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Interactions between Self-Reported Alcohol Outcome Expectancies and Cognitive Functioning in the Prediction of Alcohol Use and Associated Problems: A Further Examination

Andrew K. Littlefield, MA, Alvaro Vergés, Denis M. McCarthy, PhD, and Kenneth J. Sher, PhD

Department of Psychological Sciences, University of Missouri-Columbia and the Midwest Alcoholism Research Center, Columbia, Missouri

Abstract

A recent debate regarding the theoretical distinction between explicit and implicit cognitive processes relevant to alcohol-related behaviors was strongly shaped by empirical findings from dual-process models (Moss & Albery, 2009; Wiers & Stacy, 2010; Moss & Albery, 2010). Specifically, as part of a broader discussion, Wiers & Stacy (2010) contended that alcohol-related behaviors are better predicted by self-reported alcohol expectancies for individuals with good executive control and with good verbal abilities relative to those without such abilities. The purpose of the current paper is to further test whether *self-reported* alcohol outcome expectancies are moderated by measures of cognitive functioning. Using multiple indices of alcohol use, alcohol-related consequences, self-reported alcohol outcome expectancies, and cognitive functioning, both cross-sectional and longitudinal analyses were conducted in a prospective sample of 489 individuals at varying risk for alcohol use disorders. Results from a series of regression analyses testing interactions between self-reported alcohol expectancies and cognitive functioning showed minimal support for the hypothesized pattern discussed by Wiers et al. (2010) regarding self-reported alcohol outcome expectancies. The overall rates of significance were consistent with Type I error rates and a substantial proportion of the significant interactions were inconsistent with previous findings. Thus, the conclusion that cognitive measures consistently moderate the relation between self-reported alcohol expectancies and alcohol use and outcomes should be tempered.

Keywords

alcohol outcome expectancies; dual-process models; cognitive functioning; alcohol use

Dual-process models have become of an increasing interest to psychologists (see Smith & DeCoster, 2000 for review), and several recent dual-process models suggest that both automatic (implicit)¹ and controlled/reflective (explicit) cognitive processes influence

Correspondence regarding this article should be addressed to Andrew K. Littlefield, University of Missouri-Columbia, Department of Psychological Sciences, 200 South 7th St., Columbia, MO 65211-0001. Phone: 573-884-1485. Fax: 573-884-5588. akl9af@mail.missouri.edu.

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¹For the purposes of this paper, the terms *implicit* and *automatic* are used interchangeably; however, see Wiers et al., 2007, for a discussion of distinctions for these two terms.

addictive behaviors (Deutsch & Strack, 2006; Evans & Coventry, 2006; Stacy, Ames, & Knowlton, 2004; Wiers et al., 2007; see Stacy & Wiers, 2010). Among the most well studied explicit cognitive factors are self-reported alcohol expectancies (e.g., Smith, Goldman, Greenbaum & Christiansen, 1995; see Jones, Corbin, & Fromme, 2001 for a review). Automatic, implicit cognitive processes, such as those measured through experimental tasks (e.g., Implicit Association Task [IAT]; Greenwald et al., 1998) have also garnered attention (see Stacy & Wiers, 2010).

The theoretical distinction between explicit and implicit cognitive processes, specifically those that are thought to be relevant to expectancies related to alcohol, is currently a matter of debate (e.g., Moss & Albery, 2009; Wiers & Stacy, 2010; Moss & Albery, 2010). For example, some researchers have suggested that alcohol expectancies should be considered as if-then propositions that are conceptually and empirically distinct from implicit associations (e.g., Stacy & Wiers, 2010; Wiers & Stacy, 2010; see Wiers et al., 2007). However, others have not emphasized this distinction (e.g., Moss & Albery, 2009) and instead posit that alcohol expectancies “are the result of learned associations in memory” (p.521), a view consistent with modern learning perspective on conditioning (e.g., Rescorla, 1988).

