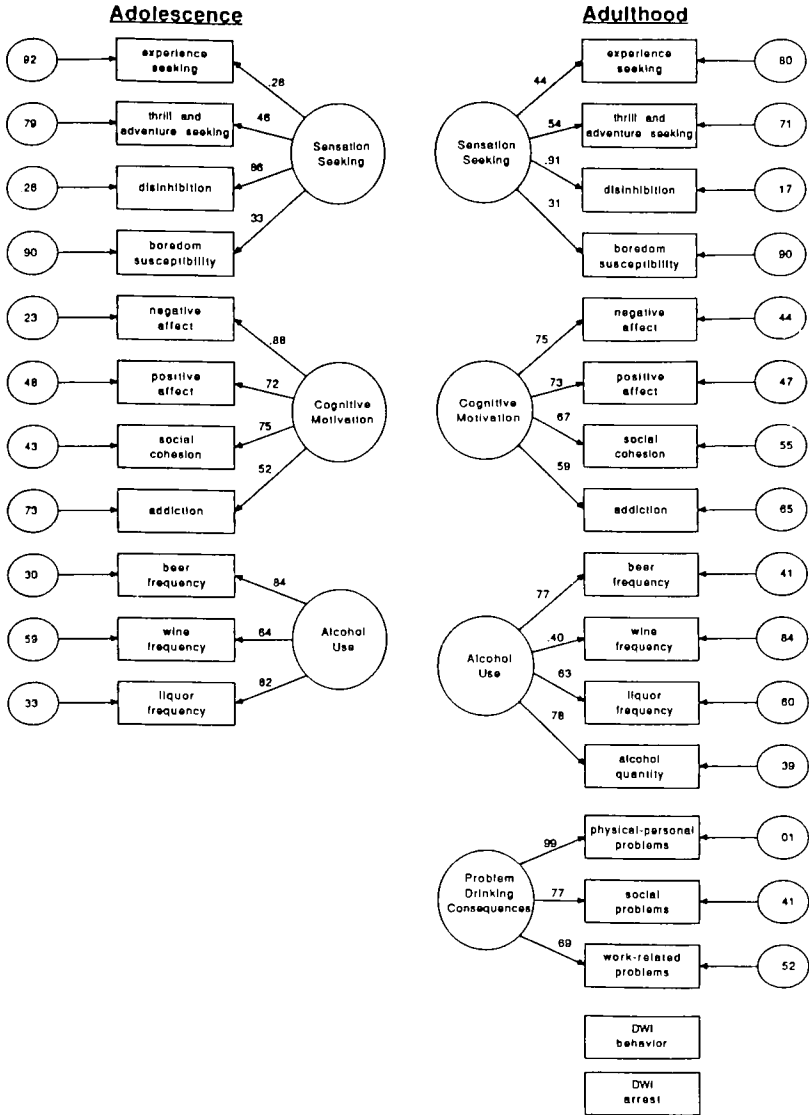


FIGURE 1
Final confirmatory factor analysis model.

Note. Large circles represent latent factors, rectangles are measured variables, and small circles are residual variables, with residual variances shown. Standardized estimates are provided. All factor loadings were significant at $p < .01$ or less, based on unstandardized estimates.

general effect paths, are depicted in this figure. Because all significant paths cannot be clearly presented in Figure 2, Table 1 lists additional, specific effect paths on DWI variables and on other adult variables. The pattern of significant paths (general and specific effects) is described below in terms of our substantive focus. Although all significant specific effects from the final model are reported so that their potential replication can be investigated in future research, our subsequent interpretation will emphasize only the strongest specific effects.

LONGITUDINAL EFFECTS ON PROBLEM DRINKING CONSEQUENCES

General Effect Paths, From Factor-To-Factor. As shown in Figure 2, both Cognitive Motivation and Alcohol Use factors in adolescence significantly predicted the Problem-Drinking Consequences factor in adulthood. The Sensation Seeking factor in adolescence did not significantly predict adult Problem-Drinking Consequences.

Specific Paths Predicting DWI Variables. As depicted in Figure 2, the adolescent Alcohol Use factor significantly predicted adult DWI behavior and DWI arrest variables. Although no other adolescent factors significantly predicted these two adult DWI variables, DWI behavior was significantly predicted by several specific indicators in adolescence, independently from the indicators' common factors (see Table 1). As shown in Table 1, disinhibition (one indicator of Sensation Seeking) and positive affect (one indicator of Cognitive Motivation) each significantly predicted later DWI behavior. Two indicators of adolescent Alcohol Use (beer and wine frequency) also predicted DWI behavior, over and above the previously reported effect from the common factor of Alcohol Use (see Table 1). No specific effect paths to the other DWI variable (DWI arrest) were significant, other than the previously reported effect of adolescent Alcohol Use.

