Contextual Influences on Alcohol Expectancy Processes*

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ABSTRACT. Objective: Context may differentially influence expectancy dimensions, in turn affecting drinking behavior. The present study examined alcohol cue and mood contextual influences on expectancy activation, controlling for more stable self-reported expectancy endorsement. We were particularly interested in the specific effects of negative mood on affect-relevant (tension reduction) expectancies. **Method:** Regularly drinking undergraduates (N = 140; 64 female) underwent a mood (stress or neutral) induction procedure and then were presented with alcohol or nonalcohol beverage cues. Participants next completed a computerized expectancy response time task (ETASK), and self-report measures of drinking variables. **Results:** Individual difference analyses generally replicated previous reports on the inverse relationship between alcohol involvement and ETASK response time. However, examination of contextual effects revealed a different pattern of ETASK responding. Participants exposed to alcohol cues were slower to respond to expectancy items than those in the nonalcohol cue condition. Mood and expectancy type moderated this effect; response time after alcohol cues slowed selectively for those in the stress mood condition and only for tension-reduction expectancy items. **Conclusions:** These data highlight the dimensionality of expectancies that comes into relief when contextual factors are considered. Expectancy response times index both facilitation, when examined in the context of drinking expertise, and interference, in response to motivationally relevant stimuli. Our data also support the specificity of contextual effects on those expectancies that are context relevant (i.e., mood). Further consideration of these contextual effects on dynamic expectancy processes may improve prediction of drinking behavior in real-world settings. (*J. Stud. Alcohol Drugs* **68:** 759-770, 2007)

FROM THE FRAMEWORK OF Social Learning Theory (SLT), alcohol use may be viewed as a learned response to a complex interaction of individual and environmental contingencies (Maisto et al., 1999). Further, beliefs about alcohol's effects (i.e., alcohol expectancies) are a powerful correlate of alcohol use (Carey, 1995; Cohen and Fromme, 2002; Goldman et al., 1999; Greenbaum et al., 2005; Jones and McMahon, 1994; Stacy et al., 1991). SLT suggests these expectancies to be a proximal determinant of drinking behavior, influenced by more distal individual- and environmental-level contextual factors.

Several studies have examined such contextual factors to understand proximal influences on alcohol expectancy processes. Many of these have used self-report expectancy measures (e.g., Birch et al., 2004; Dunn and Yniguez, 1999; Wall et al., 2000) that rely on aggregate scores across forced-choice endorsement items as an index of alcohol beliefs. Yet, these measures may fail to reflect the full dimensionality of alcohol expectancies (Goldman et al., 1991; Wiers and Stacy, 2006). Specifically, although well equipped to assess the strength of relatively stable differences in alcohol expectancies across individuals (i.e., whether an individual holds a belief about alcohol generally), this approach may be less sensitive to important dynamic changes in expectancies within the individual across different contexts.

Methods for assessing dynamic expectancy dimensions have been the focus of recent interest in the alcohol literature (Leigh, 1989; Leigh and Stacy, 1994; Palfai et al., 1997). Derived from the social cognition literature (see Fazio, 2001; Fazio and Olson, 2003), many of these methods have built on those used in attitude activation research, and rely on response time to a target "attitude object" to index the importance, availability, or accessibility of that target to the individual. According to Fazio (1995, 2001; Fazio et al., 1986), such response time paradigms assess the attitudes-behavior association in memory. This automatic response does not require deliberate evaluation or assessment. Indeed, the participant likely is unaware that response time is indexing the accessibility of that belief.

Data from Fazio and others (Bassili, 1995, 1996; Fazio, 2000; Fazio and Williams, 1986; Fazio et al., 1989) suggest that these more automatic cognitions are important motivators of behavior. Self-report endorsement measures rely heavily on conscious reflection on the individual's beliefs about alcohol. As a result, these measures may fail to detect changes in well-learned, implicit processes that may be automatically activated by drinking contexts and operate outside of the individual's awareness. As such, although expectancies assessed via explicit methods show consistent

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associations with drinking behavior (Greenbaum et al., 2005; Jones and McMahon, 1994; Stacy et al., 1991), it also has been suggested that less consciously accessible dimensions of expectancies may be particularly relevant to expectancy processes that occur dynamically in response to contextual cues (Krank et al., 2005).

Measuring dynamic expectancy processes

Addiction researchers frequently have used response time tasks (e.g., probe reaction time tasks, modified Stroop) to capture variation in drug urge that may be particularly sensitive to contextual factors such as drug deprivation, drug cue exposure, and mood states. Use of these tasks is predicated on the assumption that drug use urge occupies working memory resources as the individual plans, prepares, or otherwise contemplates near-term drug use (Cox et al., 2006; Curtin et al., 2006; Tiffany et al., 1990). This premise is a core component of Tiffany's (1990) model and continues to be a central feature of more contemporary theories about urge responding (e.g., Curtin et al., 2006). Moreover, emerging neurobiological evidence supports the recruitment of pre-frontal brain structures associated with working memory by drug cues in the context of urge (Curtin et al., 2006; Franken et al., 2006; Zinser et al., 1999).

As a result of the occupation of working memory resources for drug-related cognition in response to drug cues and related stimuli, response time to other simultaneous tasks that require even minimal attention (e.g., verbal color naming, behavioral responding to auditory probes, answering questions about the self-relevance of alcohol expectancies, etc.) will be slowed to the degree that working memory resources are less available for these tasks. For example, in two separate experiments, Sayette and Hufford (1994) observed that smokers were slower to respond to auditory probes presented while they manipulated smoking-related paraphernalia (e.g., lighted cigarette, lighter) versus a control condition. Moreover, in the second experiment in that paper, cue-related slowing was greater among tobacco-deprived versus non-deprived smokers. Similar interference by drug-related stimuli that tap working memory resources has been observed in tasks including math and language comprehension (Madden and Zwaan, 2001), sentence completion (Zwaan and Truitt, 1998), and color-naming tasks involving addiction words (described next).

