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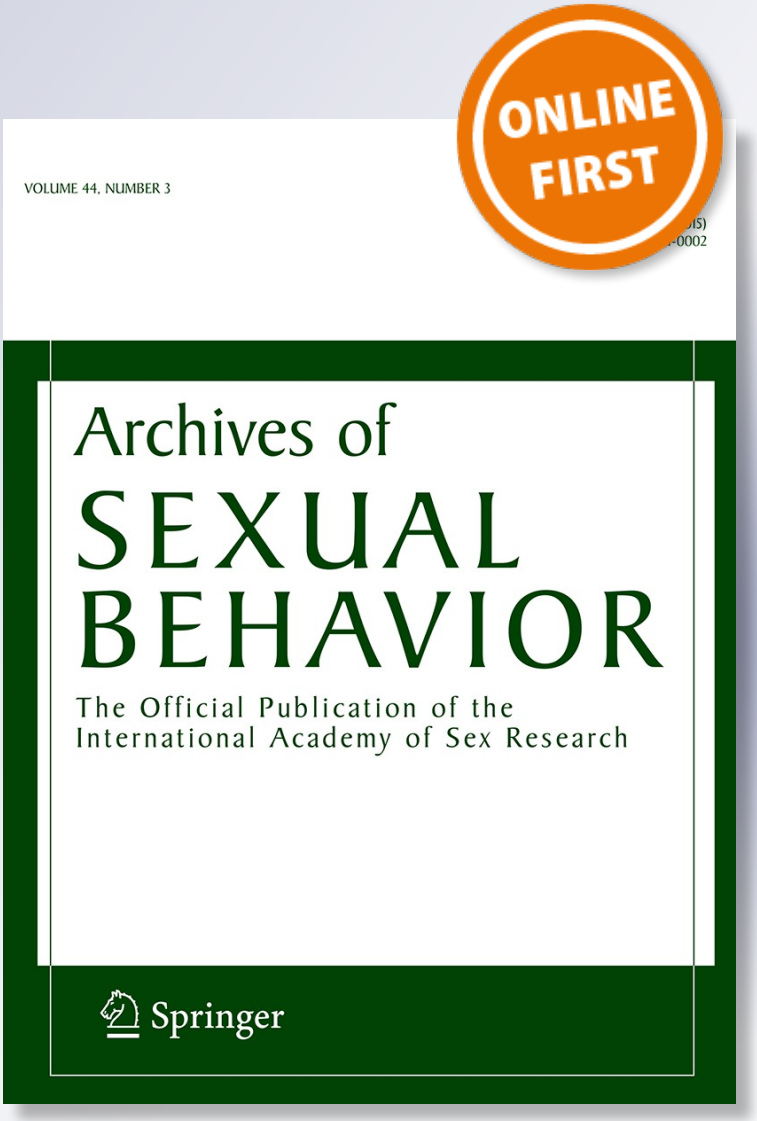

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ORIGINAL PAPER

Acute Effects of Intoxication and Arousal on Approach/Avoidance Biases Toward Sexual Risk Stimuli in Heterosexual Men

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Abstract This study tested the effects of alcohol intoxication and physiological arousal on cognitive biases toward erotic stimuli and condoms. Ninety-seven heterosexual men were randomized to 1 of 6 independent conditions in a 2 (high arousal or control) × 3 (alcohol target BAC = 0.08, placebo, or juice control) design and then completed a variant of the Approach–Avoidance Task (AAT). The AAT assessed reaction times toward approaching and avoiding erotic stimuli and condoms with a joystick. Consistent with hypotheses, the alcohol condition exhibited an approach bias toward erotic stimuli, whereas the control and placebo groups exhibited an approach bias toward condom stimuli. Similarly, the participants in the high arousal condition exhibited an approach bias toward erotic stimuli and the low arousal control condition exhibited an approach bias toward condoms. The results suggest that acute changes in intoxication and physiological arousal independently foster biased responding toward sexual stimuli and these biases are associated with sexual risk intentions.

