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Short Communication

Sex moderates stress reactivity in heavy drinkers

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HIGHLIGHTS

- Study examined stress effects on craving and mood among heavy drinkers.
- Females showed greater stress-induced craving and negative mood than males.
- The relationship between mood and craving was stronger among females.

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ABSTRACT

Psychological stress and alcohol use disorders have a well-known connection. Individual differences in stress reactivity have been an area of interest in alcohol research, particularly given the relationship between craving and stress reactivity to later relapse. The present study examines the role of sex on stress-induced alcohol craving and emotional reactivity using a guided imagery stress paradigm. Participants were 64 non-treatment seeking heavy drinkers from the community who completed a two-session protocol that included two guided imagery exposures, Stress and Neutral. Participants reported their mood and craving before and after each exposure using the Differential Emotions Scale and the Alcohol Urge Questionnaire respectively. Analyses revealed a significant Stress × Sex × Trial effect on craving [F (1,61) = 5.35; $p < .05$] after controlling for AUDIT scores [F (1,61) = 8.16; $p < .01$] such that females reported greater increases in craving from baseline to post-imagery during the stress imagery versus the neutral imagery condition, than did males. Mood reactivity analysis showed similar patterns. Specifically, there was a significant Stress × Sex × Trial effect on the anxiety subscale of the DES [F (1,61) = 15.81; $p < .001$] such that females reported greater increases in anxiety from baseline to post-imagery during the stress imagery versus the neutral conditions, than did males. These results suggest that female heavy drinkers were more sensitive to the effects of the stress-induction on alcohol craving and mood reactivity than males. If supported by future studies, these initial findings may help advance understanding of the mechanisms of stress and mood regulation as central to alcoholism liability and recovery in females.

1. Introduction

The link between psychological stress and alcohol use disorders is well established (Pohorecky, 1991). Data from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) showed that greater number of life stressors were associated with greater levels of frequent heavy drinking (Dawson, Grant, & Ruan, 2005). In laboratory settings, stress induction has been shown to provoke physiological reactivity and lead to subsequent drinking (Thomas, Bacon, Randall, Brady, & See, 2011).

Given the relation of craving and stress reactivity to later relapse (Bottlender & Soyka, 2004; Brown, Vik, Patterson, Grant, & Schuckit, 1995), individual differences in stress reactivity have been an area of interest in alcohol research. Many studies have utilized the Trier Social Stress Task (TSST; Kirschbaum & Pirke, 1993) for laboratory stress induction. However, this paradigm relies on an individual's social and performance anxiety to induce stress. The present study utilized guided imagery (Sinha et al., 2009) to recreate a stressful event unique to the individual, thus boosting external validity relative to the TSST, which has been shown to be effective in drug abusing populations (Fox et al., 2005).

Further, sex is an important consideration in stress reactivity research. A human laboratory study of healthy social drinkers using guided imagery for stress induction found that women showed greater negative emotional response than men and that men's alcohol craving was associated with higher subjective emotional responses (Chaplin, Hong, Bergquist, & Sinha, 2008). The aforementioned study, however,

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showed no sex differences in alcohol craving. In a study of heavy drinkers using the TSST for stress induction, men consumed more alcohol post-stress than women (Nesic & Duka, 2006). Studies of sex differences in alcohol craving have also yielded mixed results. For example, Willner, Field, Pitts, and Reeve (1998) reported that male, but not female, social drinkers showed greater craving for alcohol after consumption of a priming dose of alcohol (i.e., small alcoholic beverage). In a study of cue reactivity, it was found that women were more reactive to alcohol cues than men when in a negative mood state (Rubonis, Colby, Monti, Rohsenow et al., 1994). While the cognitive mechanisms by which individuals may be more vulnerable to stress and/or cue-induced craving remain opaque, recent studies have found that rumination (Caselli, Bortolai, Leoni, Rovetto, & Spada, 2008; Caselli et al., 2010) and desire thinking (Caselli & Spada, 2011) predict drinking status broadly. Rumination, defined as a passive focus on one's symptoms of distress and possible causes and consequences of those symptoms, has been found to be elevated among females (Nolen-Hoeksema & Jackson, 2001). Desire thinking, defined as voluntary cognitive processing involving verbal and imaginal elaboration of a desired target (Caselli & Spada, 2011), may also serve to maintain cue-induced craving. In fact, Kavanagh, Andrade, and May (2004) argue that one's ability to accept the occurrence of craving and reduce the elaboration of desire is an effective strategy to cope. Therefore it is plausible, yet remains untested, that females may experience greater stress and cue-induced craving as a function of elevations in rumination or desire thinking. Interestingly, the aforementioned associations between rumination and drinking status hold even after controlling for co-occurring depressive symptoms (Caselli et al., 2008; Caselli et al., 2010). According to this line of research, individuals with such preservative cognitive styles may hold stressful information in mind longer and perhaps even elaborate on its content, thus leading to greater increases in alcohol craving.

