Virtual Reality Cues for Binge Drinking in College Students

4 authors, including:

Joseph Ryan
University of Central Missouri
335 PUBLICATIONS **3,808** CITATIONS

SEE PROFILE

David S Kreiner
University of Central Missouri
94 PUBLICATIONS **530** CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Silver Alert Study View project

indepentent investigation not part of another project View project

Virtual Reality Cues for Binge Drinking in College Students

Joseph J. Ryan, Ph.D., David S. Kreiner, Ph.D., Marla D. Chapman, M.S., and Kim Stark-Wroblewski, Ph.D.

Abstract

We investigated the ability of virtual reality (VR) cue exposure to trigger a desire for alcohol among binge-drinking students. Fifteen binge-drinking college students and eight students who were nonbingers were immersed into a neutral-cue environment or room (underwater scenes), followed by four alcohol-cue rooms (bar, party, kitchen, argument), followed by a repeat of the neutral room. The virtual rooms were computer generated via head-mounted visual displays with associated auditory and olfactory stimuli. In each room, participants reported their subjective cravings for alcohol, the amount of attention given to the sight and smell of alcohol, and how much they were thinking of drinking. A 2×6 (type of drinker by VR room) repeated measures ANOVA was conducted on the responses to each question. After alcohol exposure, binge drinkers reported significantly higher cravings for and thoughts of alcohol than nonbinge drinkers, whereas differences between the groups following the neutral rooms were not significant.

Introduction

BINGE DRINKING AMONG COLLEGE STUDENTS is a major problem on American campuses. Binge drinking is the consumption of five or more alcoholic beverages at one sitting by men and four or more drinks at a single sitting by women.[1] One drink is defined as "one 12-ounce bottle of beer, one 5-ounce glass of wine, or 1.5 ounces of distilled spirits."[2] According to Calhoun et al.,[3] 20.2% of college students drink heavily. Binge drinking during the college years can have negative consequences, including poor academic performance, conflicts with the law, and motor vehicle accidents.[4]

Virtual reality (VR) technology utilizes computer graphics, motion trackers, head-mounted displays, and audio and olfactory stimuli to create virtual environments depicting a variety of situations, including those involving drug- and alcohol-related situations. Previous research demonstrates that specific VR-cue exposure produces significant increases in the desire for nicotine among smokers[5] as well as for heroin[6] and cocaine[7] among drug addicts and drug abusers. For example, Bordnick, Graap, et al.[8] exposed smokers to VR rooms with and without smoking cues such as the presence of cigarette packages and of people smoking. Smokers had increases in self-reported cravings and skin conductance response as a result of the cue exposure. Bordnick, Traylor, et al.[9] used a similar procedure to investigate whether exposure to alcohol-related cues could increase the desire for alcohol among individuals with problem drinking behaviors. Results indicated that alcohol-related VR cues did produce increased craving for alcohol among individuals with alcohol use disorders.

Cho et al.[10] also investigated cravings for alcohol in a VR setting. Their participants reported higher cravings for alcohol when an avatar in the VR scenario applied social pressure. Although the presence of alcohol in VR affected cravings, it did so only when there was no social pressure in the form of an avatar. Further, an analysis of where participants were looking (reflected by measuring the angle between the direction of head gazing and the direction of alcohol cues or the avatar) indicated that the avatar was more influential than the presence of alcohol. It is important to note that the sample in the Cho et al. study did not report high levels of alcohol consumption.

A demonstration that virtual cues trigger a desire to binge drink would constitute an advance in substance abuse research by providing a method to (a) investigate alcohol use behaviors among college students and (b) identify interventions to weaken associations between environmental cues and the desire to drink. This is the first study to assess the utility of VR-cue exposure for alcohol in altering the behaviors of students with a history of binge drinking. If it can be established that VR cues can be effective in eliciting cravings for alcohol, the research will provide the basis for effective treatments to weaken those associations. It was hypothesized that college student binge drinkers, in comparison to a control group, would demonstrate an increase in self-reported desire to binge drink after experiencing VR alcohol cues.

Department of Psychology, University of Central Missouri, Warrensburg, Missouri.

