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Operant responding for alcohol following alcohol cue exposure in social drinkers

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HIGHLIGHTS

- Motivation to drink after cue exposure was measured with an operant response task.
- Social drinkers drank in accordance with their typical drinking habits.
- Alcohol cues may not lead to excessive consumption in non-dependent drinkers.

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ABSTRACT

Introduction: Cue reactivity paradigms have found that alcohol-related cues increase alcohol consumption in heavy drinkers and alcoholics. However, evidence of this relationship among non-alcohol dependent "social" drinkers is mixed, suggesting that individual differences must be considered when examining cue-induced drinking behavior. One important individual difference factor that might contribute to cue-induced drinking in the laboratory is the amount of alcohol that participants typically drink during occasions outside the laboratory. That is, those who typically consume more alcohol per occasion could display greater cue-induced drinking than those who typically drink less. The present study examined this hypothesis in healthy, non-dependent beer drinkers.

Methods: The drinkers were exposed to either a series of beer images intended to prime their motivation to drink beer or to a series of non-alcoholic images of food items that served as a control condition. Following cue exposure, motivation to drink was measured by giving participants an opportunity to work for glasses of beer by performing an operant response task.

Results: Results indicated that drinkers exposed to alcohol cues displayed greater operant responding for alcohol and earned more drinks compared with those exposed to non-alcohol (i.e., food) cues. Moreover, individual differences in drinking habits predicted subjects' responding for alcohol following exposure to the alcohol cues, but not following exposure to food cues.

Conclusions: The findings suggest that cue-induced drinking in non-dependent drinkers likely results in consumption levels commensurate with their typical consumption outside the laboratory, but not excessive consumption that is sometimes observed in alcohol-dependent samples.

1. Introduction

It has long been known that alcohol cues induce reactions in drinkers which may increase alcohol-seeking behavior. Indeed, decades of cue reactivity research has shown that exposure to alcohol cues can lead to physiological and subjective changes in an individual that are assumed to underlie increased craving for alcohol. In general, these studies have shown that exposure to alcohol cues may induce changes in heart rate, blood pressure, skin conductance, salivation, as well as changes in self-reported mood, and subjective craving for alcohol (e.g., Beirness & Vogel-Sprott, 1984; Drummond, 2000; Field & Duka, 2002; Fox, Bergquist, Hong, & Sinha, 2007; Monti et al., 1987; Newlin, 1986; Staiger & White, 1988).

In terms of actual alcohol consumption, cue reactivity studies have attempted to show that alcohol cues can prime the motivation to drink. Individuals in these studies are typically shown alcohol cues (e.g., alcohol bottle or alcohol images) or neutral cues (e.g., food items or office supplies). The degree to which such cue exposure primes alcohol consumption is measured by how much alcohol is subsequently consumed by subjects when given ad libitum access to alcohol, or during bogus taste-rating tasks where they are asked to sample and evaluate the taste of alcoholic beverages (Carter & Tiffany, 1999).

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Studies using these methods have shown that alcohol cues increase alcohol consumption in alcoholics (e.g., Cooney, Baker, Pomerleau, & Josephy, 1984; Kaplan et al., 1985; Ludwig, Wikler, & Stark, 1974; Monti et al., 1987).

The most compelling evidence that alcohol cues prime the motivation to drink in these individuals has been demonstrated by cue reactivity studies that use operant response tasks in which participants must "work" to obtain alcoholic drinks according to fixed or progressive ratio schedules. Operant tasks are said to provide a more direct assessment of the motivation to drink because the tasks require work or effort on the part of the subject to acquire alcohol compared with ad libitum access or taste-rating measures where alcohol is simply freely available (Fillmore & Rush, 2001; Stafford, LeSage, & Glowa, 1998). Operant tasks assess motivation to drink by the number of operant responses displayed for alcohol, and in the case of progressive ratios, by the highest ratio of responses completed for an alcoholic drink (i.e., the breakpoint). Their use as measures of motivation to drink has been documented for some time, particularly their ability to detect cue-induced priming of drinking behavior in alcoholics (e.g., Mello & Mendelson, 1965; Mendelson & Mello, 1966; Nathan, O'Brien, & Lowenstein, 1971).

Although such studies provide compelling support for the idea that alcohol cues can motivate excessive alcohol consumption, the finding is almost entirely based on samples of alcohol-dependent or problem drinkers, such as binge drinkers (Carter & Tiffany, 1999). Evidence for cue-induced drinking in nondependent (i.e., social) drinkers has been equivocal (Tiffany, 2000). There could be several reasons for the failure to reliably observe cue-induced drinking in social drinkers. It is generally accepted that alcohol cues (e.g., images of alcoholic beverages) motivate drinking behavior because they have acquired conditioned incentive properties having been previously paired with the rewarding effects of consuming alcohol. With repeated pairing, the cues themselves come to elicit an incentive effect that motivates the drinker to seek alcohol (e.g., Litt, Cooney, Kadden, & Gaupp, 1990; Tiffany & Conklin, 2000). Accordingly, one explanation for the failure to observe cue-induced drinking behavior in social drinkers might simply be that social drinkers have not had a sufficient drinking history necessary to develop conditioned responses to alcohol cues (Vogel-Sprott & Fillmore, 1999). However, this seems somewhat unlikely given that social drinkers readily display other conditioned reactions (e.g., physiological and behavioral changes) in response to alcohol cues (e.g., Laberg, Hugdahl, Stormark, Nordby, & Aas, 1992; Monti et al., 1993; Niaura et al., 1988).