A major line of reasoning supporting Wiers and Stacy’s (2010) perspective that associations are distinct from expectancies are several empirical studies suggesting that individual differences in executive control moderates the expectancy-alcohol relation. More specifically, Wiers and Stacy (2010) suggest that “... there are well-replicated crossover interactions in the prediction of alcohol-related behaviors, supporting a distinction between associations and expectancies. That is, alcohol-related behavior is predicted relatively well by self-reported expectancies in people with good executive control (Thush et al., 2008) and in people with good verbal abilities (Tapert, McCarthy, Aarons, Schweinsburg, & Brown, 2003); but in people with relatively poor executive control, alcohol-related behavior is better predicted by measures of implicit associations (Grenard et al., 2008; Houben & Wiers, 2009; Thush et al., 2008; Wiers et al., 2009)” (p. 14). This phenomenon is considered to be a “central hypothesis from dual-process models” (Stacy & Wiers, 2010, p. 565).

The purpose of the current paper is to further test whether the relation between *self-reported* alcohol outcome expectancies and alcohol outcomes is moderated by measures of cognitive functioning. Though the authors refer to well-replicated findings, we are aware of only two studies that document the interaction regarding self-reported expectancies and cognitive functioning (e.g., Tapert et al., 2003; Thush et al., 2008). Moreover, since these studies utilized different measures of cognitive functioning and alcohol-related behaviors, we tested these relations using multiple measures of alcohol use and alcohol-related consequences as well as various measures cognitive functioning, both cross-sectionally and longitudinally, in a prospective sample of 489 individuals at varying risk for alcohol use disorders (see Sher, Walitzer, Wood, & Brent, 1991).

Method

Participants and Procedure

Data were drawn from a prospective high-risk study on family history of alcoholism (FH) and other correlates of alcoholism (see Sher, et al., 1991, for a full description of the study). The baseline sample comprised of 489 freshmen (46% male, mean age = 18.2) from a large Midwestern University. Based on criteria discussed below, half (51%) of the respondents were classified as FH positive (FH+). Respondents were prospectively assessed seven times over 16 years (Years 1, 2, 3, 4, 7, 11, and 16) by both interview and paper-and-pencil questionnaire. In all, over 84% of participants were retained over the first 11 years of the study, and over 78% were retained through Year 16 (mean age = 34.5).

Measures

Family history of alcoholism—At baseline, criteria from the Short Michigan Alcoholism Screening Test (SMAST; Selzer, Vinokur, & van Rooijen, 1975), adapted to measure paternal and maternal drinking problems (F-SMAST and M-SMAST; Crews & Sher, 1992), and the Family History-Research Diagnostic Criteria interview (FH-RDC; Endicott, Andreasen, & Spitzer, 1978), were used to diagnose paternal family history of alcoholism (FH). A positive FH was coded if the biological father scored a 4 or more on the F-SMAST and met FH-RDC criteria for alcoholism (see Sher et al., 1991 for more details).

Cognitive Measures—A total of seven measures of cognitive functioning were used. Five of these subtests—Vocabulary, Similarities, Digit Span-Forward, Digit Span-Backward, and Block Design—were from the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981). The sixth measure was the Wechsler Memory Quotient from the Wechsler Memory Scale (WMS; Russell, 1975; Wechsler, 1944; see Nixon, 1995), and the seventh measure was the HRNB Booklet Category Test (see Sher, Martin, Wood, & Rutledge, 1997, for more details). All cognitive assessments were administered by trained technicians supervised by Kenneth J. Sher, PhD. All assessments involving spoken verbal responses were recorded on audiotape, cross-edited by a second technician, and reviewed by a supervisor to ensure appropriate procedures. Additionally, all scoring was reviewed similarly and disagreements (e.g., in scoring Vocabulary or Similarity) were resolved in weekly staff meetings attended by Dr. Sher and the technicians. Note that all technicians were, minimally, post-baccalaureate (and some had master's degrees). Follow-up assessments for a subset of participants included in the current sample suggest moderate to high rank-order stability for these cognitive measures across time (see Wood, Sher, & Bartholow, 2002).

Alcohol Use—Two measures were used to assess alcohol use at each wave: total quantity/frequency of alcohol consumption and a composite of three items assessing number of heavy drinking occasions (5 or more drinks on a single occasion) per week, based on the past 30 days, and number of times high/drunken in past 30 days. These items have been shown to be reliable (i.e., alphas > .80; see Sher et al., 1991; Sher, Wood, Wood, & Raskin, 1996, for more details).