Keywords Implicit associations · Alcohol administration · Risky sex

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Introduction

Heterosexual young adult men are at elevated risk for a number of negative outcomes stemming from their sexual behavior. For example, individuals aged 15–24 are estimated to account for 50 % of all new sexually transmitted disease infections (CDC, 2014). Indeed, men aged 20–24 have the highest rates of chlamydia and gonorrhea among men, and rates of HIV infection have increased in recent years in the 20–29-year-old age range (CDC, 2013, 2014). In addition to risk for sexually transmitted diseases, sexual risk behavior can lead to unintended pregnancies, and here, too, young adults are at elevated risk, with the highest rates of unintended pregnancies occurring in the 20–24-year-old range (Finer & Zolna, 2011). Finally, heterosexual young adult men are at risk of perpetrating sexual assault, given that 19 % of undergraduate women report being sexually assaulted while attending college (Krebs, Lindquist, Warner, Fisher, & Martin, 2009). Sexual behavior of young adult men promises immediate and apparent positive consequences, whereas negative consequences are often delayed (e.g., health problems that are not immediately apparent) and of lower probability (e.g., sexual stimulation is almost always pleasurable, STIs occur on a lower percentage of sexual encounters). Sexual decision-making involves integrating these competing influences on behavioral approach and avoidance. Much previous work has focused on evaluation of deliberate constructs (e.g., knowledge, skills, behavioral intentions (George et al., 2009; Maisto et al., 2004; Maisto, Palfai, Vanable, Heath, & Woolf-King, 2012). The current study shifts this focus to examine implicit factors that may contribute to behavior in the heat of the moment (Bargh & Morsella, 2008).

Implicit Cognition

Although definitions vary across disciplines, implicit cognition may be broadly defined as cognitive influences on behavior

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that occur spontaneously, without need for deliberation, introspection, or awareness (Stacy & Wiers, 2010). Research indicates that implicit cognitive factors account for unique variance (over and above explicit measures) in a variety of behaviors including substance use (Stacy & Wiers, 2010), eating behavior (Hofmann & Friese, 2008), and aggression (Wiers, Beckers, Houben, & Hofmann, 2009). In respect to sexual behavior, implicit approach biases toward erotic stimuli are associated with behavioral measures of viewing erotic stimuli as well as self-reported relationship status (Hofmann, Friese, & Gschwendner, 2009a). Implicit attitudes toward condom use are associated with both self-reported condom use as well as intentions in laboratory analog studies (Czopp, Monteith, Zimmerman, & Lynam, 2004). Czopp et al. found that implicit attitudes predicted intentions during relatively low-risk cue scenarios and explicit attitudes predicted intention in the high-risk scenarios. Their findings are consistent with the premise that the effect of implicit attitudes is dependent upon the degree of deliberate processing a situation demands. In addition, several studies have found that implicit cognition (i.e., spontaneous sex-related word associations to ambiguous cues) predicted less consistent condom use and/or more sexual partners (Ames, Grenard, & Stacy, 2013; Grenard, Ames, & Stacy, 2013; Stacy, Ames, Ullman, Zogg, & Leigh, 2006; Stacy, Newcomb, & Ames, 2000). Consistent with dual-process theories (Hofmann, Friese, & Strack, 2009c; Wiers et al., 2007), Ames et al. (2013) and Grenard et al. (2013) demonstrated that the association between implicit cognition and sexual behavior is attenuated among individuals with better executive cognitive functioning. Finally, Hepler, Albarracin, McCulloch, and Noguchi (2012) reported that individuals made more commission errors in response to sex than condom cues on a variant of the Go/No-Go task. This suggests that individuals had stronger approach biases toward the sexual relative to the condom stimuli.

We suggest that the relative balance of approach/avoidance biases toward sexual stimuli and condom stimuli may be an important factor contributing to the likelihood of having unprotected sex. Research indicates that individuals exhibit implicit biases toward approaching and avoiding stimuli (Hofmann et al., 2009a; Ostafin & Palfai, 2006), and that these biases are associated with evaluation of the stimuli (Chen & Bargh, 1999; Phaf, Mohr, Rotteveel, & Wicherts, 2014) and influence behavior (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). Importantly, implicit approach and avoidance biases and their relation with behavior vary as a function of both state factors and individual difference characteristics.

State Factors

The association between implicit approach biases (and other forms of implicit cognition) and behavior has been shown to be moderated by individual differences in working memory capacity and executive control (Ames et al., 2013; Grenard et al., 2013; Hofmann, Friese, & Roefs, 2009b; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Peeters et al., 2012), as well as intoxication (Hofmann & Friese, 2008) decreasing, or increasing the strength of the association, respectively. The observed moderating effects of working memory, executive control, and intoxication are consistent with dual-process models, which posit that there is a fast acting, reflexive, associative network that acts relatively automatically, and a slower, more deliberative network that uses more effortful control (Hofmann et al., 2009c; Lieberman, 2007; Wiers et al., 2007). The relative balance of these two systems at a given time results in behavior that is either "impulsive" or "controlled." Hence, when executive control is low, either due to individual difference factors or due to acute effects of intoxication, implicit factors exhibit a stronger effect on behavior.