Method

Participants

Twenty-three college students were selected from a pool of volunteers who completed a drinking history survey. Fifteen were binge drinkers, and eight were nonbinge drinkers. Means for age and number of alcoholic beverages typically consumed at one sitting for binge drinkers were 21.3 years ($SD = 0.8$) and 8.1 drinks ($SD = 2.7$). Means for nonbinge drinkers were 28.0 years ($SD = 10.61$) for age and 0.56 ($SD = 0.5$) for number of drinks typically consumed at a single sitting.

Virtual reality

Virtually Better, Inc. (Atlanta, Georgia) produced the software that provided the VR experience. In addition to the software, two Dell computers and a head-mounted display obtained from Virtually Better were utilized. This display consisted of a 3D visor containing two small television screens, one for each eye. The visor had a full-motion tracking device that provided a 360-degree view of the computer-generated virtual world. A handheld controller (Gravis Destroyer Tilt, Virtually Better) was used by participants to answer questions presented visually at specific points during the VR experience. Ear phones were used to present participants with environmentally appropriate sounds, and an Insignia 200W receiver-amplifier processed the sounds (e.g., virtual people talking, door closing after the participant leaves the virtual rooms). An EnviroScent Scent Palette was employed to emit a variety of odors appropriate to the virtual environment. The scents used were vanilla, beer, whiskey, lit cigarette, pizza, perfume, coffee mocha, citrus fusion, and flower shoppe. Other than the beer scent, odor-emitting materials were purchased from Envirodine Studios, Inc. (Elmhurst, Illinois). To make the beer scent, Coors Light beer was poured into a container filled with scent beads purchased from Virtually Better. These scent beads or cartridges soaked up the liquid and emitted a strong beer scent.

Procedure

Each participant was seen individually in the VR laboratory by the same experimenter. Following a brief period of conversation and rapport building, the participant was seated in a comfortable chair and a head-mounted display and ear phones were positioned and a controller device for responding to questions concerning the desire to drink was placed in his or her hands. The scent of a favorite drink was prepared. Each participant experienced 5 minutes in a neutral-cue room (picture of underwater scenes) and then entered four alcohol-cue rooms (kitchen, bar, argument, party) with visual and olfactory alcohol cues and avatars (i.e., graphical images of people) who encouraged drinking behavior (see Figs. 1–4). The neutral-cue room experience was repeated at the end of the VR session. Bordnick et al.[9] demonstrated that the alcohol-cue rooms elicited stronger cravings for alcohol than did the neutral-cue rooms in a sample of individuals with alcohol use disorders. After leaving each room, each participant used the handheld controller to provide ratings on an 11-point Likert-type scale (0, *not at all*, to 10, *more than ever*). The four ratings were the same as those used by Bordnick et al.[9]:

1. Adjust the slider to indicate your greatest craving for alcohol (to drink) at this time.

FIG. 1. Screenshot of kitchen room.

2. How much did you pay attention to the sight of alcohol in the room?
3. How much did you pay attention to the smell of alcohol in the room?
4. How much did you think about drinking while you were in the room?

Statistical analysis

The hypothesis was tested by determining whether differences in ratings between binge drinkers and nonbinge drinkers depended on the type of room. If the alcohol-cue rooms tended to elicit cravings particularly for the binge drinkers, then a significant interaction should emerge between type of drinker (binge vs. nonbinge) and VR room. To test this hypothesis, we conducted a 2×6 repeated measures

FIG. 2. Screenshot of bar room.

FIG. 3. Screenshot of argument room.

ANOVA on the responses to each question, with type of drinker and VR rooms as the factors. In these analyses, a main effect of type of drinker indicates an overall difference in mean ratings between binge drinkers and nonbinge drinkers. A main effect of VR room indicates a difference among the six VR rooms in mean ratings. The relevant test for the hypothesis is that of the interaction between type of drinker and room. For ratings on which there was a significant interaction, we determined the source of the interaction by performing t tests to compare ratings of binge drinkers to nonbinge drinkers on each of the rooms. Because the Mauchly test indicated a violation of sphericity, F tests are reported with degrees of freedom adjusted according to the Greenhouse-Geisser method.