In a similar vein, addiction researchers have modified the classic Stroop task for participants to color-name addiction-related rather than incongruent color words (for a review, see Cox et al., 2006). In these tasks, alcoholics display slower color-naming response times to alcohol vs. neutral words (e.g., Cox et al., 2000; Johnsen et al., 1994). Even in non-alcohol-dependent individuals, mood primes have been shown to slow the color naming of alcohol words among those motivated to drink for emotional reasons (Stewart et al., 2002). Similar findings have been reported with smokers; tobacco-deprived smokers (vs non-deprived) are slower to color name smoking vs. neutral words (Gross et al., 1993; Waters and Feyerabend, 2000). Moreover, Waters et al. (2003) found that the degree of response time slowing of smoking-related words for smokers on the day they quit predicted treatment success. Together, these studies suggest response time tasks to be a useful method for evaluating cognitive responses to motivationally significant stimuli.

Palfai and colleagues (1997; Palfai, 2001) have developed a response time-based "Expectancy Task" that is potentially suitable to assess dynamic expectancy variation. In this task, participants make speeded responses to a series of yes/no questions about the positive effects of alcohol. Preliminary research with this task has shown that drinking "expertise," commonly indexed by indicators of alcohol involvement, is associated with *faster responding* to alcohol expectancy items. Such facilitation is consistent with the putatively easier accessibility of this item content for heavier or more frequent drinkers (Palfai, 2001; Read et al., 2004). Thus, this task appears to be sensitive to stable, trait-like individual differences in expectancies. We hypothesize, however, that this task also should be sensitive to phasic contextual influences. Specifically, selective *slower responding* should be observed on trials where motivationally significant urges are primed by alcohol expectancy items. Consistent with results with Stroop and probe tasks, as working memory resources are allocated to urge-related processing, task interference (i.e., slower responding) should be observed on associated expectancy task items.

Thus, we believe that two, somewhat paradoxical, sources of independent variation should be observed in expectancy task response times, depending on the context in which these responses are analyzed. First, we expect that individuals with extensive alcohol involvement should respond faster on this task because of their increased access to and/or expertise regarding alcohol's effects. Second, and independent of this first effect, we also anticipate that contextual factors may interact with alcohol expectancies to prime urge processing that occupies working memory and produces selective response time slowing. Thus, if response facilitation associated with alcohol expertise is controlled, we believe the remaining response time variance will allow us to probe expectancy network components that may not be available via methods requiring conscious introspection. The primary goal of the present research was to use this approach to test dynamic, contextual variation in expectancy network activation. We focus on two contextual factors, alcohol cues and mood state, which could influence in-the-moment cognitions about alcohol and, in turn, affect behavioral (drinking) choices (Birch et al., 2004; Goldstein et al., 2004; Stewart et al., 2002).

Contextual influences: Alcohol cues and mood

Alcohol cues. Alcohol cues are thought to activate urge to drink, possibly by stimulating cognitive-emotional processes relevant to alcohol (Drummond et al., 1995). It has been argued that alcohol expectancies are cue dependent (Hintzman, 1986; Stacy et al., 1994) and therefore may be activated, enhanced, or altered in response to alcohol cues. Moreover, some theorists have suggested that urges themselves are affective in nature (Baker et al., 1986, 2004) and that affect-relevant expectancies may dynamically covary with this cue-induced urge. Empirical tests of these hypotheses have been sparse, but some data support such an association (Cooney et al., 1997; Dunn and Yniguez, 1999; Wall et al., 2000).

Negative mood. Several theoretical models argue that mood states may activate affect-relevant alcohol expectancies which, in turn, lead to drinking (Cox and Klinger, 1990; Goldman et al., 1999; Lang et al., 1999). Negative affect has shown a complex relationship with alcohol involvement in college drinkers (Cooper et al., 1995; Flynn, 2000; Kassel et al., 2000; Read et al., 2003), but in general has been associated with problem drinking in this group (Camatta and Nagoshi, 1995; Hutchinson et al., 1998; Kassel et al., 2000; MacLean et al., 1999). Accordingly, those expectancies (e.g., tension reduction) pertaining to alcohol's ability to ameliorate negative affect may be selectively activated in negative mood states.

In addition to their unique effects, cue and mood may also have interactive effects on expectancy processes. Indeed, conditioned responses to alcohol cues may increase in strength when elicited in affectively charged contexts (Cooney et al., 1997; Niaura et al., 1988). Individual studies have independently examined unique cue and affect influences on alcohol expectancies (e.g., Cooney et al., 1997; Greeley et al., 1992; Litt et al., 1990), but their interactive effects have not adequately been examined to date. Further, both the influences of alcohol cues and affect on dynamic activation of possibly implicit components of the expectancy network have not been examined.

Present study

In this study, we tested the unique and interactive effects of alcohol cues and negative mood on the alcohol expectancy network. We were particularly interested in the specificity of negative mood on expectancies most likely to be influenced by such mood states (i.e., tension-reduction expectancies). We made the following three predictions:

1. Consistent with previous research (Palfai, 2001; Read et al., 2004), individuals with more extensive alcohol involvement and more knowledge about alcohol's expected effects will have easier access to alcohol expectancies in memory and thus faster overall ETASK response times.

2. Alcohol cues and negative mood will, independently or interactively, dynamically activate alcohol expectancies and occupy working memory with urge-related processing. Thus, task responding will be slowed, independently or interactively, by the alcohol cue and/or mood manipulations. This slowing will be tested most sensitively when individual differences associated with task facilitation are controlled.

3. Task-related response slowing associated with the negative mood manipulation should be selective to trials involving mood-relevant, tension-reduction alcohol expectancies.