Alternatively, state factors may alter the relative salience of stimuli. The alcohol myopia model posits that alcohol constricts attention and efficiency of cognitive processing such that behavior is more guided by immediate salient stimuli (Steele & Josephs, 1990). Interestingly, among heavier drinkers, mere exposure to alcohol cues results in a narrowing of attentional scope associated with approach motivation (Hicks, Friedman, Gable, & Davis, 2012). Similarly, the attention myopia model suggests that factors such as physiological arousal alter cognitive processing and cause behavior to be more strongly influenced by immediate salient cues (Ward et al., 2008). Research by Ward et al. indicates that physiological arousal acts to narrow attentional scope, resulting in behavior that is highly cue dependent.

Finally, alcohol and physiological arousal may increase the strength of automatic approach processes. For example, the increased physiological arousal due to emotional stimuli, exercise, or intoxication during the ascending limb of the BAC curve may enhance functioning in the automatic, reflexive, and control system (Lieberman, 2007). Low-dose alcohol primes increase automatic attentional and approach biases toward alcohol cues (Farris & Ostafin, 2008; Schoenmakers, Wiers, & Field, 2008). Alcohol's effect on reward pathways may act as a prime facilitating approach toward other salient rewards (Phaf et al., 2014), such as sexual stimuli, as well. Hence, several lines of evidence suggest that intoxication and physiological arousal may enhance reflexive non-conscious response patterns, increase approach motivation toward rewarding stimuli, and impair deliberative control over behavior. The net result of this is that sexual behavior when intoxicated or aroused is more influenced by immediate salient factors such as the attractiveness of the partner or sexual arousal than by knowledge related to consequences of unprotected or unwanted sex. Indeed, alcohol use has been implicated as a risk factor for engaging in unprotected sex (Maisto et al., 2004, 2012), increased number of sexual partners (Dogan, Stockdale, Widaman, & Conger, 2010), and tied to increased risk of sexual assault for both perpetrators and victims

(Abbey, 2011; Krebs et al., 2009). In addition, both sexual and general physiological arousal are associated with increased sexual risk behavior (Ariely & Loewenstein, 2006; George et al., 2009; Meston & Frohlich, 2003). In the current study, we tested whether alcohol intoxication or physiological arousal affects implicit approach biases toward sexual stimuli and condoms.

In summary, the current literature indicates that approach biases are associated with increased risk behavior, including sexual behavior (Hofmann et al., 2009a; Ostafin & Palfai, 2006; Wiers et al., 2013). The literature also indicates that intoxication and arousal may increase sexual risk behavior, in part, by decreasing attention to inhibitory cues (Maisto et al., 2012; Steele & Josephs, 1990; Ward et al., 2008) or by priming implicit approach biases toward reward (Farris & Ostafin, 2008; Phaf et al., 2014; Schoenmakers et al., 2008). Finally, research suggests that intoxication may increase associations between implicit biases and behavior (Hofmann & Friese, 2008). Taken together, these data suggest that the effects of acute alcohol intoxication and arousal on sexual risk behavior may be due in part to their increasing approach biases toward sexual stimuli, but this hypothesis has not been tested. Therefore, the purpose of this study was to test this hypothesis by use of an alcohol administration experimental design. Specifically, we hypothesized that alcohol intoxication and arousal would result in biases toward sexual risk stimuli characterized by (1) faster approach versus avoidance responses to erotic stimuli, (2) slower approach versus avoidance responses to condom stimuli, and (3) faster approach toward erotic stimuli relative to condom stimuli. Finally, we hypothesized that (4) intentions to have unprotected sex will be correlated with the implicit biases. That is, men whose responses are characterized by stronger approach biases toward the sexual stimuli coupled with avoidance biases of the condom stimuli will have higher intentions for risky sex.

Method

Participants

Participants were 97 heterosexual men aged 21–32 ($M = 22.27$, $SD = 1.74$). Ninety percent were white, 3 % black, 2 % Asian, and 5 % multiracial. Three percent were Hispanic. Participant inclusion criteria included being over 21, being a moderate to heavy drinker, heterosexual orientation, being sexually active in the past year but not currently in an exclusive relationship, and not having any conditions for which drinking alcohol would be contraindicated. This sample is a portion of individuals who participated in a larger study of sexual risk taking. Wray, Simons, and Maisto (2014) present additional detail on the sample. Only men were included due to limited resources available for the study.

