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The Effects of Acute Ethanol Consumption on Sexual Response and Sexual Risk-Taking Intent

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Abstract Two theories of sexual risk taking (disinhibition and alcohol myopia) were tested using genital measures of sexual response and computer measures of sexual risk propensity. A total of 44 men and women completed two sessions comparing responses to erotic films while consuming alcohol (breath alcohol doses were .025 g/kg and .08 g/kg) or juice alone. After consuming alcohol, more sexual arousal was reported in response to neutral films and at a breath alcohol level of .08 g/kg as compared to no alcohol. Genital responses for men and women increased during sexual films, but men did not respond as strongly when breath alcohol level was .08 g/kg. Intentions to have intercourse with a new partner at baseline predicted the level of sexual arousal reported. As self-reported sexual arousal increased in response to sexual films and higher alcohol dose, the intent to engage in intercourse with a new partner increased. Alcohol dose was *not* related to later sexual intercourse intentions. With no direct relationship of alcohol and intercourse intentions, results appear more consistent with a disinhibition model of sexual arousal.

Keywords Alcohol myopia · Acute alcohol intoxication · Sexual arousal · Sexual risk taking · Risk propensity

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Introduction

Alcohol is viewed by many as a broad disinhibitor with pharmacological properties that release "true" sexual desires (Testa & Dermen, 1999). Data largely seem to support this view, as global association (e.g., correlational) studies (for review, see Leigh, 1990) and laboratory studies (for review, see George & Stoner, 2000) document that increased alcohol consumption is related to increased sexual risk taking. No gold standard exists for assessing sexual risk in global association studies, although the strengths and limitations of available methods have been reviewed at length (e.g., Catania et al., 2005). However, the relationship between alcohol and sexual risk taking is documented inconsistently when event-level and laboratory methods are used (Shuper et al., 2010). Event-level analysis has failed to find a relationship between alcohol and condom use (e.g., Schroder, Johnson, & Wiebe, 2009; Taylor, Fulop, & Green, 1999), while others have found that alcohol consumption leads to *decreased* impulsivity (Ortner, MacDonald, & Olmstead, 2003). One theoretical explanation for this paradoxical effect is alcohol myopia (Steele & Josephs, 1990). The alcohol myopia model posits that people differ in the cues they consider when making sexual risk decisions before drinking alcohol, alcohol decreases processing capacity, and decreased processing capacity leads the intoxicated person to consider only cues that were most salient to them before they started drinking. A third model is that sexual arousal mediates the relationship between alcohol and sexual risk taking (George et al., 2008). In the current study, sexual arousal was monitored during acute alcohol consumption to test whether alcohol directly, or through its interaction with sexual arousal, exerted effects on sexual intercourse intentions.

Alcohol affects both psychological and genital sexual arousal. Generally, alcohol is expected to enhance sexual experiences (Brown, Christensen, & Goldman, 1987) and expecting

alcohol to enhance sexual experience predicts increased alcohol consumption (Carey, 1995). In one study, 20% of women reported using alcohol exclusively for its anticipated sexual benefits (Taylor et al., 1999), whereas 13.5% of 1,902 men and women indicated that they had vaginal intercourse with a recent acquaintance specifically after drinking more than normal to make having sex easier (Anderson & Mathieu, 1998). Alcohol has also been used to reduce anticipated sexual problems (Klassen & Wilsnack, 1986; Malatesta, Pollock, Wilbanks, & Adams, 1979) and to enhance sexual sensations (Brown, Goldman, Inn, & Anderson, 1980). In laboratory studies, both men and women report increased sexual arousal in response to alcohol, at least at lower blood alcohol levels (Briddell & Wilson, 1976; Malatesta, Pollock, Crotty, & Peacock, 1982; Malatesta et al., 1979; Wilson & Lawson, 1978).

Genital responses to alcohol are much more variable. At lower breath alcohol levels (.025 BrAC), erection is enhanced in men (Farkas & Rosen, 1976), characterized by decreased erection latency (Wilson & Niaura, 1984) and difficulty inhibiting erection (Rubin & Henson, 1976). At higher levels of breath alcohol, men exhibit decreased rigidity and increased latency to maximum erection (Abrams & Wilson, 1983; Briddell & Wilson, 1976), as women exhibit declines in vaginal vasocongestion (Wilson & Lawson, 1976, 1978) or no change (Schacht et al., 2007). Nocturnal penile tumescence appears unaffected even by high blood alcohol level (Morlet et al., 1990). In general, reported sexual arousal tends to increase with intoxication, whereas genital response and control of that response is more variable (Crowe & George, 1989).

Sparse empirical evidence suggests that sexual arousal increases sexual risk behaviors. Potential mechanisms have been poorly specified as sexual arousal resulting in "impaired capacity to process information" (Canin, Dolcini, & Adler, 1999, p. 353). In qualitative studies, participants described sexual arousal as contributing to feeling a loss of control and impulsivity that leads to sexual risks (Gold & Skinner, 1997; Strong, Bancroft, Carnes, Davis, & Kennedy, 2005). In an adolescent sample, 24% of the variation in condom use was predicted by the level of sexual arousal reported (Boldero, Moore, & Rosenthal, 1992). More recently, Ariely and Loewenstein (2006) demonstrated experimentally that intentions to engage in sexual risk behaviors increased when sexually aroused.

