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TESTING ALCOHOL AS A DISCRIMINATIVE STIMULUS FOR GAMBLING BEHAVIOR

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In two training sessions, participants consumed alcohol or a control beverage and then played a pair of slot-machine simulations programmed to pay off differentially as a function of the beverage that had been consumed. During test sessions, participants again consumed either alcohol or a control beverage and were given concurrent access to the two slot-machine simulations (which were now programmed to pay off equally). Results did not indicate that alcohol (or the control beverage) controlled participants' choice behavior between the two slot-machine simulations during testing despite the history of differential reinforcement. A number of procedural details likely contributed to this result and their implications for future research are discussed.

Keywords: Alcohol, discrimination, gambling.

Drug discrimination procedures have been heavily utilized to examine the interaction between drugs and behavior (Willner, Field, Pitts, & Reeve, 1998; Hogarth, Dickinson, & Duka, 2003; Field & Duka, 2002). These studies have shown that people can make a correct choice on a task based on whether or not the drug is present. Generally, the first step in these procedures is a training phase in which one response is reinforced in the presence of a drug and another response is reinforced in its absence. During testing, participants are given the drug or a placebo and given concurrent access to the two responses, typically in the absence of reinforcement. If participants make the response previously associated with the presence or absence of the drug, then discrimination is said to have occurred.

Stimuli (e.g., colors) associated with differential reinforcement (e.g., "more than" vs. "less than"; Zlomke & Dixon, 2006) have been demonstrated to control responding when participants choose between simulated slot machines. To date, however, no study has demonstrated that choice between gambles can come under stimulus control of a drug (e.g., alcohol). This determination would appear important given that that the biggest risk factor for pathological gambling is substance use and abuse (see Petry, 2005), with research identifying a link between pathological gambling and alcohol use (e.g., Grant, Kushner, & Kim, 2002).

The present study was designed to determine whether alcohol consumption could control choice between two slot-machine simulations. During training, one simulation paid off at a higher rate than the other when participants consumed alcohol, with the reverse being true when they consumed a control beverage. During testing, participants consumed alcohol or a control beverage and were then given concurrent access to the two simulations. If discrimination occurred, then participants should prefer the simulation that

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paid out at the high rate when they had consumed that type of beverage during training. If the consumption of alcohol can control choices between gambles, then the results would indicate that the interaction between gambling and alcohol consumption may be more complex than simply the pharmacological effects of alcohol on decision making (e.g., George, Rogers, & Duka, 2005).

METHOD

Participants

Twelve individuals (6 female; 6 male) were recruited from the Psychology Department participant pool. Participants had to be 21 years of age or older (M = 21.64 yrs, SD = .81 yrs) and not have a history of gambling or drinking problems, as determined by the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987; M = .45, SD = .69) and the Michigan Alcohol Screening Test (MAST; Selzer, 1971; M = 2.27, SD = 1.42), respectively, to participate.

Materials

Participants completed four measures. The first was a demographic questionnaire that asked about his/her age, gender, marital status, ethnicity, and annual income (i.e., known risk factors for pathological gambling and/or substance abuse and dependence; Grant, Harford, Dawson, & Chou, 1994; Petry, 2005). The second was the SOGS, a widely employed screening tool used to identify potential pathological gamblers (i.e., a score of 5 or more). Participants who scored 5 or more were not allowed to continue. The third was the MAST, which identifies participants who may be problem drinkers (i.e., a score of 6 or more). Participants who scored 6 or more were not allowed to continue. The fourth measure was a short survey asking whether or not the participants thought they had consumed alcohol and to estimate their blood-alcohol content (BAC) level, which was administered after each session.

Apparatus

The experiment was conducted in a small, windowless room. The room contained two desktop computers with a slot machine program on each (MacLin, Dixon, & Hayes, 1999). BAC levels were determined using a breathalyzer (Alcomonitor CC Series 02.XX; Intoximeters Inc., St. Louis, MO). A standard household scale was used to weigh participants, which was necessary to calculate the alcohol dosage that would be administered.

