

Effects of Alcohol Priming on Social Disinhibition

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Recent studies have suggested that exposure to rudimentary alcohol cues activates mental representations of alcohol expectancies in long-term memory, thereby promoting expectancy-consistent behavior changes. However, reliance in these previous studies on self-report measures raises the possibility that prior findings were an artifact of experimental demand. The present study was aimed at ruling out this alternative explanation by reinvestigating the effects of alcohol priming on nonconsumptive behavior using an implicit measure of social disinhibition. In three experiments, participants were exposed to either alcohol or control beverage images, then asked to type as quickly as possible the first word that came to mind in response to a series of provocative (e.g., *feces*) and neutral (e.g., *chair*) stimulus words. Participants' response times were surreptitiously measured. Results revealed that participants exposed to images of alcohol, relative to control beverages, were faster to generate free associations to provocative, but not neutral, words, suggesting enhanced social disinhibition. This effect was limited to conditions of heightened evaluation, ruling out alternative explanations based on knowledge activation or arousal. Participants reported no suspicions regarding the connection between the image viewing and free association tasks nor any awareness that their response times had been collected. Results suggest that the behavioral effects of alcohol priming do not result from demand characteristics and offer the first evidence that exposure to rudimentary alcohol-related stimuli may suffice to influence social disinhibition in a manner akin to that expected to result from actual or placebo alcohol consumption.

Keywords: alcohol, expectancies, priming, social disinhibition

It is a fundamental principle of social cognition that the beliefs, concepts, and expectancies constituting an individual's knowledge about the world are mentally represented in an associative memory network (Carlston & Smith, 1996). Memory representations coding for distinct units of knowledge are conceived of as varying over time in their activation potential or accessibility, reflecting their likelihood of entering conscious thought (Higgins, 1996). Stimuli associated with a particular mental representation may prime this representation, temporarily increasing its accessibility (Neely, 1991). For instance, exposure to the word *doctor* may prime the representation of *nurse* in long-term memory (LTM), making it more likely that this concept will come to mind. Moreover, distinct sources of priming are posited to additively influence accessibility. For example, the concept "nurse" will be rendered more accessible by exposure to the words *doctor* and *patient*, than by exposure to *doctor* alone. Critically, priming has been found to significantly influence perception. To illustrate, when the concept of "aggression"

is rendered more accessible via priming, it promotes a tendency to view an ambiguous behavior as hostile as opposed to merely assertive or playful (Bushman & Anderson, 2002). Through its impact on perception, primed knowledge subsequently exerts a powerful influence on overt action. For instance, when an ambiguously hostile behavior (e.g., a mild shove) is directed toward an individual in whom the concept of aggression has been primed, his or her enhanced tendency to perceive the action as hostile should facilitate an attempt to respond aggressively (e.g., Chen & Bargh, 1997).

Building on these findings, alcohol researchers have recently begun to conceptualize alcohol outcome expectancies as mental representations in LTM (Goldman, 2002; Stacy, 1997). Consistent with this approach, it has been demonstrated that alcohol expectancies, like other types of stored knowledge, may be primed by associated external cues. Specifically, research has suggested that alcohol expectancies may be activated via exposure to alcohol-related stimuli (e.g., words such as *beer*, *wine*; e.g., Kramer & Goldman, 2003) as well as by exposure to outcome-related stimuli (e.g., words such as *happy*, *horny*, and *talkative*; e.g., Roehrich & Goldman, 1995). Moreover, recent findings indicate that primed alcohol expectancies, like other accessible knowledge structures, may subsequently influence social perception. For instance, it was recently discovered that exposure to alcohol advertisements, relative to control ad-

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vertisements, led individuals to subsequently perceive the ambiguously aggressive behavior of another person as more hostile (Bartholow & Heinz, 2006). This suggests that due to links in memory between alcohol and its expected effects (which commonly include heightened aggression; Critchlow, 1986), alcohol-related images primed the mental representation of aggression, bolstering the likelihood that cognitive material associated with aggression would be activated and used to interpret the target person's behavior.

Complementing these findings, recent research has found that rudimentary alcohol cues can influence behavioral tendencies in an expectancy-consistent fashion. In one study (Friedman, McCarthy, Bartholow, & Hicks, 2007, Experiment 2), participants were exposed to either alcohol-related (e.g., *beer*) or control words (e.g., *juice*). Afterward, they were falsely led to believe that a research assistant's error would force them to redo an onerous task. They were then given the opportunity to aggress against the assistant by submitting an unfavorable performance evaluation to her supervisor. It was found that after exposure to alcohol cues, but not control cues, participants with stronger expectancies that alcohol promotes aggression, but not those with stronger alcohol expectancies in domains irrelevant to the experimental context (e.g., sociability), tendered relatively hostile evaluations. These results suggest that for individuals with stronger aggression-related alcohol expectancies, alcohol cues primed mental representations associated with aggression, prompting greater indignation at the experimenter's carelessness and thereby engendering a more hostile response.