The few studies examining the relationship among all three variables (alcohol consumption, sexual arousal, and sexual risk taking intent) provide evidence that sexual arousal mediates the presumed direct relationship between alcohol consumption and sexual risk taking. Three laboratory studies provide strong, causal evidence that sexual arousal mediates the relationship, although exceptions exist (e.g., Harvey & Beckman, 1986). In one study, participants reported their sexual arousal and intent to engage in sex without a condom following the presentation of a vignette about an interaction with a potential partner (Abbey, Saenz, & Buck, 2005). Reported sexual arousal significantly predicted sexual risk intent. In another study, participants viewed a similar videotaped vignette with a mix of impelling and inhibiting cues under conditions of alcohol, placebo or no alcohol (MacDonald, MacDonald, Zanna, & Fong, 2000b) and rated their sexual arousal and intent to engage in intercourse. Participants who experienced higher sexual arousal reported greater intent to engage in intercourse during the alcohol condition as compared to the placebo and no alcohol conditions. George et al. (2009) employed genital measures of sexual arousal in addition to self-report measures. George et al. also manipulated sexual arousal intentionally using sexual film stimuli. They found that self-reported sexual arousal mediated the relationship of alcohol consumption and likelihood of unprotected sex for both men and women.

Two prominent cognitive models offering explanations of the role of sexual arousal in the relationship between sexual risk taking and alcohol consumption were compared in this study: disinhibition and alcohol myopia. Disinhibition theory explains alcohol as decreasing inhibition cross-modally (Fillmore & Vogel-Sprott, 1999), possibly by selectively decreasing the salience of inhibitory cues (Finn, Justus, Mazas, & Steinmetz, 1999; Vogel-Sprott, Easdon, Fillmore, Finn, & Justus, 2001). This disinhibition is thought to lead to an increase in risky sexual behaviors under the influence of alcohol (MacDonald, Fong, Zanna, & Martineau, 2000a; Wilson & Niaura, 1984). For instance, men with high sex guilt viewed erotic slides longer if they believed that they had consumed alcohol (Lang, Searles, Lauerman, & Adesso, 1980). The more strongly a person believed that alcohol was a simple disinhibitor, the more viewing time of violent-erotic pictures increased while intoxicated (George & Marlatt, 1986; Wilson & Lawson, 1976). A failure to neurally differentiate inhibition failures has been cited as evidence favoring a disinhibition model (Bartholow et al., 2003).

Data showing decreases or no change in sexual risk taking during alcohol consumption (e.g., Leigh, 1993) have led to the proposal of an alcohol myopia theory. Alcohol myopia refers to a decrease in cognitive processing capacity that limits deliberations to only the cues that were most salient before drinking started (Steele & Josephs, 1990). Alcohol clearly limits the breadth and depth of cognitive processing (Fromme, Katz, & D'Amico, 1997a; Herzog, 1999), further demonstrated by decreased activity in brain regions of executive control that are normally active during decision making (Curtin & Fairchild, 2003). Alcohol myopia explains decreases in sexual risk behaviors as limiting resources to salient inhibitory cues in those for whom inhibitory cues were most prominent at baseline.

Alcohol myopia differs from disinhibition theory in two ways that make these theories clearly distinguishable experimentally (MacDonald et al., 2000a, 2000b). First, alcohol myopia suggests that sexual risk increases *only* when impelling cues are most salient at baseline. Secondly, alcohol myopia suggests that a person whose baseline cognitive set includes high-salience

inhibitory cues would decrease sexual risk taking under the influence of alcohol. For example, expectations of alcohol's effects could be conceptualized as impelling or inhibiting cues of varying salience (Morris & Albery, 2001). Alcohol also appears to potentiate riskier sexual decisions in those with lesser verbal intelligence (Abbey, Saenz, Buck, Parkhill, & Hayman, 2006, for refutation, see Saults, Cowan, Sher, & Moreno, 2007). The crucial test is in those for whom inhibiting cues are most salient at baseline. Disinhibition theory is supported if alcohol consumption increases risk taking in this group; alcohol myopia is supported if alcohol consumption decreases risk taking in this group.

The current laboratory study had two primary goals. First, the effects of alcohol on sexual arousal (genital and self-reported) were studied. After drinking alcohol, women were expected to report more sexual arousal, but less genital sexual arousal. Men were predicted to exhibit enhanced sexual response (genital and self-reported) with low alcohol levels, but diminished sexual response (genital and self-reported) with higher alcohol levels.

Second, competing predictions of disinhibition and alcohol myopia to explain the relationship among alcohol, sexual risk taking, and sexual arousal were tested. Both alcohol and sexual arousal will influence intercourse intentions in each model; a key distinction is whether intercourse intentions at baseline (before alcohol consumption or sexual arousal) mediate the impact of alcohol and sexual arousal. Disinhibition models propose that sexual risk taking increases under the influence higher "doses" of alcohol or sexual arousal. Disinhibition would be supported if alcohol dose and sexual arousal positively predict intercourse intentions. Alcohol myopia theory suggests that intentions to engage in sexual risks will decrease under the influence of alcohol in those who were risk averse before they started drinking, but increase otherwise. Alcohol myopia would be supported if the effect of alcohol dose on risk intentions was mediated by baseline risk tendencies. Baseline risk tendencies were assessed by examining intentions to engage in intercourse at the start of the study.

