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The Effects of Acute Alcohol Consumption, Cognitive Reserve, Partner Risk, and Gender on Sexual Decision Making*

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Abstract

Objective—In past alcohol administration studies, intoxicated college students have been more willing to have unprotected sex with a hypothetical new partner than sober or placebo students. The objective of the present research was to extend past work by examining the effects of gender, cognitive reserve, and partner risk on intoxicated sexual decision making.

Method—Before assigning participants (60 women and 60 men) to a drink condition, cognitive reserve was assessed with the reading subtest of the Wide Range Achievement Test 3 (WRAT3). After drinking, participants watched a video of a male and female college student in a sexual situation. There were two versions of the video that were identical, except for information that suggested the opposite-gender character had many past sexual partners or only a few.

Results—There was a significant interaction between drink condition and cognitive reserve such that intoxicated participants with lower WRAT3 scores were more likely than other participants to indicate that they would have unprotected sex if they were in this situation. Partner risk did not influence participants' willingness to have unprotected sex; however, they were less interested in dating the high-risk partner.

Conclusions—As expected, participants with less cognitive reserve made riskier decisions when intoxicated. Unexpectedly, although participants clearly perceived the high- and low-risk partners differently, this did not affect their willingness to have unprotected sex with this hypothetical partner. These findings demonstrate the need for sexually transmitted disease/ HIV prevention programs that go beyond factual presentations and provide students with the skills they need to assess risk realistically and the need for programs with messages tailored for individuals with low cognitive skills.

College students experience many negative consequences from heavy alcohol consumption, including academic problems, personal injuries, impaired driving, interpersonal violence, and vandalism (Perkins, 2002). In the area of risky sexual behavior, 16% of a national sample of college students reported that they had sex without a condom when intoxicated at least once during the past school year (American College Health Association. 2005). Several

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other studies of college students have found comparable rates of unprotected sexual intercourse when drinking alcohol (Meilman, 1993; Poulson et al., 1998; Wechsler et al., 2002).

Alcohol administration studies have demonstrated that acute alcohol consumption affects sexual decision making (Fromme et al., 1999; Maisto et al., 2002, 2004). MacDonald and colleagues (1996) found that intoxicated male college students reported being more likely to have unprotected sex with a woman in a video than did sober male college students. In another study, both male and female college students who consumed alcohol were more likely than sober participants to report that they would have sex without a condom in a hypothetical situation, even after controlling for the effects of usual drinking and condom use (Abbey et al., 2005). The study presented in this article extends past research by taking into consideration the effects of cognitive reserve, partner's level of risk, and gender on intoxicated sexual decision making.

Cognitive models of alcohol's effects

Intoxication impairs a large number of cognitive functions, including verbal and spatial learning, visual discrimination, episodic and working memory, abstract reasoning, set shifting, behavioral inhibition, planning, and judgment (Finn et al., 1999; Giancola, 2000; Peterson et al., 1990). Recent research has focused on alcohol's effects on executive cognitive functioning (ECF) and the capacity to plan, initiate, and alter goal-directed behavior (Bartholow et al., 2003; Curtin and Fairchild, 2003; Giancola, 2004). Acute alcohol consumption impedes response inhibition, particularly when the task requires suppression of a compelling, predominant response (Abroms et al., 2003; Curtin and Fairchild, 2003; Fillmore et al., 2000). Intoxicated individuals tend to focus on immediate, salient, superficial cues rather than distal, covert, or embedded cues (Steele and Josephs, 1990; Taylor and Leonard, 1983). These findings suggest that, when confronted with an opportunity to have unprotected sex with a new partner, intoxicated college students are more likely than sober students to focus on and feel compelled to act on immediate, salient information such as their partner's physical attractiveness and their own sexual arousal. When intoxicated, inhibiting cues such as the risk of contracting a sexually transmitted disease (STD), pregnancy, or one's moral values may be insufficient to repress the desire for sexual gratification.

The aggression literature can serve as a guide for sexual risk-taking research. Alcohol consumption does not produce aggressive behavior in everyone or in every context (Giancola, 2004; Pihl et al., 2003). Instead, alcohol's role in aggressive behavior is complex, follows multiple pathways, and may differ for individuals with different constellations of risk factors. One line of investigation has focused on the effects of pre-existing cognitive abilities in conjunction with acute alcohol consumption. Among individuals with high cognitive abilities, even after drinking alcohol, there should be enough "reserve" capacity to inhibit impulsive aggression. In contrast, among intoxicated individuals with low cognitive abilities, impulsive aggression is less likely to be restrained (Giancola, 2000). In support of this hypothesis, several researchers have found increased aggression on laboratory tasks

among intoxicated participants with low predrinking scores on measures of ECF (Giancola, 2004; Lau et al., 1995).

Although the research reviewed previously has used measures of ECF to assess cognitive abilities, the neuropsychology literature describes the contributions of intelligence, verbal skills, and education to cognitive reserve (Le Carret et al., 2003; Scarmeas et al., 2003; Stern, 2002). Cognitive reserve has been defined as “the ability to optimize or maximize performance through differential recruitment of brain networks, which perhaps reflect the use of alternative cognitive strategies” (Stern, 2002, p. 451). Measures of verbal skills have been consistently associated with aggressive behavior in alcohol research, although they are typically used as a covariate rather than investigated in their own right (Giancola, 2004; Lau et al., 1995). In her extensive review of the development of antisocial behavior, Moffitt (1993) observed that persistently antisocial children typically have neuropsychological deficits in the verbal and executive domains. Individuals with lower verbal skills may experience increased cognitive demand when making complex decisions, particularly those that involve many potential benefits and costs that must be simultaneously evaluated (Stern, 2002). The cognitive impairments induced by acute alcohol consumption are likely to tax these individuals' already limited cognitive reserve, thereby enhancing the likelihood that they will make poor decisions.

