

Automatic effects of alcohol cues on sexual attraction

Ronald S. Friedman¹, Denis M. McCarthy¹, Jens Förster² & Markus Denzler²

University of Missouri–Columbia, MO, USA¹ and International University, Bremen, Germany²

Correspondence to:

Ronald S. Friedman
Department of Psychological Sciences
University of Missouri–Columbia
210 McAlester Hall
Columbia
MO 65211
USA
Tel: (573) 884 8140
E-mail: friedmanr@missouri.edu

Submitted 7 April 2004;

initial review completed 7 September 2004;

final version accepted 19 November 2004

ABSTRACT

Aims The present study tested whether suboptimal priming (which may be defined as ‘under viewing conditions rendering conscious identification highly improbable’) with alcohol-related stimuli would activate existing expectancies about alcohol’s effects on sexual desire. It was predicted that alcohol cues, relative to non-alcohol cues, would activate expectancies of alcohol’s aphrodisiac properties. We hypothesized that for men, stronger expectancies in this regard would predict an increased tendency to judge women as sexually attractive following the alcohol primes.

Design Two experimental studies manipulated cue (alcohol *versus* control) and rating dimension (attractiveness *versus* intelligence). Self-reported alcohol expectancies of sexual desire were assessed approximately 1 month prior to the study. Study 2 assessed additional expectancy content domains.

Setting and participants Study 1 comprised 82 undergraduate males and study 2 78 undergraduate males. Studies were conducted at the University of Missouri–Columbia, Columbia, Missouri, USA.

Interventions In both experiments, male participants were suboptimally primed with either alcohol-related or control words. Following this priming, they were presented with a series of photographs of young women and asked to either rate their attractiveness or their intelligence.

Findings and conclusions In both studies, a three-way interaction between cue, rating dimension and alcohol expectancies was found. Within the attractiveness rating condition a two-way interaction was found, indicating that in this condition, stronger expectancies that alcohol increases sexual desire predicted higher attractiveness ratings after suboptimal exposure to alcohol primes. No effects emerged in the intelligence rating condition. Discussion centers on implications for sexual risk-taking as well as a range of other non-consumptive behaviors.

KEYWORDS: Alcohol, attraction, expectancy, priming.

INTRODUCTION

Over the past two decades, psychological research on alcohol use and abuse has convergently supported the notion that alcohol expectancies, mental representations regarding the changes in affect and behavior presumed to result from alcohol consumption, substantially influence drinking behavior (for reviews see Goldman *et al.* 1999; Jones *et al.* 2001). More specifically, this research suggests that alcohol expectancies are activated cognitively

in alcohol-relevant situations (e.g. Stacy 1997; Goldman 2002). When these expectancies are positive, for instance suggesting that alcohol makes people more sociable or fuels their sexual arousal, the proclivity to consume alcohol is increased. Conversely, when these expectancies are negative, for instance suggesting that alcohol makes people sick or tired, this proclivity is diminished.

Interestingly, recent research has demonstrated that the activation of alcohol expectancies may often involve little or no conscious involvement. For example, Kramer

& Goldman (2003) have reported evidence that words related to arousal (a positive alcohol expectancy, likely to be held by heavier drinkers) are activated automatically in heavier drinkers by exposure to alcoholic beverage words, whereas words related to sedation (a negative alcohol expectancy, likely to be held by lighter drinkers) are activated automatically in lighter drinkers by alcoholic beverage words. Moreover, a related series of studies has demonstrated that the influence of expectancies on actual alcohol consumption may be relatively automatic as well. Specifically, Roehrich & Goldman (1995) discovered that individuals who were merely exposed to positive alcohol expectancy words, in what they believed was an entirely unrelated context, subsequently consumed significantly more beer than control participants. These findings were replicated recently by Stein *et al.* (2000), who additionally ruled out the alternative explanation that positive expectancy concepts had influenced alcohol consumption by eliciting positive mood. Together, these studies suggest that mere activation of alcohol expectancy representations in long-term memory may impact drinking with little or no intention or awareness (see also Stacy *et al.* 1994; Stacy 1997).

The automatic activation of alcohol expectancies by alcohol cues, and the influence of this activation on drinking behavior, raises the question of whether exposure to alcohol cues influences not only alcohol consumption, but other variants of behavior or judgement, without intention or awareness. For instance, a common positive expectancy regarding alcohol is that it will increase sexual desire (e.g. Brown *et al.* 1980; Fromme *et al.* 1993). Previous studies using balanced placebo designs have already demonstrated elegantly that the (false) belief that one is ingesting alcohol is sufficient to enhance self-reported sexual arousal (George & Marlatt 1986). The belief that one has received alcohol has also been found to interact with a priori sex-related expectancies in the prediction of sexual arousal and post-'drinking' behavior (George *et al.* 2000). It may be predicted, based on the foregoing logic, that analogous effects will emerge simply from exposure to alcohol-related stimuli, without the belief that one will consume alcohol. As such, mere exposure to alcohol cues might implicitly activate expectancies concerning sexual arousal, and in turn influence arousal-related behaviors or judgements.