Method

Participants

Participants were recruited via local newspaper advertisements for a study of "Information Processing in College Students." Those who responded to the ads were confirmed eligible by telephone. Eligibility criteria were student status, age (18-24), and drinking at least once per month for the past 3 months. Following the screen, 178 eligible students were assigned (within gender) to mood and cue conditions (described below) and completed experimental procedures. Twelve participants were dropped from analyses because they correctly guessed the study objectives (see below) or did not complete all individual difference measures. Participants who positively endorsed at least one item from each expectancy type were included in analyses ($N = 140$ out of 166). Thus, the final sample consisted of 140 (64 female) students. Average (SD) age was 20.2 (1.6) years. The majority of participants (77%, $n = 108$) were white, 6% ($n = 9$) were Asian, 6% ($n = 9$) were black, 4% ($n = 6$) were Hispanic, and 6% ($n = 8$) identified themselves as "other." Participants drank an average of 21.6 (15.4) drinks per week during an average of 3.8 (1.6) drinking occasions per week. Mean weekend (Friday and Saturday) consumption was 6.8 (4.0) drinks each night. About 70% of the sample drank five or more drinks in one sitting at least one to two times per week. On average, participants experienced 19 (9.2) different types of alcohol consequences in the past year.

General procedure

Sessions were conducted on weekdays between 1 PM and 5 PM in a medium-sized room with a desk, a small table, a computer monitor, and a computer mouse. After consent, participants completed baseline mood and alcohol urge questions, along with demographic and health behavior measures (included to further mask the purpose of the study from participants). The mood manipulation was then administered, followed by the presentation of alcohol cues, and then the expectancy task (ETASK). Alcohol cues were presented in two phases, described below. After the ETASK, mood and urge to drink again were assessed. Next, participants provided the mood manipulation speech or scene description rating (see the following). Finally, participants completed the remaining self-report measures of alcohol involvement and related constructs.

Experimental manipulations

Mood manipulation. After obtaining measures at baseline and before completing the ETASK, participants were given two different instruction sets depending on their assigned mood condition (stress vs neutral). Participants assigned to the stress mood condition were told that the study was designed to examine information processing and intellectual functioning. They were further informed that, after completing the ETASK, they would be given 2 minutes to compose a 10-minute speech that would be presented to a panel of "judges" who would use this speech to assess their intellectual functioning, and thus, that the speech would be videotaped (Martin, 1990). Participants were told that their speech topic would be randomly assigned, and that this topic would be given to them *just before* their presentation. This instruction was designed to prevent participants from attempting to prepare their speech during the ETASK. Participants in the neutral mood condition were told that, following the ETASK, they would listen to a brief audio-taped scene description and would rate how well they were able to envision that scene.

After completion of the ETASK and posttask mood and craving questions, participants in the stress mood condition were given their presentation topic, were allowed 2 minutes to prepare, and then offered their presentation to the "judges." Participants in the neutral mood condition listened to the brief scene, and then rated the vividness of the images.

Alcohol cues and expectancy task (ETASK). The Expectancy task (ETASK; see Figure 1) used in this study was based on the work of Fazio et al. (1986) and was previously adapted by Palfai et al. (1997) The ETASK is a computerized sentence-completion task in which participants respond to a series of positive alcohol expectancy items or personality trait items. It was further adapted in this study to include a beverage cue exposure manipulation (alcohol or nonalcohol). All stimuli were presented on a desktop computer monitor with display and presentation time controlled using DMDX software (Forster and Forster, 2003). Before beginning the task, participants completed eight practice trials including both alcohol expectancy and personality trait items and were offered an opportunity to ask questions about the task.

The ETASK consisted of two phases. The first phase (Phase 1; see Figure 1) was the alcohol/nonalcohol beverage cue exposure. In this phase, participants were exposed to a series of 20 beverage cues (alcohol or nonalcohol visual images, manipulated between subjects). Each beverage cue was presented for 6 seconds with an inter-image interval of 250 ms. The second phase (Phase 2; Figure 1) consisted of the presentation of expectancy or personality word stimuli, within which were embedded more alcohol cue images. The purpose of this embedding was to sustain the cue effects throughout the expectancy/personality word trials. Accordingly, in this second phase, participants completed a series of 52 alcohol expectancy or personality item trials that were randomly intermixed. Each trial was preceded by the presentation of a beverage cue presented for 4 seconds. Beverage cue type (alcohol or no-alcohol) was consistent with participants' previously assigned beverage cue condition from Phase 1. Following each beverage cue, one of two item stems was presented for 2 seconds. Alcohol expectancy item trials were preceded by the stem "Alcohol helps me . . ." Personality items were preceded by the stem "Usually I . . ." After a 1-second delay, the stem was completed with either an expectancy item target word or a personality item target word (e.g., Alcohol helps me . . . RELAX; Usually I . . . TRUST PEOPLE). Participants responded by pressing one of two response keys ("yes" or "no") to indicate whether the stem/target word described them. Participants were instructed to respond as quickly and accurately as possible.

Participants completed 26 alcohol expectancy and 26 personality trait items. Alcohol expectancy items were taken from Kushner et al. (1994). As the effects of laboratory manipulations of mood tend to be relatively brief (i.e., 30 minutes or less), only those items from expectancy domains thought to be most relevant to the mood manipulation and general experimental context (i.e., tension reduction, social facilitation, activity enhancement) were used in this study to limit the duration of the expectancy task. Personality trait items were chosen randomly from the Big Five Inventory (John et al., 1991), a widely used broadband measure of personality. The primary dependent measure for the ETASK was the response time to positively endorsed alcohol expectancy words (Palfai, 2001). Response time to positively endorsed personality items was used to control for individual differences in overall response speed. The Spearman-Brown estimate of the split half reliability of this task was .84.