A full discussion of the issues associated with defining and measuring cognitive reserve, intelligence, and ECF are beyond the scope of this article, as is the debate regarding the extent to which intelligence tests measure innate abilities or learned skills (Ackerman, 2005; Davidson and Downing, 2000; Espy et al., 2001; Siegler, 2003). Some researchers have distinguished between the concepts of “fluid” and “crystallized” intelligence, with fluid intelligence being captured by the performance-type aspects of intelligence quotient (IQ) tests and crystallized intelligence being captured by knowledge-based aspects of IQ and achievement tests (Duncan et al., 1996). For example, Giancola and colleagues (1998) used three performance measures from the Wechsler intelligence scale as indicators of ECF/ fluid intelligence and the vocabulary scale from the Wechsler to assess crystallized intelligence/ skills. In the current study, the reading subtest of the Wide Range Achievement Test 3 (WRAT3) was used to assess crystallized verbal skills (Wilkinson, 1993). Although this vocabulary test is only a partial indicator of cognitive reserve, this study provides a first step in examining the effects of pre-existing cognitive functioning in laboratory studies of sexual risk taking.

Risk assessment

College students exhibit high rates of STD/human immunodeficiency virus (HIV) risk behavior, including inconsistent condom use, multiple partners, and alcohol use during sexual activity (Cooper, 2002; Lewis et al., 1996). Many students report that they do not have to worry about HIV/AIDS because they are in a monogamous relationship (Fromme et al., 1999). Although most of these relationships do not last long, students feel safe because they are only in one relationship at a time (Linville et al., 1993). Even when engaging in “hook-ups,” only 20% of college students routinely take precautions to avoid STDs, and even fewer discuss past risky behavior with their hook-up partner (Paul and Hayes, 2002).

Many young adults believe that they can judge whether a partner is sexually safe without asking questions about past sexual history or condom use (Buysse and Ickes, 1999; Hammer et al., 1996). College students report that they assess potential partners' sexual risk through indirect cues such as assessing physical appearance, knowing their friends, and observing whether or not the individual is a "flirt." Bringing up the topic of STDs or HIV, including being tested, is often perceived as a sign of distrust that can threaten a relationship (Hammer et al., 1996).

Overview of study and hypotheses

This study examines the main and interactive effects of acute alcohol consumption, cognitive reserve, partner risk, and gender on participants' hypothetical willingness to engage in sex without a condom with a new partner. We hypothesized that intoxicated participants who had low WRAT3 scores would be more willing to engage in risky sex in a hypothetical situation than would those with high WRAT3 scores. Individuals with average or lower than average WRAT3 scores who are intoxicated may lack the cognitive reserve required to make a thoughtful decision about whether or not they should have sex without a condom with a new partner.

Partner risk was expected to have main effects and to interact with alcohol consumption. In comparison with participants who viewed a low-risk partner (e.g., few past partners, looking for a committed relationship), those who viewed a high-risk partner (e.g., many past partners, not interested in a long-term relationship) were expected to evaluate their partner as more sexual and less trustworthy and to be less willing to engage in unprotected sex or to date them in the future. Additionally, partner risk was hypothesized to interact with drink condition. Sober participants were expected to be less willing to have unprotected sex with a hypothetical new partner who was described as being high risk, compared with a new partner described as being low risk. In contrast, intoxicated participants were expected to ignore the implications of the high-risk cues and therefore be equally willing to have unprotected sex with a high- or low-risk partner.

Most of the alcohol administration studies that have examined sexual decision making have included participants of only one gender (MacDonald et al. 1996; Maisto et al., 2002, 2004; Murphy et al., 1998). However, there are many reasons to expect gender differences in response to risky sexual situations. As compared with men, women express more concern about the consequences of unprotected sex (Amaro, 1995). Women are judged more harshly than men for having many sexual partners (Crawford and Popp, 2003), and men report having more positive attitudes about casual sex and more one-night stands (Oliver and Hyde, 1993). Based on this research, we expected main effects of gender and interactions between gender and drink condition. Overall, as compared with men, women were expected to be less likely to report that they would have sex without a condom with a hypothetical new partner, to trust their partner less, and to be less interested in dating their partner in the future. Intoxicated men and women were expected to focus less on inhibitory cues than sober individuals. Because inhibitory cues were initially more salient for women, drink condition was expected to have the largest impact on women's willingness to have unprotected sex.

A placebo condition was included as an additional control condition to ensure that alcohol's effects were the result of actual alcohol consumption rather than beliefs about alcohol's effects. Most recent sexual decision making studies have not found placebo effects (Abbey et al., 2005; Fromme et al., 1999; MacDonald et al., 2000; Maisto et al., 2004).

Method

Participants

Sixty male and 60 female college students at a large, urban university were recruited from enrollment lists and flyers posted on campus. Participants were required to be 21 years of age or older (mean [SD] = 24.2 [3.3]). Fifty-seven percent of participants were white. 24% were black, 7% were Asian or Pacific Islander, 5% were Arabic or Middle Easterner, 3% were Hispanic, and the remaining 4% had other ethnic backgrounds. On average, participants reported that they had consumed 24.9 (26.4) alcoholic drinks in the past 30 days.

Procedures

Individuals who expressed interest in participating in a study of social perception were screened by telephone to verify that they fit the criteria for alcohol administration research. In addition to the age requirement, they had to have consumed at least four drinks containing alcohol on a single occasion in the past year, have consumed at least one alcoholic drink in the past 30 days, have no history of alcohol or drug problems, and have no health problems or medication use that contraindicated alcohol consumption (National Institute on Alcohol Abuse and Alcoholism, 1989). Participants were required to be single and heterosexual because it was important that they could identify with the heterosexual couple depicted in the stimulus film. Eligible participants were asked to abstain from alcoholic beverages for 24 hours before the start of the lab session and from food and beverages other than water for 4 hours before its start.