Specific Paths Predicting Subscales of Problem Drinking Consequences. In four instances, indicators and factors assessed in adolescence predicted specific indicators of the Problem-Drinking Consequences construct measured in adulthood (see Table 1). Work-related problems in adulthood was significantly predicted by thrill and adventure seeking (an indicator of Sensation Seeking) and by social cohesion (an indicator of Cognitive Motivation) in adolescence.

Physical/personal problems in adulthood was significantly predicted by the Sensation Seeking factor and by the beer frequency indicator of Alcohol Use in adolescence.

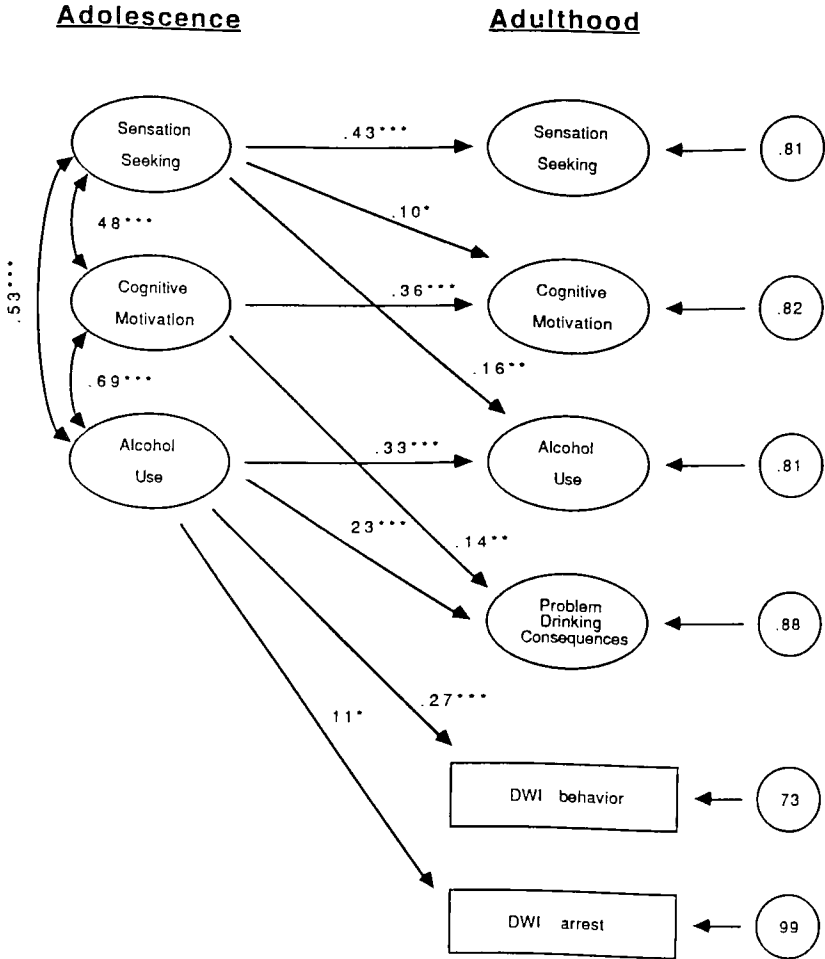


FIGURE 2
Final structural equation model and standardized estimates.

Note. Ovals designate latent factors, and the two rectangles represent measured variables used as single-indicator constructs. Small circles represent construct residuals. Path coefficients are depicted with single-headed arrows, and double-headed arrows represent correlations between constructs.

Significance levels are based on critical ratios on unstandardized estimates (* $p < .05$; ** $p < .01$; *** $p < .001$). Several additional regression effects, not depicted in this figure, are given in Table 1. Correlations among construct residuals were each positive in sign and ranged from 0 to .65.

LONGITUDINAL RELATIONS BETWEEN SENSATION SEEKING AND COGNITIVE MOTIVATION

General Effect Paths, From Factor-To-Factor. The Sensation Seeking factor assessed in adolescence significantly predicted Cognitive Motivation measured in adulthood. However, adolescent Cognitive Motivation did not predict adulthood Sensation Seeking (see Figure 2).