The present study was designed to test this hypothesis experimentally. Specifically, in initial sessions, undergraduate men were administered a survey assessing their expectancies that alcohol increases sexual desire. They then returned for an experiment in which they were 'sub-optimally' primed (i.e. under viewing conditions rendering conscious identification highly improbable; see Murphy & Zajonc 1993) with either alcohol-related or control words. We chose to implement a suboptimal as

opposed to an optimal priming methodology to provide the strongest possible test of our hypothesis. Following this subtle priming procedure, they were presented with a series of photographs of young women and asked to rate either the attractiveness of the women or how intelligent they looked. It was predicted that suboptimal exposure to alcohol, relative to non-alcohol cues, would activate expectancies regarding alcohol's aphrodisiac properties. Stronger expectancies in this regard would then predict an increased tendency to judge women as sexually attractive following the alcohol primes. However, these variables were predicted to have no interactive effect on physiognomic judgements of women's intelligence, inasmuch as expectancies regarding alcohol's effects on sexual arousal should be irrelevant to such judgements.

METHOD

Experiment 1

Participants

Participants were 82 heterosexual males, between the ages of 18 and 27 years. All were undergraduates at the University of Missouri–Columbia who were enrolled in an introductory psychology course and who had completed a 200-item battery of diverse personality measures approximately 4–6 weeks earlier. This battery included the alcohol expectancy measure of interest (see below). In terms of drinking habits, 53 participants (64.6%) reported drinking alcohol once or twice a week, 18 (21.9%) reported drinking about once a month, two (2.4%) reported drinking only three or four times a year, three (3.7%) reported drinking between one and four times in their lives and six (7.3%) reported never having consumed alcohol. Participants signed up for the experiment through a departmental website. All male undergraduates who had completed the premeasures were eligible to participate. Upon arrival at the laboratory, participants were run in groups of up to eight at visually isolated computer stations. They neither saw nor interacted with one another during the session. Participants were randomly assigned to condition by the computer. This served to keep experimenters blind to condition and enabled multiple conditions to be administered in a given session. Participants received course credit for participation.

Procedure

Alcohol expectancies. In order to assess expectancies that alcohol would increase sexual desire, participants were administered the Sexual Effects of Drinking Question-

naire (SEDQ; Skinner 1992). This measure has been used in past research assessing alcohol and expectancy effects on sexual desire (see George *et al.* 2000). Items include the statement, 'having a few drinks would increase or decrease your feelings of sexual', followed by six subjective states ('arousal', 'interest', 'enjoyment', 'excitement', 'pleasure' and 'desire'). Responses were tendered on a five-point scale anchored at 1 (decrease a lot) and 5 (increase a lot). Exploratory factor analysis, using the 1087 participants from the pretest battery, was used to test the factor structure of the SEDQ. Principle axis factoring with Varimax rotation was employed. Based on the scree plot, a two factor solution explaining 76% of the variance was identified. One factor (items 3–5) assessed expectancies regarding alcohol's effects on feelings experienced during sex. Items loading on the second factor (1, 2 and 6) assessed expectancies regarding alcohol's effects on the desire to have sex. Our hypotheses pertained solely to the 'desire' factor, thus analyses to be reported below were calculated using mean scores on items 1, 2 and 6.

Priming task. The procedure for this task was administered by computer. Participants were provided with the cover story that they would be completing a set of tasks related to a number of different projects. They were then administered a lexical decision task (ldt) in which they were presented on screen with a series of letter strings and asked to indicate whether each string was a word or not. This task actually served as the vehicle for surreptitiously priming participants with alcohol versus control words. Specifically, participants were given 110 ldt trials. Each trial began with the presentation of a fixation cross '+' in the center of the screen. This was replaced after 1000 ms by a forward masking string '&&&&&&&&&', presented for 400 ms, which was subsequently replaced by either a randomly selected alcohol-related word (alcohol cue condition) or control word (non-alcohol cue condition) for 40 ms. The alcohol cue words included 'beer', 'whiskey', 'cocktail', 'lager', 'rum', 'vodka', 'keg', 'drunk', 'wasted', 'booze', 'martini', 'liquor', 'malt' and 'pitcher'. The control words included 'cup', 'punch', 'water', 'juice', 'coffee', 'soda', 'tea', 'lemonade', 'cola', 'shake', 'smoothie', 'espresso' and 'ice'. These cue words, printed in capital letters, were replaced immediately by a backward masking string 'XXXXXXXXXX', presented for 400 ms. Based on previous research using analogous 'suboptimal' priming methodologies (e.g. Chartrand & Bargh 1996; for a review see Bargh & Chartrand 2000) and based on the results of our own pilot tests, we concluded that forward and backward masked cue words presented at such exceedingly brief durations would not be consciously identifiable. After each backward mask disappeared, par-

ticipants were presented randomly with a letter-string (e.g. 'hall' or 'nogzpz'). They were asked to press the 'Z' key if the stimulus was a word and the '/' key if it was not a word, and to respond as quickly as possible. Participants were not informed that masked words would be presented to them before each letter-string appeared on screen, but were only asked to 'get ready to respond' upon seeing the '+' sign preceding each trial (thereby ensuring their gaze was fixated in the direction of the masked cues to be presented immediately afterward).

Rating task. The ldt task took approximately 5 minutes. Immediately after completing the ldt phase, participants were told that they would be completing a survey regarding 'interpersonal impressions'. Here, they were randomly presented with a series of 21 color photographs (approximately 4 × 3 cm) of a variety of young women (high school seniors) with a diverse range of facial features and from a variety of racial groups. The photographs were taken from samples of 'senior portraits' posted by various professional photographers on their commercial websites. With a single exception (in which the legs of the woman were partially visible), all the photographs were head-and-shoulders shots in which the participants were casually dressed. In the attractiveness rating condition, participants were asked to indicate how attractive they found each woman on a nine-point scale anchored at 1 (not at all) and 9 (extremely). In the intelligence rating condition, participants were asked to indicate how intelligent each woman looked on the same scale. After completing this rating task, participants were thoroughly debriefed and released. No participants indicated any awareness of the content of the primes they had been exposed to earlier in the session, nor any suspicion that such priming had occurred.

