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Effects of Alcohol and Caffeine on Wheel Running Activity in the Mongolian Gerbil

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PETTIJOHN, T. F. *Effects of alcohol and caffeine on wheel running activity in the Mongolian gerbil.* PHARMAC. BIOCHEM. BEHAV. **10**(3) 339–341, 1979.—This study investigated the effects of various doses of alcohol (0.8, 1.6, 2.4 g/kg) and caffeine (5, 10, 15, 20 mg/kg) on wheel running activity in 180 male and female adult Mongolian gerbils. Animals were tested for two 10-min trials 48 hours apart. Thirty min prior to Trial 2, injections were administered intraperitoneally. The results indicate that low doses of both alcohol and caffeine increase and higher doses of alcohol decrease wheel running activity in gerbils of both sexes. These results agree with other findings on activity in other animals, and serve as a baseline for future drug research in the gerbil.

Wheel running activity Gerbils Alcohol Caffeine

THE MONGOLIAN gerbil is an active rodent that will run in an activity wheel for extended periods of time. Habituation is not a problem and over several test periods gerbils do not show any appreciable decrease in their activity level [13]. Sex differences have been reported. Male gerbils run more in the light phase and females are more active in the dark phase [14].

Several studies have examined the effects of stimulant and depressant drugs on behavior in the gerbil [1,6]. Martindale and Hines [7] tested 1.5 mg/kg amhetamine and 22.5 mg/kg nembutal on wheel running and found that 15 min after IP injection the amphetamine had no effect while the nembutal significantly reduced the number of wheel revolutions made by the gerbils. The negative effects of amphetamine could have been due to the low dose used. Nyby, Belknap, and Thiessen [10] needed 5 and 12 mg/kg amphetamine to reduce feeding and hoarding behavior in gerbils. Another study [6] reported that 8 mg/kg amphetamine and 1 to 2 g/kg alcohol produced increased activity levels of gerbils in an open field test situation. To continue investigating the influence of stimulant and depressant drugs on the behavior of gerbils, the present study tested the effects of various doses of alcohol and caffeine on wheel running activity in male and female adult Mongolian gerbils.

METHOD

Animals

The animals for the study consisted of 90 male and 90 female experimentally naive adult (12–15 mo) Mongolian gerbils (*Meriones unguiculatus*). The animals were born in the Psychology Department colony room on the Marion Campus. All animals were group reared in large opaque plastic laboratory cages (48 × 27 × 20 cm) which contained Absorb-Dri wood chip bedding, Purina Lab chow, and water ad lib. A LD 12:12 light cycle and a temperature of 23°C were maintained in the animal colony room.

Procedure

All testing was carried out in a Lafayette Instrument Company Activity Wheel No. 86041, which had a diameter of 36 cm. Testing was conducted during the light phase of the light cycle in a quiet experimental room adjacent to the colony room.

The gerbils were randomly assigned to one of nine test groups, each of which consisted of 20 animals (10 of each sex). There were three alcohol dose levels tested: 0.8 g/kg, 1.6 g/kg, and 2.4 g/kg body weight of absolute alcohol (diluted to 20% v/v). There were four caffeine dose levels tested: 5 mg/kg, 10 mg/kg, 15 mg/kg, and 20 mg/kg body weight (given in a concentration of 2 mg/ml). Two control groups were included: no treatment, in which the animals were tested without any injection; and saline, in which animals received an injection of 1 ml/kg physiological saline.

The number of complete wheel revolutions produced by each animal was counted automatically for two 10-min trials, 48 hours apart. For the pre-treatment trial (Trial 1), an animal was placed in the wheel for 10 min and then removed and returned to its home cage. After 47.5 hours, the animal received the treatment IP injection (if assigned to one of the eight injection groups). The gerbil was retained in a holding cage for 30 min, and then was placed in the activity wheel for the 10-min treatment trial (Trial 2).