Studies have shown analogous priming effects in other behavioral domains associated with the expected outcomes of alcohol consumption. For instance, Friedman et al. (2007, Experiment 1) presented male participants with either alcohol-related or control beverage-related words. Afterward, participants were led to believe that they would be observed interacting with a female undergraduate of undisclosed identity, a situation likely to produce apprehension. Prior to this anticipated meeting, participants were asked to indicate the extent to which they would prefer for their observed interaction with the unknown woman to occur under more versus less anxiety provoking circumstances (i.e., alone vs. in a group, face to face vs. over the Internet, and for a longer vs. shorter period of time). Analyses revealed an interactive effect on preference expression such that following exposure to alcohol cues (but not nonalcohol cues), participants with stronger expectancies that alcohol reduces tension were more willing to interact under relatively stressful circumstances. This effect was also content specific, it was obtained using alcohol expectancies regarding tension reduction but not with alternative expectancies (e.g., social assertiveness) that were less applicable within the experimental context. Similar results were obtained by Friedman, McCarthy, Förster, and Denzler (2005) who found that after near-subliminal exposure to alcohol cues, men with stronger expectancies that alcohol increases sexual desire rated a set of young women depicted in photographs as more attractive.

Together, these initial studies strongly suggest that exposure to rudimentary alcohol cues activates mental representations of alcohol expectancies in LTM, thereby promoting expectancy-consistent changes in nonconsumptive behavior. However, these studies also share an important limitation: They all relied on self-report measures, using fixed-format response scales to either assess the perceived aggressiveness or attractiveness of targets (Bartholow & Heinz, 2006; Friedman et al., 2005) or to gauge attitudes or intentions presumed to reflect feelings of hostility or relaxation (Friedman et al., 2007). This reliance on self-report measures raises the possibility that the findings at least partially resulted from demand characteristics, that is, from participants guessing the experimental hypothesis and responding in a manner that would help the researchers confirm their predictions (Crano, 1996).

On initial consideration, there are at least two reasons to call this alternative account into question. First, the debriefings administered following the previous studies revealed little or no ability on the part of participants to accurately discern the true purpose of the procedures. Second, a few of the studies at issue employed near-subliminal priming methodologies that made it difficult if not impossible to detect the content of the primes (i.e., that they were related to alcohol). However, given that participants often fail to accurately report their motives or suspicions in debriefings (Aronson, Ellsworth, Carlsmith, & Gonzales, 1990; cf. Nisbett & Wilson, 1977) and that participants are occasionally able to detect the identity of primes presented under near-subliminal conditions (Draine & Greenwald, 1998), it remains possible that demand characteristics did in some way contribute to these provocative findings.

To more conclusively rule out the possibility that the effects of alcohol priming on nonconsumptive behavior are driven by experimental demand, it was necessary to re-explore these effects using an implicit behavioral measure, which would avoid reactivity by eliminating self-report and concealing from participants the fact of measurement as well as the significance of the variables assessed. In social-cognitive research, the most commonly employed mode of implicit measurement involves the assessment of response time (RT) to presented stimuli (Fazio & Olson, 2003). RT is useful as an implicit measure for several reasons: First and foremost, it may be readily assessed covertly, without informing participants that their responses are being timed. Second, even if participants do become aware that their response times are being collected, it is more difficult for them to systematically alter these times than to modify their responses on fixed-format surveys. Finally, it may be difficult if not impossible to guess the underlying variable(s) that RT is meant to assess. For all of these reasons, RT measurement provides a convenient and effective means of mitigating demand characteristics (Abelson, 1995).

Based on these considerations, we sought to implement RT-based dependent measures to implicitly assess the effects of alcohol priming on nonconsumptive behavior. Naturally, this required observing a type of drinking-related behavior that entails variance in response latency. We propose that one such behavior is social disinhibition, which

may be defined as diminished concern with self-presentation, that is, with others' views of the self vis-à-vis one's intelligence, morality, status, or physical characteristics (Goffman, 1959). Individuals often choose their actions and words more carefully when in the presence of a high-status or unfamiliar observer and/or in evaluative situations in which they must guard against saying or doing something that would provoke feelings of embarrassment. It follows that social disinhibition may be revealed by a general tendency to respond more impulsively or with less hesitation under such circumstances. Restated, social disinhibition may be operationalized as diminished time to respond under circumstances in which the individual is confronted with evaluative pressure.

As alluded to above, the expectancy that alcohol promotes social disinhibition has been found to be extremely common among men and women from a diverse range of cultural backgrounds (see Critchlow, 1986). Consistent with this observation, balanced placebo design studies have revealed that the mere belief that one has consumed alcohol suffices to diminish self-presentational concerns (e.g., Abrams & Wilson, 1979; Lang, Searles, Lauerman, & Adesso, 1980; Wilson, Abrams, & Lipscomb, 1980). For instance, participants reported less embarrassment with watching erotic films in the laboratory after consuming what they falsely believed was a dose of alcohol (Abrams & Wilson, 1980; see Källmen & Gustafson, 1998, for a review). Building on these findings, it may be predicted that by priming alcohol expectancies regarding social disinhibition, rudimentary alcohol cues may independently foster disinhibited behavior. As discussed above, this enhanced disinhibition may be manifested in a speeding of responses, or at least an absence of response retardation, when individuals are placed under evaluative pressure.