Results and discussion

As an initial step in analyzing the data, we computed a series of 2 (cue) × 2 (rating dimension) ANOVAs on participants' SEDQ scores, lexical decision times (during the priming phase), self-reported drinking habits (amount of alcohol regularly consumed) and their ratings of the photographs (see Tables 1 and 2 for descriptive statistics).

Table 1 Descriptive statistics (overall): experiment 1.

Measure	M	SD
SEDQ	3.75	0.84
Attractiveness (<i>n</i> = 43)	4.44	1.10
Intelligence (<i>n</i> = 39)	5.68	0.74
Lexical decision time (ms)	945.64	390.47

Table 2 Descriptive statistics indexed by experimental condition: experiment 1.

Cue Measure	Ratings dimension							
	Attractiveness				Intelligence			
	Alcohol (n = 21)		Control (n = 22)		Alcohol (n = 21)		Control (n = 18)	
	M	SD	M	SD	M	SD	M	SD
SEDQ	3.52	0.97	3.85	0.62	3.81	0.70	3.83	1.04
Photograph rating	4.19	1.26	4.69	0.88	5.61	0.72	5.77	0.79
Lexical decision time (ms)	880.12	352.68	841.47	315.92	1149.80	523.73	911.19	249.10

These analyses revealed two significant effects. First, there was a main effect of rating dimension on lexical decision times, $F_{1,78} = 4.26$, $P < 0.05$. This result suggests that participants who, due to the vagaries of random assignment, would ultimately make intelligence ($M = 860.34$; $SD = 330.93$) as opposed to attractiveness ratings ($M = 1039.67$; $SD = 432.02$) in the second phase of the experiment were slower to make lexical judgements in the initial phase of the experiment. To test whether this difference influenced our findings, we entered lexical decision time as a covariate in subsequent analyses. Lexical decision time did not influence the reliability of predicted effects or moderate these effects (see below). Secondly, there was a main effect of rating dimension on responses to the photographs, with participants rating the women in the photographs as more intelligent ($M = 5.68$; $SD = 0.74$) than attractive ($M = 4.44$; $SD = 1.10$), $F_{1,78} = 36.27$, $P < 0.001$. At present, there is no reason to suspect that this unpredicted difference had any significant bearing on the effects to be reported below (although this possibility cannot be ruled out with the data at hand).

Proceeding to our primary analyses, we predicted a three-way interaction between cue (alcohol *versus* control), rating dimension (attractiveness *versus* intelligence) and alcohol expectancies on participants' ratings of women. This interaction should reflect that: (1) stronger expectancies regarding alcohol's aphrodisiac properties predict an increased tendency to rate women as attractive following suboptimal exposure to alcohol cues, relative to control cues; and (2) these variables have no individual or collective influence on ratings of how intelligent women look (as this rating dimension is irrelevant to the activated expectancy).

As an initial step, we first computed a 2 (cue) \times 2 (rating dimension) ANOVA, in order to determine whether there were any effects of the experimental manipulations, independent of alcohol expectancies. This analysis revealed only an unpredicted main effect of rating dimension, $F_{1,78} = 36.26$, $P < 0.0001$, suggesting that

men rated women as appearing more intelligent ($M = 5.68$) than attractive ($M = 4.44$). To test for the predicted three-way interaction, we then submitted ratings to a simultaneous multiple regression analysis, entering the experimental factors as well as alcohol expectancy scores as predictors. This analysis indeed revealed a significant three-way interaction, $B = 0.30$, $t(74) = 2.27$, $P < 0.03$.

To clarify the nature of this effect, we conducted separate simultaneous multiple regression analyses examining the interactions between cue [alcohol (-1) *versus* control (1)] and alcohol expectancies within each rating dimension group. In line with predictions, the analysis within the attractiveness condition revealed a reliable two-way interaction, $B = -0.50$, $t(39) = -2.27$, $P < 0.03$, suggesting that stronger self-reported expectancies that alcohol increases sexual desire predict an increased tendency to view women as attractive after suboptimal exposure to alcohol primes, relative to control primes. Critically, no such interaction, or any other reliable effects, emerged in the intelligence rating condition, $ts < 1$.

The nature of these effects may be additionally elucidated by separately examining the zero-order correlations between alcohol expectancy scores and photograph ratings within each of the four experimental cells. First, within the attractiveness/control cue group, this correlation (r) was -0.50 ($df = 20$), whereas within the attractiveness/alcohol cue group it was $+0.21$ ($df = 19$), reflecting that alcohol cues positively moderated the slope of the relationship between alcohol expectancies and attractiveness. The significant cue-alcohol expectancy interaction within the attractiveness condition alone indicates that this moderation was statistically reliable. Secondly, within the intelligence/control cue group, the correlation between alcohol expectancy scores and photograph ratings was 0.41 ($df = 16$), whereas within the intelligence/alcohol cue group it was 0.11 ($df = 19$). As indicated by the non-significant cue-alcohol expectancy interaction within the intelligence condition alone, this

modest negative moderation effect was not statistically reliable.

