Alcohol Dose Effects on Fear Conditioning with Varying Levels of Threat Intensity

Christine A Moberg, Stefanie M Weber, Jason N Jaber, Allison M Grant, & John J Curtin
UNIVERSITY OF WISCONSIN-MADISON

ABSTRACT

The stress reducing properties of alcohol are well known and occasionally pursued by all drinkers. However, frequent use of use of alcohol to reduce stress predicts subsequent problems with alcohol (Cooper, 1995; Schroder & Perrine 2007). In addition, contemporary models of addiction implicate changes in stress system function due to chronic alcohol use in the etiology of alcohol dependence (Koob & LeMoal, 2008). Therefore, clarification of the nature of alcohol's effect on stress is important to understand both social and problematic alcohol use.

Research on the alcohol-stress relationship has been guided for decades by the Stress-Response Dampening (SRD) model, which proposed that alcohol reduces emotional response to aversive stimuli generally, across drinkers, blood alcohol concentrations (BACs), and varied stressors. This broad thesis has not been consistently supported by laboratory research (Greeley & Oei, 1999). However, recent evidence suggests that SRD effects may be more likely at higher BACs (Donohue et al., 2007). Moreover, the characteristics of the stress manipulation may also moderate these effects (e.g., threat probability, Moberg & Curtin, 2009; focus of attention, Curtin et al. 2001). The current project parametrically varied BAC and included a novel manipulation of threat intensity to examine the overall and interactive effects of these two factors on stress response.

Ninety-two participants were assigned to one of four BAC groups (target BACs of 0%, 0.04%, 0.075%. or .011%). Participants viewed a series of 6s colored square cue presentations, in intermixed shock and no-shock blocks. During shock blocks, shocks were administered at the termination of each cue. The color of the cue indicated the intensity of the shock: mild, moderate, or intense, based on each participant's individual tolerance threshold. Startle potentiation (startle during shock cues relative to no-shock cue) was used to index stress response to mild, moderate and intense shock cues.

Startle potentiation increased with increasing shock cue intensity. A significant main effect of BAC group was observed with startle potentiation decreasing as BAC increased. Shock cue intensity moderated this BAC effect such that the BAC effect on startle potentiation was strongest at the highest shock intensity. These results suggest that stress response is attenuated at higher blood alcohol concentrations and this alcohol dose response effect is more robust when the stress-eliciting stimulus is highly potent.

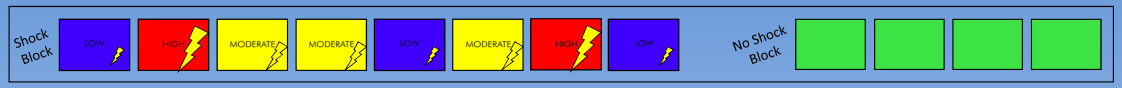
BACKGROUND

- Stress reduction is a common expectation of alcohol consumption, and individuals who drink in order to reduce stress are more likely to develop alcohol problems than those who do not.
- The Stress Response Dampening (SRD) Model has been the theoretical background on which much alcohol-stress research has been based. The SRD Model suggests that alcohol reduces stress broadly, across situations, type of stress and BAC levels.
- However, laboratory research has not consistently supported this hypothesis (see Curtin & Lang, 2007, for a review).
- Recent evidence suggests that there are BAC effects such that alcohol has direct, suppressive effects on fear response at the highest doses (Donohue, et al. 2007).

The goal of the current study is to examine the effects of parametric manipulation of shock intensity and alcohol dose in order to better characterize the effects of alcohol on emotional response.

HYPOTHESES

- Increasing shock intensity will produce higher fear response.
- As BAC increases, fear response will be reduced.
- The highest threat intensity will provide the best context to observe alcohol's SRD effects (BAC X Intensity interaction).

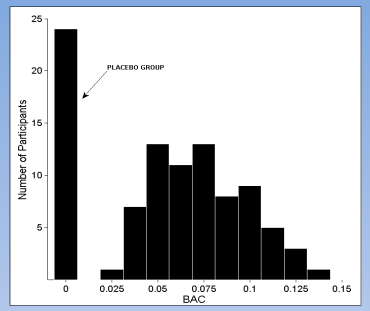


RESULTS

SHOCK INTENSITY MANIPULATION

- There was a significant **main effect of shock intensity**, F(2,176)=24.97, p<.001, indicating that we were able to increase startle potentiation by increasing shock intensity

We then used repeated contrasts to examine the within-subjects effects of shock intensity.
- A **trend level effect** was found for the **mild vs. moderate shock** comparison, F(1,88)=3.86, p=.053,
- We found a **significant effect** when comparing **moderate vs. intense shock**, F(1,88)=20.02, p<.001.