When participants arrived for the lab session, they were escorted into a private room and given a breath analyzer test (Alco-Sensor IV, Intoximeters, Inc., St. Louis, MO) to confirm that they had a blood alcohol concentration (BAC) of zero. The experimenter reviewed the consent form and verified participants' health screening information. Women took a urine pregnancy test to confirm that they were not pregnant. The reading subtest of the WRAT3 was then administered (see the *Measures* section below for more information).

Participants were randomly assigned to one of three drink conditions: sober, placebo, or alcohol. Using a double-blind procedure, a bartender poured drinks in front of the participant from tonic and vodka bottles that appeared to be unopened. Participants in the alcohol condition consumed 80-proof Absolut vodka (2.00 g/kg body weight for men and 1.85 g/kg for women) mixed in a 3:1 ratio with Canada Dry tonic water and calculated to induce a peak BAC of .080%. This BAC level was chosen because past research suggests that it is sufficient to impair a variety of cognitive functions (Peterson et al., 1990). Participants in the sober and placebo conditions were given an amount of tonic calculated to equal the total fluid content in the alcohol formula previously described. Sober participants' drinks were

poured only from a tonic bottle; however, flattened tonic was poured from a vodka bottle for placebo participants. Participants' drinks were then given a squirt of liquid from a lime-juice container. In the sober and intoxicated conditions, this container held lime juice. In the placebo condition, this container was filled with vodka. A squirt of vodka gives placebo drinks the taste and smell of alcohol but does not provide enough alcohol to affect participants' BACs (Sayette et al., 1992). Participants' drinks were poured into three cups, and the participants were given 5 minutes to consume each beverage, followed by a 5-minute absorption period.

After the absorption period, participants were given a breath analyzer test. Placebo and alcohol condition participants were told that they had a BAC of .079%; participants in the sober condition were told they had a zero BAC reading. This BAC feedback was intended to reinforce drink condition instructions and to enhance the perception that intoxication levels were stable. Next, participants sat at a computer and watched a video containing the stimulus materials and then completed a computerized questionnaire. When finished, they were given another breath analyzer test. In the placebo and alcohol conditions, participants were told that they had a BAC of .081%; participants in the sober condition were told they had a zero BAC. Before being debriefed, participants answered feedback questions to determine if they had suspicions or concerns about any aspect of the study. Participants who received alcohol remained at the laboratory until they were at a BAC of .030%, when a responsible party drove them home, or until they were at a BAC of .005%. Participants were paid \$12 an hour.

Stimulus materials

Participants watched a 12-minute video about two college students, Lisa and Mark. They were asked to put themselves in the place of the same-gender character as they watched the video and imagine that this experience was happening to them. The video was professionally produced and extensively pilot tested to ensure that students found it realistic and interesting. In the first scene, Mark and Lisa run into each other outside a classroom after completing a final exam. They know each other from other classes but have not dated. Mark encourages Lisa to attend a party that evening. In the second scene, Lisa arrives at the party, Mark greets her and offers her a drink, they play cards with others, and then go to another room and talk. As the party is ending, Mark invites Lisa back to his apartment to talk more. In the third scene, they look through a photo album at Mark's apartment and begin kissing on his couch. Lisa and Mark kiss and touch each other for several minutes and then the film fades out. They are shown consuming four drinks during the evening. Two parallel versions of the video were developed to enhance participants' identification with the characters in the video. The two videos were filmed simultaneously so that everything was identical except for the ethnicity of the actors; one film used a white dyad and the other used a black dyad. These two ethnic groups were selected because they represent the majority of students at this university. Students from other ethnic groups were asked which of the two videos they would prefer to watch.

Risk manipulation—Participants were randomly assigned to watch a version of the video that depicted the opposite-gender character as being either high or low risk. The same-

gender character was always depicted as low risk. Four different cues were manipulated to form the high- and low-risk versions. These cues were selected based on focus groups that were conducted to determine the types of cues that students typically use to evaluate partner risk. First, a paragraph of background information about the opposite-gender character was provided to participants before the video began. In addition to providing general material about the character's major and hobbies, in the low-risk female character version it stated that Lisa had dated a few different people, enjoyed being in a serious dating relationship, and had two sexual partners. In the high-risk female version, Lisa was described as having dated a lot of different people, enjoyed being in casual dating relationships, and had 10 sexual partners. The information was identical in the low- and high-risk male character versions except the number of previous sexual partners was 3 (low) and 15 (high). The higher numbers for men were in response to students' feedback about what they considered a "low" and "high" number of partners for each gender.

Within the video, three brief segments differed in the high- and low-risk versions: (1) Before interacting at the party, each of the two main characters was shown telling a same-gender friend that they liked the other character. In the low-risk version, the friend made a comment about how the other character seemed to like them as well. In the high-risk version, the friend said, "Aren't you still seeing Tony/Mary?" The main characters indicated that it was not an exclusive relationship and that they had been hoping that Mark/Lisa would show an interest in them. (2) During the party, there was a scene in which each character was seen standing close to and laughing with several other people. In the low-risk version, the others were the same gender as the character; in the high-risk version, they were of the opposite gender. (3) When the two characters were talking on the couch near the end of the party, each volunteered some information about their own past relationships. The high-risk character indicated having been in quite a few relationships in college but nothing serious. The low-risk character indicated having ended a relationship a while ago and not having been in one since.