Measures

Approach–Avoidance Task (AAT)

The AAT is designed to measure speed of approach and avoidance movements to erotic and condom stimuli. The erotic stimuli were screen captures of a man and woman engaged in oral sex and intercourse derived from the sexual prime video. The condom stimuli included pictures of condoms in and out of packaging. The task utilizes the method described in Hofmann et al. (2009a) but introduces a condom comparison group. This task is based on research indicating that arm flexion and extension are related to implicit positive evaluation/approach and negative evaluation/avoidance, respectively (Chen & Bargh, 1999; Phaf et al., 2014). Participants completed 40 trials in which they pulled a joystick toward them when an erotic picture appeared on a computer monitor and pushed a joystick away from them when a picture of a condom appeared. They were instructed to imagine they were pulling the object toward them when pulling the joystick and pushing the object away from them when pushing the joystick. To facilitate this effect, images on the screen zoomed in or out depending on the response. A 500 ms fixation cross appeared before each stimulus, and there was a 1,000 ms intertrial interval. Participants then completed a second block of 40 trials in which the instructions were reversed (pull condoms toward you, push erotic pictures away). Block order was counterbalanced, and order of stimuli was randomized. Reaction time during each trial was the dependent variable. All stimuli were presented on a 15-inch CRT monitor, and the task was programmed in MATLAB using the COGENT toolbox to provide accurate estimates of reaction time.

Explicit Measures

Participants viewed a sexual risk scenario video developed by Maisto et al. (2004). In the video, a man and a woman coworker meet at a party. After the party, they are deciding whether they should use a condom during their impending first sexual encounter. The woman encourages the man not to use a condom because she is on birth control, implying that risk is minimal. Participants rated their subjective level of sexual arousal and the likelihood that they would have unprotected vaginal sex with the woman in the scenario on 9-point anchored rating scales (not at all aroused/extremely aroused; not at all likely/extremely likely). We used ratings of sexual arousal and intentions from this final sexual risk scenario prior to completing the AAT as measures of explicit sexual risk outcome.

Manipulation Check

Participants estimated the number of alcoholic drinks they had received on an open-ended question and rated their level

of intoxication on a 10-point anchored rating scale (1 = not at all, 10 = more intoxicated than you have ever been).

Descriptive Measures

The Quantity–Frequency–Variability index (Cahalan, Cisin, & Crossley, 1969) assessed typical drinking behavior in the past 3 months. The Sexual Behavior Survey was used to assess recent sexual behavior (e.g., number of sexual partners, frequency of vaginal and anal intercourse, etc.) and condom use (Carey et al., 1997; Gordon, Carey, & Carey, 1997).

Procedure

Participants were randomized to condition in a three [juice control, placebo, alcohol (BAC = 0.08 %)] × 2 (control, high physiological arousal) design. A placebo condition was used to control for potential expectancy effects on the association between alcohol and sexual behavior (Fromme, D'Amico, & Katz, 1999). Beverages were mixed in front of the participants, and alcoholic beverages consisted of 80-proof vodka mixed with chilled orange juice in a 1:4 ratio. The target BAC was determined by the formula of Curtin (2000), which accounts for differences in participants' weight and height. For the placebo participants, flat tonic water was substituted for the vodka (poured from a vodka bottle) and a "floater" of vodka was placed on the top from a lime juice container. All participants drank 2–3 drinks (depending on volume) in the course of a 15-min consumption period. After consuming beverages and a 5-min absorption period, participants in the high physiological arousal condition pedaled on a recumbent bike, and heart rate was monitored until reaching a sustained 150 beats/min. Participants in the low arousal group were allowed to browse magazines during this time (which did not contain information or images about alcohol or sexual risk behavior).[1] The experimenter adjusted resistance levels and encouraged alterations in participant effort on the recumbent bicycle to reduce variability in the time it took for participants to reach the target heart rate. Following the experimental manipulations, participants completed a delay discounting task (part of the parent study's measures). After this task, participants in the physiological arousal condition pedaled on the bike a second time to reach a sustained 150 beats/min. Participants in the physiological arousal control group browsed magazines for a comparable period. All participants then viewed a sexual arousal prime (a brief erotic film clip) and sexual risk scenarios to assess risk intentions. Approximately 40 min after the beverage administration (i.e., at the end of ascending limb of alcohol absorption) and 15 min after the arousal manipulation, participants completed the implicit sexual approach–avoidance tendencies task. The timeline is thus (1) beverage administration (and 5-min absorption period), (2) physiological arousal manipulation, (3) delay discounting task (not relevant to this study), (4) second physiological arousal manipulation (booster session), (5) view sexual arousal prime, (6) view and rate sexual risk scenarios, and (7) complete the implicit sexual approach–avoidance tendencies task. See Wray et al. (2014) for further detail on study procedures. All procedures were approved by the university IRB.