We tested this hypothesis in three studies. Based on a procedure developed by Bartholow and Heinz (2006), exposure to alcohol cues was manipulated by having participants view images of either alcohol or of control beverages as part of an ostensibly unrelated task. To assess (dis)inhibition, all participants completed a computerized free-association task after viewing the images. Specifically, participants were sequentially presented with a series of words on the computer screen and instructed to type in the first word that came to their mind on seeing the stimulus word, as quickly as possible. A subset of these words was related to taboo topics of excretion and/or sex (e.g., feces, intercourse). It was assumed that responses to these provocative words would be slower (i.e., more inhibited) among participants who were more concerned with saying something embarrassing (e.g., inappropriately intimate, crass, or perverted) and/or faster among those who were relatively disinhibited. To heighten potential evaluative concerns, participants were seated in a room with an experimenter who they were told would be viewing their responses as they completed the task. To minimize the possibility of demand characteristics, participants were not informed that their responses were being timed.

Experiment 1

Experiment 1 provided an initial test of the hypothesis that individuals exposed to alcohol-related cues would subsequently display less social inhibition. Participants were first exposed to either alcohol or control images under the guise of a marketing study. Afterward, they completed a free-association task in which their response times to both provocative and neutral words were measured. We predicted that participants who were first exposed to alcohol cues would respond more quickly to the provocative words during the free-association task, an indication that they were more socially disinhibited than their counterparts in the control group.

Method

Participants. Participants were 69 (43 female, 26 alcohol, 17 control; 26 male, 10 alcohol, 16 control) college undergraduates. Participants were tested individually and received partial course credit for their participation. The self-reported racial composition of the sample was as follows: 65.2% White, 14.5% African American, 5.8% Asian American, and 10.1% other (4.3% failed to respond). With regard to drinking behavior, both frequency and quantity of alcohol consumption were assessed. In terms of drinking frequency, one participant (1.4%) reported drinking alcohol almost daily, 38 (55.1%) reported drinking once or twice a week, 19 (27.5%) reported drinking about once a month, four (5.8%) reported drinking only three to four times per year, two (2.9%) reported drinking between one and four times in their lives, and five (7.2%) reported never having consumed alcohol. In terms of drinking quantity, five participants (7.2%) reported drinking more than nine drinks per occasion, 29 (42.0%) reported drinking between four and eight drinks, 23 (33.3%) reported drinking between two and three drinks, seven (10.1%) reported drinking one drink or less, and five (7.2%) reported never drinking alcohol. A composite drinking index was computed, representing the product of drinking frequency and quantity. There were no reliable differences between experimental groups on any measure of drinking, all $ps > .51$. In this and both subsequent experiments, we also conducted follow-up analyses to determine whether gender or drinking behavior moderated the observed effects. In no instance did we find significant moderation by either variable.¹

¹ It is important to note that the gender composition of participants in the alcohol condition was 48% men, 52% women, whereas in the control condition it was 28% men, 72% women. This partial confounding of experimental condition and gender raises the possibility that the findings of Study 1 were artifactual. However, as will be discussed, the findings were replicated in Study 2, in which the gender composition was far more balanced (alcohol: 43% men; control: 33% men) and in Study 3 in which it was almost perfectly balanced (alcohol: 25% men; control: 23% men). Moreover, there were no statistically reliable main effects of gender on RTs to either provocative or neutral words in any of the three studies. This argues against the possibility that the reported effects of alcohol priming were an artifact of gender differences.

Procedure. On beginning the experiment, participants were greeted by a female experimenter and seated at a computer. After signing an informed consent sheet, they were told that they would be engaging in a variety of experimental tasks that were of interest to different researchers in the psychology department. The computer presented all further experimental instructions and randomly assigned participants to condition, serving to keep the experimenter blind to condition.

On beginning the experiment, participants first completed a practice version of the free-association task in which eight neutral words appeared one at a time on the computer screen. Participants were instructed to type, as quickly as possible, the first word that came to their mind after seeing each target word. This practice version of the task was provided to give participants an opportunity to familiarize themselves with the free-association task. Following this, participants were administered the experimental manipulation. Under the guise of a marketing experiment, participants viewed a series of 54 images depicting cameras, fruits, and beverages (presented for approximately 3 s each) and were instructed to focus on the color and quality of the images. It was assumed that by having participants view a range of products it would increase the plausibility of the cover story and reduce the likelihood that participants would suspect that the beverage-related stimuli in the marketing study were meant to influence their responses on the subsequent free-association task. Images were presented in the center of the computer screen and they ranged in size from approximately 2×2 in to 5×5 in. Depending on condition, the last 20 images that participants viewed depicted either alcoholic (e.g., beer, wine, whiskey) or control beverages (e.g., juice, soft drinks, water). Images depicted either the beverages in isolation or people consuming them. No text was included in the images except the text on product labels.