Method

Participants

Participants were recruited through newspaper ads and flyers requesting volunteers for a study of alcohol and sexual response who were not experiencing problems becoming sexually aroused. Over the phone, volunteers were informed that the study would require consuming alcohol, viewing erotic videos, and recordinggenital sexual arousal. Volunteers were informed that heterosexual or bisexual volunteers were sought. Participants were screened to be over age 21 years, not taking medications contraindicating alcohol consumption, and to score <10 on the Michigan Alcohol Screening Test (Seltzer, Vinokur, & Rooijen, 1975). Additionally, women could not be pregnant. Women's sessions were scheduled within the week following menses to estimate follicular (pre-ovulatory) phase to control for possible effects of menstrual cycle (Lindman, Koskelainen, & Ericksson, 1999).

Forty-four volunteers ($N = 21$ men) between the ages of 21 and 54 years ($M = 24$, $SD = 5.8$) participated. Most participants were students ($N = 36$, 81.8%), European-American ($N = 36$, 81.8%), and more likely to regard religion as "Not important" ($N = 14$, 31.8%) than "Very important" ($N = 4$, 9.1%). Participants had "any sexual contact" with a median of 15 sexual partners in their lifetime and three (6.8%) reported never having masturbated. Three participants were excluded from further analyses due to becoming ill during alcohol consumption ($N = 1$), experimenter error ($N = 1$), and excessive movement artifacts ($N = 1$). Participants were compensated $5 per hour for the first session, $6 per hour for the second session, and a $10 bonus for completing both sessions.

Measures and Procedure

Each participant was shown six, 3-min sexual film excerpts over two sessions (see Procedure). Every sexual film depicted a consensual, erotic, heterosexual encounter, edited to contain equal parts of kissing/foreplay, oral sex being performed on the man and then the woman, and penile-vaginal intercourse. Low base rate content unlikely to appeal broadly (e.g., anal sex, Woodard et al., 2008) was excluded. Films were randomized using random number generators for establishing order such that any sexual film appeared only once per participant, but had an equal chance of appearing in any of the six occurrences. The six films were selected separately for men and women according to their report of maximal sexual arousal in a previous study (Janssen, Carpenter, & Graham, 2003). A neutral film also was used, which was a documentary about underwater creatures (National Geographic, 1995).

Emotional and Sexual Responses Film Questionnaire

This 42-item questionnaire was based on Heiman and Rowland's (1983) questionnaire assessing self-reported affect and sexual response with similar format to the Postive and Negative Affect Scales (Watson, Clark, & Tellegen, 1988). While a time-continuous measure of sexual arousal is preferable for analytic purposes, alcohol consumption could confound such a measure. For example, alcohol's interference with motor control or increasing susceptibility to distraction (Wincze, Hoon, & Hoon, 1977) might be misleading. The questionnaire presented a series of possible feelings (e.g., "guilty") or physical sensations (e.g., "warmth in genitals"). Participants were asked to indicate whether they were feeling or experiencing each item on a 1–7 point scale anchored from "Not at all" to "Intensely." The item used as the dependent variable for self-reported sexual arousal asked participants to rate their "sexual arousal." The

questionnaire was completed immediately after the computer task, and the computer task was completed immediately after each film. The psychometric properties of this instrument are not known, despite its frequent use in research, so should be interpreted with caution.

Genital Response

Rigiscan. The Rigiscan Plus monitor (Timm Medical Technologies, Eden Prarie, MN) continuously monitors both radial rigidity and circumference. It has two cable loops that are covered with fitted cloth for comfort and cleanliness: one is placed at the base of the penis above the testicles and the other is placed just below the corona. As the Rigiscan typically is used as a clinical instrument to measure nocturnal penile tumescence, it is restricted to sampling circumference once every 15 s and rigidity once every 30 s. Limited psychometric testing suggests that the Rigiscan may slightly underestimate circumference, particularly when rigidity is low (see Janssen, Prause, & Geer, 2007), and test–retest values are not available. Since rigidity and tumescence values are highly correlated (Levine & Carrol, 1994), the index with the higher time resolution most comparable to other measures of penile response, tip circumference, was analyzed. Despite several limitations of the instrument, the stimuli used in this study were long (several minutes) and selected for high intensity. Thus, large penile responses were expected and lessen the concern about its validity at low response levels.

Vaginal Photoplethysmograph. The vaginal photoplethysmograph (VP; Palti & Bercovici, 1967; refined by Sintchak & Geer, 1975) is a small cylindrical device made of clear acrylic plastic. An infrared light is embedded in the cylinder of the device and projects toward the vaginal wall. The light reflected back to a photosensitive cell within the body of the probe was recorded. It is assumed that more light will return to the phototransistor cell as the amount of blood in the vaginal blood vessels increases (Prause & Janssen, 2006). A stabilizing, acrylic plate was attached to the external cord to help stabilize it (Laan, Everaerd, & Evers, 1995). The VP was cleaned with Cidexplus, a glutaraldehyde-based antiseptic, to high-level disinfection standards.

The VP output typically is filtered to yield two signals. The alternating current signal, referred to as the vaginal pulse amplitude (VPA), is a sawtooth signal that is thought to reflect pressure changes within the blood vessels of the vagina's vascular walls (Hoon, Coleman, Amberson, & Ling, 1981). The signal was band-pass filtered (.5–30 Hz) and digitized (80 Hz) using a BIOPAC system (Model MP100). The amplitude of each peak was measured and peak amplitude was averaged within 15 s time bins to be consistent with the sampling restrictions of the Rigiscan (see above). The first author visually deleted signal artifacts, a technique demonstrated to yield comparable outcomes to a standardized, wavelet-based artifact reduction technique (Prause, Williams, & Bosworth, 2010).

