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**The Effects of Caffeine on Operant Behavior in the Mongolian Gerbil**

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### Abstract

The present study looks at the effects of stomach loads of caffeine on operant behavior in Mongolian gerbils (*Meriones unguiculatus*). Four male and four female gerbils were trained to a fixed interval schedule of 30 seconds with Noyes 4.5 mg rodent pellets used for reinforcement. A data collection and analysis package for Apple computers was used to measure the post-reinforcement response frequencies and number of reinforcements. Data was collected using a baseline of saline stomach loads of 1% of body weight, and then stomach loads of ascending concentrations caffeine mixed with saline (10, 20, 40, 60 mg/kg) with two to three days of non-intervention in between each load for the animals to return to baseline. Results show no significant increases in operant behavior regardless of dosage level, although females show a significantly higher activity level than males with the 40 mg/kg dosage of caffeine.

### The Effects of Caffeine on Operant Behavior in Mongolian Gerbils

Mongolian gerbils (*Meriones unguiculatus*) were first used in behavioral research by Schwenkter (1963) who suggested that gerbils might be difficult to condition using food for reinforcement. Campbell, Straney, & Neuringer (1969) reported that gerbils show low rates of bar pressing for food under continuous reinforcement (CRF) and variable interval reinforcement of 1 minute. These experimenters suggested that food may represent a weak reinforcer for the gerbils independent of the deprivation level and type or amount of food. Other research has shown that gerbils are easily conditioned to bar press for both food and water reinforcement. Vander Weele, Abelson, and Tellosh (1973) report rapid conditioning of gerbils by utilizing their natural behaviors of exploration, scratching, and marking with food and water as reinforcement. These experimenters recommended a deprivation level of eighty to eighty-five percent of normal body weight, as well as shorter periods of operant conditioning (20 to 30 minutes) due to the large number of competing and incompatible behaviors seen in the gerbil.

Vander Weele and Abelson (1973) observed 17 gerbils under several different operant schedules, including fixed interval (FI), variable interval (VI), fixed ratio (FR), and differential reinforcement of low rate responding (DRL). The characteristic scallop that is seen with other animals under a FI schedule was not found in the gerbil except at the four minute interval where it was seen in only two of the animals. The gerbils paused briefly after a reinforcement and then lever pressed at a steady rate until the next reinforcement. The VI schedule showed that gerbils performed similarly to rats and pressed continuously except for a pause after reinforcement. On a DRL schedule a gerbil would respond at a steady low rate with occasional response bursts when the animals scratched at the bar. These

experimenters recommended using lighter bar weights and conventional rewards in shaping operant behavior in the gerbil, as well as shorter experimental periods and an eighty to eighty-five percent body weight deprivation level.

Research has looked at the effects of caffeine on rat behavior, but there is very little research available about the interaction between this chemical and the gerbil. Sanger (1980) used intraperitoneal injections of caffeine at 10, 20, 40, 60 milligrams per kilogram of body weight to look at the effects on differential reinforcement of low rate (DRL) responding in rats and gerbils. Data analysis suggested that gerbils tend to respond with slight increases in overall response rates, except at the highest dosage in which decreases were seen. However, Sanger does note that within the gerbils tested there were large individual variations with inconsistent results.

Loke and Meliska (1984) found that a 40 mg/kg caffeine injection increased ambulation and rearing in white rats, similar to results found in other experiments (Cunha & Masur, 1978; Gupta, Dandiya, Gupta, & Gabba, 1971). Loke and Meliska hypothesize that the caffeine may decrease effects of fatigue in animals as it attenuates "the amount of decline typically found in ambulation that occurs after several minutes of open field testing." Meliska and Brown (1982) looked at the effects of caffeine on operant behavior in rats reported an initial enhancement of FI lever pressing, followed by a decrease in performance during the second hour. Holtz and Goldstein (1984) administered a 25 mg/kg dosage of caffeine to rats orally and reported little observed effect of caffeine on operant behavior.