BAC MANIPULATION

Participants were randomly assigned to one of four beverage groups:
- Placebo
- Low (target BAC = .04%)
- Moderate (target BAC = .075%)
- High (target BAC = .11%)

However, the histogram of mean achieved BACs (at left) indicates a more continuous distribution. In order to clarify the pattern of results, we conducted analyses with BAC treated both as a categorical variable and a quantitative variable.

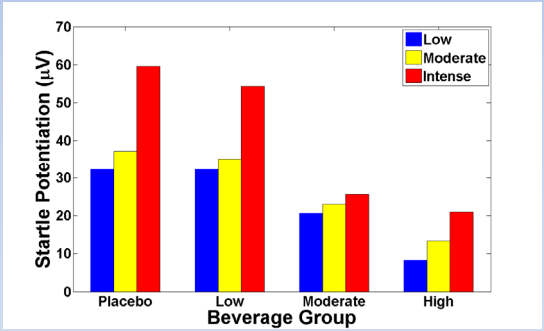
CATEGORICAL BAC ANALYSIS

BEVERAGE GROUP. We found a **main effect of Beverage Group,** F(3,88)= 5.63, p=.001. Contrasts were used to further examine this effect.
- Placebo vs. Low dose p=.747
- Low vs. Moderate dose p= .038
- Moderate vs. High dose p=.283

INTERACTION. The **interaction of beverage group and shock intensity was significant**, H-F corrected F(6, 176)=2.52, p=.028.

In order to decompose the interaction between shock intensity and BAC treated categorically, we conducted repeated contrasts.

Low vs. Moderate intensity X BAC F(3,88)=0.12, p=.947
Moderate vs. High intensity X BAC F(3,88)=2.63, p=.055



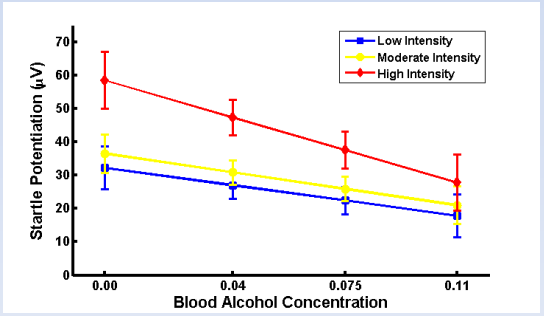
CONTINUOUS BAC ANALYSIS

BEVERAGE GROUP. There was a **main effect of Mean BAC,** F(1,90) = 13.23, p<.001, indicating that startle potentiation decreased as blood alcohol concentration increased.

INTERACTION. There was a **significant interaction of mean achieved BAC and shock intensity**, H-F corrected F(2,180)=5.28, p=.009

Single degree-of-freedom contrasts were used to decompose the interaction.
Low vs. Moderate intensity X BAC F(1,90)=0.02 p=.885
Moderate vs. High intensity X BAC (1,90)=5.64 p=.020

These results indicate that the effect of blood alcohol concentration was greatest during the most intense shocks, relative to moderate and low intensity shocks



METHOD

General Procedure
- All participants completed a pre-drink baseline startle assessment and a post-drink shock tolerance assessment
- Participants viewed blocks of 6s colored square cue presentations separated by variable ITIs (10-20s)
- Alternate between Shock and No-Shock blocks
  - No-Shock: No shocks are administered
  - Shock: Shock intensity may be low, moderate, or high. Administered at 5.5s post cue onset

Measure Used
- The primary dependent measure was **startle potentiation**
- **Startle potentiation** was computed as the increase in startle response to an acoustic "startle probe" from a No-Shock to a Shock condition
- We computed average startle potentiation scores for each level of shock intensity

INTERPRETATIONS

•Other research from our laboratory suggests that moderate doses of alcohol may reduce anxiety responses that are elicited in the face of uncertain threat (Moberg & Curtin, 2009; see also Hefner et al., poster). However, **this experiment indicates that at high blood alcohol concentrations, alcohol may suppress what we (and others) have labeled fear response to certain threat (contingent, highly probable, imminent).**

• This effect of alcohol may be most sensitively detected during high intensity threat, possibly because floor effects on the reduction of startle potentiation are avoided . **If this is the case, researchers should aim to use the most potent manipulations available in order to detect hypothesized effects.**

• Future work should examine the effect of dividing different levels of shock into separate blocks, as the unpredictability of the next shock's intensity may have led to a sense of anxiety in participants and activated brain pathways which are known to be affected by alcohol.

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