Measures

WRAT3—Before drinking, participants completed the reading subtest of the WRAT3 (Wilkinson, 1993). This subtest consists of two sets of 42 words that participants pronounce to the experimenter. This measure is normed for age and scores are standardized, with a mean of 100 and a standard deviation of 15. The WRAT3 reading subtest is a well-validated, easy-to-administer measure that is frequently used to estimate verbal intelligence (Griffin et al., 2002; Kareken et al., 1995; Letz et al., 2003). Correlations ranging from .45 to .72 (average r approximately .60) have been found between the WRAT3 and the full-scale score on the Wechsler in adults and children (Griffin et al., 2002; Johnstone et al., 1996; Kareken et al., 1995; Vance and Fuller, 1995; Warner et al., 1987; Wiens et al., 1993; Wilkinson, 1993).

Responses to the video—After watching the video, participants answered several questions using 7-point scales, with options ranging from "not at all" (1) to "extremely" (7). Participants evaluated how sexually arousing the video was, how likely they would be to have sexual intercourse without a condom if they were in this situation, and how likely they

would be to date their partner after this evening. Additionally, participants were asked how likely they would be to discuss the use of protection to avoid pregnancy, the use of protection to avoid STDs, their partner's past sexual partners, and if their partner had been tested for HIV. These four items were combined into an index of risk discussion with a Cronbach's coefficient α of .83. Participants were also asked how foolish they would feel and how much they would regret it later if they had sex without a condom.

Participants rated the opposite-gender character on several adjectives. Five adjectives were used to assess their partner's sexuality: flirtatious, seductive, sexy, smooth, and suave. Cronbach's coefficient α was .85. Five adjectives were used to assess their partner's trustworthiness: moral, reliable, respectable, responsible, and trustworthy. Cronbach's coefficient α was .90.

Results

Preliminary analyses

Blood alcohol concentrations—Participants who consumed alcohol had a mean BAC of .072% (0.019) just before they began watching the video and a mean BAC of .072% (0.010) after completing the questionnaire. There were no gender differences in BACs ($F = 0.44$, 1/38 df, $p = .51$; $F = 0.73$, 1/38 df, $p = .79$).

Manipulation checks—On 7-point scales, participants rated the film as realistic (mean = 5.78 [1.35]) and interesting (mean = 5.63 [1.17]). Four multiple-choice questions were included to demonstrate that the risk manipulation was successful. Seventy-eight percent of participants made no errors (mean = 3.78 [0.44]), indicating that participants were attentive to the information provided.

Participants were asked several questions to ensure that the placebo manipulation was successful. There was a significant main effect of drink condition on participants' estimates of their highest BAC ($F = 13,303.10$, 2/117 df, $p < .001$). Follow-up Tukey HSD planned comparisons indicated that estimates were comparable for placebo (mean = 0.080 [0.000]) and intoxicated (mean = 0.081 [0.004]) participants, and both of these estimates were significantly different than those of sober participants (mean = 0.000 [0.000], p 's $< .001$). There was also a drink condition main effect regarding how intoxicated participants felt when they completed the questionnaire ($F = 165.35$, 2/117 df, $p < .001$). Using a response scale with options that ranged from "not at all intoxicated" (1) to "extremely intoxicated" (5), participants who consumed alcohol felt more intoxicated (mean = 3.80 [0.79]) than did placebo participants (mean = 2.35 [0.89]), who in turn felt more intoxicated than did sober participants (mean = 1.00 [0.00], p 's $< .001$). This pattern of results is consistent with findings from other alcohol administration studies (Fromme et al., 1999; Maisto et al., 2002).

WRAT3 scores—Participants' standardized WRAT3 scores ranged from 83 to 124 and did not differ across drink conditions ($F = 0.31$, 2/117 df, $p = .73$). Not surprisingly, scores in this college population tended to be on the high average end (mean = 109.78 [7.86]). Thus, for the analyses described herein, participants were divided into two groups based on their

WRAT3 reading subtest scores, with the low group composed of individuals in the low average and average range (83-109) and the high group composed of individuals in the high average and superior range (110 and above; Wilkinson, 1993).

Analysis of variance results

A series of 2 (Gender) $\times$ 3 (Drink Condition: intoxicated, placebo, sober) $\times$ 2 (Cognitive Reserve: low, high) $\times$ 2 (Partner Risk: low, high) analyses of variance were conducted. As hypothesized, there was a significant Drink Condition $\times$ Cognitive Reserve interaction ($F = 3.17$, 1/96 df, $p < .05$). Simple effects analyses were conducted to aid in interpretation of this interaction effect (Keppel, 1991). These analyses indicated that there was no effect of WRAT3 score for sober or placebo participants ($F = 0.12$, 1/38 df, $p = .73$; $F = 0.00$, 1/38 df, $p = 1.00$, respectively). As hypothesized and as can be seen in Table 1, intoxicated participants with lower WRAT3 scores were significantly more likely than intoxicated participants with higher WRAT3 scores to report that they would have sex without a condom in this situation ($F = 7.81$, 1/38 df, $p < .008$).

There was also a significant Drink Condition $\times$ Risk interaction, although only for participants' ratings of their interest in dating their hypothetical partner in the future ($F = 3.12$, 2/96 df, $p < .05$). As can be seen in Table 2, intoxicated participants did not distinguish between high- and low-risk partners ($F = 0.80$, 1/38 df, $p = .38$). In contrast, sober participants did ($F = 14.10$, 1/38 df, $p < .001$). Sober participants who viewed the video with the low-risk partner expressed significantly more interest in dating this individual in the future than did sober participants who viewed the video with the high-risk partner. Although the pattern of means was similar for placebo participants, the difference was not significant ($F = 2.17$, 1/38 df, $p = .15$).