Sexual Risk Taking Computer Task. The policy-capturing task used in this study resembles that of Blanton and Gerrard (1997) by systematically manipulating cues relevant to decision making. Systematic manipulation of cues allows the identification of which cues contributed to intentions to engage in risk. First, participants were presented with a background story. The story described meeting someone of the opposite sex at a party (see Appendix). Story elements were chosen to maximize response conflict. Conflict was created by providing both impelling (e.g., "you are getting along quite well") and inhibiting (e.g., "you don't have a condom") cues. The story was presented in full only once. Prompts for relevant details were provided prior to each completion of the intercourse intent computer task for which the background story was created.

The actual computer task involved participants rating their intention to have intercourse, given the background story, with different sexual targets. Each slide represented a potential sexual target. Each slide contained a picture of an opposite-sex person (five different pictures presented alone on five slides) who varied in attractiveness, a statement about a person's number of past sexual partners (0, 1, 5, 10, or 30 partners; 5 slides) that varied in health risk, or both, fully crossed (25 slides). This should permit identification of whether impelling or inhibiting cues more strongly influenced intercourse intentions. An initial pool of 60 (30 men, 30 women) color portraits (showing head and chest) of persons with pleasant affect were selected from the internet to vary in attractiveness. Sixty-five participants from a university participant pool rated each photograph for attractiveness. Photographs were selected that represented the most attractive, least attractive, and evenly-spaced rank distribution between the most and least attractive to reach five photographs of each sex. The partner numbers were selected to span the average number of sexual partners since the age of 18 reported by men ($M = 16.9$, $SD = 50.94$) and women ($M = 5.32$, $SD = 12.06$) in a nationally representative sample (Laumann, Gagnon, Michael, & Michaels, 1994). The participant was asked to judge for each slide how likely they would be to have sexual intercourse with the target on a scale of 1 ("Very unlikely") to 9 ("Very likely").

Each volunteer participated in two counterbalanced sessions on separate days (see one session format in Fig. 1). The sessions were identical, except that one session participants consumed only juice (cranberry juice) and the other session participants consumed alcohol (cranberry juice and vodka). The participant was aware of the alcohol content of the beverage throughout the study.

Upon arrival to the lab, each participant completed an informed consent statement and completed a series of background questionnaires on the computer. The rest of the procedure was identical for both sessions except for the beverage type (juice or alcohol + juice) being consumed.

First, participants watched 15 min of a neutral, nature film. Next, they completed the Sexual Risk Taking Computer Task

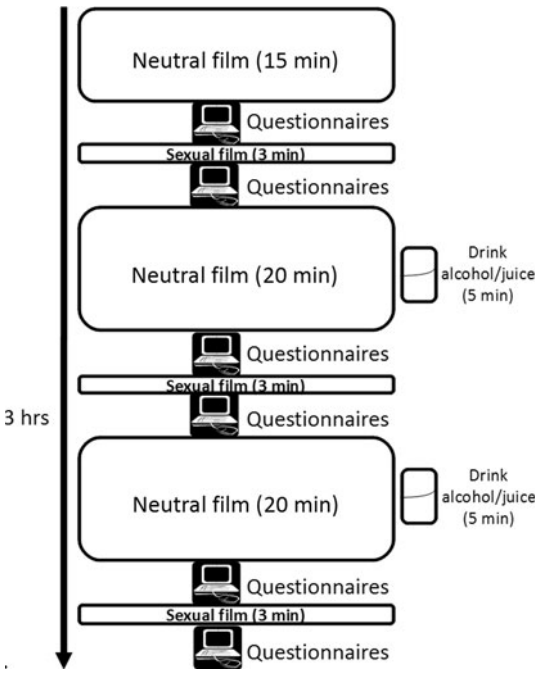


Fig. 1 Procedure for each session. Only the content (alcohol and juice or juice alone) of the drink consumed during the neutral videos varied by session

(SRTCT) and the Emotional and Sexual Responses Film Questionnaire (ESRFQ). Then, they viewed a 3 min sexual film. Then they repeated the SRTCT and the ESRFQ. During the next neutral film, participants consumed the designated beverage (juice or alcohol + juice) served by the experimenter. When they reached the desired BrAC of .025 (or 20 min had elapsed for juice only), they repeated the SRTCT and the ESRFQ. Then, they watched another sexual film, after which they repeated the SRTCT and the ESRFQ. During the next neutral film, participants consumed the second designated beverage (juice or alcohol + juice). When they reached the desired BrAC of .08 (or 20 min had elapsed for juice only), they repeated the SRTCT and the ESRFQ. Then they watched another sexual film, after which they repeated the SRTCT and the ESRFQ. Each session lasted approximately 3 h. After the second session, participants were debriefed and completed a questionnaire about their experiences.

Beverage Administration. Participants were asked to refrain from eating for 3 h and drinking alcoholic beverages for 24 h before each session. Participants were breathalyzed prior to each session to ensure BrAC = 0. Alcoholic beverages consisted of three parts cranberry juice to one part 80 proof vodka. Dosage was determined by the desired BrAC, self-reported body weight, and biological sex (Watson, Watson, & Batt, 1981). While the dosing was customized per participant characteristics, one may think of a BrAC of .025 g/kg as consistent with one glass of wine in an hour and .08 g/kg as consistent with 3–4 glasses of wine in an hour. Participants beverage consumption was timed to ensure sufficient testing time at the target BrAC. To standardize neutral film viewing time to the extent possible, the alcohol for the low-dose condition was presented after 5 min of the neutral film had elapsed. BrAC was measured approximately every 2 min following drink completion. To control for ascending/descending limb effects of alcohol, the questionnaire and computer task were completed when their BrAC was within .01 of the desired dose and ascending from previous BrAC measurement. Participants were required to stay after their alcohol session until their BrAC reached .00. BrAC was obtained from an Alco-Sensor IV (Intoximeters, Inc., Saint Louis, MO).