[1] Individuals in the control condition spent the same amount of time (on average) engaged in activities requiring no physical exertion.

Results

Data Cleaning and Descriptive Information

Prior to the analysis we removed incorrect (i.e., an approach response on an avoidance trial or vice versa) responses (3.60 % of responses) and responses that were faster than 300 ms (2.94 %) or slower than 1,500 ms (0.8 %; cf. Hofmann et al., 2009a; Palfai & Ostafin, 2003). Percent of omitted data did not vary as a function of condition (p's ≥ .866 in two-sample tests of proportions). Extremely fast responses increase the chance that the response is anticipatory or premature and the slow responses may indicate the participant was either distracted or attended to the stimuli rather than responding immediately as instructed. Three participants (2 in the placebo/lo arousal condition and 1 in the beverage control/high arousal condition) responded correctly <75 % (range 37.5–62.6 %) of the time and were omitted from the analysis. Four participants were excluded from the analyses due to multivariate outliers (2 in the alcohol/high arousal condition, 1 in the beverage control/low arousal condition, 1 in the placebo/low arousal condition). The 90 participants in the data analyses consisted of 41 participants in the high arousal condition (15 in beverage control, 13 in placebo beverage, and 13 in alcohol condition) and 49 in the low arousal condition (16 in beverage control, 16 in placebo beverage, and 17 in alcohol condition). Hence, in total, there were 30 participants in the intoxication condition, 29 in the alcohol placebo condition, and 31 in the beverage control condition. Eighty-nine percent of participants were classified as heavy drinkers on the Quantity–Frequency–Variability index (Cahalan et al., 1969). In the past 3 months, participants reported an average of 1.38 (SD = 1.50) sexual partners, 7.66 (SD = 11.61) occasions of vaginal intercourse, and using a condom on 67.65 % of times they had vaginal intercourse. Peak BAC in the alcohol condition was $M = 0.067$ %, SD = 0.01 %; range 0.051–0.097 %. Mean BAC in the alcohol condition prior to initiating the implicit task was $M = 0.062$ %, SD = 0.01 %; range 0.037–0.097 %. Pairwise contrasts following one-way ANOVAs indicated that those in the placebo group estimated that they had consumed more alcoholic drinks, $F(1, 87) = 45.60$, $p < .0001$, and were more intoxicated, $F(1, 87) = 14.49$, $p = .0003$, than the beverage control group. Similarly, those in the alcohol condition estimated that they had consumed more alcoholic drinks, $F(1, 87) = 7.12$,

$p = .0091$ and were more intoxicated, $F(1, 87) = 44.24, p < .0001$, than the placebo group. Hence, the placebo manipulation was successful though individuals did not perceive themselves as intoxicated as those actually receiving alcohol. One participant in the placebo group reported 0 drinks on the manipulation check. Removing the individual from analysis did not affect results and hence they were retained. There were no differences in peak BAC in the alcohol condition, as a function of physiological arousal condition, $t(28) = 1.42$. Participants were moderately aroused following viewing the sexual prime ($M = 4.47$, SD = 1.80).