Results

For craving for alcohol, the main effect of room was significant, $F(3.04, 63.85) = 10.88$, $p < 0.001$, partial $\eta^2 = 0.34$, but the main effect of type of drinker was not significant, $F(1, 21) = 3.76$, $p = 0.07$, partial $\eta^2 = 0.15$. There was a significant room by drinker interaction on reported craving, $F(3.04,

FIG. 4. Screenshot of party room.

Table 1. Means and Standard Deviations for Question 1: Craving for Alcohol

	Drinking group			
	Binge		Nonbinge	
Room	M	SD	M	SD
Neutral A	0.21	0.35	0.51	0.84
Kitchen*	2.12	1.60	0.66	0.85
Bar	2.49	1.69	1.37	2.53
Argument	0.48	0.64	0.34	0.61
Party*	2.44	1.83	0.60	1.07
Neutral B	0.61	1.04	0.12	0.35

*Independent samples t test indicated a significant difference at $p < 0.05$ between binge drinkers and nonbinge drinkers.

63.85) = 3.71, $p = 0.02$, partial $\eta^2 = 0.15$. Binge drinkers indicated significantly higher cravings than nonbinge drinkers in the kitchen and party rooms, whereas differences between groups in the barroom, argument room, and the two neutral rooms were not significant. Table 1 presents response means and standard deviations for alcohol craving.

For attention to the sight of alcohol, there was a significant main effect of room, $F(3.00, 62.95) = 62.83$, $p < 0.001$, partial $\eta^2 = 0.75$, but not of type of drinker, $F(1, 21) = 0.92$, $p = 0.35$, partial $\eta^2 = 0.04$. The room by drinker interaction was not significant, $F(3.00, 62.95) = 1.91$, $p = 0.14$, partial $\eta^2 = 0.08$.

The same pattern of results occurred for ratings of attention to the smell of alcohol. There was a significant main effect of room, $F(2.16, 45.44) = 8.72$, $p < 0.001$, partial $\eta^2 = 0.29$, but not of type of drinker, $F(1, 21) = 1.53$, $p = 0.23$, partial $\eta^2 = 0.07$; and the room by drinker interaction was not significant, $F(2.16, 45.44) = 1.11$, $p = 0.34$, partial $\eta^2 = 0.05$.

For ratings on thinking about drinking, the main effect of room was significant, $F(3.15, 66.14) = 21.87$, $p < 0.001$, partial $\eta^2 = 0.70$, as was the main effect of type of drinker, $F(1, 21) = 6.72$, $p = 0.02$, partial $\eta^2 = 0.24$. There was a significant room by drinker interaction, $F(3.15, 66.14) = 2.94$, $p = 0.04$, partial $\eta^2 = 0.12$. Binge drinkers indicated higher levels of thinking about drinking than did nonbinge drinkers in the bar and party rooms, with minimal differences between binge and nonbinge drinkers in the kitchen room, argument room, and the two neutral rooms (see Table 2).

Table 2. Means and Standard Deviations for Question 4: Thinking about Drinking

	Drinking group			
	Binge		Nonbinge	
Room	M	SD	M	SD
Neutral A	0.53	0.83	0.38	0.52
Kitchen	5.13	2.83	2.75	2.49
Bar*	5.27	2.60	2.25	3.01
Argument	1.60	1.50	0.75	1.16
Party	3.93	2.58	1.38	1.19
Neutral B	1.07	1.75	0.12	0.35

*Independent samples t test indicated a significant difference at $p < 0.05$ between binge drinkers and nonbinge drinkers.

Discussion

The current results support the hypothesis that VR cues can trigger alcohol cravings in college students whose history includes binge drinking. Binge drinkers reported higher cravings for alcohol than did nonbinge drinkers in two of the four cue rooms that incorporated alcohol cues, but the two groups did not differ in reported cravings in the two neutral rooms. Similarly, binge drinkers indicated higher levels of thinking about drinking than did nonbinge drinkers in two of the cue rooms that included alcohol cues, but not in the neutral rooms.