There were also three significant main effects of risk condition, two of which were moderated by significant interactions with participant's gender. High-risk partners (mean = 5.09 [1.13]) were perceived by both men and women as being significantly more sexual than were low-risk partners (mean = 4.41 [0.97]; $F = 6.27$, 1/96 df, $p < .01$). There were significant Risk $\times$ Gender interactions for partner's trustworthiness and interest in future dating ($F = 4.22$, 1/96 df, $p < .04$; $F = 6.42$, 1/96 df, $p < .01$, respectively). Simple effects analyses indicated that, for men, level of partner risk made no difference in their judgments; trust: high risk (mean = 5.12 [0.98]), low risk (mean = 4.93 [1.08]; $F = 0.54$, 1/58 df, $p = .46$); date: high risk (mean = 5.43 [1.14]), low risk (mean = 5.63 [1.24]; $F = 0.42$, 1/58 df, $p = .52$). Women, however, perceived the high-risk partner as significantly less trustworthy and were significantly less interested in dating him, compared with the low-risk partner; trust: high risk (mean = 4.19 [1.32]), low risk (mean = 5.15 [0.86]; $F = 11.00$, 1/58 df, $p < .002$); date: high risk (mean = 4.10 [1.63]), low risk (mean = 5.67 [1.30]; $F = 17.03$, 1/58 df, $p < .001$).

There were a number of significant main effects of gender, although contrary to prediction, there were no interactions of gender and drink condition. As can be seen in Table 3, compared with women, men trusted their partner more, were more likely to have unprotected sex that evening, and were more interested in dating their partner later. Although women were less likely to report that they would have unprotected sex in this

hypothetical situation, women indicated that they would feel more foolish and experience more regret if they did so. There were no significant differences between women's and men's sexual arousal, perceptions of their partner's sexuality, or likelihood of discussing risk factors with their partner before having sex.

The only significant main effect of drink condition was for sexual arousal ($F = 6.33$, 2/96 df, $p < .003$). Follow-up Tukey HSD planned comparisons indicated that sober participants were significantly less sexually aroused by the video (mean = 2.86 [1.63]) than were intoxicated (mean = 4.24 [1.85]) or placebo (mean = 3.91 [1.66]) participants, whose scores did not significantly differ from each other.

Discussion

In several previous studies (Abbey et al., 2005; MacDonald et al., 1996), intoxicated participants were more willing to have unprotected sex with a hypothetical partner than were sober or placebo participants. In this study, only intoxicated participants who had low average or average verbal skills, as measured by the WRAT3, expressed more interest than other participants in having unprotected sex. These findings can be interpreted within the context of theoretical models that describe cognitive reserve (Richards and Sacker, 2003; Stern, 2002). In general, people with lower cognitive reserve may have a more difficult time making complex decisions, particularly those that involve many potential benefits and costs that must be simultaneously evaluated. The cognitive impairments induced by acute alcohol consumption are likely to tax these individuals' already limited cognitive reserve, thereby enhancing the likelihood that they will make poor decisions. Unexpectedly, intoxicated participants with high WRAT3 scores were least likely to report that they would have sex without a condom in this situation. This suggests that individuals with high levels of cognitive reserve may be particularly vigilant when drinking and sometimes overcompensate for expected impairments (cf. Fillmore and Blackburn, 2002). A few aggression researchers have examined the effects of acute alcohol consumption in conjunction with measures of ECF (Giancola, 2004; Pihl et al., 2003). We are not aware of a study that has examined the effects of cognitive reserve on sexual decision making or one that has used the WRAT3 to assess cognitive functioning. Thus, it is important to replicate these findings in future research.

As found in past research, acute alcohol intoxication did not influence all the components of sexual decision making that one might expect. Alcohol is one of many variables that influence sexual decision making, and its effects must be considered in context (Cooper, 2002). Most sexually active individuals make decisions about whether they should use a condom with a new partner based on subjective factors, such as how much they care for the person, how healthy the person looks, and if the person seems to be the type that "sleeps around a lot" (Hammer et al., 1996). Objective risk factors such as partner's frequency of condom use, number of past partners, intravenous drug use, and STD/HIV test results are seldom discussed among new sexual partners (Paul and Hayes, 2002). In this study, none of the independent variables were significantly related to participants' likelihood of discussing common risks before deciding to have sex with this hypothetical partner. Comments made by students in focus groups conducted to aid in the development of the stimulus materials

demonstrated that decisions about condom use were rarely made based on objective information about partners' past behavior. Male and female college students were convinced that they could tell by looking if a prospective partner had an STD.

The cues that were manipulated to suggest a high- or low-risk partner were successful in portraying different types of people, with the high-risk partner perceived as more sexual and less trustworthy than the low-risk partner. Although there were no differences in willingness to have unprotected sex with the high- versus low-risk partner, sober participants were less interested in dating the high-risk partner than were intoxicated participants. It is disturbing from a prevention perspective that participants' willingness to have unprotected sex with a hypothetical partner was unaffected by knowledge that this person had been in many relationships and currently had at least one other partner. Although women often express more caution about sexual partners than do men (Amaro, 1995), there were relatively few gender differences. Unlike men, women in this study perceived the high-risk partner as less trustworthy and were less interested in dating him. However, although women were less likely than men to indicate that they would have unprotected sex in this situation, these ratings were unaffected by partner risk or alcohol consumption.