Regression Model

We tested a random effect regression model in Stata 13 (StataCorp, 2013) with reaction time as the criterion and indicators of type of stimuli (sexual vs. condoms), response (approach vs. avoid), experimental condition, and block (first or second to control for task order, counterbalanced) as predictors (see Table 1). This data analytic approach allows participants to have a random intercept, hence controlling for random variation in reaction times that are due to unmeasured individual differences. Due to the kurtosis of the reaction time variable, responses were log transformed. We tested stimuli × (response, beverage condition, physiological arousal condition), response × (beverage condition, physiological arousal condition), and stimuli × response × (beverage condition, physiological arousal condition) interactions. We omitted alcohol × physiological arousal condition interactions due to the small cell sizes. The regression model indicated significant stimuli × response × beverage condition, $\chi^2(2) = 15.18, p = .001$, and stimuli × response × physiological arousal, $\chi^2(1) = 27.17$, $p < .001$, interactions. These interactions are depicted in Figs. 1 and 2, respectively. In support of hypothesis 1, estimation of the average marginal effects indicated that the alcohol ($b = -0.04, p = .001$) and high arousal ($b = -0.03$, $p = .004$) conditions were associated with faster approach versus avoidance of sexual stimuli. In respect to hypothesis 2, the alcohol and high physiological arousal conditions showed no response bias toward the condom stimuli (p's > .412). However, the low physiological arousal ($b = -0.07$, $p < .001$), placebo ($b = -0.05, p < .001$), and control beverage ($b = -0.04, p = .001$) conditions exhibited the opposite pattern, an approach bias toward condom stimuli. Thus, relative to the control group, the alcohol and high physiological arousal conditions show stronger avoidance of condoms (consistent with hypothesis 2). However, this is manifested in the absence of the approach bias seen in the control groups rather than a significant avoidance bias of condoms. In support of hypothesis 3, individuals in the alcohol condition ($b = -0.05$, $p < .001$) and high physiological arousal condition ($b = -0.05, p < .001$) were significantly faster to approach sexual stimuli relative to condoms. In contrast, participants in the control beverage ($b = -0.00, p = .774$) and placebo conditions ($b = 0.02$, $p = .153$) did not differ in speed of approach to sexual relative to condom stimuli. Finally, those in the physiological arousal control condition were faster to approach condoms versus sexual stimuli ($b = 0.02, p = .015$).

Table 1 Random effects regression model predicting reaction time

	B	SE *b*	*P*
Block	0.06	0.01	<.001
Erotic stimuli	−0.04	0.01	.005
Response	−0.08	0.01	<.001
Stimuli × response	0.07	0.02	<.001
Placebo condition	0.10	0.04	.007
Alcohol condition	0.05	0.04	.177
Stimuli × placebo	−0.03	0.02	.096
Stimuli × alcohol	0.00	0.02	.808
Response × placebo	−0.01	0.02	.724
Response × alcohol	0.03	0.02	.096
Stimuli × response × placebo	0.05	0.03	.046
Stimuli × response × alcohol	−0.05	0.03	.051
Arousal condition	0.03	0.03	.407
Stimuli × arousal	0.04	0.01	.010
Response × arousal	0.07	0.01	<.001
Stimuli × response × arousal	−0.11	0.02	<.001

Number of observations = 6,739, Number of subjects = 90. $\chi^2(16) = 224.03$, $p < .0001$. Placebo and alcohol conditions are dummy coded. Dummy coded contrasts were used in the analyses for the placebo ($n = 29$) and alcohol ($n = 30$) conditions (1) versus the control ($n = 31$) group (0). A score of 0 on both indicates the comparison beverage control group. Response is coded 1 = approach, 0 = avoid

Correlations with Explicit Measures

We calculated a *D* score[2] following the procedures of Greenwald, Nosek, and Banaji (2003). Mean RT during the approach sexual stimuli/avoid condom stimuli block was subtracted from the avoid sexual stimuli/approach condom stimuli block and this score was divided by the subject SD. Positive scores indicate a bias toward approaching sexual stimuli and avoiding condom stimuli relative to the converse. Due to the substantial effects of the counterbalanced order (i.e., block, see Table 1), we calculated semi-partial correlations to control for this. Results indicated a significant association between the *D* score and the final ratings of intention to have unprotected sex ($r = .21$, $p = .047$) but not sexual arousal ($r = .12, p = .281$). In support of hypothesis 4, this indicates that implicit biases among men conducive to unprotected sex (i.e., biases characterized by faster responses when approaching the sexual stimuli and avoiding the condom stimuli)

[2] The *D* score is similar to the well-known Cohen's *d* measure of effect size in that it is taking a mean difference and dividing by a standard deviation. However, *D* is calculated by dividing by the subject SD across all trials rather than using the pooled within-condition SD (Greenwald et al., 2003).