The present study is designed to look at the effects of varying levels of caffeine on operant behavior in the Mongolian gerbil using a different method of administration. The stomach load procedure allows for a more

'natural' administration and absorption of the fluids.

## Method

### Subjects and Apparatus

Subjects were 4 male and 4 female Mongolian gerbils (Meriones unguiculatus) purchased from Tumblebrook Farms. All animals were over 150 days old and were experimentally naive. While not in operant chambers, animals were housed in 17.5 x 17.5 x 22.5 cm wire bottomed cages manufactured by Wahman with a temperature range of  $21 \pm 4$  °C (approximately 72 °F). Food was Purina Powder Rat Chow. Water was freely available from an inverted graduated cylinder at the front of the cage. Standard operant chambers with one lever manufactured by Lafayette Instrument Company were used. A data collection and analysis package for Apple computers was used to measure the post-reinforcement response frequencies and number of reinforcements given to each animal. The operant chambers contained one 15 g tension response lever located 3 - 1/8 inches above the floor with a pellet receptacle positioned 2 - 3/8 inches to the right of the lever. An inverted graduated cylinder was available for ad lib water consumption. A 1 inch diameter lamp located directly over the operant bar and 2 - 1/2 inches above the cage floor was the only light source in the cage. A 1/4 inch metal grid was used to line the floor of the chamber so the animal's feet would not fall through the bars. It had been observed that without the wire mesh the animal's feet slipped through and created a source of competitive, disruptive behavior.

### Procedure

Animals were food deprived to 80% of their body weight and trained to bar press using a FR schedule with a single Noyes 4.5 mg rodent pellet for reinforcement per press. The gerbils were then moved to a fixed interval (FI)

schedule of thirty seconds. Baseline data was collected for thirty minutes for operant behavior on the FI schedule without any intervention for four days. The next four days, animals were stomach loaded with 3% saline solution and placed in the operant chamber for thirty minutes following a thirty minute delay. This delay was pre-experimentally determined to be the period in which the animals recovered from the ether used in the stomach loading procedure and metabolically absorbed the load. Stomach loads were administered with a French 8 urethral catheter while gerbils were under light ether anesthesia. Once the results from this run stabilized to match the initial baseline data, the gerbils were stomach loaded with 1% of their body weight with ascending dosages of caffeine using saline as the vehicle (10, 20, 40, 60 mg/kg of body weight) with two to three days in between each level to allow the animals to recover and return to baseline.

### Results and Discussion

Results show that there are no significant increases in operant behavior at any of the caffeine dosages. Analysis of variance showed no significant differences at any level, although there were significant differences between the individual animals at all dosage levels. There were unexplained significant sex differences between the animals at the 40 mg/kg dosage of caffeine. See table 1 for means and standard deviations of all groups.

Incidental observations indicate that subjects became very active at the lowest levels of caffeine and that there is an increase in competitive behaviors such that they interfere with the lever pressing response. Caffeine may decrease the appetite of the animals and therefore, their motivation to bar press. Future research needs to focus on the reasons for the lack of increase in operant behavior to determine the role of appetite and/or the

competing behaviors. As there are no data available on the long term effects of caffeine administration on behavior in an operant setting or the rate at which caffeine is absorbed and/or metabolized, future research should focus on this area to establish a meaningful relationship.



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Psychonomic Society, 1, 62-64.

Table1Sample Size and Means for Operant Lever Presses for All Treatments

Sex	N	Treatment Condition				
		Saline Load	C - 10 mg	C - 20 mg	C - 40 mg	C - 60 mg
Male	4	111.50	133.75	159.25	93.75*	148.25
Female	4	215.67	274.50	277.75	320.25*	158.75
Totals	8	327.16	508.25	437.00	414.00	307.00

Note: C is caffeine dosage in milligrams per kilogram.

N is sample size.

\* Indicates significant difference at the .05 level.