As noted earlier, most studies in this domain have not found differences based on expectancy set; placebo participants provide responses similar to those of sober participants (Abbey et al., 2005; Fromme et al., 1999; MacDonald et al., 2000; Maisto et al., 2004). With one exception, this was also the case in the present study. Both intoxicated and placebo participants reported being more sexually aroused by the video than did sober participants. Perceived sexual arousal is the dependent measure that has most frequently been associated with expectancy effects in past sexuality research (George and Stoner, 2000). The reason for this is not completely clear, although George and colleagues have hypothesized that placebo effects are most likely in situations in which individuals feel that their sexual response may be deviant. Perhaps participants felt uncomfortable acknowledging that a video they watched in the lab was sexually arousing, and this encouraged placebo participants to attribute their arousal to alcohol consumption. There is a need for more carefully articulated theories to guide researchers' hypotheses about when they should expect to find only pharmacological effects of alcohol and when they should also expect to find expectancy effects.

Limitations and directions for future research

Although students at this university are ethnically diverse, future research is needed with community samples. The use of a college sample also produced a distribution with relatively high overall verbal skills; therefore, the effects of cognitive reserve might be stronger in general population studies. Many adolescents engage in risky sexual behavior when drinking alcohol; however, alcohol administration studies cannot include individuals under the legal drinking age of 21. Another limitation associated with alcohol administration studies is the need to rely on proxy measures of sexual risk taking. Although the realism of the stimulus materials was established through extensive pilot testing, there is a need for complementary data from well-designed surveys that assess the co-occurrence of alcohol consumption and sexual risk taking.

As a measure of reading skills, the WRAT3 assesses only one component of cognitive reserve. Thus, to pinpoint the types of predrinking cognitive impairments that are most likely to interact with alcohol consumption, future research should include measures that assess a broad range of cognitive skills, including multiple components of verbal functioning (e.g., comprehension, reading, writing) and major components of ECF (e.g., response inhibition, working memory, set shifting). Recent research on boys' antisocial behavior suggests that spatial skills deficits may also be linked to aggression and other risk behaviors (Raine et al., 2005).

Implications for prevention programs

The findings from this study document the need for STD/HIV prevention programs that go beyond factual presentations and provide students with the skills they need to assess risk realistically. College students perform well on tests of basic HIV/AIDS knowledge; however, they have difficulty applying this abstract knowledge to their own personal decisions. Although the findings need to be replicated, these results indicate that college students tend to use irrelevant factors to determine partner risk and are willing to have unprotected sex with a high-risk partner. These findings also suggest that prevention programs are needed that provide tailored messages for individuals with low cognitive skills.

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References

- Abbey A, Saenz C, Buck PO. The cumulative effects of acute alcohol consumption, individual differences and situational perceptions on sexual decision making. *J Stud Alcohol*. 2005; 66:82–90. [PubMed: 15830907]
- Abrams BD, Fillmore MT, Marcynski CA. Alcohol-induced impairment of behavioral control: Effects on the alteration and suppression of prepotent responses. *J Stud Alcohol*. 2003; 64:687–695. [PubMed: 14572191]
- Ackerman, PL. Ability determinants of individual differences in skilled performance. In: Sternberg, R.J.; Pretz, J.E., editors. *Cognition and Intelligence: Identifying the Mechanisms of the Mind*. New York: Cambridge Univ. Press; 2005. p. 142–159.
- Amaro H. Love, sex, and power: Considering women's realities in HIV prevention. *Amer Psychol*. 1995; 50:437–447. [PubMed: 7598292]
- American College Health Association. The American College Health Association National College Health Assessment (ACHA-NCHA), spring 2003 reference group report. *J Amer Coll Hlth*. 2005; 53:199–210.
- Bartholow BD, Pearson MA, Gratton G, Fabiani M. Effects of alcohol on person perception: A social cognitive neuroscience approach. *J Pers Social Psychol*. 2003; 85:627–638.
- Buyse A, Ickes W. Communication patterns in laboratory discussion of safer sex between dating versus nondating partners. *J Sex Res*. 1999; 36:121–134.
- Cooper ML. Alcohol use and risky sexual behavior among college students and youth: Evaluating the evidence. *J Stud Alcohol Supplement*. 2002; (14):101–117.
- Crawford M, Popp D. Sexual double standards: A review and methodological critique of two decades of research. *J Sex Res*. 2003; 40:13–26. [PubMed: 12806528]
- Curtin JJ, Fairchild BA. Alcohol and cognitive control: Implications for regulation of behavior during response conflict. *J Abnorm Psychol*. 2003; 112:424–436. [PubMed: 12943021]