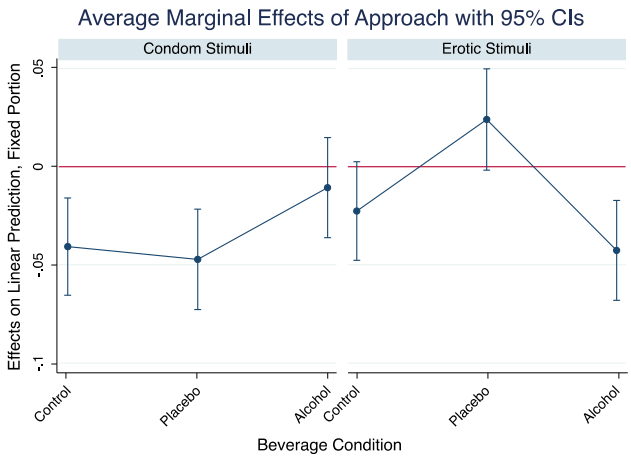

Fig. 1 Marginal effects of approach versus avoidance as a function of stimuli and beverage condition. Negative values indicate an approach bias (i.e., faster to respond on approach relative to avoidance trials)

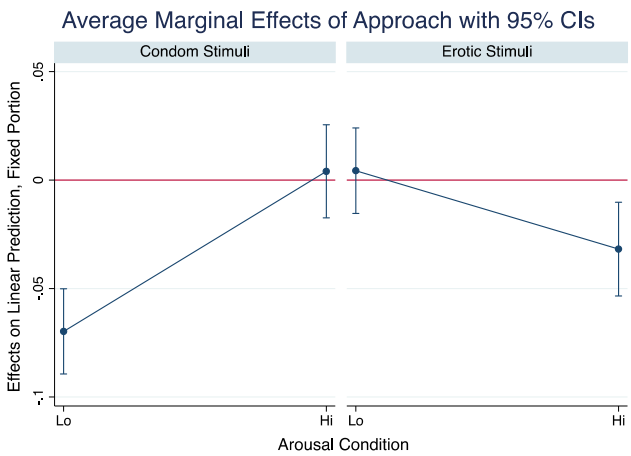

Fig. 2 Marginal effects of approach versus avoidance as a function of stimuli and arousal condition. Negative values indicate an approach bias (i.e., faster to respond on approach relative to avoidance trials)

are correlated with their explicit intentions to have unprotected sex. This provides evidence of construct validity of the task due to the convergence of implicit and explicit responses. However, this implicit bias was not significantly associated with reported sexual arousal, suggesting that the effect is specific to unprotected sex intentions rather than heightened sexual arousal.

Discussion

Alcohol and high physiological arousal in heterosexual men were independently associated with a significantly faster approach toward sexual stimuli relative to condoms and a response pattern characterized by an approach bias toward sexual but not condom stimuli. In contrast, the low arousal, beverage control, and alcohol placebo conditions exhibited the opposite pattern; avoidance responses were faster for sexual relative to condom stimuli and they evinced an approach bias to condom stimuli. These results are consistent with the hypothesis that the relationship between alcohol and physiological arousal on sexual risk in men is due, in part, to their effects on implicit associations toward sexual risk and protective stimuli. We suggest that this pattern places heterosexual men at greater risk for engaging in risky sexual behavior when intoxicated and aroused.

What These Data Show

The significant correlation between explicit assessments of sexual risk intention and the implicit measure of cognitive bias support the validity of the sexual risk AAT task and adds to previous research showing significant associations between implicit cognition and sexual risk behavior (Ames et al., 2013; Czopp et al., 2004; Grenard et al., 2013; Stacy et al., 2000). The pattern of responses is consistent with elevated sexual risk behavior when intoxicated or sexually aroused observed in previous research (George et al., 2009; Maisto et al., 2004, 2012). When confronted with two stimuli, erotic sexual material and condoms, men who are physiologically aroused or intoxicated exhibit an implicit bias toward approaching the sexual stimuli. In addition, given sexual stimuli, men who are intoxicated or aroused exhibit an approach bias (relative to avoidance). Hence, when the choice is sexual stimuli versus condoms, they exhibit an appetitive bias toward the sex cues. Similarly, when confronted with sexual stimuli, and the choice is to approach versus avoid, intoxication and arousal independently predict a bias toward approach behavior. Conversely, as seen in Figs. 1 and 2, the pattern of responses for the high physiological arousal and alcohol conditions toward condoms represents a shift (relative to control groups) from an approach bias toward one of increasing avoidance. This pattern of responses is consistent with an automatic tendency toward engaging in sexual risk behavior. The response pattern is one in which the strength of approach toward sexual stimuli is increasing while the strength of approach toward condoms is diminishing as either intoxication or arousal increases. The intoxicated or aroused man's body and mind are primed toward risky sex, an inclination that necessitates executive control to inhibit (Hofmann et al., 2009c). From the perspective of dual-process models (Friese & Hofmann, 2009; Hofmann et al., 2009b, 2009c), individual differences in executive control may then contribute to observed differences across persons in the likelihood of sexual risk behavior when intoxicated or aroused. The experimental effects of the beverage and physiological arousal conditions indicate that this risk propensity is triggered by acute effects of intoxication and physiological arousal, as the control groups did not exhibit this pattern of risky response biases. In fact, the comparison groups exhibited biases conducive toward protected sex. The risk promoting response pattern observed in the alcohol group

but not placebo group suggests the observed effects are not due to expectancies.