Manipulation check measures

Manipulation checks. Mood was assessed at three points (baseline, after mood manipulation/immediately before the task, and immediately after the task). Mood was assessed with the Affect Grid (Russell et al., 1989), which evaluates current affective state according to dimensions of valence (i.e., pleasant /unpleasant) and arousal/sedation. Participants

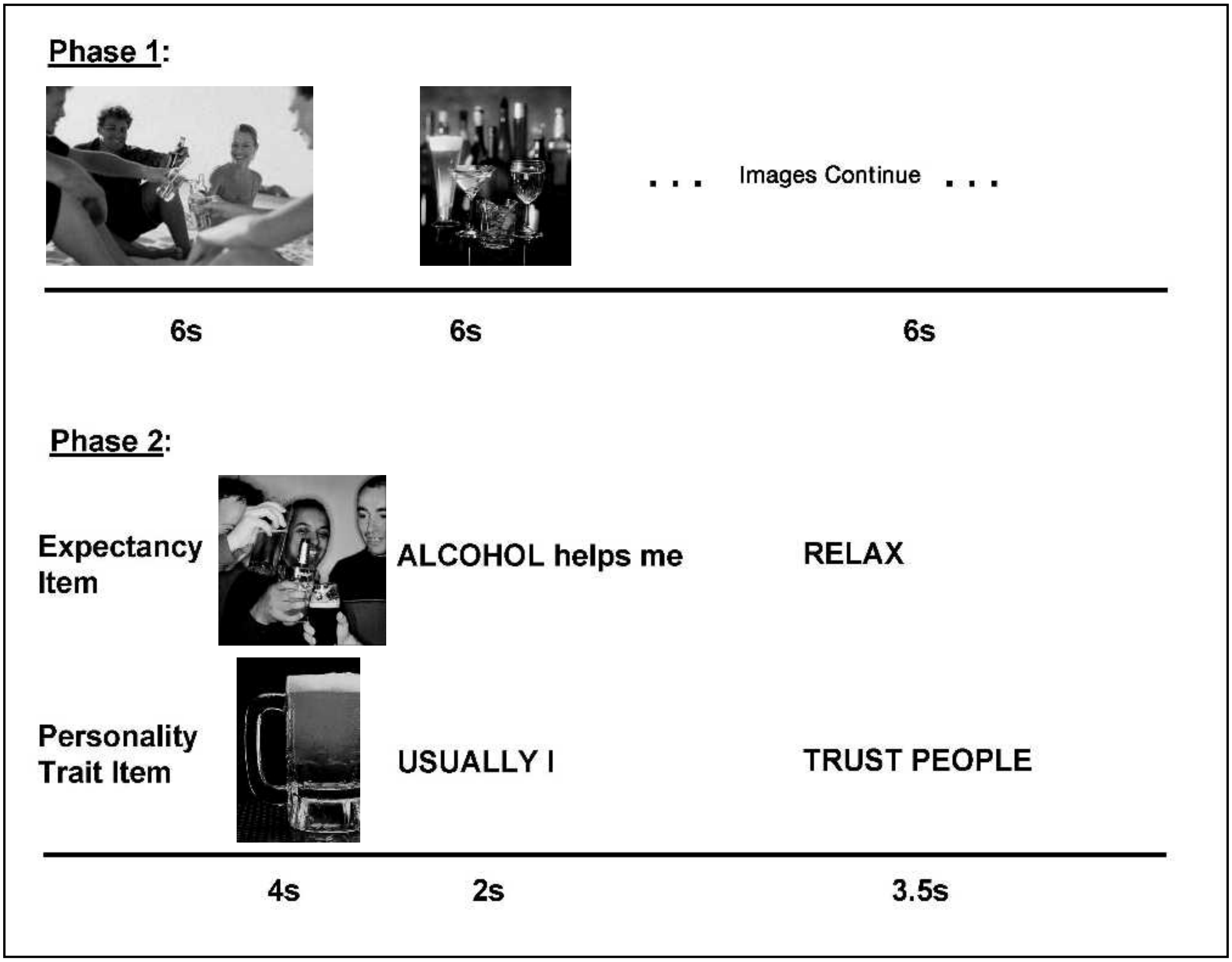

FIGURE 1. Cue Presentation and expectancy response time task (ETASK) Administration Timeline

were read an instruction set by a research assistant, and then asked to rate "How are you feeling right now?" by marking a single "X" on the grid. Mood valence scores range from 1 ("pleasant") to 9 ("unpleasant"). Urge to drink alcohol was assessed twice (baseline and immediately after the task) with a one item question asking the participant to rate the strength of her/his desire to drink at that moment. The potential range of scores for the urge measure was 1 ("no desire") to 7 ("very strong desire"). Change across time in the mood and urge measures were used to verify the success of the mood and cue manipulations, respectively. In addition, to assess whether participants were blind to the mood manipulation, two items were administered at the end of the session ("Please tell us what you think this study is about" and "Why do you think we asked you to give a speech?"). Qualitative responses to these items were recorded by research assistants, and reviewed by the first author at the conclusion of data collection. The criteria for deletion from the study were the following: (1) awareness of the mood manipulation and (2) accurately linking the experimenters' interest in their concern about speech performance (e.g., anxiety, worry, fear), and alcohol beliefs. Nine participants met one or both of these criteria, and thus were dropped from data analyses as described earlier.

Alcohol-related individual differences

All alcohol-related individual difference questions (use and problems, expectancies, motives) were administered at the end of the session so as not to inadvertently prime expectancies during the task.

Alcohol use and problems. Before questionnaire administration, the term "standard drink" was operationalized. Participants were asked to query research assistants with any questions pertaining to quantification of alcohol consumption. A range of alcohol behaviors was assessed, including typical quantity and frequency of alcohol consumption, and average frequency of heavy drinking (five or more drinks in a single sitting). Alcohol consequences were assessed with the Young Adult Alcohol Consequences Questionnaire (Read et al., 2006), a measure designed to assess consequences relevant to the college milieu. Self-reported expectancies were assessed with 35 items from Kushner et al. (1994). These items assessed a range of relatively static beliefs about positive alcohol effects (PAE). As noted, three of a possible four subscales identified by Kushner and colleagues were also used in the ETASK (26 items). These subscales were tension reduction (nine items; $\alpha = .71$), social facilitation (eight items; $\alpha = .73$), and activity enhancement (nine items; $\alpha = .60$). The fourth subscale (performance enhancement, nine items; $\alpha = .70$) was included only in the posttask self-report assessment. To be consistent with the ETASK, self-report items were rated dichotomously (yes/no) such that participants responded only whether they believed each descriptor to be true about the effects of alcohol for them. Cronbach's α for the total PAE score in this sample was .85. Self-reported PAE total score was controlled in analyses of ETASK response time to provide for tests of individual differences and contextual factors that predict *unique* variance in the ETASK measure independent of variation in these more stable self-reported expectancies.