Specific Paths. Disinhibition and boredom susceptibility (both indicators of adolescent Sensation Seeking) significantly predicted indicators of adult Cognitive Motivation (positive affect and addiction, respectively); however, the predictive effects were opposite in sign (see Table 1); this was not found to be a suppression effect. The adolescent Cognitive Motivation factor significantly predicted adult boredom susceptibility.

LONGITUDINAL EFFECTS ON ALCOHOL USE

General Effect Paths, From Factor-To-Factor. Adolescent Sensation Seeking and Alcohol Use factors significantly predicted the adult Alcohol Use factor. The path from adolescent Cognitive Motivation to adult Alcohol Use was not significant.

Specific Paths. Even though the Cognitive Motivation factor did not predict the Alcohol Use factor, two indicators of adolescent Cognitive Motivation significantly predicted adult indicators of Alcohol Use: negative affect predicted wine frequency and addiction predicted alcohol quantity. The only other specific paths predicting adult Alcohol Use variables were adolescent indicators of Alcohol Use (see Table 1).

OTHER SPECIFIC PATHS

Several other specific paths were significant, though these regression effects are not a focus of our article. In all but one instance, these paths were between variables representing the same constructs assessed over time, between adolescence and adulthood (see Table 1).

DISCUSSION

The present longitudinal results demonstrated several important predictive effects of constructs assessed in adolescence on constructs measured in adulthood. To some extent, these effects represented a prediction of change in the dependent constructs over time, because

TABLE 1. Specific Regression Paths Not Depicted in Figure 2

ADOLESCENT PREDICTOR VARIABLE		ADULTHOOD DEPENDENT VARIABLE		STANDARDIZED PARAMETER ESTIMATE
OBSERVED (R)	LATENT	OBSERVED	LATENT	
Predictors of drinking consequences				
Disinhibition		DWI behavior		.37 ^{**}
Positive affect		DWI behavior		.14 ^{***}
Beer frequency		DWI behavior		.14 ^{***}
Wine frequency		DWI behavior		.08 [*]
Thrill and adventure seeking		Work-related problems		.06 [*]
Social cohesion		Work-related problems		.08 [*]
		Physical/personal problems		.08 ^{**}
Beer frequency	Sensation seeking	Physical/personal problems		.07 ^{***}
Sensation-seeking-to-cognitive motivation paths				
Disinhibition		Positive affect		.10 [*]
Boredom susceptibility		Addiction		-.08 [*]

Cognitive motivation-to-sensation-seeking path

Cognitive Motivation		.08*
	Boredom susceptibility	
	Predictors of alcohol use	
	Wine frequency	.11**
	Alcohol quantity	.07*
	Alcohol quantity	.11**
	Liquor frequency	.11**
	Beer frequency	.11***
	Other paths	
	Experience seeking	.16***
	Experience seeking	.07*
	Thrill and adventure seeking	.43***
	Thrill and adventure seeking	.12*
	Negative affect	.08*
	Negative affect	.08*
	Addiction	.08*
	Sensation Seeking	.08*
Negative affect		
Addiction		
Beer frequency		
Wine frequency		
Thrill and adventure seeking		
Boredom susceptibility		
Thrill and adventure seeking		
Negative affect		
Beer frequency		
Positive affect		
Thrill and adventure seeking		

Note. (R) denotes variable residual. Significance of parameter estimates is based on critical ratios on unstandardized estimates; * $p < .05$; ** $p < .01$; *** $p < .001$.

the effects of earlier levels of most of the constructs were controlled in the analysis (see Newcomb, 1990). The results based on this prospective analysis, in which predictors preceded the dependent constructs by a quite extensive period of time, has several important implications for the theoretical and applied issues raised earlier in this article.

SENSATION SEEKING PREDICTS COGNITIVE MOTIVATIONS

One of the more novel findings from the present study was the significant, long-term prediction of adult Cognitive Motivations toward alcohol use, a type of expectancy construct, by Sensation Seeking, assessed in adolescence. High Sensation Seeking may imply an increased sensitivity to certain types of reinforcement (e.g., Zuckerman, 1984), and this sensitivity may be manifested cognitively (when behaviors having these reinforcing properties have been performed, such as alcohol or other drug use). Consistent with this interpretation, Sher, Walitzer, Wood, and Brent (1991) found that a general personality construct of behavioral undercontrol, which included an aspect of Sensation Seeking, predicted expectancies cross-sectionally. Importantly, Sher and colleagues found that family risk of alcoholism predicted expectancies only *indirectly* through its prediction of behavioral undercontrol.