What These Data Do Not Show

Although the response pattern discussed above is clear, the mechanisms underlying it are less so. The data do not seem to indicate that intoxication or physiological arousal is associated with an overall deficit in inhibiting a prepotent response nor "simply" activating an appetitive approach system (cf. Gladwin, Figner, Crone, & Wiers, 2011; Weafer & Fillmore, 2008). In this regard, the beverage and physiological arousal control groups exhibited an approach bias toward condoms but not sexual stimuli and this was reversed in the alcohol and high physiological arousal conditions. Hence the approach biases are highly dependent upon the stimuli, and it is difficult to discern what pattern of prepotent responses and impaired inhibition would give rise to these data. Alternatively, approach tendencies, alcohol, arousal, and sexual stimuli could be linked via an associative network (Del Boca, Darkes, Goldman, & Smith, 2002). Spreading activation could then account for the facilitation of linked stimuli and behavioral patterns. Associative network models suggest that concepts that are linked via similarity or experience are more likely to be co-activated (Del Boca et al., 2002; Goldman & Darkes, 2004; Simons, Dvorak, & Lau-Barraco, 2009). These models suggest that spreading activation in memory networks contribute to expectancy effects and shape alcohol-related behavior. This cannot be ruled out for arousal. However, the lack of a placebo effect for the beverage condition suggests that if this was the case, then it was more than activating the "idea" of drinking, but rather activating the internal state of intoxication.

Limitations

Several limitations should be noted. First, the data are consistent with but do not provide direct evidence that alcohol's and physiological arousal's relation to sexual risk is mediated by their effects on implicit associations about risky sex. Participants completed this pilot project following completion of all procedures for the parent study. The limited sample size, the effect of block order, and completion of the AAT following the explicit sexual risk measures made a formal test of mediation impractical. Second, the sample size is relatively small, restricted to heterosexual men, and we were unable to estimate an interaction between beverage condition and arousal due to the small cell sizes. Third, the AAT program utilized response blocks, and individuals needed to switch set halfway through the task. This approach is used extensively with the IAT and previous versions of the AAT (Greenwald et al., 2003; Hofmann et al., 2009a) but may not be optimal for use with experimental designs regarding acute intoxication. There was a substantial effect of block, with individuals slower to respond during the second block regardless of which stimuli were paired to approach versus avoid. Given the possible impairing effects of intoxication on executive function requiring set shifting (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000), this complicates data analysis. We utilized a random effects model, in part to allow for random variation in reaction time across persons. Versions of the AAT that utilize non-relevant stimulus features rather than blocks to determine response may be optimal (Wiers, Rinck, Kordts, Houben, & Strack, 2010). Fourth, the delay between the physiological arousal manipulation and completing the AAT calls into question whether the individuals were still physiologically aroused at that time. Hence, it is unclear whether the effect of the physiological arousal condition is due to direct effects of physiological arousal or indirect effects via reactions to the subsequent sexual prime and risk scenarios. Finally, future research is needed to evaluate associations between implicit approach–avoidance biases and actual sexual risk behavior.

Summary

Alcohol intoxication and physiological arousal were associated with implicit response biases toward sexual stimuli and condoms. Recent theory regarding the influence of unconscious processes on behavior suggest that "action precedes reflection" (Bargh & Morsella, 2008, p. 73). This statement rings true for the sexual risk behavior of intoxicated and aroused men in the heat of the moment. Further research is needed to determine if similar effects are observed among women or among men who have sex with men. Almost by definition, sexual risk behavior is not a rational behavior engaged in following careful analysis of pros and cons. Having the requisite knowledge, skills, and motivation to avoid risky sex may be insufficient at the time when a sexual situation occurs. In conjunction with previous research on implicit cognition and sexual behavior (e.g., Ames et al., 2013; Grenard et al., 2013; Hofmann et al., 2009a), the results suggest that implicit cognitive processes may be a fruitful intervention target to reduce sexual risk behavior.

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