In sum, the results of experiment 1 suggest that the more men possess expectancies that alcohol will increase their sexual desire, the more that alcohol cues implicitly activate these expectancies, automatically bolstering the perceived attractiveness of unfamiliar women. However, these results leave unanswered questions concerning the specificity of this effect. Positive expectancy content domains, such as expectancies for increased sexual arousal or tension reduction, are intercorrelated (Goldman *et al.* 1997). Perhaps individuals with more positive alcohol expectancies of *any* type, sexual or otherwise, exhibit an increased tendency to view women as attractive when exposed to alcohol cues. Experiment 2 was designed to rule out this alternative explanation for these findings.

Experiment 2

Participants

Participants were 78 heterosexual males, between the ages of 18 and 26 years. All were undergraduates at the University of Missouri–Columbia who were enrolled in an introductory psychology course and who had completed a 200-item battery of diverse personality measures approximately 4–6 weeks earlier. This battery included the alcohol expectancy measures of interest (see below). Unlike in experiment 1, descriptive information regarding ethnicity was collected for this sample. The self-reported ethnic composition of the participants was as follows: African American/black (eight; 10.26%); Asian/Asian Pacific Islander (six; 7.69%); Caucasian (60; 76.92%); Latino/Hispanic (one; 1.28%); and other (three; 3.85%). In terms of drinking habits, six participants (7.7%) reported drinking alcohol almost daily; 37 (47.4%) reported drinking alcohol once or twice a week, six (7.7%) reported drinking about once a month, 10 (12.8%) reported drinking only three or four times a year, 13 (16.7%) reported drinking between one and four times in their lives and six (7.7%) reported never having consumed alcohol. Participants signed up for the experiment through a departmental website. All male undergraduates who had completed the premeasures were eligible to participate. Upon arrival at the laboratory, participants were run in groups of up to eight at visually isolated computer stations. They neither saw nor interacted with one another during the session. Participants were randomly assigned to condition by the computer. As in experiment 1, this served to keep experimenters blind to condition and enabled multiple conditions to be administered in a given session. Participants received course credit for participation.

Procedure

The procedure of experiment 2 was identical to that of the first experiment. However, in addition to completing the SEDQ in an initial survey battery, participants also completed the sociability, tension reduction, and liquid courage subscales of the Comprehensive Effects of Alcohol Questionnaire (CEOA, Fromme *et al.* 1993). These subscales assess the extent to which individuals possess (non-sexual) positive expectancies regarding alcohol (i.e. that it will make them sociable, peaceful, or courageous). The CEOA was used as its reliability and validity have been found to be comparable (Fromme & D'Amico 2000) to other expectancy measures [Alcohol Expectancy Questionnaire (AEQ); Brown *et al.* 1980; AEQ-A; Christiansen *et al.* 1982], with the advantage of requiring significantly shorter administration time.

Results and discussion

As an initial step in analyzing the data, we computed a series of 2 (cue) \times 2 (rating dimension) ANOVAs on participants' SEDQ scores, CEOA scores, lexical decision times (during the priming phase), self-reported drinking habits (amount of alcohol regularly consumed) and their ratings of the photographs (see Tables 3 and 4 for descriptive statistics). These analyses revealed a single significant effect: as in experiment 1, there was a main effect of rating dimension on responses to the photographs, with participants rating the women in the photographs as more intelligent ($M = 5.47$; $SD = 0.79$) than attractive ($M = 3.81$; $SD = 1.35$), $F_{1,74} = 32.18$, $P < 0.001$. Again, we have no reason to believe this unpredicted effect has any bearing on our primary findings.

Proceeding to these primary results, to test for the predicted three-way interaction, we again submitted ratings to a simultaneous multiple regression analysis, entering the experimental factors as well as alcohol expectancy scores as predictors. This analysis once again revealed a significant three-way interaction, $B = 1.40$, $t(69) = 2.54$, $P < 0.02$. To clarify this effect, we again conducted separate simultaneous multiple regression analyses examin-

Table 3 Descriptive statistics (overall): experiment 2.

Measure	<i>M</i>	<i>SD</i>
SEDQ	3.38	1.02
CEOA—sociability	3.18	0.70
CEOA—tension reduction	2.53	0.78
CEOA—liquid courage	2.63	0.81
Attractiveness ($n = 42$)	3.81	1.35
Intelligence ($n = 36$)	5.47	0.79
Lexical decision time (ms)	860.35	319.71

Table 4 Descriptive statistics indexed by experimental condition: experiment 2.

Cue Measure	Ratings dimension							
	Attractiveness				Intelligence			
	Alcohol (n = 21)		Control (n = 21)		Alcohol (n = 18)		Control (n = 18)	
	M	SD	M	SD	M	SD	M	SD
SEDQ	3.78	0.74	3.68	0.89	3.04	1.30	2.86	0.90
CEOA-S	3.25	0.76	3.34	0.56	3.06	0.69	3.04	0.79
CEOA-TR	2.53	0.85	2.59	0.87	2.42	0.72	2.60	0.69
CEOA-LC	2.76	0.82	2.84	0.69	2.38	0.79	2.44	0.89
Photograph rating	3.90	1.45	4.00	1.36	5.53	0.76	5.49	0.86
Lexical decision time (ms)	877.56	331.91	725.91	152.18	909.96	315.20	964.33	441.17

ing the interactions between cue [alcohol (-1) versus control (1)] and alcohol expectancies within each rating group. Consistent with experiment 1, the analysis within the attractiveness condition revealed a significant two-way interaction, $B = -1.17$, $t(38) = -2.38$, $P < 0.03$, suggesting that stronger self-reported expectancies that alcohol increases sexual desire predict an increased tendency to view women as attractive after suboptimal exposure to alcohol primes, relative to control primes. In addition, as before, no reliable effects emerged in the intelligence rating condition, $t_s < 1$.