- Davidson, JE.; Downing, CL. Contemporary models of intelligence. In: Sternberg, RJ., editor. *Handbook of Intelligence*. New York: Cambridge Univ. Press; 2000. p. 34-49.
- Duncan J, Emslie H, Williams P, Johnson R, Freer C. Intelligence and the frontal lobe: The organization of goal-directed behavior. *Cog Psychol*. 1996; 30:257–303.
- Espy KA, Molfese VJ, DiLalla LF. Effects of environmental measures on intelligence in young children: Growth curve modeling of longitudinal data. *Merrill-Palmer Q*. 2001; 47:42–73.
- Fillmore MT, Blackburn J. Compensating for alcohol-induced impairment: Alcohol expectancies and behavioral disinhibition. *J Stud Alcohol*. 2002; 63:237–246. [PubMed: 12033701]
- Fillmore MT, Dixon MJ, Schweizer TA. Differential effects of alcohol on responses to negatively and positively primed stimuli. *J Stud Alcohol*. 2000; 61:872–880. [PubMed: 11188493]
- Finn PR, Justus A, Mazas C, Steinmetz JE. Working memory, executive processes and the effects of alcohol on go/no-go learning: Testing a model of behavioral regulation and impulsivity. *Psychopharmacology*. 1999; 146:465–472. [PubMed: 10550497]
- Fromme K, D'Amico EJ, Katz EC. Intoxicated sexual risk taking: An expectancy or cognitive impairment explanation? *J Stud Alcohol*. 1999; 60:54–63. [PubMed: 10096309]
- George WH, Stoner SA. Understanding acute alcohol effects on sexual behavior. *Annual Rev Sex Res*. 2000; 11:92–124. [PubMed: 11351836]
- Giancola PR. Executive functioning: A conceptual framework for alcohol-related aggression. *Exp Clin Psychopharmacol*. 2000; 8:576–597. [PubMed: 11127429]
- Giancola PR. Executive functioning and alcohol-related aggression. *J Abnorm Psychol*. 2004; 113:541–555. [PubMed: 15535787]
- Giancola PR, Mezzich AC, Tarter RE. Executive cognitive functioning, temperament, and antisocial behavior in conduct-disordered adolescent females. *J Abnorm Psychol*. 1998; 107:629–641. [PubMed: 9830250]
- Griffin SL, Mindt MR, Rankin EJ, Ritchie AJ, Scott JG. Estimating premorbid intelligence: Comparison of traditional and contemporary methods across the intelligence continuum. *Arch Clin Neuropsychol*. 2002; 17:497–507. [PubMed: 14592003]
- Hammer JC, Fisher JD, Fitzgerald P, Fisher WA. When two heads aren't better than one: AIDS risk behavior in college-age couples. *J Appl Social Psychol*. 1996; 26:375–397.
- Johnstone B, Callahan CD, Kapila CJ, Bouman DE. The comparability of the WRAT-R Reading Test and NAART as estimates of premorbid intelligence in neurologically impaired patients. *Arch Clin Neuropsychol*. 1996; 11:513–519. [PubMed: 14588456]
- Kareken DA, Gur RC, Saykin AJ. Reading on the Wide Range Achievement Test-Revised and parental education as predictors of IQ: Comparison with the Barona formula. *Arch Clin Neuropsychol*. 1995; 10:147–157. [PubMed: 14589736]
- Keppel, G. *Design and Analysis: A Researcher's Handbook*. Third. Upper Saddle River, NJ: Prentice Hall; 1991.
- Lau MA, Pihl RO, Peterson JB. Provocation, acute alcohol intoxication, cognitive performance, and aggression. *J Abnorm Psychol*. 1995; 104:150–155. [PubMed: 7897038]
- Le Carret N, Lafont S, Letenneur L, Dartigues JF, Mayo W, Fabrigoule C. The effect of education on cognitive performances and its implication for the constitution of the cognitive reserve. *Devel Neuropsychol*. 2003; 23:317–337. [PubMed: 12740188]
- Letz R, DiIorio CK, Shafer PO, Yeager KA, Henry TR, Schomer DL. A computer-based reading test for use as an index of premorbid general intellectual level in North American English-speaking adults. *Neurotoxicology*. 2003; 24(4-5):503–512. [PubMed: 12900063]
- Lewis DF, Goodhart F, Burns WD. New Jersey college students' high-risk behavior: Will we meet the health objectives for the year 2000? *J Amer Coll Hlth*. 1996; 45:119–126.
- Linville, P.; Fisher, G.; Fischhoff, B. AIDS risk perceptions and decision biases. In: Pryor, J.; Reeder, GD., editors. *The Social Psychology of HIV Infection*. Mahwah, NJ: Lawrence Erlbaum; 1993. p. 5-38.
- MacDonald TK, MacDonald G, Zanna MP, Fong G. Alcohol, sexual arousal, and intentions to use condoms in young men; Applying alcohol myopia theory to risky sexual behavior. *Hlth Psychol*. 2000; 19:290–298.