After viewing the images, participants completed a longer version of the free-association task that was designed to assess social disinhibition. In this task, participants were presented with 35 words, one by one, on the computer screen. They were instructed to type the first word that came to their mind in response to the prompt word as quickly as possible. There were two types of words presented during the task; 27 neutral words (e.g., *elephant*, *computer*, *weather*) and 8 provocative words (e.g., *feces*, *intercourse*, *thong*, *prostitute*, *vagina*, *rectum*, *penis*, and *ejaculate*). Words in each group did not reliably differ in their mean length, ($M_{\text{neutral}} = 6.59$; $M_{\text{provocative}} = 7.25$), $t(33) = -.938$, $p < .36$.² The words were presented randomly, with provocative words fixed to appear in positions 4, 7, 12, 16, 20, 23, 28, and 31, respectively. Again, we assumed that participants would likely experience social inhibition when typing the first word that came to their mind in response to the provocative words, especially with the added evaluative pressure present during the task (see below). As such, we operationalized disinhibition on the task as reduced latency to respond to the provocative words.

To heighten feelings of evaluation during the free-association task, participants were informed that their responses

on this task would be transmitted through the computer network and would be fully visible to the experimenter. The experimenter was seated in the same room as the participant and viewed a computer monitor while the participant completed the task. The experimenter did not actually monitor the participant's responses, but the appearance of monitoring was obtained by shielding the experimenter's computer screen from the view of participants. Following completion of this task, participants completed a demographic and drinking history questionnaire. Finally, they were probed to see if they made a connection between the beverage images and the free-association task. Specifically, using a "funneled" debriefing procedure (Aronson et al., 1990), participants were first asked if they had any comments or thoughts regarding the "two experiments" they just completed, followed by what they thought the researchers who designed the experiments were trying to measure, and finally whether they thought the two experiments were connected in any way, and if so, how.

Results and Discussion

Raw descriptive statistics regarding response times on the free-association task are reported in Table 1. Following the recommendations of Fazio (1990), prior to conducting our primary analyses, we sought to lessen the impact of any outlying responses by deleting any individual response time that exceeded three standard deviations of the individual's mean for that target category (i.e., provocative vs. neutral). This resulted in the deletion of fewer than 1.5% of the responses. Further, to reduce positive skew in this speeded RT data, all responses were log transformed prior to analysis.

To assess social disinhibition on the free-association task, we conducted an analysis of covariance (ANCOVA) on mean response time to the provocative words while controlling for mean response time to the neutral words. It is necessary to control for neutral response times to mitigate the influence of random error—there are substantial individual differences in response time, irrespective of target content (see Blanton, Jaccard, Gonzales, & Christie, 2006; McFarland & Crouch, 2002). In line with predictions, results indicated that participants who viewed alcohol images ($M_{\text{adj}} = 3.54$ log s) were quicker to respond to the provocative words than control participants ($M_{\text{adj}} = 3.60$ log s), $F(1, 66) = 7.07$, $p < .02$, $\eta^2 = .097$. Additional contrasts revealed that participants in the alcohol group were not

² As noted by an anonymous reviewer, normative word frequency has also been found to influence RT. Differences in raw frequency between provocative and neutral words were assessed by consulting norms developed by Lund and Burgess (1996; see also, Balota et al., 2007) based on a corpus of 131 million words. Unfortunately, one of our provocative stimuli (*feces*), and three of our neutral stimuli (*ice cream*, *recliner*, and *t-shirt*) were not included in this corpus. However, analysis of the remaining stimuli suggested that provocative words were less frequently used ($M = 2,963$), than were neutral words ($M = 33,814$), although this difference was not conventionally reliable, $t(28) = 1.46$, $p < .16$.

Table 1
*Experiment 1: Response Times (in Seconds) to
 Provocative and Neutral Words*

Word type	Alcohol		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Provocative	4.17	1.55	4.61	2.64
Neutral	3.62	1.02	3.28	1.09

Note. $n = 69$.

quicker than control group participants to respond to neutral words, $t(67) < 1.76$, *ns*. Postexperimental interviews revealed no awareness on the part of participants either regarding the connection between the alcohol images and the subsequent free-association task or regarding the fact that RT was being measured. Thus, Experiment 1 offered the first evidence that mere exposure to alcohol-related images, in the absence of either actual or placebo consumption, can independently engender social disinhibition. Moreover, it offered the strongest evidence to date that effects of alcohol priming on nonconsumptive behavior are not an artifact of experimental demand.