To further elucidate the nature of these effects, we again separately computed zero-order correlations between alcohol expectancy scores and photograph ratings within each of the four experimental cells. First, within the attractiveness/control cue group, this correlation (r) was -0.60 ($df = 19$), whereas within the attractiveness/alcohol cue group it was $+0.14$ ($df = 19$), reflecting that alcohol cues positively moderated the slope of the relationship between alcohol expectancies and attractiveness. The significant cue-alcohol expectancy interaction within the attractiveness condition alone indicates that this moderation was statistically reliable. Secondly, within the intelligence/control cue group, the correlation between alcohol expectancy scores and photograph ratings was $+0.04$ ($df = 16$), whereas within the intelligence/alcohol cue group it was -0.32 ($df = 16$). As indicated by the non-significant cue-alcohol expectancy interaction within the intelligence condition alone, this moderation effect in the opposite direction was not statistically reliable.

In order to rule out the possibility that the aforementioned effects were not specific to expectancies regarding the aphrodisiac properties of alcohol, we recomputed all analyses separately substituting mean scores on the three CEOA subscales for scores on the SEDQ subscale. Critically, although each of these subscales was reliably (positively) correlated with expectancies regarding sexual

desire [sociability: $r(75) = 0.54$, $P < 0.0001$; tension reduction: $r(75) = 0.30$, $P < 0.01$; liquid courage: $r(75) = 0.31$, $P < 0.006$], none of these measures interacted significantly with the experimental factors in predicting ratings of the women on either dimension. As such, it appears that the effects of implicit alcohol cues on perceived attractiveness are moderated by the activation of alcohol expectancies specific to sexual desire, as opposed to sociability, tension reduction or courage.

GENERAL DISCUSSION

In two experiments, it was found that following suboptimal exposure to alcohol-related words, relative to control words, men with stronger self-reported expectancies that alcohol increases sexual desire rated women as more sexually attractive, but not more intelligent-looking. Evidence was also provided (experiment 2) that these interactive effects were driven specifically by sexual expectancies and not by other types of positive expectancies regarding alcohol consumption.

Broadly speaking, the results of the present study go beyond previous research in suggesting that exposure to rudimentary alcohol cues not only promotes alcohol consumption (e.g. Roehrich & Goldman 1995), but: (1) may also engender other distinct variants of expectancy-consistent behavior (here, judgements of sexual attractiveness); and (2) may do so even when the eliciting cues are processed without focal awareness. On a theoretical level, these findings complement strongly the pioneering work of Marlatt (e.g. Marlatt & Rohsenow 1980), Wilson (e.g. Wilson 1981) and others, who have demonstrated that mere expectancies regarding alcohol consumption, independent of the pharmacological properties of ethanol, may substantially influence social behavior (e.g. disinhibition). Moreover, these findings support the notion that alcohol expectancies may be modeled as mental repre-

sentations that serve as 'templates' for perception, subtly altering the on-line utility of behaviors associated with alcohol intake (Stacy 1997; Wiers *et al.* 1997; Goldman 2002; Wiers *et al.* 2002). Unlike previous research in this vein, the present findings also suggest that transiently activated alcohol expectancy representations may also serve as templates for *social* perception and behavior (cf. Higgins 1996), here, moderating the subjective sexual attractiveness of potential mates.

Limitations of the present research

What is the underlying mechanism?

While the present findings are consistent with predictions, they also leave a number of important issues unresolved. Perhaps foremost among these is that of the precise mechanism by which the expectancies triggered by alcohol cues heighten judgements of attractiveness. As alluded to above, we propose that the process is largely perceptual. Specifically, it may be that for individuals with strong expectancies that alcohol will increase sexual desire, semantic representations linked to the concept of 'sexual desire' may be activated in the presence of mere alcohol cues. Such representations may include constructs such as 'sexy', 'beautiful' or, more colloquially, 'hot'. According to well-established principles of knowledge activation and application (for a review, see Higgins 1996), when semantic constructs are rendered accessible to consciousness, they are more likely to be used in interpreting a perceptual stimulus. For instance, it has been demonstrated that when activation of the stereotype of African American (a social category that includes the construct of 'hostility') is contextually primed, individuals are more likely to perceive the ambiguously hostile actions of a target person as relatively aggressive (see, e.g. Devine 1989). Similarly, when the construct of 'persistent' is contextually activated, individuals are more likely to perceive the behavior of a target person as persistent rather than stubborn (Higgins *et al.* 1977). As such, in the present study, it is possible that for individuals with strong expectancies that alcohol increases sexual desire, alcohol cues activate attractiveness-related constructs, leading them to directly perceive the target women in the photographs as more attractive.

However, in addition to this 'perceptual template' model, other possible mechanisms may account, in whole or in part, for the present findings. For instance, a learning-based interpretation would posit that expectancies regarding alcohol's aphrodisiac properties are developed through frequent experience of sexual desire during alcohol consumption. Alcohol cues, which are paired repeatedly with alcohol consumption, may come to function as conditioned stimuli, independently eliciting

increased sexual desire in the absence of alcohol consumption. According to this learning approach, exposure to alcohol cues should increase attractiveness ratings in individuals with stronger desire-related alcohol expectancies by contextually bolstering their sexual motivation and thereby their receptivity to sexual stimuli (i.e. images of members of the opposite sex).