Although the cross-sectional nature of Sher et al.'s (1991) findings did not allow for strong inferences about the likely relationship between behavioral undercontrol and expectancy over time, the present study corroborated the prediction of an expectancy construct (Cognitive Motivation) by an aspect of behavioral undercontrol (Sensation Seeking) over an extended period of time. In addition, the present longitudinal model provided an investigation of predictive direction over time, in which Sensation Seeking was found to be a significant predictor of Cognitive Motivations but Cognitive Motivations did not predict Sensation Seeking. Taken together, the findings of Sher et al. and the present results suggest that personality traits, and perhaps their influences on behavior, are to some extent manifested cognitively. Although expectancies may act as a more proximal motivator of behavior, these expectancies appear to be derived in part from personality characteristics. Continued research investigating the causes and predictors of Sensation Seeking and related personality traits (e.g., Sher et al., 1991; Stacy et al., 1991c; Zuckerman, 1984) is likely to increase our understanding of the instigating components of a

causal chain that may culminate, in part, in cognitive predispositions toward engaging in sensation seeking behaviors, such as alcohol and other drug use.

PREDICTORS OF PROBLEM VULNERABILITY

Both Sensation Seeking and Cognitive Motivation had long-term predictive effects on alcohol use or its problem consequences, beyond adolescent levels of alcohol use. As independent predictors of problem consequences, these constructs appear to represent different manifestations of problem vulnerability. A more specific interpretation of these findings is that Cognitive Motivations, which probably represent an amalgamation of social learning, direct experience, and personality predispositions, constitute the cognitive manifestations of vulnerability that are available to introspection through self-report. The independent predictive effects of Sensation Seeking, on the other hand, may reflect the component of trait predisposition that is not readily available to introspection through reports of anticipated drug effects, such as measures of expectancies.

A second possibility is that Cognitive Motivation, if measured more completely, would have represented problem vulnerability more thoroughly; a more complete assessment of the cognitive aspect of vulnerability may have eclipsed any independent effects of more distal personality factors, such as Sensation Seeking. One of the most likely areas of incomplete measurement of cognitive motivations involves drinking and driving behaviors (DWI). In fact, DWI appears to have its own motivations, somewhat different than the precursors of alcohol use per se (Donovan, Marlatt, & Salzborg, 1983). In our results, the only fairly strong predictive effect of Sensation Seeking on problem drinking was the specific effect of the disinhibition subscale on DWI behavior; the lack of assessment of cognitive motivations peculiar to drinking and driving may have accounted for this independent effect.

It should also be emphasized that the Sensation Seeking factor had no direct effects on the Problem-Drinking Consequences factor, whereas Cognitive Motivation did have a direct effect on this dependent factor. When considered in conjunction with our earlier discussion of the predictive effects of Sensation Seeking on Cognitive Motivation, the overall pattern of findings suggests that Sensation Seeking and Cognitive Motivation may reflect different aspects of vulnerability that are linked together in a chain of steps leading to problem drinking. However, hypotheses of complex mediational chains are best evalu-

ated in longitudinal designs that measure more than two waves of the relevant constructs, which our future assessments of the present variables may provide.

GENERAL AND SPECIFIC EFFECTS ON DRINKING PROBLEMS

Our analysis of general and specific effects on drinking problems may shed light on the usefulness of theoretical approaches that emphasize one or the other type of effect, or that suggest that both effects should occur. However, an analysis of specific effects in a large multivariate model is likely to capitalize on chance, when a large number of specific effects are evaluated. Under these conditions, most specific effects should be considered provisional, requiring replication and use of stringent criteria of significance. In the present study, only one out of 27 possible specific effects involving the prediction of drinking problems by Cognitive Motivation met our more stringent significance criterion. The lack of specific effects was accompanied by the presence of a general-effect path from the Cognitive Motivation factor to the Problem Drinking Consequences factor. This finding is somewhat more consistent with expectancy theories that emphasize the effects of general factors of expectancies or motivations (e.g., Stacy, Dent, et al., 1990; Stacy, Widaman, & Marlatt, 1990), although it is possible that a more exhaustive measurement of expectancies or drinking problems would show some specific effects not found in the present study.