Control beverages consisted of four "parts" cranberry juice alone to equal the volume of liquid consumed in the alcohol session. It should be noted that the third sexual film within the alcohol session was always presented while the BrAC = .08. To enable the separation of the effects of time or alcohol, the juice only session also included three sexual films. This control was used rather than a between-subjects design, because the female measure of sexual arousal, the vaginal photoplethysmograph, is not recommended for between-subjects comparisons due to its relative scale.

Data Analysis

To verify the sexual arousal in response to the sexual films, analyses first focused on establishing this sexual response for genital and self-reported sexual response and sexual intercourse intent. A regression could have been used for these analyses, but an ANOVA approach was used to simplify interpretation of these results, which did not address the primary hypothesis. Specifically, a 2 (Session: Alcohol, Juice) × 3 (Film set: 1st, 2nd, 3rd) × 2 (Film type: Erotic, Neutral) repeated-measures ANOVA was conducted for the dependent variables of self-reported sexual arousal and physiological sexual arousal. Since the absolute range of the vaginal measure is unknown, the analyses of genital responses were run separately for men and women. The average genital response in the last minute of each film was used to allow comparison against the analysis of self-reported sexual arousal. Return-to-baseline tests were embedded in the analyses. If neutral film responses differed significantly from one another during juice only sessions, a baseline correction would be required.

For the primary hypotheses, path analysis was used to examine whether the independent variables of alcohol dose, baseline intent to engage in intercourse with the fictional partners, and sexual arousal level predicted the dependent variable intercourse intent. Genital sexual arousal effects then are reported both to verify that participants were sexually aroused by the visual sexual stimuli used and attempt to replicate other studies finding mixed effects of alcohol on genital response.

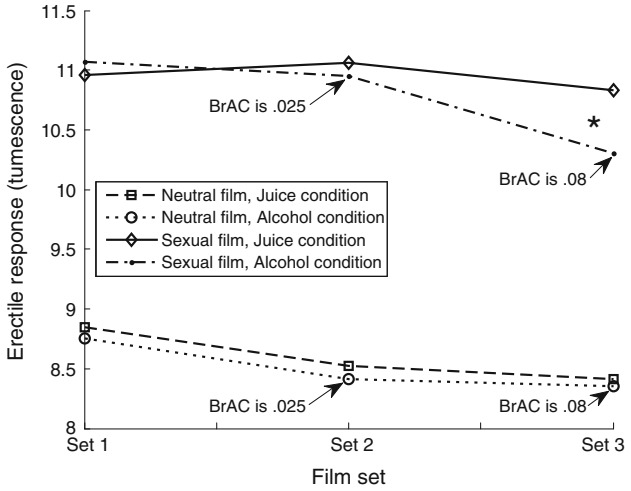


Fig. 2 Erectile response by session, film type and set. *$p = .09$

Repeated-measures results were Greenhouse-Geisser (Greenhouse & Geisser, 1959) corrected when appropriate. Exact p values for α are reported except where $p > .05$ or $p < .001$.

Results

Genital Sexual Arousal

For women, there was a main effect for Film Type $F(1, 20) = 92.90$, $p < .001$, $\eta_p^2 = .82$. This reflects women becoming more aroused during the sexual, $M(SE) = 10.95$ (.91) mV, than the neutral, $M(SE) = 5.32$ (.59) mV, films. No other main or interaction effects were significant.

Men exhibited the pattern of erectile responses shown in Fig. 2 between the Film Set, Film Type, and Session. Although this interaction was not significant $F(2, 38) = 2.66$, $p = .089$, the test was underpowered.[1]

Subjective Sexual Arousal

There were significant interactions of Session X Film Type, $F(1, 40) = 5.22$, $p = .03$, $\eta_p^2 = .12$, and Session X Film set, $F(2, 80) = 3.60$, $p = .04$, $\eta_p^2 = .08$. Participants reported more sexual arousal to neutral films in the alcohol session, and more sexual arousal to sexual films in the juice only session (see Table 1). All three possible contrasts were examined for the Session X Film set interaction. Contrasts indicated that the effect was due to participants reporting more sexual arousal during the last film set of the alcohol session (when BrAC = .08) as compared to their baseline than during the juice only session, $F(1, 40) = 4.94$, $p = .03$, $\eta_p^2 = .11$ (see Fig. 3).

Table 1 Reported sexual arousal higher during neutral films when consuming alcohol

		Film condition	
		Neutral *M* (*SE*)	Sexual *M* (*SE*)
Drink condition	Juice	1.24 (.09)	4.48 (.23)
	Alcohol	1.46 (.12)	4.33 (.15)

Note: Absolute range, 1–7

Predictors of Intercourse Intent

The computerized risk intent task was designed to permit the comparison of impelling (attractiveness) versus inhibiting (sexual partner history) cues. This tests the alcohol myopia model. In contrast with the pilot test, however, the ordinal ranking of sexual targets was not replicated in this sample. For example, participants at baseline reported very low intent to engage in intercourse with a person who had zero previous sexual partners as compared to a person with one previous partner. Participants had been expected to report a greater intent to engage in intercourse with such a low-risk potential partner. Also, the photographs of the women were not rated as having the same order of attractiveness as found in the pilot test. As a result, a modified data analysis strategy was used for these data.