Experiment 2

Experiment 2 was conducted with the aim of conceptually replicating Experiment 1 in a manner that would even more forcefully argue against any mediating role of demand characteristics. Specifically, rather than passively viewing the images as in Experiment 1, in Experiment 2 participants were required to rate the images on a variety of dimensions. This was meant to further bolster the plausibility of the cover story and diminish the likelihood that participants would suspect that the stimuli they viewed were meant to influence their responses on the subsequent free-association task. In addition, to more convincingly demonstrate that the effect of alcohol priming on disinhibition results from the activation of alcohol-related concepts in memory, as opposed to concepts associated with social interaction, the images used in Experiment 2 were stripped of any depictions of people. It was again predicted that participants who were initially exposed to alcohol cues would subsequently respond more quickly to the provocative words during the free-association task.

Method

Participants. Forty-two (26 female, 12 alcohol, 14 control; 16 male, 9 alcohol, 7 control) undergraduates participated in return for partial course credit. All participants were run in individual testing sessions. The self-reported racial composition of the sample was as follows: 61.9% White, 14.3% African American, 9.5% Asian American, and 11.9% other (2.4% failed to respond). With regard to drinking frequency, three participants (7.1%) reported drinking alcohol almost daily, 24 (57.1%) reported drinking once or twice a week, seven (16.7%) reported drinking about once a month, three (7.1%) reported drinking only

three to four times per year, three (7.1%) reported drinking between one and four times in their lives, and two (4.8%) reported never having consumed alcohol. With respect to drinking quantity, five participants (9.5%) reported drinking more than nine drinks per drinking occurrence, 20 (47.6%) reported drinking between four and eight drinks, 12 (28.6%) reported drinking between two and three drinks, three (7.1%) reported drinking one drink or less, and three (7.1%) reported never drinking alcohol. There were no reliable differences between experimental groups on any measure of drinking, all $ps > .45$.

Procedure. The procedure of Experiment 2 was identical to that of Experiment 1 with the exception of the change in priming methodology alluded to above. To manipulate exposure to alcohol or control beverages, participants were told that they would rate a series of images of different consumer products used in advertising. To enhance the cover story, all participants first rated six different images of digital cameras on four dimensions (i.e., how colorful the image was, how “eye-catching,” how much they enjoyed viewing the image, and how much they liked the image) using a 7-point Likert scale based on a scale ranging from 1 (*very little*) to 7 (*very much*). Participants randomly assigned to the alcohol condition then rated six alcohol images (depicting beer cans, bottles, kegs, or hard liquor) on the same dimensions using the same scale whereas participants assigned to the control condition rated images of nonalcoholic beverages (depicting bottled water, juice, soft drinks, or sports drinks). The images contained no text except for that included on product labels. All images were again presented in the center of the screen, and they ranged in size from approximately 2×2 in to 5×5 in.

Results and Discussion

Descriptive statistics for response times during the free-association task are reported in Table 2. Outlying responses were handled in the same way as in Experiment 1, resulting in the deletion of less than 1.5% of the responses. All responses were again log transformed prior to analysis.

To assess social inhibition on the free-association task, we again conducted an ANCOVA on mean response time to the provocative words controlling for mean response time to the neutral words. Results replicated those of the previous study in that participants who viewed alcohol images ($M_{\text{adj}} = 3.52$ log s) were quicker to respond to the provocative words than control participants ($M_{\text{adj}} = 3.56$ log s), $F(1, 39) = 4.70$, $p < .04$, $\eta^2 = .108$. Participants in the

Table 2
*Experiment 2: Response Times (in Seconds) to
 Provocative and Neutral Words*

Word type	Alcohol		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Provocative	3.50	0.87	4.22	1.17
Neutral	3.22	0.82	3.36	0.72

Note. $n = 42$.

alcohol group were not quicker to respond to neutral words, $t(40) < 1$, *ns*. As in Experiment 1, participants who first viewed images of alcohol exhibited less inhibition on the free-association task. Likewise, postexperimental interviews revealed no suspicions regarding the connection between the manipulation and the dependent measures nor any suspicion that RT was being measured to assess disinhibition or otherwise.

Experiment 3

The foregoing experiments provide converging evidence that exposure to alcohol related cues subsequently engenders social disinhibition. Participants who were exposed to alcohol images selectively generated free associations to provocative words more rapidly than those exposed to control images, suggesting that they were less concerned with avoiding an embarrassing response.

However, despite their consistent findings, Experiments 1 and 2 also suffered from a number of limitations. First, many of the provocative words used in both experiments directly pertained to sex (e.g., *penis*, *vagina*, *intercourse*). Thus, it is possible that due to common associations between alcohol and sex (e.g., George, Cue, Lopez, Crowe, & Norris, 1995), particularly among participants in our undergraduate samples, images of alcohol rendered sex-related knowledge constructs more accessible in memory, and that this in turn speeded responses to the provocative words (i.e., an associative priming effect; Neely, 1991). Second, it is possible that participants who viewed the alcohol images experienced heightened physiological arousal in response to viewing the images. This arousal may have facilitated attention and/or motivation and thereby sped subsequent response times to the relatively salient provocative stimuli (Cacioppo, Berntson, & Crites, 1996; Matthews & Margetts, 1991). Finally, although steps were taken in the previous experiments to heighten the evaluative pressure experienced by participants, it is difficult to confirm that the effects elicited were indeed due to alcohol-primed participants experiencing less inhibition during the free-association task than control participants.