RESULTS

Effects of Alcohol

A 2 by 5 by 2 Analysis of Variance was run on sex (male and female) by treatment (no treatment, saline, and the three

TABLE 1

MEAN (± SEM) WHEEL REVOLUTIONS PER 10 MIN FOR PRE-TREATMENT AND TREATMENT TRIALS

	Males		Females	
Treatment Condition	Pre-Treatment	Treatment	Pre-Treatment	Treatment
No treatment	92.4 (± 0.9)	90.2 (± 11.2)	80.3 (± 4.1)	85.6 (± 6.2)
Saline	95.7 (± 8.0)	91.9 (± 10.1)	77.8 (± 4.2)	81.4 (± 4.1)
Alcohol 0.8 g/kg	98.6 (± 8.5)	155.2 (± 20.0)	82.7 (± 4.8)	139.7 (± 10.2)
Alcohol 1.6 g/kg	98.1 (± 4.4)	175.5 (± 14.2)	84.4 (± 4.8)	154.3 (± 9.1)
Alcohol 2.4 g/kg	91.7 (± 4.9)	48.6 (± 12.3)	82.0 (± 2.9)	34.1 (± 12.6)
Caffeine 5 mg/kg	93.2 (± 8.4)	157.8 (± 13.7)	90.7 (± 10.3)	136.2 (± 18.4)
Caffeine 10 mg/kg	95.6 (± 10.4)	164.6 (± 12.6)	89.3 (± 6.4)	141.2 (± 9.9)
Caffeine 15 mg/kg	80.5 (± 3.7)	109.4 (± 5.5)	82.2 (± 5.5)	103.2 (± 10.9)
Caffeine 20 mg/kg	92.9 (± 10.4)	107.8 (± 18.7)	80.6 (± 7.5)	87.7 (± 9.6)

alcohol dose levels) by trial (Trial 1 and Trial 2), with repeated measures on the last variable. Cicchetti's [4] extension of the Tukey post hoc test was used to further test significant interactions. Table 1 shows the mean pretreatment (Trial 1) scores (±SEM), and the mean no treatment, saline, and alcohol dose level treatment condition (Trial 2) scores (±SEM) for males and females. The sex variable was significant, $F(1,90)=7.18$, $p<0.01$, with males being more active in every condition (overall mean scores were 103.79 for males and 90.23 for females). Since the current research was run in the light phase, it was expected that males would obtain higher scores than females [14]. Both sexes responded similarly to the treatments, as can be seen in Table 1.

The overall treatment effect was highly significant, $F(4,90)=31.45$, $p<0.001$, as was the treatment by trial interaction, $F(4,90)=48.61$, $p<0.001$. The Cicchetti Test showed the scores for Trial 2 to be significantly ($p<0.01$) different than Trial 1 for the three alcohol dose levels, but not for the two control groups. As shown in Table 1, 0.8 g/kg alcohol increased activity by 63%, and 1.6 g /kg alcohol increased activity by 81%, while 2.4 g/kg alcohol decreased it by 52%.

Effects of Caffeine

Table 1 also shows the mean pretreatment (Trial 1) scores (±SEM) and the mean caffeine treatment (Trial 2) condition scores (±SEM) for males and females. The data from the control groups was again analyzed with the caffeine treatment groups. The sex variable was significant, $F(1,108)=5.05$, $p<0.001$, with males again being more active in every condition. Both sexes responded similarly to the treatments, as can be seen in Table 1.

The overall treatment effect was significant, $F(5,108)=7.02$, $p<0.01$, indicating that cafeine does affect the wheel running activity of gerbils. The trial variable was significant, $F(1,108)=81.30$, $p<0.001$, as was the dose by trial interaction, $F(5,108)=14.75$, $p<0.01$. The Cicchetti Test showed the scores for Trial 2 to be significantly (<0.01) different than Trial 1 for the 5, 10 and 15 mg/kg caffeine dose levels, but not for the 20 mg/kg caffeine dose or the two control groups. As shown in Table 1, 5 mg/kg caffeine increased activity by 60%, 10 mg/kg caffeine increased activity by 65%, and 15 mg/kg caffeine dose increased activity by 31%. The 20 mg/kg caffeine dose increased activity by only 13%, which was not significantly different from the pretreatment score.

DISCUSSION

This study demonstrated that both alcohol and caffeine affect wheel running activity in adult male and female gerbils in a dose-related manner. Low doses of both a CNS depressant (alcohol) and a CNS stimulant (caffeine) cause activity levels as measured by an activity wheel to increase significantly in both male and female gerbils. A high dose of alcohol causes significantly decreased activity scores, while a high dose of caffine does not produce any change in activity levels. Knowledge of dose level effects is important for research in which it is desirable to have a baseline dose which will affect behavior without incapacitating the animal.