Specifically, the average risk intent score for each condition was used for analyses. For example, consider someone who started with a low average intent to engage in intercourse at baseline. Their response pattern would support alcohol myopia if their intent to engage in intercourse further decreased following alcohol consumption. However, it would no longer be possible to say the lower risk intent was due to an attentional decrease to inhibiting cues or increase to impelling cues. The average sexual intent ratings did not differ between sessions at baseline $t(40) < 1$. Thus, baseline sexual intent was operationalized as the average sexual intent rating over both baselines. Higher scores indicated a greater likelihood of pursuing sexual intercourse with the target; lower scores indicated a lower likelihood of pursuing sexual intercourse with the target (see Fig. 4).

The results of the regressions are provided in Fig. 5. While each Durbin-Watson statistic was <2, η_p^2 consistent with the time

[1] The difference became significant if the data were binned to enter minute as a predictor. Male genital response effects that did reach the predetermined alpha cutoff include: Men exhibited a main effect of Film Set, $F(2, 38) = 16.07$, $p < .001$, $\eta_p^2 = .46$, and Film Type, $F(1, 19) = 94.33$, $p < .001$, $\eta_p^2 = .83$. The Film Set effect was due to a decrease in erection in response to the third as compared to the first, $F(1, 19) = 35.70$, $p < .001$, $= .65$ and second $F(1, 19) = 12.36$, $p = .002$, $\eta_p^2 = .39$, film sets. The Film Type effect was due to a higher erectile response to sexual as compared to neutral films. There were no other significant main or interaction effects. The nonsignificant interaction was included, because it suggests that the significant main effects may be due to a lower response to the sexual film when men reached BrAC = .08.

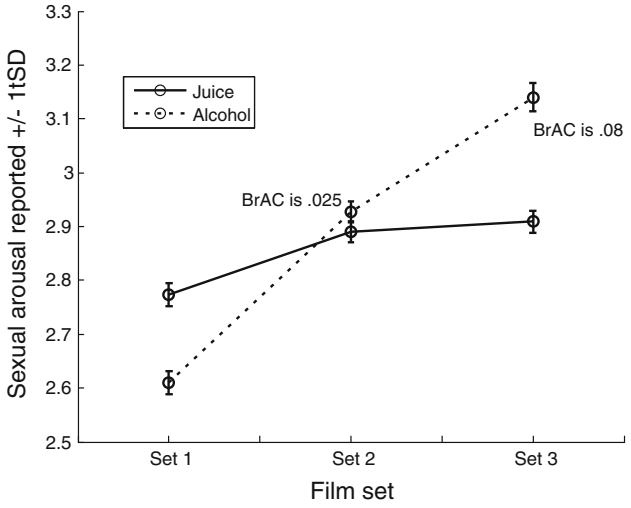


Fig. 3 Self-reported sexual arousal for each session by film set (±1 SD)

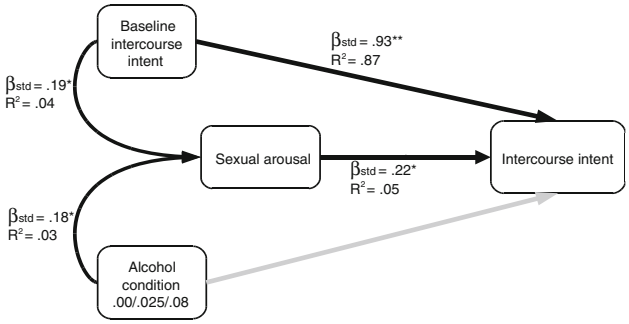


Fig. 5 Hypothesized mediating mediators path model tested

series nature of these data, none approached <1. Other regression assumptions did not appear violated.

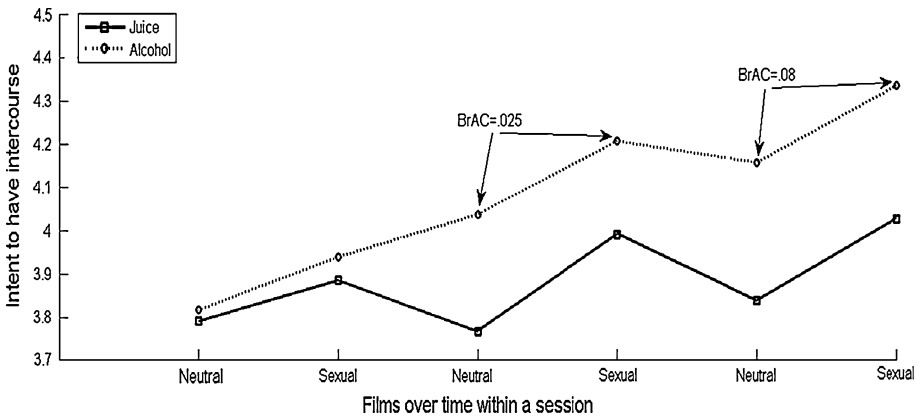
As expected, reporting higher intercourse intent at baseline predicted greater intent to have intercourse following sexual films and during alcohol consumption (see Fig. 5). Stronger intent to engage in intercourse at baseline also predicted greater reports of sexual arousal. Also, the more sexually aroused the participants reported feeling, the greater their intentions to engage in sexual intercourse. The level of alcohol consumed for each of the three sexual films, however, did not predict intentions to engage in sexual intercourse.

