Negative affect drives ethanol intake during drinking-in-the-dark (DID) sessions in P-rats


1College of Pharmacy, Division of Pharmacology and Toxicology, 2Behavioral Neurosci, 3Department of Biology, Univ. of Texas, AUSTIN, TX

Abstract

Positive and negative motivational effects are well-established components of excessive ethanol drinking. Clinical studies report strong emotional impulses often fuel binge drinking after periods of abstinence. However, no previously reported animal studies have monitored emotional responses during excessive ethanol (EtOH) drinking to examine motivational components of this behavior. Undetectable to humans, rats emit ultrasonic vocalizations (USVs) to convey positive and negative emotional appraisals of environmental social or drug-related cues recently reported “positive affect” 50-kHz USVs in rats, induced by cocaine and cocaine-conditioned cues (Ma et al 2010; Maier et al 2012), and further enhanced by drug and cue abstinence. (Maier 2020). Within this study, we utilized alcohol-prefering “P” rats and a “drinking-in-the-dark” (DID) procedure, and recorded USVs throughout 7-h DID sessions. Over 8 weeks of DID sessions, EtOH intake ranged from approx 2.0-2.5 g/kg/session and increased to approx 3.0 g/kg in Reinstate sessions conducted 1 and 2 wks after DID sessions. Ethanol intake measurement accuracy was confirmed by determining blood alcohol content (BAC) through gas chromatography procedures in a subsequent 30 min EtOH access session. Experimental findings revealed that 50-kHz and 22-28 kHz (“negative affect”) USVs were emitted by both EtOH- and H2O (Control) access groups during various intervals of DID sessions. Positive affect 50-kHz USVs did not significantly vary between experimental and control groups during drinking intervals or in anticipation of drinking. However, the number of negative affect (22-28 kHz) USVs emitted during periods of EtOH unavailability was strongly correlated with EtOH intake during the same DID session. These findings indicate that negative, rather than positive reinforcement processes can immediately motivate EtOH drinking in “P” rats.

Methods

Animals, groups, and handling phase

Sixteen alcohol-prefering rodents (approximately 6 weeks old; INRA Core, Indiana University) were acclimated to the facility and handled for three weeks. Shortly before the start of the study, the animals were singly housed in a room with a reverse light-dark cycle (lights off at 7:00). Food and water were available ad libitum.

DID Sessions

The rats were transferred from their home cage to an experimental cage. After a ten-minute anticipatory period, each rat received three 1-hour ethanol access periods separated by two hours with just water. During the ethanol access periods, the rats were presented with water, 15% and 30% ethanol. The experiment was conducted 5 days/week with a 2-day weekend between each week. USVs were recorded only three days/week. The drinking sessions were conducted over 8 weeks paired with a coffee scent.

Extinction and reinstatement

Extinction was followed by 1 week of extinction paired with a peppermint scent. During extinction, the bedding in the experimental cages was not changed at all. Then, 2 reinstatement sessions were conducted 1 week apart, with a coffee scent on the first day and a peppermint scent on the second. The animals were left undisturbed in their home cages during the week between the two sessions. One week after reinstatement with the peppermint scent, the rats were given access to alcohol for 30 minutes, and then blood alcohol levels were measured using gas chromatography.

Conclusion

Spontaneously elicited negative affect USVs (22-28 kHz) may be unique to Alcohol-prefering rats. In contrast to cocaine-experienced animals (Maier et al 2012), positive affect USVs (50 kHz) are not uniquely associated with impeding alcohol availability.

Negative affect appears to be particularly associated with ethanol drinking: Spontaneously emitted 22-28 kHz USVs are 1) increased during EtOH drinking, 2) increased during NO EtOH access intervals, and 3) significantly correlated with ethanol intake levels

References


Supported by NIAAA INIA West Consortium (CDP). NIAAA T32 AA073715-07. University of Texas VP Research Office (MP, SK, HS). APPIC Fellowship Program (NT)