Alcohol Outcomes—Two measures of negative alcohol outcomes were assessed at each wave. A sum of 13 items that measured events related to alcohol dependence (e.g., *In the past year, how many times have you... "found you needed larger amounts of alcohol to feel any effect, or that you could no longer get high or drunk on the amount that used to get you high or drunk?"*) and a sum of 14 items measured negative consequences associated with drinking experienced in the past year (e.g., *In the past year, how many times have you... "been arrested for drunken driving, driving while intoxicated, or driving under the influence of alcohol?"*). These measures have shown adequate reliability (i.e., alphas > .70; see Jackson & Sher, 2005, for more details).

Alcohol Expectancies—Three subscales derived from a larger pool of items (see Kushner, Sher, Wood, & Wood, 1994; Sher et al., 1996) were used to assess alcohol expectancies. The three scales included tension reduction (9 items; e.g., "Drinking makes me feel less tense or nervous"), social lubrication (8 items, e.g., "Drinking makes me feel less shy"), and activity enhancement (9 items, e.g., "Drinking makes many activities more enjoyable"). These scales have displayed good reliability (i.e., alphas > .80; see Sher et al., 1996) and rank-order stability across assessment waves.

Analytic Procedure

To test whether cognitive measures moderated the relation between self-reported alcohol expectancies and alcohol use and associated outcomes, a series of regression analyses that estimated the main effects of the respective expectancy and cognitive measures, as well as the interaction of the two constructs, were conducted. Sixty models were estimated for each cognitive measure. Twelve of these models were cross-sectional (i.e., three expectancy measures $\times$ four alcohol measures at age 18) and forty-eight were longitudinal (i.e., three expectancy measures $\times$ four alcohol measures $\times$ four ages [21, 25, 29, 35]). Longitudinal models included the corresponding baseline measure of alcohol use/outcome and all models were adjusted for family history of alcoholism and sex.² Continuous measures were centered before interaction terms were computed. This resulted in 420 (84 cross-sectional, 336 longitudinal) total models.

Results

Given the goal of this paper is to determine the extent to which interaction terms of the cognitive and expectancy measures from the 420 models were significant ($p < .05$) and whether the specific pattern of significant interactions was consistent with previous findings (i.e., the self-reported expectancy-alcohol relation is stronger in individuals with higher scores in cognitive tasks), a summary of findings from these models is provided in Table 1. As shown in Table 1, only three of the 84 cross-sectional models (3.57%) had significant interaction terms in the hypothesized direction (with a two-tailed, univariate alpha set at .05); the likelihood of obtaining this number (or greater) of significant tests, given univariate alpha at .05, was .80 (that is, within chance expectation; see Table 1). These significant interactions were limited to models including digit span forward and the booklet test. Of the 336 longitudinal models, 33 (9.82%) were significant (see Table 1). However, probes of the interaction suggested that of the 33 significant interaction terms, only 12 (3.57%, $p = .91$) displayed patterns that were consistent with the hypothesized interaction whereas the remaining 21 (6.25%, $p = .18$) interactions were in the *opposite* direction (i.e., the self-reported expectancy-alcohol relation was stronger in individuals with *lower* scores in cognitive tasks).

Considering the current findings, overall, were not consistent with the findings from Tapert et al. (2003) and Thush et al. (2008), we then examined whether the hypothesized interactions might be found for a subsample of individuals. Given that the two previous studies (i.e., Tapert et al., 2003; Thush et al., 2008) used samples comprised of mostly male, at-risk participants, a series of regression analyses including three-way interaction terms involving sex and family history of alcoholism were then conducted. Expanding on our original models, 840 total models (168 cross-sectional, 672 longitudinal) were estimated. Half of these models included three-way interaction terms involving the expectancies, cognitive measures, and family history of alcoholism (adjusting for sex) and half included three-way interaction terms involving the expectancies, cognitive measures, and sex (adjusting for family history of alcoholism). Of the 84 cross-sectional models including sex in the three-way interaction, ten (8.40%) were significant and 40 (12%) of the 336 longitudinal models were significant. Only five (5.95%) of the cross-sectional models and only seven (2.08%) of the longitudinal models were found to have significant three-way interactions involving family history. Further, probes of the significant interactions did not result in consistent findings across cognitive measures. Thus, results from the three-way interactions did not resolve the largely non-significant and inconsistent results from the 2-way interaction analyses.