Discussion

The results of this psychophysiological study indicated that alcohol consumption exerted only an indirect effect on intentions to engage in sexual intercourse by increasing the level of sexual arousal experienced. Intentions to have intercourse prior to any drinking strongly predicted subsequent intentions, but stronger baseline intentions to engage in intercourse also increased the level of sexual arousal experienced. Participants reported significantly higher sexual arousal during the alcohol session during the last two films (neutral and sexual), during which their BrAC = .08, than during the comparable films in the juice only session. Participants also reported higher sexual arousal to the neutral films during the alcohol session as compared to the juice only session. Women exhibited a genital response during the sexual films, but the response magnitude did not vary by the amount of alcohol consumed. Men exhibited a genital response during the sexual films, and their genital response during the third/last sexual film of the alcohol session (BrAC = .08) was less than the third sexual film in the juice only session. Simple main effects, such as for visual sexual stimulus exposure, were moderate to large in size, while the theory-relevant contrasts tended to have smaller effect sizes.

The genital and self-reported responses to alcohol were mostly consistent with previous research. Reported sexual arousal tends to increase with alcohol dose (Malatesta, Pollack, Crotty, & Peacock, 1982; Wilson & Lawson, 1976) and, while erectile responses declined over repeated film viewings, these were not specific to the alcohol dose (Briddell & Wilson, 1976; Farkas & Rosen, 1976; George et al., 2006; Wilson & Niaura, 1984). The current study used a somewhat higher level of high alcohol dose as compared to some earlier studies. In men, the facilitation of erection at the lower dose of alcohol reported by Farkas and Rosen (1976) was not replicated. Also, there appeared to be a non-significant pattern of alcohol accel-

Fig. 4 Descriptives of intercourse intentions over time within session



erating men's genital response habituation to sexual films. Previous investigations of women's genital responses documented a decrease in VPA with increasing alcohol dose (Wilson & Lawson, 1976, 1978). The present results were consistent with Schacht et al. (2007) documenting no change in women's genital sexual arousal due to alcohol. Self-reported and genital sexual responses frequently diverge (for review, see Chivers, Seto, Lalumière, Laan, & Grimbos, 2010) and, for alcohol, it generally appears that reported sexual arousal increases more, or in opposition to, genital sexual arousal.

Given widespread cultural aphorisms like "whiskey dick" or "brewer's droop," it is surprising that a BrAC of .08 did not more markedly impair erectile response. However, this finding was consistent with studies documenting that penile erection still can be voluntarily controlled at high alcohol doses (George et al., 2006; Rubin & Henson, 1976). It is also possible that alcohol expectancies have changed with new cultural norms or when individuals experience sex while intoxicated and do not have sexual difficulties.

There were several limitations in our study. The sexual nature of this study could introduce participation bias. Volunteers for sexual psychophysiological studies report higher number of heterosexual and homosexual sexual partners, wider breadth of sexual behaviors, lower sexual guilt, and lower social desirability (Plaud, Gaither, Hegstad, Rowan, & Devitt, 1999). The normative sexual stimuli used likely reduced other potential biases, such as general sensation seeking (Gaither, Sellbom, & Meier, 2003). Less is known about bias in those volunteering for studies that also administer alcohol. Participants in this study were selected because they consumed a level of alcohol that would not generally be considered problematic, which also may decrease the number of the participants who had attempted intercourse following alcohol consumption. Also, despite efforts to recruit a sample more representative of the community, largely students volunteered to participate. A second limitation was the relatively small sample size. Statistical power was reduced in particular for analyses of genital responses, which required splitting the sample by gender. As a result, the possibility of Type II errors was disproportionately high for several analyses that should caution interpretation of these data. In particular, the lack of an effect of session (alcohol or juice) for women's highly variable genital response should be interpreted cautiously until replicated with a larger sample. Finally, the purpose of the study was not to study the impact of alcohol expectancies per se, so a balanced placebo design was not used. Clearly, participants' expectations about the effects of alcohol on sexual arousal and intercourse intentions could influence responses and deserve exploration in the future.

The sexual risk intent task did not clearly separate inhibiting and impelling cues as intended, resulting in a less ideal "baseline risk propensity" average value from the task. The difficulty with the task was somewhat surprising given research indicating some universality of attractiveness evaluations based onbiological factors, such as facial symmetry (Thornhill & Gangsteadt, 1993, although see Bronstad, Langlois, & Russell, 2008 for refutation), which did not vary between participants. Whether or not the participant assumed that a condom was available, past sexual partner number also should have been linearly associated with risk, because both herpes simplex virus and human papillomavirus are transmittable even with proper condom use. Concerning the impelling cue, the attractiveness of opposite-sex faces increases with intoxication (Jones, Jones, Thomas, & Piper, 2003), possibly due to a decreased ability to accurately perceive sensory cues of attraction, such as facial symmetry (Souto, Bezerra, & Halsey, 2008). It may, therefore, be an erroneous assumption that attractiveness can be used as an impelling cue; on the other hand, the altered weighting of attractiveness during intoxication deserves characterization. Concerning the intended inhibiting cue, several non-random samples of students suggest that our sample was aware that higher numbers of sexual partners increases risk for human papilloma virus (85% reported "true," Gerend & Magloire, 2008), although only about 50% of another sample knew that herpes simplex virus could be transmitted even during condom use (Lewis, Rosenthal, Succop, Stenberry, & Bernstein, 1999). One strategy to enhance the task could be to provide education about these infections and their link to past partner number (e.g., Doherty & Low, 2008), rather than providing the simple instruction to consider past partner number an indicator of sexual risk. The possibility that attractiveness altered perception of sexual partner history (or vice versa) appears unlikely as these vary independently under the influence of alcohol (Kruse & Fromme, 2005). While this task may offer several benefits over more typical vignette or questionnaire approaches, the only real benefit observed in its use here was the decreased ability of individuals to easily monitor their own patterns of response by condition and known error variability estimates.