Regardless of whether the explanation for the present effects lies in 'cool' perceptual or 'hot' motivational processes, we would maintain that the activation of expectancies by alcohol cues are context dependent. More specifically, if exposure to alcohol cues indeed activates expectations regarding alcohol, it should activate all manner of alcohol expectancies (sociability, aggressiveness and motor impairment), not only sexuality expectancies. However, which of these activated expectancies influence subsequent behavior would depend on the nature of the task at hand. For instance, if the task involves eye-hand coordination, activated sexual expectancies may have little effect, whereas concurrently activated beliefs that alcohol engenders motor impairment may undermine physical coordination, even in the absence of alcohol ingestion.

The role of gender

Another limitation of this initial study is that it did not include female participants. The choice to include only male participants was based on precedent: prior studies examining alcohol expectancy effects on sexuality (George & Marlatt 1986; George *et al.* 2000) have also included only male participants. However, it is important to note that on a conceptual level, we have no a priori reason to expect that an analogous effect would not be obtained using a female sample. Of course, it is also possible that the sexual expectancies regarding alcohol may have a different influence on women's attractiveness ratings of men following exposure to alcohol cues. For example, women who believe alcohol will make them more sexually receptive may defend against their own heightened sexual inclinations by raising, as opposed to lowering, their subjective thresholds for male attractiveness in alcohol-related contexts. This could be driven by the salience of concerns of being stigmatized as promiscuous and/or fears of sexual aggression (cf. Mussweiler & Förster 2000).

The role of target attractiveness

Another issue is whether the normative attractiveness of the evaluated target influences the effect. Is the effect stronger for the more physically attractive targets or, conversely, for less physically attractive targets? Stimuli for this initial study were not pretested for attractiveness, but

instead selected to avoid images of extremely attractive and unattractive women to prevent ceiling and floor effects on experimental ratings. However, in an informal attempt to explore the effect of normative attractiveness, we did compute our omnibus regression tests of the predicted cue \times rating dimension–alcohol expectancy interaction separately for the 10 images rated highest and the 10 rated lowest in attractiveness. In both experiments 1 and 2, the predicted interaction (suggesting that alcohol cues bolster attractiveness but not intelligence ratings for men with stronger expectancies regarding alcohol's aphrodisiac properties) was statistically significant ($P_s < 0.05$) for the more attractive women and marginally significant for the less attractive women ($P_s < 0.08$). There were no significant four-way interactions between this *ad hoc* within-participants factor [i.e. attractiveness (high versus low)] and the remaining factors. Therefore, although the effect for ratings of less attractive women was non-significantly less reliable, our research hypothesis was essentially confirmed for both relatively attractive as well as unattractive females. None the less, the results of these *ex post facto* analyses are inconclusive as the mean ratings of attractiveness used to categorize the photographs were collected subsequent to, and potentially contaminated by, the experimental manipulation. Future research can explore this issue by use of pretested high and low attractive targets as stimuli.

The role of prime extremity

Another potentially important factor we did not vary in the present study is the extremity of the alcohol primes utilized. Specifically, in both our experiments, we used several primes that were associated with heavy alcohol consumption (e.g. 'whiskey', 'keg', 'pitcher'). Our findings may therefore apply to only to the activation of expectancies in heavy drinking situations. Some research has found that expectancies may differ by alcohol dose level (Southwick *et al.* 1981; Connors *et al.* 1987). As such, alcohol cues that are associated with lighter drinking situations (e.g. 'champagne', 'cocktail') may very well not activate the sex-related alcohol expectancies presently at issue. Examination of this notion will provide an interesting avenue for future research.

Additional implications

A pathway to risky sex?

Heavy alcohol consumption has been consistently associated with risky sexual behavior (for a review, see Cooper 2002). Although the links between alcohol use and sexual risk taking are complex, Cooper holds that their association can be interpreted within the context of alcohol

myopia (Steele & Josephs 1990). Alcohol myopia maintains that alcohol use constricts the scope of attention, bolstering focus upon highly salient cues and impairing the ability to consider more peripheral cues, such as distal negative consequences. In some situations, therefore, alcohol use may increase the strength of salient sexual cues and decrease the consideration of less salient negative consequences. Alcohol expectancy researchers have also hypothesized that expectancies that alcohol intensifies sexual pleasure may increase the subjective utility of having sex, 'crowding out' concerns with prospective risks (Lowenstein 1996; Fromme *et al.* 1999).

Most recently, Jones and colleagues (Jones *et al.* 2003) have suggested that alcohol intake may bolster the likelihood of engaging in risky sex by increasing the perceived facial attractiveness of potential mates. Their hypothesis represents an inductive inference from a finding by Agocha & Cooper (1999) that the probability of having risky sex is positively associated with the facial attractiveness of the prospective sexual partner. Interestingly, Jones *et al.* (2003) indeed found correlational evidence that individuals who had earlier ingested alcohol subsequently rated opposite-sex faces as more attractive, whereas there was no such proclivity on their parts to rate the faces as more distinctive or to rate wrist-watches as more attractive.