In light of the literature associating sex with stress reactivity and alcohol craving, this study examines the role of sex on stress-induced alcohol craving and emotional reactivity in heavy drinkers. Specifically, this study tests whether gender moderates stress reactivity at the level of both mood reactivity (i.e., positive mood, negative mood, and anxiety) and stress-induced craving for alcohol. This may be especially important given recent evidence that the sex gap in alcohol use may be closing ("Vital signs: Binge," 2013; Keyes, Grant, & Hasin, 2008). Based on the aforementioned studies, it is hypothesized that men will report greater stress-induced alcohol craving than women, and that women will show greater negative emotional response to stress induction than men. Moreover, this study will utilize guided imagery, an ecologically valid approach, to examine this relationship and will control for symptoms of depression and anxiety, which may bias stress-reactivity.

2. Methods

2.1. Participants and procedures

Non-treatment seeking heavy drinkers were recruited from the Los Angeles community (N = 64). Inclusion criteria were: age 18–65 and an Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993) score of 8 or higher to verify heavy drinking levels. Exclusion criteria included: current or past 30-day treatment for alcohol problems; lifetime diagnosis of schizophrenia, bipolar or psychosis; current, regular use of psychoactive drugs, other than marijuana. Data for this study were culled from a previous investigation of genetic determinants of stress reactivity (Ray, 2011).

Following a telephone screen, participants were invited in to complete a two-session protocol. At the first session participants provided written informed consent and completed self-report measures at which time a Breath Alcohol Concentration (BrAC) of 0.00 g/dl was required. Additionally, participants provided information about a recent non-traumatic, stressful, *unresolved* event and a neutral event. Events were coded as one of four types: interpersonal, medical, achievement, or environmental. The participants then received relaxation training and imaginal exposure training in order to enhance completion of the guided imagery protocol. At the second visit, participants completed two guided imagery exposures, Stress and Neutral, each consisting of 5-minute tape-recorded scripts recounting the events described by participants at the first visit (Sinha, 2009; Sinha, Fuse, Aubin, & O'Malley, 2000). Guided imagery exposures were conducted one hour apart. Experimental conditions were conducted one hour apart and in randomized and counterbalanced order to avoid carryover effects (see Ray, 2011). All procedures were approved by the UCLA Institutional Review Board for Human Research. Participants were compensated $50 for completing the study.

2.2. Measures

The following measures were administered pre and post neutral and stress exposures during the protocol.

2.2.1. Alcohol Urge Questionnaire (AUQ)

The AUQ, an 8-item scale, was used to assess state levels of alcohol craving using a 7-point Likert scale (Bohn, Krahn, & Staehler, 1995). Observed Cronbach alphas for the AUQ ranged from .92 to .94 across administrations showing excellent reliability.

2.2.2. Differential Emotions Scale (DES)

The DES is 31-item measure of mood, including positive mood, negative mood, and anxiety. Mood items on the DES are rated on a 5-point Likert scale (Sinha et al., 2009). The positive mood subscale had Cronbach alphas ranging from .89 to .93, the negative mood subscale ranged from .76 to .88, and the anxiety subscale ranged from .58 to .73.

2.2.3. Beck Depression Inventory (BDI-II)

The BDI-II is a 21-item measure which assesses for depressive symptoms present over the past two weeks (Beck, Steer, & Brown, 1993). Scores range from 0 to 63 with a total score above 20 indicating moderate to severe depression.

2.2.4. Beck Anxiety Inventory (BAI)

The BAI is a 21-item measure of anxiety symptoms present over the past week (Beck & Steer, 1993). Scores range from 0 to 63 and total scores above 16 are indicative of moderate to severe anxiety.

2.3. Data analysis plan

To test the study hypothesis regarding sex differences on stress reactivity, a series of mixed design analysis of variance (ANOVAs) were conducted in which Imagery (Stress versus Neutral) and Trial (Before and After Imagery) were within-subject factors, Sex was a between-subjects factor, and scores on mood and alcohol craving were the dependent measures. New variables were created to represent differences between post-stress and pre-stress mood, and post-stress and pre-stress craving, in order to examine the relationship between craving and mood during stress induction. Given that there were differences by sex on measures of alcohol use and alcohol problems (i.e., AUDIT), these variables were entered in the models as covariates. Additionally, BAI, BDI-II, and stressor type were added to the models, one at a time, as covariates.

3. Results

3.1. Participant characteristics

The mean age of the sample was 20.75 (SD = 2.64). The majority of the sample was employed part-time or were full-time students