To remedy these shortfalls, we modified the design of the previous experiments by adding a condition in which participants were exposed to low, as opposed to high, evaluative pressure. Under conditions of low evaluative pressure, concerns with embarrassment should be minimized and, accordingly, there should be little or no motivation to inhibit responses. Naturally, without the motive to inhibit, there can be no tendency to disinhibit, to release one's self from inhibitory forces. Therefore, if alcohol-primed participants indeed respond more quickly to provocative words because they are relatively disinhibited, then they should not demonstrate this tendency under low evaluative pressure, when there is no inhibition from which to be released. However, if the observed pattern of results is due to one of the alternative mechanisms suggested, then viewing alcohol images should result in equally quick if not quicker responding to the provocative words under conditions of low pressure. Specifically, differential activation of sex-related

material in memory should take place to an equivalent extent under conditions of high and low evaluation. Furthermore, any arousal-based effects of alcohol-related images should, if anything, be more robust under conditions of low pressure, as these would permit greater variance in arousal level—high pressure conditions may create a relative ceiling on arousal. Therefore, in line with our hypothesized disinhibitory account, we predicted that we would replicate the findings of Experiments 1 and 2, but only under conditions of high evaluative pressure.

Method

Participants. Participants were 82 (58 female, 17 alcohol/evaluation, 16 control/evaluation, 15 alcohol/no evaluation, 10 control/no evaluation; 24 male, 4 alcohol/evaluation, 5 control/evaluation, 6 alcohol/no evaluation, 9 control/no evaluation) undergraduates. All participants were tested individually. The self-reported racial composition of the sample was as follows: 67.1% White, 11.0% African American, 7.3% Asian American, and 13.4% other (1.2% failed to respond). With regard to drinking frequency, five participants (6.1%) reported drinking alcohol almost daily, 38 (46.3%) reported drinking once or twice a week, 23 (28.0%) reported drinking about once a month, four (4.9%) reported drinking only three to four times per year, nine (11.6%) reported drinking between one and four times in their lives, and three (3.7%) reported never having consumed alcohol. With regard to drinking quantity, seven participants (8.5%) reported drinking more than nine drinks per drinking occurrence, 38 (46.3%) reported drinking between four and eight drinks, 21 (25.6%) reported drinking between two and three drinks, 12 (14.6%) reported drinking one drink or less, and four (4.9%) reported never drinking alcohol. There were no reliable differences between experimental groups on any measure of drinking, all $ps > .17$.

Procedure. The procedures and materials used in Experiment 3 were identical to those used in Experiment 2 with the exception that half of the participants completed the free-association task under conditions designed to eliminate any feelings of evaluative pressure. Participants in this no evaluation condition were instructed via computer that their responses on the task would be anonymous, and that they would be grouped with the responses of other participants so that they could never be traced back to them. In addition, the experimenter was not present in the room while these participants completed the experimental tasks. Participants in the evaluation condition completed the free-association task under the exact same conditions as the previous two experiments. The experimenter remained blind as to whether participants were exposed to images of alcohol or control beverages.

Results and Discussion

Raw descriptive statistics for response times during the free-association task are reported in Table 3. The data was reduced in the same way as in the previous experiments, resulting in the deletion of less than 1.5% of the responses. All responses were again log transformed prior to analysis.

Table 3
Experiment 3: Response Times (in Seconds) to Provocative and Neutral Words

Word type	Evaluation				No evaluation			
	Alcohol		Control		Alcohol		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Provocative	4.09	1.59	5.35	4.13	4.67	1.65	4.66	2.11
Neutral	3.24	0.72	3.43	1.36	3.71	0.82	3.99	1.08

Note. $n = 82$.

To assess social disinhibition on the free-association task, we conducted a 2 (alcohol vs. control) \times 2 (evaluation vs. no evaluation) ANCOVA on mean response time to the provocative words, controlling for mean response time to the neutral words. The analysis revealed two significant effects. First, there was a significant main effect for evaluation condition, $F(1, 77) = 5.64, p < .05$, such that participants who completed the experiment under conditions of heightened evaluative pressure were slower to respond to the provocative words (after controlling for neutral response times). This supports the assumption that responding to provocative words under evaluative conditions creates inhibitory pressure. This main effect was qualified by a significant interaction between prime content and evaluative condition, $F(1, 77) = 4.99, p < .03, \eta^2 = .061$.