This study is the first to demonstrate that among college students with a history of binge drinking, virtual alcohol cues significantly increase the reported desire to drink. These findings parallel previous investigations demonstrating that VR cues presented to smokers and drug abusers, respectively, produce significant increases in the desire for nicotine[5] and illicit drugs.[6,7] Our findings were consistent with those of Cho et al.[10] in demonstrating the effectiveness of VR cues for alcohol cravings in moderate drinkers as well as with the findings of Bordnick et al.[9] on alcohol cravings in problem drinkers. The fact that differences between binge drinkers and nonbinge drinkers differed in only some of the situations suggests that cravings may be sensitive to the specific context. Although it was not the focus of the present study, Cho et al.'s[10] research suggests that social pressure in VR may be an important factor in which contexts are likely to trigger alcohol cravings. Of the nonneutral rooms in the present study, both the bar and party rooms contained an avatar that represented social pressure (in the form of offering a drink to the participant). In both of these rooms, we found significant differences in reported thinking about drinking between binge drinkers and nonbinge drinkers. In the party room but not in the barroom, we found a significant difference between the two groups in reported craving for alcohol. When comparing our results to those of Cho et al.,[10] one should consider that cultural differences between the U.S. and Korean samples may be related to any effects of social pressure from the avatars. These results suggest that the presence of social pressure in the form of an avatar may be important for understanding triggers for alcohol use in binge drinkers. More research is needed to identify how specific contextual cues may be related to cravings.

It should also be noted that the comparison group of nonbinge drinkers reported cravings for alcohol, just not at binge-drinker levels. It is possible that the VR scenarios trigger alcohol cravings even in nonbinge drinkers. It is also important to note the substantial difference in age between the binge and nonbinge drinking groups; nonbinge drinkers were approximately 7 years older on average than binge drinkers. Another important limitation with the present study is that the dependent variables were all self-report measures. However, the findings of Cho et al.[10] indicated consistency in findings between self-reported craving and the more objective measure of where participants were looking.

Finally, the small number of participants, particularly of nonbinge drinkers, limited statistical power. Differences for some of the rooms might have been significant with a larger sample.

Future investigations need to incorporate physiological assessments (e.g., skin conductance response) into their protocols to more fully elucidate the phenomena of VR-cue exposure. In addition, the possibility of using VR-cue exposure to teach coping and refusal skills within the clinical setting is worthy of exploration.

Disclosure Statement

No competing financial interests exist.

References

1. Borsari B, Carey KB. Two brief alcohol interventions for mandated college students. Psychology of Addictive Behaviors 2005; 19:296–302.
2. U.S. Department of Health & Human Services. Alcohol alert. Alcohol Research & Health 2005; 28:1–8.
3. Calhoun VD, Carvalho K, Pearlson GD. Using virtual reality to study alcohol intoxication effects on the neural correlates of simulated driving. Applied Psychology & Biofeedback 2005; 30:285–306.
4. Brower AM. Are college students alcoholics? Journal of American College Health 2002; 50:1–4.
5. Bordnick PS, Graap KM, Copp H, et al. Utilizing virtual reality to standardize nicotine craving research: a pilot study. Addictive Behaviors 2004; 29:1889–94.
6. Kuntze MF, Stoermer R, Mager R, et al. Immersive virtual environments in cue exposure. CyberPsychology & Behavior 2001; 4:497–501.
7. Saladin ME, Brady KT, Graap KM, et al. A preliminary report on the use of virtual reality technology to elicit craving and cue reactivity in cocaine dependent individuals. Addictive Behaviors 2006; 31:1881–94.
8. Bordnick PS, Graap KM, Copp HL, et al. Virtual reality cue reactivity assessment in cigarette smokers. CyberPsychology & Behavior 2005; 33:487–92.
9. Bordnick PS, Traylor A, Copp HL, et al. Assessing reactivity to virtual reality alcohol based cues. Addictive Behaviors 2008; 33:743–56.
10. Cho S, Ku J, Park J, et al. Development and verification of an alcohol craving-induction tool using virtual reality: craving characteristics in social pressure situation. CyberPsychology & Behavior 2008; 11:302–09.

Address correspondence to:
Dr. Joseph J. Ryan
Department of Psychology
University of Central Missouri
Lovinger 1111
Warrensburg, MO 64093

E-mail: ryan@ucmo.edu