The predictive effects of Sensation Seeking on drinking problem variables or factors was solely through specific effects, although the general effect of the Sensation Seeking factor on the consumption factor (Alcohol Use) was also significant. These findings are consistent with previous research on Sensation Seeking (e.g., Zuckerman, 1979), which has shown that the general factor and its subscales may diverge in their prediction of different constructs. Zuckerman (1979, 1984) has outlined a number of mechanisms that may account for divergent prediction, in terms of both general and specific effects of Sensation Seeking.

ASSESSMENT AND INTERVENTION IMPLICATIONS

The most obvious practical implication of the present findings is the utility of Cognitive Motivation and Sensation Seeking as predictors of the development of later drinking problems, beyond that predicted by adolescent alcohol use alone. As long-term predictors, the measure-

ment of these constructs should help identify those adolescents at risk for future alcohol-related problems. These constructs should be added to the list of other constructs found to have prognostic value in longitudinal (for review, see Nathan, 1988) and cross-sectional (e.g., Barnes, Welte, & Dintcheff, 1991) research on alcohol abuse. Beyond mere identification of those at risk, a consideration of individual variability in these constructs can assist the development of interventions that attempt to nullify the harmful consequences of strong sensation seeking needs or strong expectancies for positive effects of alcohol.

Sensation seeking may constitute the personality-trait manifestation of biological risk (see Sher et al., 1991; Zuckerman, 1979, 1984). As a fairly stable personality trait (Stacy et al., 1991c), attempts to change the trait may not be simple or practical. Instead, it may be preferable to help the individual develop a range of alternative sensation seeking activities as healthy behavioral options (Zuckerman, 1979). Of course, it is usually not enough to simply provide a list of such alternatives, and appropriate therapeutic strategies need to be used to encourage the development of cognitive and behavioral habits that support the use of such alternatives. It also may not be enough to help the problem-prone individual develop an apparent preference or liking of healthy alternatives, unless some procedures are used to make the alternatives salient during moments of high risk for problem drinking. One of these procedures will be outlined briefly below.

The development and effective use of alternative behaviors is also a reasonable goal for interventions regarding expectancies, or cognitive motivations, toward alcohol use. Assessment of expectancies for diagnostic purposes may use nomothetic scales, such as Cognitive Motivations or other scales of alcohol expectancies (e.g., Brown, Goldman, Inn, & Anderson, 1980), or more ideographic methods (Stacy, Widaman, & Marlatt, 1990, Study 2), which ask respondents to write down and respond to their own listings of expected alcohol outcomes. In either instance, an assessment of expected drinking outcomes can facilitate the design of interventions that help the problem-prone individual learn alternative methods of attaining similar, desired outcomes. Such assessments can also help in the design of procedures that encourage changes in expectancies that may be motivating problem drinking.

Whether an intervention goal in treatment or prevention is expectancy-change or the development of behavioral alternatives, it is likely that additional procedures are necessary to make program information more salient when it is needed most: during high-risk situations or

cognitive-emotional states. In the expectancy accessibility model (Stacy, Dent et al., 1990; Stacy, Krank, & Marlatt, 1989; Stacy, Widaman, & Marlatt, 1990), expectancies or other acquired cognitions involving the use of alternative behaviors must be accessible from memory during behavioral decision before they can influence behavior (cf. Fazio & Williams, 1986). In this model, newly learned or changed expectancies, as well as memories for the use of alternative behaviors, must become highly accessible from memory if they are to compete with expectancies for the positive effects of alcohol, which may be quite accessible because of repeated episodic encodings in situations that promote drinking. To become more accessible when they are needed the most, newly learned cognitions and behaviors must become associated in memory with cognitions, emotions, and/or situations that are "high-risk" antecedents of problem behavior. In relapsing alcoholics, high-risk situations are often ones associated with frustrating events and anger, as well as social pressures (Marlatt & Gordon, 1985). Among adolescent drinkers, high-risk is likely to involve adolescent social situations, such as drinking parties (Brown, Stetson, & Beatty, 1989).

The primary point of the expectancy accessibility model is that accessibility of information or knowledge is highly cue-dependent (for review, see Ratcliff & McKoon, 1989), whether the information is considered to reside in semantic, episodic, or other memory systems. To the degree that program information becomes associated or connected in memory with the "cues" (e.g., thoughts, affects, persons, etc.) that are integral to high-risk situations, the program information will become more accessible when needed, increasing its potential for effective use in the situation. A number of procedures for enhancing this memory association are available (Stacy, Krank, & Marlatt, 1989).

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