The effects of alcohol found in the current study generally agree with studies on the effects of alcohol on aggression in rats [9], mice [3], and dogs [12]. It has been suggested [5] that alcohol reduces the inhibitory action of the cortex, which has the effect of increasing dominant behaviors. Since running wheel activity appears to be reinforcing to the gerbil, alcohol increases it until ataxia begins to appear (at 2.4 g/kg).

The finding that the lower doses of caffeine increased wheel activity while the highest dose produced scores which were not significantly different from pre-treatment levels generally agrees with studies on the effects of stimulants on various behaviors in rats [8,15]. One study [2] reported that a dose of 20 mg/kg increased slightly gregariousness in rats, possibly because of a general increase in locomotor activity (and hence frequency of social interactions). In the current study, the 20 mg/kg caffeine dose did not produce signs of stereotyped behavior. It is possible, however, that this high caffeine dose disrupted the animals concentration or increased stress close to the levels which can lead to seizures in the gerbil [11].

From an examination of the Trial 1 and Trial 2 scores for

the no treatment and saline control groups, it can be concluded that no habituation effects occurred from repeated testing 48 hours apart. Intraperitoneal injections do not have an effect on wheel running behavior in gerbils, as evidenced by the similar scores for the no treatment and saline control animals in Trial 2. Such data suggest that no treatment control groups can be eliminated in future research investigating drug effects on running wheel behavior. These results indicate that the activity wheel is a reliable technique for testing the effects of drugs on gerbils in a standard experimental situation.

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REFERENCES

1. Beaton, J. The sedative effects of nicotinamide on gerbil wheel-running activity. *Experientia* **32:** 1036–1037, 1976.
2. Cappell, H. and B. Latané. Effects of alcohol and caffeine on the social and emotional behavior of the rat. *Q. J. Stud. Alcohol* **30:** 345–356, 1969.
3. Chance, M. R. S., J. H. MacKintosh and A. K. Dixon. The effects of ethyl alcohol on social encounters between mice. *J. Alcohol* **8:** 90–93, 1973.
4. Cicchetti, D. V. Extension of multiple-range tests to interaction tables in the analysis of variance. *Psychol. Bull.* **77**(6): 405–408, 1972.
5. Cutler, M. G., J. H. MacKintosh and M. R. Chance. Effects of the environment on the behavioral response of mice to non-ataxic doses of ethyl alcohol. *Neuropharmacology* **14:** 841–846, 1975.
6. Järbe, T. and G. Ohlin. Interactions between alcohol and other drugs on open-field and temperature measurements in gerbils. *Arch. Int. Pharmacodyn.* **227:** 106–117, 1977.
7. Martindale, C. and D. Hines. Effects of amphetamine and nembutal on social exploration in the Mongolian gerbil. *Pharmac. Biochem. Behav.* **7:** 573–574, 1977.
8. Miczek, K. A. Intra-species aggression in rats: Effects of d-amphetamine and chlordiazepoxide. *Psychopharmacologia* **39:** 275–301, 1974.
9. Miczek, K. A. and H. Barry, III. Effects of alcohol on attack and defensive-submissive reactions in rats. *Psychopharmacology* **52:** 231–237, 1977.
10. Nyby, J., J. Belknap and D. Thiessen. The effects of d- and l-amphetamine upon hoarding behavior and feeding in the Mongolian gerbil (*Meriones unguiculatus*). *Physiol. Psychol.* **2**(4): 497–499, 1974.
11. Pettijohn, T. F. Influence of social group size on seizure frequency in Mongolian gerbils. *J. gen. Psychol.* **99**(1): 149–150, 1978.
12. Pettijohn, T. F. The effects of alcohol on agonistic behavior in the Telomian dog. *Psychopharmacology* 1979, in press.
13. Powell, R. and S. Peck. Running-wheel activity and avoidance in the Mongolian gerbil. *J. exp. Analysis Behav.* **12:** 779–787, 1969.
14. Roper, T. Sex differences in circadian wheel running rhythms in the Mongolian gerbil. *Physiol. Behav.* **17:** 549–551, 1976.
15. Zucker, I. and P. Milner. The effect of amphetamine on established hoarding in the rat. *Psychon. Sci.* **1:** 367, 1964.