Another explanation is that the general notion that alcohol cues should motivate excessive drinking in social drinkers might not be tenable. There is little reason to expect that a non-dependent, social drinker with no history of heavy drinking would drink excessively in response to alcohol cues, especially in a comparatively sterile laboratory environment. Indeed, for such individuals, exposure to alcohol cues might at the most, prime motivation to consume an amount of alcohol commensurate with amounts they typically consume during a drinking occasion outside the laboratory. Thus for non-dependent drinkers an important factor in the degree to which alcohol cues might prime the motivation to drink is the amount of alcohol typically consumed by the individual outside the laboratory. That is, for non-dependent drinkers, alcohol cue exposure in the laboratory might, at the most, instigate the subject to drink an amount of alcohol that they would typically consume outside the laboratory. Such an account could explain why alcohol cue exposure often fails to "prime" alcohol consumption in social drinkers beyond levels observed in control conditions in which social drinkers are exposed to non-alcoholic "neutral" cues.

The present study sought to test the hypothesis that exposure to alcohol cues primes motivation to drink in social drinkers at quantities that are generally commensurate with their own individual typical quantities consumed per occasion outside the laboratory. Participants provided measures of their typical drinking habits and then completed an alcohol cue exposure treatment followed by a test of their motivation to drink using an operant response task. A group of control subjects underwent the identical procedure but were exposed to non-alcohol (i.e., food) cues. It was predicted that alcohol cue exposure would prime the motivation to drink, but that operant responding for alcohol would be generally proportionate to the subjects' quantity of alcohol typically consumed per occasion outside the laboratory. Thus the amount of alcohol earned on the operant response task was expected to be positively related to the subjects' typical quantity of alcohol consumed outside the laboratory. By contrast, food cues were not predicted to prime subjects' motivation to drink, and thus no such relationship was predicted between their typical drinking habits and their operant responding for alcohol in the laboratory.

2. Methods

2.1. Participants

Forty-eight adults between 21 and 35 years of age participated in this study. Twenty-four subjects (10 women and 14 men) were randomly assigned to the alcohol cue exposure treatment and twenty-four subjects (11 women and 13 men) were randomly assigned to the food cue exposure treatment. The racial makeup of the sample was Caucasian ($n = 40$), African-American ($n = 4$), American Indian/Alaskan Native ($n = 1$), Hispanic/Latino ($n = 1$), and those reporting "other" ($n = 2$). Volunteers completed questionnaires that provided information on demographics, drinking habits, other drug use, and physical and mental health status. For inclusion, all volunteers had to report at least bi-monthly consumption of alcohol and had to indicate that beer was their preferred beverage. Volunteers who self-reported head trauma, psychiatric disorder, or substance abuse disorder were excluded from participation. Volunteers were also excluded if their current alcohol use met dependence/withdrawal criteria as determined by the substance use disorder module of the *Structured Clinical Interview for DSM-IV (SCID-IV)*. As an additional screening measure for alcohol dependence, volunteers scoring 5 or higher on the Short-Michigan Alcoholism Screening Test (Selzer, Vinokur, & van Rooijen, 1975) were excluded from participation in the study.

No participant reported the use of any psychoactive prescription medication and recent use of amphetamines (including methylphenidate), barbiturates, benzodiazepines, cocaine, opiates, and tetrahydrocannabinol was assessed by means of urine analysis. Any volunteer who tested positive for the presence of any of these drugs was excluded from participation. No female volunteers who were pregnant or breast-feeding participated in the research. The University of Kentucky Medical Institutional Review Board approved the study, and participants received $60 for their participation.

2.2. Apparatus and materials

2.2.1. Cue exposure treatment

Participants were exposed to a series of images of appetitive stimuli that were either alcohol-related or food-related. The images were presented at 5 3/4 in. by 7 1/4 in. on a computer display. For the alcohol cue exposure treatment, participants were required to view 40 alcohol-related images, 20 complex scenes with alcohol embedded (i.e., no greater than 30% of the image) and 20 simple images in which alcohol was the sole object (e.g., a bottle of beer). In order to ensure that the alcohol images were appealing to beer drinkers, all of the alcohol images consisted of beer. The images were selected to emphasize the positive aspects of drinking beer. Images depicted cold beer being poured into frosted glasses, people enjoying beer in pleasant social settings, and the like. Each image was presented for 15 s with a 2 s inter-image interval between images during which a blank screen was visible. Participants completed the task in two sets of 20 images (10 complex and 10 simple). To ensure that participants attended to the images, they were informed that the images were part of a memory test. Prior to the first set, participants were told that the purpose of the task was to closely inspect the images for later recall during the session. The