Procedure

Participants were run individually, with each completing four sessions conducted on separate days. The researcher instructed participants to refrain from eating for at least 3 hours prior to each session. At the beginning of the first session, the researcher obtained informed consent and had the participant complete the demographic questionnaire, SOGS, and MAST. After scoring the SOGS and MAST to determine continued participation (no participants had to be dismissed), the researcher recorded the participant's BAC level to ensure it started at 0, which was done each session. The researcher then weighed the participant and used the information to mix either an alcoholic beverage with a dose of 0.35 ml/kg for females and 0.40 ml/kg for males or a placebo beverage. The alcoholic beverage was a 3 to 1 mixture of orange juice and 90% grain alcohol, with the dosage intended to produce a BAC reading of approximately 0.04. Because participants differed in weight, the amount of alcohol (in ounces) varied across participants. This particular dosage level was chosen because previous research has shown that alcohol can be discriminated at this level and produce positive subjective effects (Davidson, Carnara, & Swift, 1997). The placebo beverage was orange juice with alcohol wiped on the rim of the glasses with a cotton swab.

The first two sessions were training sessions. Participants consumed the beverage in three equal doses, one per 5-min interval, over a 15-min period. Half of the participants consumed alcohol in the first session and the placebo beverage in the second. The order was reversed for the other half of the participants. After participants finished their drinks, the researcher measured their BAC level and then every 5 min for 15 min. No specified activity occurred during this 15-min period (i.e., participants did not play the slot-machine simulation). After the last reading, the researcher instructed the participant to gamble 25 consecutive trials on each slot-machine simulation (50 trials total). Each simulation started with 100 credits worth 5 cents each ($5) and, on any given trial, participants could bet one or five credits. One simulation was programmed to pay back at a rate of 1.74% while the other was programmed to pay back at a rate of 118.43%. Which computer paid out at the higher rate varied as a function of which beverage the participant had consumed. Which computer served as the higher-payout simulation during the alcohol session was counterbalanced across participants.

The last two sessions were testing sessions. Participants again consumed an alcoholic or control beverage, with the order again counterbalanced across participants. Participants were then given concurrent access to both slot-machine simulations, again with both loaded with 100 credits each. The researcher told the participant that s/he could gamble for 30 min, until all the credits were lost, or until the participant decided to quit gambling. In testing sessions, both simulations were programmed to pay out at a rate of 1.74%.

After every session, participants filled out the questionnaire that asked them to identify whether they had consumed alcohol and to estimate their BAC. The researcher remained with the participant until the participant's BAC was below 0.02. After the final session, participants were debriefed, paid for the number of credits they had accumulated across the four sessions, given extra course credit, and dismissed.

RESULTS AND DISCUSSION

One male participant declined to gamble on the simulations during either of the testing sessions. Data from this participant were not analyzed because it was not possible to determine whether his gambling was controlled by the type of beverage consumed.

Results for the remaining 11 participants suggested their gambling did not vary as a function of the type of beverage consumed during the testing sessions. A two-way (Beverage by Computer) repeated measures ANOVA was conducted on the number of credits bet on each computer simulation for each participant. The main effect of beverage ($F(1, 10) = 1.58$, $p = .238$, $\eta^2 = .136$), computer ($F < 1$, $\eta^2 = .000$), and interaction between beverage and computer ($F < 1$, $\eta^2 = .083$) each failed to reach statistical significance (i.e., $p < .05$). An identical two-way ANOVA, conducted on the number of trials played on each simulation, also resulted in non-significant main effects of beverage ($F < 1$, $\eta^2 = .022$) and computer ($F(1, 10) = 1.50$, $p = .249$, $\eta^2 = .130$), as well as interaction between beverage and computer ($F < 1$, $\eta^2 = .043$). A Chi-square conducted on which computer the participants played first during the two testing sessions was also not significant ($X^2 \geq .14$, $df = 1$, $p = .800$).