Also, it is not clear how average sexual intercourse intent in the laboratory reflects real-world decisions or behaviors. However, sexual risk behaviors typically are performed in private and not easily validated (Catania et al., 2005) and the best methods for assessing sexual risk in surveys is debated (for review, see Schroder, Carey, & Vanable, 2003a, 2003b). Laboratory studies tend to assess intent to engage in sexual intercourse in response to vignettes of sexual situations or face-valid questionnaires. The vignettes typically are read (e.g., Corcoran & Thomas, 1991; George, Gournic, & McAfee, 1988; Testa, Livingston, & Collins, 2000) or viewed as a video (e.g., MacDonald et al., 2000a, 2000b) by the participant and followed by a single question of intent to engage in a sexually risky behavior. The vignettes typically are designed to maximize response conflict (Steele & Southwick, 1985) by roughly equated inhibiting (e.g., not having a condom available) and activating (e.g., the partner is very attractive) cues. Vignettes appear superior to questionnaires used to assess risk intent (e.g., Fromme, Katz,

& Rivet, 1997b), since questionnaires provide no controlled context to assess contributing decision variables, other than a known quantity of alcohol consumed (e.g., Fromme et al., 1997a, 1997b). However, vignettes are problematic due to their face validity and the unknown psychometric properties of individual item response. Laboratory studies manipulating factors thought to affect decision making assess these factors more directly by questioning sexual intents repeatedly over the range of the variables of interest (Wiederman, 1999). The novel task designed for this study systematically manipulated inhibiting and impelling cues to allow inhibiting and impelling cues to be separated to test alcohol myopia models, but it clearly would require additional development to allow better separation of impelling and inhibiting cues.

One alternative to this task would have been to explicitly ask whether the participant would have unprotected sex with the person; however, even the possibility of acquiring HIV might have suppressed variability across conditions. Thus, results from this task are discussed as indicative of risk "intent" or intercourse "intent" to make clear that no sexual behaviors actually were performed. In addition to providing a high-conflict context for each decision, the number of decisions minimizes a person's ability to monitor their own response pattern. In addition to assessing intercourse intent during the study, the very first completion of this task prior to consuming any drink or viewing erotica was used to quantify participants' baseline intercourse intent.

Since no direct effect of alcohol on intercourse intent was identified, neither disinhibition nor alcohol myopia were strongly falsified. If sexual arousal is considered an impelling cue, the increase in impelling cue salience leading to greater intercourse intent could be interpreted as support for the alcohol myopia model. However, disinhibition due to sexual arousal, which is positively related to alcohol dose, is better supported by these data. To most directly test the alcohol myopia effect of baseline differences in impelling and inhibiting cues predicting later risk, a task that better models these dimensions separately is desirable. The fact that intercourse intent at baseline predicts intercourse intent later in the study may only reflect the familiar tenet that past behavior is the best predictor of future behavior. However, it is clear that sexual arousal better predicted sexual intercourse intentions than alcohol dose. Interventions, then, may avoid contributing to sexual risk taking driven by alcohol expectancies by portraying alcohol as primarily influencing sexual arousal. Also, strategies to diminish sexual arousability prior to anticipated intoxication may be helpful. Orgasm through low-risk means (for instance, through masturbation) could decrease later arousability and sexual risk taking. Consequences of orgasm have been characterized as lasting at least 1 h (Krüeger et al., 2006). Whether changes following orgasm diminish or potentiate subsequent sexual arousability and the time course of either effect is unknown. Methods to reliably reduce sexual arousability during anticipated drinking situations could help reduce sexual risk taking under the influence of alcohol.

Appendix

Description Read to Participant

You will view many slides in this task. Each screen may have a photograph of a person. Also, the screen may tell you how many sexual partners this person has had. Sometimes the screen will give you only a picture, sometimes only the statement about their number of past sexual partners, and sometimes it will give you both. You will see each person's picture several times.

You should imagine that you have met this person at a party at a friend's house and you are getting along quite well. This person wants you to go back to his/her apartment and have sexual intercourse with you. However, you do not have a condom and cannot be sure that they do either. Based just on the information that you are given on the screen, you will then be asked to make a judgment as to how likely you would be to have sex with them. You should make this judgment as though you do not currently have a partner. Also, although some people believe that more sexual partners increase a person's sexual skills (or make them "good in bed") you should only consider the number of partners as the likelihood that this person has a sexually transmitted disease. Therefore, the more sexual partners a person has had, the more likely that the person has an STD.

Please try to give your first impression and try to be as honest as possible when responding in this task. I will tell you over the intercom when to do this task. The sheet on the wall will remind you what the main features of this story are that you should remember.

Prompt Immediately Preceding the Task

You will now complete the computer task. Recall that in this situation you should think of the pictures as people that you have met at a party that are interested in you. Also remember that you should only consider the number of partners as the likelihood that the person has a sexually transmitted disease. Use the strip on the keyboard to remind you of the question that you are answering.

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