Drinking motives. Drinking motives were assessed with Cooper's 20-item scale (1994). Response options for this measure range from 1 (almost never/never) to 5 (almost always/always). Cronbach's α for the total drinking motives score in this sample was .86. Subscales include coping ($\alpha = .77$), enhancement ($\alpha = .81$), social ($\alpha = .85$), and conformity ($\alpha = .84$).

Results

Manipulation checks

Verification of mood manipulation. Affect grid valence scores were analyzed within a Mood (neutral vs stress) × Cue (non-alcohol vs alcohol) × Time (baseline vs pretask vs posttask) mixed model analysis of variance (ANOVA) to confirm the efficacy of the mood manipulation. Partial eta-squared (η_p^2) effect-size estimates are reported to document the magnitude of critical effects. As expected, a significant Mood × Time interaction was observed ($F = 4.83$, 2/270 df, $p = .01$, $\eta_p^2 = .04$). Follow-up analyses indicated that the time effect was significant in the stress condition ($F = 10.96$, 2/126 df, $p < .001$, $\eta_p^2 = .15$), with greater negative mood after the mood manipulation, just before the ETASK (mean [SE] = 4.63 [0.22], $p < .001$), and after the ETASK just before the speech (mean = 4.75 [0.23] $p < .001$) relative to baseline (mean = 3.94 [0.23]). Negative mood was not significantly different between these two later time points ($p = .39$) in the stress condition, suggesting that the induced negative mood was sustained throughout the experiment. In contrast, there was no effect of time on mood in the neutral mood condition ($F = 1.01$, 1/148 df, $p = .35$) (baseline: mean = 3.75 [0.20]; pretask: mean = 3.62 [0.20]; posttask: mean = 3.91 [0.21]). No other effects were observed.

Verification of beverage cue exposure manipulation. Self-reported urge to drink was analyzed within a Mood (neutral vs stress) × Cue (no-alcohol vs alcohol) × Time (baseline vs posttask) mixed model ANOVA to confirm that the beverage cue and mood manipulations effectively elicited urge to drink alcohol. A significant Mood × Cue × Time interaction was observed ($F = 4.38$, 1/136 df, $p = .04$; $\eta_p^2 = .03$). Follow-up analysis showed a significant Time effect; drink urge increased from baseline to posttask in the alcohol/neutral mood ($p < .001$; $\eta_p^2 = .28$; baseline: mean = 1.67 [0.14]; posttask: mean = 2.46 [0.25]), in the no-alcohol/stress mood ($p = .03$; $\eta_p^2 = 0.16$; baseline: mean = 1.43 [0.13]; posttask: mean = 1.96 [0.27]), and in the alcohol/stress mood conditions ($p = .006$; $\eta_p^2 = 0.19$; baseline: mean = 1.65 [0.18]; posttask: mean = 2.03 [0.24]). Thus, all conditions involving either alcohol cue or stress significantly increased drink urge. The time effect on drink urge was not significant in the no-alcohol/neutral mood condition ($p = .18$; $\eta_p^2 = 0.05$; baseline: mean = 1.83 [0.22]; posttask: mean = 2.03 [0.21]). No other significant effects were observed.

Individual differences

As expected, a significant zero-order correlation was observed between ETASK overall alcohol expectancy item response times and personality item response times ($r = 0.78$, 138 df, $p < .001$). To control for these individual differences in overall response speed, all subsequent analyses of ETASK alcohol expectancy response times control for personality trait item response times (i.e., personality trait response times are partialed in correlation analyses or included as a covariate in an analysis of covariance [ANCOVA]).

To test for task facilitation associated with alcohol involvement and knowledge about alcohol's effects (Hypothesis 1), first-order partial correlations were calculated between individual difference measures and overall ETASK alcohol expectancy response time (partialing personality item response time). For readers less familiar with partial correlations, tests of first-order partial correlations are statistically equivalent to results from regression analyses that control for personality item response time by including it as an additional predictor variable. As expected, a significant partial correlation was observed between ETASK expectancy response times and self-reported PAEs ($r = -.50$, 137 df, $p < .001$); participants who endorsed more positive alcohol expectancies responded faster to ETASK expectancy items. Significant negative first-order partial correlations also were observed between ETASK response times and all four drinking motives scales: coping (*pr* = -.32, 137 df, $p < .001$), social (*pr* = -.42, 137 df, $p < .001$), enhancement (*pr* = -.35, 137 df, $p < .001$), and conformity (*pr* = -.20, 137 df, $p = .02$). Participants who endorsed more of these motives for drinking responded faster to ETASK alcohol expectancy items (see Table 1, first results column). Significant or trend-level negative partial correlations were observed with frequency of heavy (five or more drinks) alcohol use, (*pr* = -.21, 137 df, $p = .01$), and alcohol problems (*pr* = -.14, 137 df, $p = .10$), respectively. Although in the same direction, the partial correlations with past-6-month drinking frequency (*pr* = -.09, 137 df, $p = .27$) or drinking quantity (*pr* = -0.05, 137 df, $p = .57$) were not significant.

In this final set of individual difference analyses we examined individual differences that predicted *unique* variance in ETASK response times, independent of variance in self-reported PAEs. To accomplish this, second-order partial correlations (partialing personality item response time and self-reported PAEs) were calculated between ETASK response times and alcohol-related individual differences. Significant negative second-order partial correlations continued to be observed between ETASK response times and the social (*pr* = -.25, 136 df, $p = .004$) and enhancement drinking motives subscales (*pr* = -.17, 136 df, $p = .05$); participants who endorsed more of these motives responded faster to ETASK items even after partialing out stable self-reported positive alcohol expectancies (Table 1, second results column). Interestingly, however, no significant partial correlations were observed for coping motives (*pr* = -.07, 136 df, $p = .40$), conformity motives (*pr* = -.12, 136 df, $p = .17$), 6-month alcohol-use frequency (*pr* = .06, 136 df, $p = .46$), 6-month quantity (*pr* = .01, 135 df, $p = .88$), heavy (five or more drinks) drinking frequency, (*pr* = -0.09, 136 df, $p = .28$), or alcohol problems (*pr* = .08, 136 df, $p = .34$).