To clarify the nature of this interaction, we conducted simple effects tests comparing responses of alcohol and control image participants within each evaluative condition. Within the evaluative condition, we essentially replicated our previous results, finding a marginally significant difference between alcohol and control participants, $F(1, 78) = 3.46, p < .068, \eta^2 = .041$. As in Experiments 1 and 2, participants who were initially primed with alcohol images ($M_{\text{adj}} = 3.59$ log s) were faster to respond to provocative words than were control participants ($M_{\text{adj}} = 3.65$ log s) on the subsequent free-association task, thereby indicating diminished inhibition. In the no evaluation condition, the alcohol ($M_{\text{adj}} = 3.59$ log s) and control ($M_{\text{adj}} = 3.55$ log s) groups did not reliably differ, $F(1, 78) = 1.37, p > .25, \eta^2 = .023$. There were no main effects or interactive effects of prime type on RTs to neutral words. These results bolster our hypothesis that a relative decrease in social inhibition following exposure to alcohol images is responsible for the facilitative effects of these images on RTs to provocative words. Again, had the effects been due to a confounding variable such as activation of sex-related memory constructs or sheer arousal, either no interaction or an interaction suggesting greater alcohol-cued facilitation in the no evaluation group should have been obtained. Finally, as in the two preceding studies, no participants suspected a connection between the image rating task and their responses on the free-association task nor reported any awareness that their response times were being collected. Again, although the responses offered during postexperimental interviews may fail to reveal awareness of deception, the fact that not a single participant (of the nearly 200 observed in our three studies) expressed any inkling of the true nature of

the procedure argues against the possibility that the effects were driven by experimental demand.

General Discussion

Recent studies have suggested that exposure to images or words related to alcohol may suffice to influence social perception and behavior in a manner consistent with the expected effects of alcohol consumption. The present studies build on these findings by extending them to an important, yet heretofore unexplored domain of alcohol-related behavior, social disinhibition. Moreover, by using an implicit measure of behavior based on reaction time, these studies offer the strongest evidence to date that the behavioral effects of alcohol priming do not result from demand characteristics. Rather, inasmuch as participants neither believed that they had consumed or would consume alcohol during the session, the findings at hand support the contention that exposure to alcohol cues activates stored memory representations of the expected effects of alcohol consumption and thereby engenders a tendency to act in accordance with the contents of these expectancies (Goldman, 1999; Stacy, 1997).

In terms of their practical implications, our results suggest that even in the absence of actual or expected alcohol consumption, exposure to alcohol-related contextual cues (e.g., the sight or smell of alcoholic beverages) may reduce the threshold for engaging in behaviors that would otherwise be inhibited. Presumably, such behaviors may include physical aggression (see Giancola, 2000), the use of social stereotypes (see Bartholow, Dickter, & Sestir, 2006), and sexual risk taking (see Cooper, 2006), all of which have been previously linked to alcohol use. The results at hand also point to the potential risks of incidental exposure to alcohol-related stimuli in contexts that (typically) neither do nor should involve drinking. For instance, they suggest that by implicitly undermining behavioral inhibition, billboard advertisements for alcoholic beverages may inadvertently promote moving violations (e.g., making an illegal U-turn to compensate for missing a highway exit) and aggressive driving (e.g., passing a slow moving motorist despite oncoming traffic). If predictions of this ilk are borne out empirically, it would unequivocally suggest that interventions aimed at mitigating the ill effects of drinking must extend beyond curbing alcohol consumption to altering, via expectancy challenge or otherwise, the content of underlying

ing cognitions regarding the effects of alcohol (e.g., see Lau-Barraco & Dunn, 2008; Wood, Capone, Laforge, Erickson, & Brand, 2007).

Although the results of these three experiments do offer strong converging evidence for our hypothesis, they nonetheless leave a number of important questions to be addressed in future research. First, our experiments do not address whether alcohol priming effects on disinhibition are moderated by individual differences in the strength of domain-relevant alcohol expectancies. In a number of previous studies examining the effects of alcohol priming on nonconsumptive behavior, the effects have been more pronounced for individuals with stronger expectancies regarding the behavior assessed. For instance, prior research has found that individuals with stronger expectancies that alcohol fosters aggression are more likely to perceive an ambiguously hostile action as aggressive (Bartholow & Heinz, 2006) as well more likely to express overt aggression toward a perceived offender (Friedman et al., 2007). Such findings are important inasmuch as they firmly bolster the notion that the effects of alcohol primes on nonconsumptive behavior result from differential activation of alcohol expectancies.

Given the value of directly demonstrating expectancy-based moderation, future research examining alcohol priming effects on social disinhibition should also include idiographic measures of expectancies regarding the (dis)inhibitory effects of alcohol. Unfortunately, although established measures of alcohol expectancies have included subscales designed to assess disinhibition expectancies, these have either conflated disinhibition with other expectancy domains (e.g., euphoria; Southwick, Steele, Marlatt, & Lindell, 1981; social assertiveness; Goldman, Greenbaum, & Darkes, 1997) or assessed disinhibition expectancies within limited behavioral domains (e.g., emotional expressiveness, sexual risk-taking; Leeman, Toll, & Volpicelli, 2007). As such, existing measures may be ill-suited to uniquely capture variance in expectancies regarding the influence of alcohol on concerns with social evaluation. Therefore, investigating the moderating influence of individual differences in social (dis)inhibition expectancies on the priming effects at issue may need to await the development of a suitably targeted alcohol expectancy inventory.