²Analyses that were not adjusted for family history yielded results and conclusions that were nearly identical to those reported here.

Discussion

Though the previous findings from Tapert et al. (2003) and Thush et al. (2008) that suggested the self-reported expectancy-alcohol relation is stronger among individuals with higher scores in cognitive measures, the current results, taken together, showed minimal support for this notion. The overall rates of significance were consistent with Type I error rates (set at, given the multiple statistical tests, a non-conservative $p=.05$) and a substantial proportion of the significant interactions were inconsistent with the hypothesized pattern discussed by Wiers et al. (2010). Thus, the conclusion that cognitive measures consistently moderate the relation between *self-reported* alcohol outcome expectancies and alcohol use and consequences should be tempered.

It is possible that differences in sample characteristics at least partially account for the discrepant findings. For example, Tapert et al. (2003) used a sample of a 139 adolescents recruited from inpatient alcohol and drug treatment centers whereas Thush et al. (2008) used a sample of 81 adolescents recruited from low-level vocational schools in their analyses. However, though these relatively small samples (compared to the current dataset) comprised mainly of male adolescents, there was significant age overlap in all three samples (i.e., Thush et al., age range 14–20; Tapert et al., age at baseline approximately 16 with a eight year follow-up; current paper age range 18 at baseline with a 17 year final follow-up). Further, all three samples include a substantial proportion of “at-risk” participants and three-way interactions in the current paper involving family history of alcoholism and sex did not provide consistent support for the hypothesized interactions. Given that the participants in the Thush et al. (2008) paper were recruited from “four low-level vocational schools” and participants were recruited from treatment centers in Tapert et al. (2003), our sample most likely has higher overall cognitive functioning, though a significant portion of our sample showed relatively low intellectual functioning for a college sample. Thus, though it is somewhat unclear to what extent cognitive functioning across the different studies can be considered comparable, we would speculate that our sample has higher cognitive functioning than the previous samples, albeit with a wide range of ability. Given these considerations, it seems unlikely that differences in sample characteristics account for the discrepant findings.

It is also possible that differences in assessment may have lead to the divergent findings. For example, Tapert et al. (2003) used global positive changes from the AEQ to measure alcohol expectancies, a composite measure of language abilities (as measured from subtests from the Wechsler Intelligence Scale for Children-Revised [WISC-R; Wechsler, 1974]), and DSM-III-R (American Psychiatric Association, 1987) alcohol abuse and dependence symptom count. Thush et al. (2008) used an 18 item measure “representing an explicit version of the implicit test words” (p. 118) that consisted of three expectancy scales (see Thush et al., 2008; Wiers et al., 2002), the Self-Ordered Pointing Task (SOPT; Peterson et al., 2002) to measure working memory, and a composite consisting mostly of measures of alcohol consumption (both lifetime and past-12 months) as a alcohol involvement measure (see Thush et al., 2008, for more details). Notably, our current paper used a) multiple measures of expectancies that assessed expectancies for various positive outcomes associated with alcohol, b) multiple indices of alcohol use and associated outcomes, including items related to alcohol abuse and dependence, c) multiple assessments of cognitive ability including measures related to verbal abilities and working memory. Though it is possible that we would have obtained findings more consistent with the previous interactions using different measures of the relevant constructs, our use of multiple assessments reduces this possibility³.

Regardless of differences in sampling characteristics and measures, it is not apparent, given the previous comments regarding the theoretical ramifications of these interactions (see Stacy & Wiers, 2010; Wiers & Stacy, 2010), that these effects should be restricted to specific populations (e.g., at-risk adolescents) or specific explicit measures of alcohol outcome expectancies, alcohol involvement, or cognitive tasks (e.g., scores on the digit span forward task). Further, it should be noted that Tapert et al. (2003) found the interaction was significant for only some alcohol use disorder symptoms (e.g., missing school/work/activities due to drinking) but not others (e.g., loss of control; see Tapert et al., 2003) and a significant interaction between working memory and self-reported expectancies was only found for one of the three expectancy subscales assessed by Thush et al. (i.e., positive arousal; see Thush et al., 2008). Taken together with the current findings, it appears that the empirical support for the moderation of the self-reported alcohol expectancy-alcohol involvement relation by cognitive ability is far from consistent.