TABLE 1. Partial correlations between expectancy response time task (ETASK) scores and self-report (SR) cognition measures

Variable	Overall ETASK *pr*	Unique ETASK *pr*
Total SR expectancy	-.50‡	.00
Tension reduction	-.41‡	-.01
Social facilitation	-.46‡	-.09
Activity enhancement	-.26†	.09
Performance enhancement	-.33‡	.03
Coping motives	-.32‡	-.07
Social motives	-.42‡	-.25†
Enhancement motives	-.35‡	-.17*
Conformity motives	-.20*	-.12

Notes: "Overall ETASK" column reports partial correlations between mean ETASK scores across all three expectancy types and the explicit cognition measures, partialing only personality item response times. "Unique ETASK" column reports partial correlations between mean ETASK scores across all three expectancy types partialing both personality items and total positive alcohol expectancy scores. Although not displayed, all correlations among the self report expectancy and motives scales were positive and significant ($p \leq .05$), with the exception of the relationships between conformity motives and tension reduction, activity enhancement, performance enhancement expectancies, and enhancement motives.
*$p \leq .05$; †$p \leq .01$; ‡$p \leq .001$.

Contextual effects

ETASK expectancy response times were analyzed in a mixed-model ANCOVA with mood (neutral vs stress) and cue type (non-alcohol vs alcohol) as between subject factors and expectancy type (tension reduction vs social facilitation vs activity enhancement items) as a within subject factor. Huynh Feldt corrected *p* values are reported for all tests involving expectancy type to control for possible violations of the sphericity assumption. Personality trait item response times and self-reported PAE scores were included as covariates to control for these factors to provide tests of the effects of cue, mood, and expectancy type on unique ETASK expectancy response time variance, independent of these individual differences.

A significant main effect of cue type was observed (F = 4.00, 1/134 df, $p = .05$; $\eta_p^2 = .03$), indicating that overall ETASK alcohol expectancy response time slowed on alcohol cue trials (mean = 1,697 [24] ms) vs no-alcohol cues (mean = 1,626 [26] ms). This cue main effect was moderated by expectancy type and mood (i.e., an Expectancy Type × Mood × Cue interaction; Figure 2) (F = 4.81, 2/268 df, $p = .009$; $\eta_p^2 = .04$). To decompose this three-way interaction, separate Mood × Cue ANCOVAs were conducted for each expectancy type. The Mood × Cue interaction was significant for tension-reduction expectancies (F = 7.84, 1/134 df, $p = .006$; $\eta_p^2 = .06$), indicating that the magnitude of the cue effect varied by mood on trials involving tension reduction expectancies. The Mood × Cue interaction for social facilitation and activity enhancement expectancies were not significant. Follow-up simple effects of cue type were tested for all combinations of mood and expectancy type (i.e., six simple effect tests). Consistent with the observed Mood × Cue interaction for tension reduction expectancies, the pattern of cue type simple effects differed by Mood for tension reduction expectancies. Specifically, a significant simple effect of Cue was observed for tension reduction expectancies in the stress mood condition (F = 15.45, 1/61 df, $p < .001$; $\eta_p^2 = .20$), with ETASK expectancy response times slowed on trials preceded by alcohol (mean = 1,822 [45] ms) vs no-alcohol cues (mean = 1,550 [52] ms). In contrast, the simple effect of cue was not significant for tension reduction items in the neutral mood condition. Moreover, there were no simple effects of cue for the other expectancy types (social facilitation, activity enhancement) in either of the mood conditions.