The failure to observe discrimination in the testing sessions was not a failure of participants discriminating what type of beverage they had consumed. Data from post-session questionnaires indicated that participants correctly identified whether they had consumed alcohol in 41 of the 44 total sessions, with the 3 failures coming during training (all of which were mistakenly reporting of consuming alcohol when they had not[1]). A two-way (Beverage by Computer) repeated measures ANOVA conducted on the number of credits bet in the two training sessions indicated that there was no main effect of beverage ($F < 1$, $\eta^2 = .080$) or of computer ($F < 1$, $\eta^2 = .001$), but that the interaction between beverage and computer was significant ($F(1, 10) = 10.48$, $p = .01$, $\eta^2 = .51$). The significant interaction indicates that participants bet more credits on the different simulations during the different training sessions (i.e., the winning computer). Thus, the lack of discrimination during the testing sessions was not a function of the failure to discriminate the difference between the simulations during the training sessions.

Despite previous research suggesting that participants' gambling can come under stimulus control of stimuli such as color (e.g., Zlomke & Dixon, 2006), the present research failed to demonstrate that it could come under the control of the consumption (or non consumption) of alcohol. The present failure did not appear to be a function of the participants' ability to discriminate whether or not they had consumed alcohol, as they correctly identified whether or not they had over 93% of the time. Likewise, it does not appear to be a failure of experiencing differential reinforcement in the presence or absence of consuming alcohol.

For future research in this area, we recommend the following. First, increase the discriminability between the beverages. In the present procedure, the rim of the glasses of the placebo beverages was swabbed with alcohol. We did so because this practice is standard in alcohol research to ensure that any effects are due to the pharmacological effects of the drug rather than its subjective effects (e.g., Petros et al., 2003).

In the present instance, however, we may have been better served by maximizing the difference between the two beverages. Several potential ways of doing so would be to control beverage altogether, or both.

Second, increase the amount of training increase the dose of alcohol, eliminate the participant's experience. In the present procedure, participants experienced only one session with both the alcohol and control beverage. Doing so was problematic in several ways. For one, when participants misidentified which beverage they had consumed in a training session, it completely negated having any experience with that particular beverage (which occurred for 3 participants). Next, gambling is by nature a probabilistic enterprise. Thus, it may have been unrealistic to expect that having participants win on a certain simulation after drinking a particular beverage would condition the expectation of *always* winning on that simulation after drinking that particular beverage. In fact, participants may have had the reverse expectation – not expecting to win on that simulation because they had won on it last time. Extended training would have eliminated these problems. The latter problem may have been solved had we had participants play more than 25 trials on each simulation during the training session.

Third, increase the discriminability between the two gambling options. In the present procedure, the choice was between the same simulated slot-program loaded on two different computers. However, the researcher noted in several instances during the training session that a participant would express disappointment about losing during the session, rather than discriminating that s/he had won on one simulation and lost on the other. This discrimination might be enhanced by using different games (e.g., slot machine vs. video poker or roulette) for the different options. It is potentially worth noting at this point that the difference in payback percentages between the simulations in the present study greatly exceeded the differences one might expect to experience in a natural environment,

1. It is possible that the failure of beverage to exert stimulus control over behavior in the testing sessions occurred because 3 of the participants believed they had twice received alcohol during the training sessions, winning once on each simulation. Results were reanalyzed excluding the data from these 3 participants. Significant effects were still not observed.

such as a casino, where slot machines are generally programmed to pay back at between 80 – 98%. Thus, we did attempt to maximize discriminability in terms of payback percentage. Using different games in future research might not only further enhance discriminability, but also better mimic the natural environment (e.g., casino-goers are faced with numerous different potential games).

Finally, a clear weakness of the present design was the use of only 12 (ultimately 11) participants. Significant effects may have been observed if this number was increased several fold. However, given the procedural demands required in studies such as this one (e.g., participants coming in to the laboratory on four separate occasions), keeping the sample size small was also a practical issue. We believe that, if the above recommendations were to be followed, significant results could be observed with the present sample size.

Given the link between alcohol (and other substance) use and gambling, further research on whether choices made when gambling can come under stimulus control of the drug seems warranted. Although the present study failed to show such an outcome, its value may be that it identifies the procedural variables that may be of importance to show such an effect. Because such procedures, even as straightforward as the present one, are major undertakings both for the participants and the researchers, the present study may ultimately be invaluable.

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