While Jones *et al.* (2003) did not advance a specific mechanism to explain their correlational findings, it is possible that their results are produced by a mechanism identical or akin to that described at present—specifically, exposure to alcohol (cues) may activate expectancies that alcohol increases sexual desire, automatically leading to the perception of opposite-sex faces as more attractive. Admittedly, this is speculative; however, inasmuch as alcohol effects on facial attractiveness indeed constitute a third route to risky sex, this possibility undoubtedly warrants additional empirical examination.

Extension to other (non-consumptive) behaviors

In recent years, the field of social psychology has been revolutionized by evidence suggesting that rudimentary situational primes can surreptitiously activate action representations, eliciting overt social behavior without conscious intention or awareness (for a review, see Bargh & Chartrand 1999). For instance, in a seminal study, Bargh *et al.* (1996; experiment 1) non-consciously exposed participants to words related to rudeness, politeness, or neither concept. Afterward, participants in the 'rudeness' prime condition were observed to interrupt an ongoing (staged) conversation significantly more often than those in the control condition, who were far more likely to interrupt the conversation than those in the 'politeness' prime group. In another well-known experiment, Carver *et al.* (1983) exposed covertly one group of participants to

hostility-related words. Later, in an ostensibly separate experiment, participants who received the hostility primes, relative to those in the control group, administered what they believed were longer electrical shocks to another supposed participant.

Given these, and numerous other findings demonstrating the automatic effects of conceptual priming on overt behavior (see Hassin *et al.* 2004), the intriguing possibility emerges that covert or unconscious activation of alcohol expectancy representations may elicit similarly powerful effects on a wide range of actions. For example, suboptimal priming of alcohol-related words may activate mental representations of 'sociability', leading individuals (or at least those in whom these representations are well-developed) to make more eye contact with, or to sit closer to, or to initiate conversation more readily with strangers. Similarly, and somewhat more provocatively, incidental exposure to alcohol advertisements on the freeway may trigger mental representations concerning 'clumsiness', increasing the likelihood that individuals will make (potentially fatal) errors in handling their vehicles. On the positive side, inasmuch as individuals commonly possess the expectancy that alcohol will make them more creative (e.g. Brown *et al.* 1985), it is also possible that subtle activation of alcohol expectancy representations regarding creativity may automatically facilitate the ability to generate innovative alternatives, without the need to ingest a single ounce of ethanol.

Again, these hypotheses are grossly conjectural; however, if recent research (including the present findings) offers any indication, the effects of alcohol expectancies on behavior are remarkably subtle and far-reaching, suggesting that a great many speculations regarding the impact of these mental representations may in fact prove veridical in the course of continued investigation.

References

- Agocha, V. B. & Cooper, M. L. (1999) Risk perceptions and safer-sex intentions: does a partner's physical attractiveness undermine the use of risk-relevant information? *Personality and Social Psychology Bulletin*, **25**, 746–759.
- Bargh, J. A. & Chartrand, T. L. (1999) The unbearable automaticity of being. *American Psychologist*, **54**, 462–479.
- Bargh, J. A. & Chartrand, T. L. (2000) The mind in the middle: a practical guide to priming and automaticity research. In: Reis, H. T. & Judd C. M., eds. *Handbook of Research Methods in Social and Personality Psychology*, pp. 253–285. New York: Cambridge University Press.
- Bargh, J. A., Chen, M. & Burrows, L. (1996) Automaticity of social behavior: direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology*, **71**, 230–244.
- Brown, S. A., Goldman, M. S. & Christiansen, B. A. (1985) Do alcohol expectancies mediate drinking patterns of adults? *Journal of Consulting and Clinical Psychology*, **53**, 512–519.
- Brown, S. A., Goldman, M. S., Inn, A. & Anderson, L. R. (1980) Expectancies of reinforcement from alcohol: their domain and relation to drinking patterns. *Journal of Consulting and Clinical Psychology*, **48**, 419–426.
- Carver, C. S., Ganellen, R. J., Froming, W. J. & Chambers, W. (1983) Modeling: an analysis in terms of category accessibility. *Journal of Experimental Social Psychology*, **19**, 403–421.
- Chartrand, T. L. & Bargh, J. A. (1996) Automatic activation of impression formation and memorization goals: nonconscious goal priming reproduces effects of explicit task instructions. *Journal of Personality and Social Psychology*, **71**, 464–478.
- Christiansen, B. A., Goldman, M. S. & Inn, A. (1982) Development of alcohol-related expectancies in adolescents: separating pharmacological from social-learning influences. *Journal of Consulting and Clinical Psychology*, **50**, 336–334.
- Connors, G. J., O'Farrell, T. J., Cutter, H. S. G. & Thompson, D. L. (1987) Dose-related effects of alcohol among male alcoholics, problem drinkers and non-problem drinkers. *Journal of Studies on Alcohol*, **48**, 461–466.
- Cooper, M. L. (2002) Alcohol use and risky sexual behavior among college students and youth: evaluating the evidence. *Journal of Studies on Alcohol Supplement*, **14**, 101–107.
- Devine, P. (1989) Stereotypes and prejudice: their automatic and controlled components. *Journal of Personality and Social Psychology*, **56**, 5–18.
- Fromme, K. & D'Amico, E. J. (2000) Measuring adolescent alcohol outcome expectancies. *Psychology of Addictive Behaviors*, **14**, 206–212.
- Fromme, K., D'Amico, E. J. & Katz, E. C. (1999) Intoxicated sexual risk taking: an expectancy or cognitive impairment explanation? *Journal of Studies on Alcohol*, **60**, 54–63.
- Fromme, K., Stroot, E. A. & Kaplan, D. (1993) Comprehensive effects of alcohol: development and psychometric assessment of a new expectancy questionnaire. *Psychological Assessment*, **5**, 19–26.
- George, W. H. & Marlatt, G. A. (1986) The effects of alcohol and anger on interest in violence, erotica, and deviance. *Journal of Abnormal Psychology*, **95**, 150–158.
- George, W. H., Stoner, S. A., Norris, J., Lopez, P. A. & Lehman, G. L. (2000) Alcohol expectancies and sexuality: a self-fulfilling prophecy analysis of dyadic perceptions and behavior. *Journal of Studies on Alcohol*, **61**, 168–176.
- Goldman, M. S. (2002) Risk for substance abuse: memory as a common etiological pathway. *Psychological Science*, **10**, 196–197.
- Goldman, M. S., Darkes, J. & Del Boca, F. K. (1999) *Expectancy Mediation of Biopsychosocial Risk for Alcohol Use and Alcoholism*. In: Irving Kirsch, E., ed. *How Expectancies Shape Experience*, pp. 233–262. Washington, DC: American Psychological Association.
- Goldman, M. S., Greenbaum, P. E. & Darkes, J. (1997) A confirmatory test of hierarchical expectancy structure and predictive power: discriminant validation of the Alcohol Expectancy Questionnaire. *Psychological Assessment*, **9**, 145–157.
- Hassin, R., Uleman, J. S. & Bargh, J. A. (2004) *The New Unconscious*. New York: Oxford University Press.
- Higgins, E. T. (1996) Knowledge activation: accessibility, applicability, and salience. In: Higgins, E. T. & Kruglanski, A. W., eds. *Social Psychology: Handbook of Basic Principles*, pp. 133–168. New York: Guilford Press.
- Higgins, E. T., Rholes, W. S. & Jones, C. R. (1977) Category accessibility and impression formation. *Journal of Experimental and Social Psychology*, **13**, 141–154.