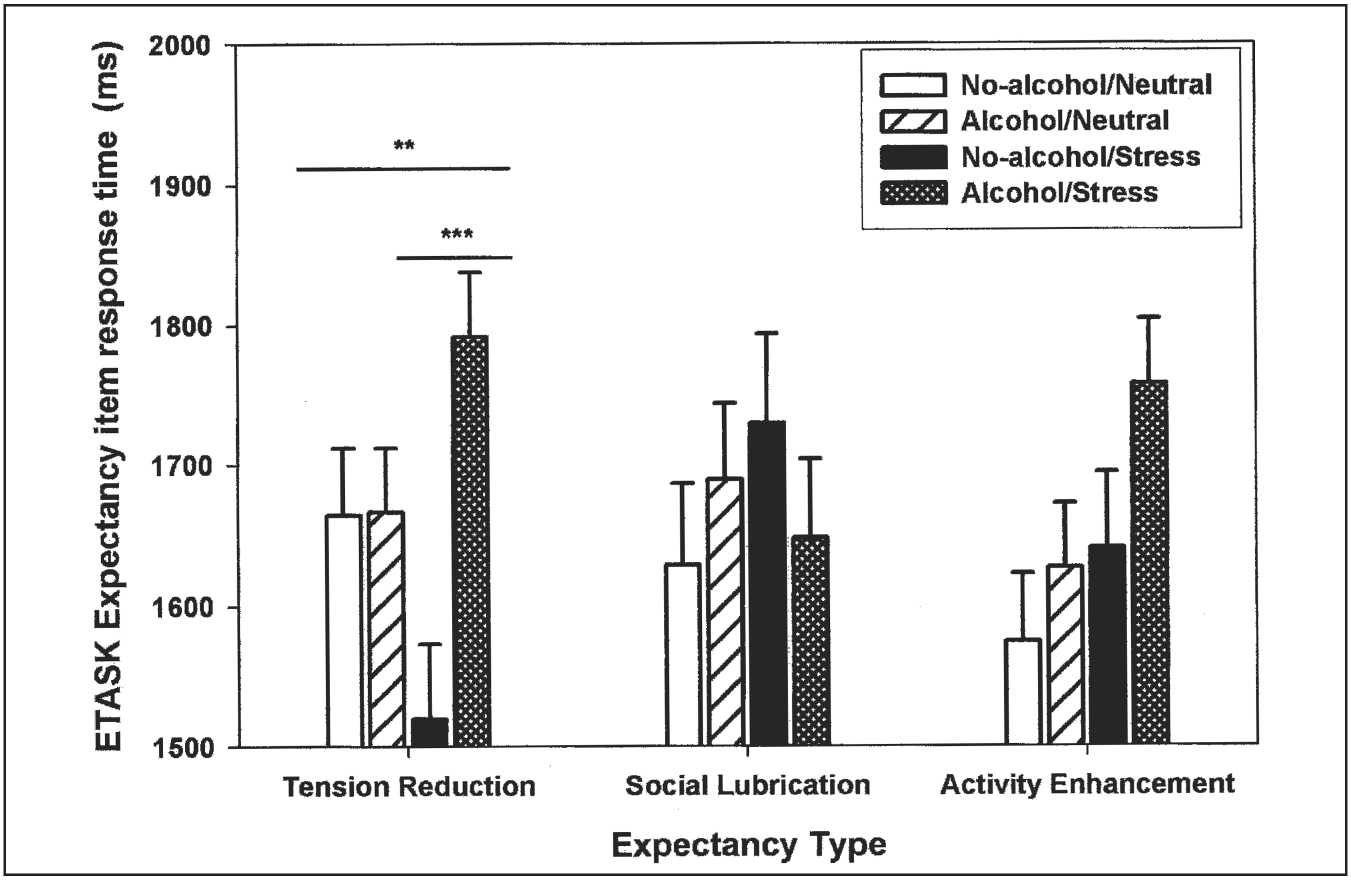

FIGURE 2. Expectancy response time task (ETASK) by Mood, Cue, and Expectancy type
**$p \leq .01$; ***$p \leq .001$.

Discussion

In this study, we examined the unique and interactive influences of cue and mood contextual factors on dynamic changes in alcohol expectancy activation, controlling for more stable self-reported expectancy endorsement. That is, we wanted to examine mood and cue influences on the activation of expectancies, above and beyond simple endorsement of beliefs about alcohol's effects. We were particularly interested in the predicted specificity of the effect of negative mood on affect-relevant expectancies (tension reduction).

Individual differences and ETASK response time facilitation

To start, the individual differences analyses generally replicated previous reports on the inverse relationship between measures of alcohol involvement and response time in the ETASK. Specifically, before controlling for self-reported PAEs, response time to expectancy items on the ETASK decreased as participants endorsed more positive expectancies about alcohol and more motives to use alcohol. Heavier drinking and number of alcohol-related problems also were associated with faster ETASK responding. This facilitation of responding has been viewed as indicating greater expectancy accessibility in memory among those who are more alcohol-involved and who self-report more well-developed beliefs about alcohol's effects (e.g., Palfai et al., 1997, 2001; Read et al., 2004; Wall et al., 2000). In other words, these participants are more fluent or "expert" with expectancy item content than participants who do not spend as much time thinking about or actually using alcohol. Consistent with this interpretation is our finding that the strongest correlation was observed between total self-reported positive alcohol expectancies and ETASK responding. In addition, ETASK facilitation significantly predicted heavy drinking among participants (five or more drinks in a single sitting) and, to a lesser extent, alcohol problems. The relationship between ETASK responding and alcohol quantity was not significant. Our sample was comprised of fairly heavy drinkers. The resulting restricted range in consumption may account for the absence of this association that has been observed previously (e.g., Palfai et al., 1997, 2001; Read et al., 2004).

However, when self-reported PAEs were controlled, the relationship between ETASK response time and heavy drinking/problems with alcohol was eliminated. This suggests that both self-reported expectancies and the variance associated with ETASK response time facilitation may tap similar processes, and may result from individual differences in previous experience with alcohol. As the goal of this study was to isolate unique dynamic variance in the alcohol expectancy network independent of these stable individual differences, we controlled for self-reported PAEs in all subsequent ETASK analyses. Interestingly, this resulted in reliable, unique ETASK variance that was selectively related to alcohol cue and mood manipulations. We turn to these effects now.

Contextual factors and ETASK response time slowing

Participants who were exposed to alcohol cues were significantly and substantially slower (71 ms) to respond to ETASK expectancy items than were participants in the nonalcohol cue condition. However, this effect of alcohol cues on ETASK responding was moderated by both mood and expectancy type. Specifically, this ETASK response time slowing that followed exposure to alcohol cues was observed selectively for participants in the stress mood condition and only for tension-reduction expectancy items.

These results provide compelling although preliminary evidence that contextual factors (i.e., alcohol cues, mood state) can dynamically activate the alcohol expectancy network, leading to a cascade of processes that may in turn influence drinking behavior in those moments. As reviewed earlier (e.g., Cox et al., 2000; Johnsen et al., 1994; Stewart et al., 2002), response slowing is observed in similar addiction tasks when working memory resources are occupied by motivationally relevant processes related to alcohol or drug use. As the urge manipulation check confirmed, the alcohol cue and stress manipulations interacted to produce alcohol urge to drink in our participants. ETASK data suggest that these contextual factors also combine to selectively activate tension reduction expectancies within the expectancy network. That is, when participants are both stressed and exposed to alcohol cues, the presentation of tension-reduction statements about alcohol interferes with task-related responding, presumably because of the diversion of working-memory resources from task performance to urge-related responding.