- MacDonald TK, Zanna MP, Fong GT. Why common sense goes out the window: Effects of alcohol on intentions to use condoms. *Pers Social Psychol Bull.* 1996; 22:763–775.
- Maisto SA, Carey MP, Carey KB, Gordon CM. The effects of alcohol and expectancies on risk perception and behavioral skills relevant to safer sex among heterosexual young adult women. *J Stud Alcohol.* 2002; 63:476–485. [PubMed: 12160107]
- Maisto SA, Carey MP, Carey KB, Gordon CM, Schum JL, Lynch KG. The relationship between alcohol and individual differences variables on attitudes and behavioral skills relevant to sexual health among heterosexual young adult men. *Arch Sexual Behav.* 2004; 33:571–584.
- Meilman PW. Alcohol-induced sexual behavior on campus. *J Amer Coll Hlth.* 1993; 42:27–31.
- Moffitt TE. Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychol Rev.* 1993; 100:674–701. [PubMed: 8255953]
- Murphy ST, Monahan JL, Miller LC. Inference under the influence: The impact of alcohol and inhibition conflict on women's sexual decision making. *Pers Social Psychol Bull.* 1998; 24:517–528.
- National Institute on Alcohol Abuse and Alcoholism. Recommended Council Guidelines on Ethyl Alcohol Administration in Human Experimentation. Rockville, MD: Department of Health and Human Services; 1989.
- Oliver MB, Hyde JS. Gender differences in sexuality: A metaanalysis. *Psychol Bull.* 1993; 114:29–51. [PubMed: 8346327]
- Paul EL, Hayes KA. The casualties of “casual” sex: A qualitative exploration of the phenomenology of college students' hookups. *J Social Pers Relation.* 2002; 19:639–661.
- Perkins HW. Surveying the damage: A review of research on consequences of alcohol misuse in college populations. *J Stud Alcohol.* 2002; (Supplement No. 14):91–100. [PubMed: 11925064]
- Peterson JB, Rothfleisch J, Zelazo PD, Pihl RO. Acute alcohol intoxication and cognitive functioning. *J Stud Alcohol.* 1990; 51:114–122. [PubMed: 2308348]
- Pihl RO, Assaad JM, Hoaken PNS. The alcohol-aggression relationship and differential sensitivity to alcohol. *Aggress Behav.* 2003; 29:302–315.
- Poulson RL, Eppler MA, Satterwhite TN, Wuensch KL, Bass LA. Alcohol consumption, strength of religious beliefs and risky sexual behavior in college students. *J Amer Coll Hlth.* 1998; 46:227–232.
- Raine A, Moffitt TE, Caspi A, Loeber R, Stouthamer-Loeber M, Lynam D. Neurocognitive impairments in boys on the life-course persistent antisocial path. *J Abnorm Psychol.* 2005; 114:38–49. [PubMed: 15709810]
- Richards M, Sacker A. Lifetime antecedents of cognitive reserve. *J Clin Exp Neuropsychol.* 2003; 25:614–624. [PubMed: 12815499]
- Sayette MA, Smith DW, Breiner MJ, Wilson GT. The effect of alcohol on emotional response to a social stressor. *J Stud Alcohol.* 1992; 53:541–545. [PubMed: 1434629]
- Scarmeas N, Zarahn E, Anderson KE, Hilton J, Flynn J, van Heertun RL, Sackeim HA, Stern Y. Cognitive reserve modulates functional brain responses during memory tasks: A PET study in healthy young and elderly subjects. *Neuroimage.* 2003; 19:1215–1227. [PubMed: 12880846]
- Siegler, RS. Thinking and intelligence. In: Bornstein, MH., editor. *Well-Being: Positive Development Across the Life Course.* Mahwah, NJ: Lawrence Erlbaum; 2003. p. 311–320.
- Steele CM, Josephs RA. Alcohol myopia: Its prized and dangerous effects. *Amer Psychol.* 1990; 45:921–933. [PubMed: 2221564]
- Stern Y. What is cognitive reserve? Theory and research application of the reserve concept. *J Int Neuropsychol Soc.* 2002; 8:448–460. [PubMed: 11939702]
- Taylor, SP.; Leonard, KE. Alcohol and human physical aggression. In: Geen, RG.; Donnerstein, EI., editors. *Aggression: Theoretical and Empirical Reviews, Vol 2: Issues in Research.* San Diego, CA: Academic Press; 1983. p. 77–101.
- Vance B, Fuller GB. Relation of scores on WISC-III and WRAT-3 for a sample of referred children and youth. *Psychol Rep.* 1995; 76:371–374. [PubMed: 7667446]
- Warner MH, Ernst J, Townes BD, Peel J, Preston M. Relationships between IQ and neuropsychological measures in neuropsychiatric populations: Within-laboratory and cross-

cultural replications using WAIS and WAIS-R. *J Clin Exp Neuropsychol.* 1987; 9:545–562.
[PubMed: 3667899]

Wechsler H, Lee JE, Kuo M, Seibring M, Nelson TF, Lee H. Trends in college binge drinking during a period of increased prevention efforts Findings from 4 Harvard School of Public Health College Alcohol Study surveys: 1993-2001. *J Amer Coll Hlth.* 2002; 51:203–217.

Wiens AN, Bryan JE, Crossen JR. Estimating WAIS-R FSIQ from the National Adult Reading Test-Revised in normal subjects. *Clin Neuropsychol.* 1993; 7:70–84.

Wilkinson, GS. *The Wide Range Achievement Test (WRAT3) Administration Manual.* Wilmington, DE: Wide Range; 1993.

Table 1
The effects of drink condition and cognitive reserve on the likelihood of having sex without a condom ($N = 120$)

Drink condition	Cognitive reserve			
	Low Mean (SD)	<i>n</i>	High Mean (SD)	<i>n</i>
Sober	2.69 (1.82)	16	2.92 (2.16)	24
Placebo	2.60 (1.93)	20	2.60 (1.82)	20
Intoxicated	3.62 ^a (2.06)	16	2.21 ^b (1.14)	24

Notes: The reading subtest of the Wide Range Achievement Test 3 (WRAT3) was used to assess cognitive reserve. Scores with different superscripts in the same row are significantly different from each other ($p < .008$).

Table 2
The effects of drink condition and partner risk on the likelihood of future dating ($N = 120$)

Drink condition	Partner risk	
	Low Mean (SD)	High Mean (SD)
Sober	5.85 ^a (1.26)	4.15 ^b (1.35)
Placebo	5.65 (1.23)	4.92 (1.92)
Intoxicated	5.31 (1.35)	5.30 (1.18)

Notes: $n = 20$ per cell. Scores with different superscripts in the same row are significantly different from each other ($p < .001$).

Table 3
Gender differences ($N = 120$)

Variable	Women Mean (SD) ($n = 60$)	Men Mean (SD) ($n = 60$)	F^a
Sexual arousal	3.38 (1.76)	3.77 (1.76)	2.39
Partner's sexuality	4.83 (1.06)	4.67 (1.14)	0.07
Partner's trustworthiness	4.67 (1.20)	5.11 (1.03)	3.92*
Discuss risk prior to having sex	3.09 (1.41)	3.06 (1.32)	0.59
Likelihood of having unprotected sex	2.17 (1.45)	3.65 (2.02)	17.28 [†]
Feel foolish after unprotected sex	6.59 (0.94)	5.81 (1.32)	11.12 [†]
Regret unprotected sex	6.26 (1.17)	4.79 (1.71)	23.90 [†]
Likelihood of dating partner later	4.89 (1.66)	5.50 (1.19)	5.02*

^a 1/96 df.

* $p < .05$:

[†] $p < .01$.