Assuming that the present effects were indeed driven by differential activation of social (dis)inhibition expectancies, the question also remains as to the exact mechanism by which alcohol expectancy activation promotes speeded responses to provocative stimuli. One possibility is that expectancy priming co-activates semantic content that in turn shapes perception of the task at hand in a manner that facilitates expectancy-consistent action. To illustrate, alcohol images may have activated semantic constructs in memory related to disinhibition (e.g., "carefree," "easygoing," "laid-back," "nonchalant," "relaxed"). The accessibility of these constructs may have biased individuals to construe the free-association task as more fun/less serious or to construe the evaluator as less threatening, thereby diminishing their hesitation in responding.

Another, nonmutually exclusive possibility is that exposure to alcohol images transiently alters the individual's self-concept, thereby promoting behavior consistent with this altered self-view. For instance, alcohol primes may have reminded individuals of times in which they behaved or felt more disinhibited. This may have led them to momentarily construe themselves as less concerned with the opinions of others and to thereby act in accordance with this self-construal (here, by responding with less hesitation to provocative words).

The viability of this proposal gains credence from a recent study by Hicks, Schlegel, Friedman, and McCarthy (2009). Hicks et al. exposed participants to either alcohol-related primes (i.e., pictures or words associated with alcohol) or neutral primes. After the priming task, participants completed an ostensibly unrelated self-concept survey that asked them to judge the extent to which they possessed sociability related (e.g., "outgoing") as well as nonsociability related (e.g., "clever") personality traits. In two studies, it was found that individuals who expected that alcohol would enhance sociability rated themselves as more extroverted overall after exposure to alcohol primes, but not after exposure to neutral primes. This suggests that alcohol primes may indeed at least momentarily alter the self-concept, such that individuals come to view themselves as generally possessing the characteristics that they associate with alcohol consumption (cf. Hull, 1981; Hull, Levenson, Young, & Sher, 1983). Inasmuch as individuals use their self-views to guide their actions (Kihlstrom & Cantor, 1984; Ruvolo & Markus, 1992), by modifying the self-concept in an expectancy-consistent fashion (e.g., biasing individuals to construe themselves as dispositionally less inhibited), alcohol primes may thereby promote expectancy-consistent nonconsumptive behavior (e.g., diminished hesitation to respond to provocative stimuli under conditions of social evaluation).

Critically, it is also entirely possible that the effects reported at present were not mediated by activation of explicit alcohol outcome expectancies, but rather, by priming of implicit expectancies or memory associations. According to Stacy (1997; see also, Smith & DeCoster, 2000; Strack & Deutsch, 2004), outcome expectancies reflect individual's conscious beliefs about the likely effects of alcohol use, whereas memory associations are not directly accessible to awareness and are typically revealed via implicit memory procedures (e.g., free association). Stacy and his colleagues convincingly argued that expectancies and associations are orthogonal—although individuals may possess both explicit expectancies and memory associations regarding the effects of alcohol use, it is also quite possible for them to possess one but not the other (see Wiers & Stacy, 2006). For instance, alcohol may come to serve as a discriminant stimulus signaling that social disinhibition will lead to reinforcement (e.g., positive attention and encouragement from peers). However, individuals may encode this reinforcement contingency into LTM without any conscious awareness that a predictive association has been formed (Bolles, 1972). In this case, they would possess a memory

association linking alcohol use to disinhibition, yet no conscious expectancy regarding disinhibition.

Conceptually speaking, mere activation of implicit memory associations may suffice to engender disinhibition following exposure to alcohol primes. For example, the presentation of alcohol images might activate a cognitive script coding for reduction in the threshold for emitting prepotent responses (e.g., initial associations to a verbal cue). Implementation of such a script may occur in the complete absence of awareness that it has been primed or that it has ever been encoded into LTM (Bargh, 1990). This suggests that future studies examining alcohol priming effects on disinhibition should include measures of both explicit as well as implicit alcohol-related cognition, to assess the unique and/or interactive, effects of these distinct types of memory constructs on nonconsumptive behavior.

In conclusion, additional research is needed to confirm the operation of a memory-based mechanism in generating the present, as well as kindred alcohol priming effects, and to specify the exact cognitive process(es) by which activation of alcohol-related memory representations shape overt action. Supplementary studies will also need to conceptually replicate the present findings using alternative operationalizations of (dis)inhibition as well as to investigate the role, if any, that these effects play among the multifarious social–cognitive factors that promote alcohol use and abuse. Given the growing evidence for the influence of mere exposure to alcohol cues on perception and behavior, it is becoming clear that these factors may be even more subtle, and thereby more insidious in their effects, than previously believed.

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