We want to explicitly state that the findings from the current paper do not address the conclusions reached by Wiers & Stacy (2010) regarding implicit measures of expectancies nor dispel other lines of evidence supporting the contentions of these authors (see Stacy & Wiers, 2010; Wiers & Stacy, 2010). Importantly, the current study did not include a measure of implicit cognitive processes. It may be that accounting for variance in implicit cognition is important in demonstrating a reliable interaction between explicit expectancies and cognitive function. Further, there is much more consistent empirical evidence suggesting that the relation between implicit measures of alcohol expectancies and alcohol outcomes is stronger in individuals with lower cognitive performance (Grenard et al., 2008; Houben & Wiers, 2009; Thush et al., 2008; Wiers, Beckers, Houben, & Hofmann, 2009). Additionally, expanding out beyond alcohol or other drug use per se, there is evidence that the relation between other explicit and implicit constructs with non-alcohol specific behaviors (e.g., eating behaviors) appear to be moderated by working memory and cognitive capacity (both state and trait) in directions consistent with Wiers and Stacy's theoretical perspective (see Hofmann & Friese, 2008; Hofmann, Friese, & Roefs, 2009; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008).

However, at the very least, the current analyses cast doubt on the notion that the relation between self-reported alcohol expectancies and alcohol outcomes is moderated by cognitive measures in at-risk college students (and presumably some other groups as well). In our opinion, given the importance of this population (i.e., at-risk college students) in alcohol research, this apparent lack of generalizability presents a significant limitation to the hypotheses tested in this paper. It is our hope that the current findings can further inform relevant debates regarding the theoretical nature of alcohol expectancies and their relation to implicit cognitive process about alcohol in various populations.

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³Notably, cross-sectional and longitudinal analyses conducted in a longitudinal sample of a cohort of college students ($N=3,720$ at baseline) who were assessed as first-time freshmen and then assessed again eight times over their four years of college suggested identical conclusions as those made here (i.e., substantial non-significance of tested interactions, significant interactions in the opposite of the hypothesized direction) using a proxy measure of cognitive functioning (i.e., ACT scores) and a different measure of alcohol expectancies than those employed here (i.e., the brief version of the Comprehensive Effects of Alcohol Questionnaire [B-CEOA; Ham, Stewart, Norton, & Hope, 2005]). A summary of these results can be provided by the first-author upon request.

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Table 1

Summary of significant interactions between self-reported alcohol expectancies and cognitive functioning found in cross-sectional and longitudinal models by measure of cognitive functioning and alcohol involvement

Outcome	Measure of cognitive functioning															
	DSF		DSB		Sim		Block		Vocab		WMQ		Booklet		Total	
	CS	Long	CS	Long	CS	Long	CS	Long	CS	Long	CS	Long	CS	Long	CS	Long
Alc Q/F	2	0	0	0	0	0	0	0	0	0	0	0	2	1	4	6
Alc Heavy	0	2	0	1	0	0	0	1	0	0	0	3	2	1	2	14
Dep Items	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5
Neg Cons	1	1	0	0	0	1	0	1	0	4	0	1	0	0	1	8
% consistent	25%	4.17%	0%	2.08%	0%	0%	0%	0%	0%	4.17%	0%	12.50%	0%	2.08%	3.57%	3.57%
PBD	0.02	0.70	1.00	0.91	1.00	1.00	1.00	1.00	1.00	0.70	1.00	0.03	1.00	0.91	0.80	0.91
Overall %	25%	6.25%	0%	2.08%	0%	2.08%	0%	4.17%	0%	37.50%	0%	12.50%	33.33%	4.17%	8.33%	9.82%

Note. DSF = digit span forward; DSB = digit span backwards; Sim = similarities; Block = block design; Vocab = vocabulary; WMQ = Wechsler Memory Quotient; Booklet = HRNB Booklet Category Test; CS=cross sectional; Long= longitudinal; Alc Q/F = quantity/frequency of alcohol use; Alc Heavy = heavy alcohol use; Dep Items = dependence items; Neg Cons = negative consequences; % consistent = percentage of significant interactions showing a pattern consistent with hypothesis; PBD = probability under the binomial distribution of finding greater than or equal to the number of consistent interactions at $p = .05$; Overall % = overall percentage of significant interactions.