- Jones, B. T., Corbin, W. & Fromme, K. (2001) Half full or half empty, the glass still does not satisfactorily quench the thirst for knowledge on alcohol expectancies as a mechanism of change. *Addiction*, **96**, 1672–1674.
- Jones, B. T., Jones, B. C., Thomas, A. P. & Piper, J. (2003) Alcohol consumption increases attractiveness ratings of opposite-sex faces: a possible third route to risky sex. *Addiction*, **98**, 1069–1075.
- Kramer, D. A. & Goldman, M. S. (2003) Using a modified Stroop task to implicitly discern the cognitive organization of alcohol expectancies. *Journal of Abnormal Psychology*, **112**, 171–175.
- Lowenstein, G. F. (1996) Out of control: visceral influences on behavior. *Organizational Behavior and Human Decision Processes*, **65**, 272–292.
- Marlatt, G. A. & Rohsenow, D. J. (1980) Cognitive processes in alcohol use: expectancy and the balanced placebo design. In: Mello, N. K., ed. *Advances in Substance Abuse: Behavioral and Biology Research*, pp. 159–199. Greenwich, CT: JAI Press.
- Murphy, S. T. & Zajonc, R. B. (1993) Affect, cognition, and awareness: affective priming with suboptimal and optimal stimulus. *Journal of Personality Social Psychology*, **64**, 723–739.
- Mussweiler, T. & Förster, J. (2000) The sex → aggression link: a perception–behavior dissociation. *Journal of Personality and Social Psychology*, **79**, 507–52.
- Roehrich, L. & Goldman, M. S. (1995) Implicit priming of alcohol expectancy memory processes and subsequent drinking behavior. *Experimental and Clinical Psychopharmacology*, **3**, 402–410.
- Skinner, J. B. (1992) Drinking to excuse threatening sexual arousal. Unpublished dissertation, State University of New York at Buffalo, Buffalo, NY.
- Southwick, L., Steele, C., Marlatt, A. & Lindell, M. (1981) Alcohol-related expectancies: defined by phase of intoxication and drinking experience. *Journal of Consulting and Clinical Psychology*, **49**, 713–721.
- Stacy, A. W. (1997) Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology*, **106**, 61–73.
- Stacy, A. W., Leigh, B. C. & Weingardt, K. R. (1994) Memory accessibility and association of alcohol use and its positive outcomes. *Journal of Experimental and Clinical Psychology*, **2**, 269–282.
- Steele, C. M. & Josephs, R. A. (1990) Alcohol myopia: its prized and dangerous effects. *American Psychologist*, **45**, 921–933.
- Stein, K. D., Goldman, M. S. & Del Boca, F. K. (2000) The influence of alcohol expectancy priming and mood manipulation on subsequent alcohol consumption. *Journal of Abnormal Psychology*, **109**, 106–115.
- Wiers, R. W., Hoogveen, K.-J., Sergeant, J. A. & Gunning, W. B. (1997) High- and low-dose alcohol-related expectancies and the differential associations with drinking in male and female adolescents and young adults. *Addiction*, **92**, 871–888.
- Wiers, R. W., van Woerden, N., Smulders, F. T. Y. & de Jong, P. J. (2002) Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology*, **111**, 648–658.
- Wilson, G. T. (1981) The effects of alcohol on human sexual behavior. *Advances in Substance Abuse*, **2**, 1–40.