It is important to acknowledge explicitly four inferences that have yet to be conclusively substantiated in our interpretation of the observed selective ETASK response time slowing associated with alcohol cues and stress. First, although there is ample and long-standing precedent for using slowing in response time tasks to index allocation of working-memory resources, response time remains an indirect measure of working-memory resource allocation. More direct measures can be incorporated easily into future studies with the ETASK. For example, event-related brain potentials such as P3 covary directly with the allocation of working-memory resources (Kramer and Spinks, 1991) and can be measured trial by trial in the ETASK. Second, we imply that the selective slowing of response time on tension-reduction items results from a synergistic match between the stress manipulation and the content focus on using alcohol for stress management in the tension-reduction items. Future research can provide stronger support for this claim by varying positive affect with a social/celebratory manipulation (perhaps an imagery task) and confirming that in this context selective slowing on social facilitation expectancy items are observed. Third, the measure of craving/urge in our study was blunt and not adequate to assess trial-by-trial variation in urge as needed given the observed moderating role of expectancy type on ETASK responding. Future research should incorporate measures that are sensitive to short-term dynamic changes in urge that we predict should track the ETASK response time changes across expectancy types. Again, such methods are available and could readily be incorporated into future research with the ETASK (e.g., see Zinser et al., 1999, for the use of electroencephalogram asymmetry to index urge responding). Finally, actual drinking behavior was not assessed in the context of our mood and cue manipulations. Again, individual differences in self-reported drinking quantity and frequency are blunt and not likely to reflect important moment-to-moment variation in the motivation to drink that may be reflected by ETASK variance across conditions in our experiment.

The observed selective response time slowing on tension reduction items provides further support for the dynamic nature of working memory in a changing environment. Both recent basic research on working memory (Kerns et al., 2004) and more clinical research examining alcohol effects on working memory (Curtin et al., 2003) demonstrate that working memory is highly dynamic. Using functional magnetic resonance imaging and brain electrophysiology, respectively, these experiments demonstrate that working memory resources are recruited and released on a trial-by-trial basis, as processing demands of the task change. We suggest that similar trial-by-trial fluctuations in working-memory recruitment are occurring in the ETASK. Urge to drink in combination with negative emotion resulting from the stress manipulation appear to prompt brief recruitment of working-memory processes directed toward the consideration of alcohol use for tension-reduction purposes. What is different about the ETASK from many other response time tasks (e.g., auditory probe) is that the ETASK assesses specific *types* of beliefs about alcohol. As such, this is the first occasion to our knowledge in which slowing to specific word stimuli is observed (in comparison, the general pattern of slowing has been observed in response to motivationally relevant cues, which has more commonly been observed in the literature). Indeed, we did not observe a broader pattern of slowing that was associated with cue or mood but instead slowing only to mood-relevant expectancies. This may be a result of the fact that the nature of the ETASK allowed us to piece out the various components of the slowing (e.g., slowing to tension-reduction expectancies versus other types of expectancies) in a way that previous tasks have not afforded. Of course, although this interpretation is consistent with theory, other explanations also are possible. Ultimately, replication of these findings, and in particular of the specificity of mood and cue effects on only relevant expectancy types, will be necessary to support this as opposed to alternative explanations.

Our findings regarding the specificity of the negative mood effect on tension-reduction expectancy reaction time are consonant with work by McKee et al. (2003) who showed similar mood effects on mood-relevant smoking expectancies, and by Birch et al. (2004), who also found mood effects on relevant alcohol beliefs (for coping-motivated drinkers). These studies examined expectancy endorsement, rather than reaction time. Findings from our study, considered with the works of McKee and Birch, suggest that mood may serve as a proximal and specific influence on both stable and dynamic expectancy dimensions. This may shed light on expectancy activation pathways, as it appears that mood-relevant expectancies are selectively activated by mood, with the likely result of drinking to alter or ameliorate negative affect.

Future directions and conclusions

Future research should consider a broader range of alcohol expectancies. In our study, we assessed only (a subset of) positive expectancies. However, both social and problem drinkers also readily endorse negative beliefs about alcohol (Dunn and Earleywine, 2001; Wiers et al., 2002). Just as positive expectancies may lead to alcohol use, these negative-outcome expectancies may serve to inhibit urge responding and/or alcohol use. In fact, recent research has suggested that both activating and inhibiting factors may exert simultaneous, unique influences on drinking behavior (Curtin et al., 2006).

This study provides preliminary evidence that contextual factors such as mood state and alcohol cues may dynamically activate cognitive processes related to alcohol. However, the full mediated pathway posited by Social Learning Theory (SLT) was not tested. SLT suggests that expectancies serve as a common pathway, through which contextual factors may influence alcohol use. Although this study manipulated two contextual factors and assessed their effects on expectancies, downstream trial-by-trial variation in urge responding was not recorded. Moreover, the eventual effect on actual drinking behavior was not tested.

This study provides a conservative test of our predictions regarding urge to drink and mood influences on expectancy activation because our sample was comprised of regular but not problem drinkers. Still, it should be noted that our sample consisted of fairly heavy drinkers, with typical alcohol consumption and alcohol problems higher than that which is generally reported in the college drinking literature. As such, it is possible that the slowing associated with alcohol cue and mood is likely to occur only in those who are more highly alcohol involved. This prediction remains to be tested in future research.

Of course, no single study can examine the full range of contextual factors relevant to expectancies. The enhancement of positive affect is an important motive for drinking, particularly among college students (Ratliff and Burkhart, 1984; Read et al., 2003; Stewart et al., 1996). As noted above, it will be important to examine whether the influence of other contextual manipulations (e.g., slowing to enhancement expectancies following positive mood and alcohol cue presentation) reveals similar findings to those observed here.

In conclusion, these data suggest that alcohol cues and mood state may dynamically affect expectancy processes, and point to the close link between affect and expectancy processes. Our findings also highlight the complexity of the expectancy process. That is, self-report measures of generally stable, easily accessible beliefs about alcohol's effects may miss motivationally important dynamic changes that occur in the expectancy network across contexts and that may guide in-the-moment decisions regarding drinking. Further consideration of these contextual effects on dynamic expectancy processes may improve prediction of situation-specific drinking behavior in real-world settings. Expectancy-based interventions focus on the modification of static beliefs about alcohol. Although heavier drinkers may show greater facility with these beliefs, it is not clear what happens in contexts where these beliefs take on more motivational relevance. Such interventions might benefit from the incorporation of relevant contextual influences and how these influences may shape beliefs and behavior choices.

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