

# Amphetamine-induced freezing in a food-motivated operant task

SHERWOOD O. COLE  
RUTGERS UNIVERSITY<sup>1</sup>

*Amphetamine, 2 mg/kg administered on four trials one week apart, produced significantly higher freezing scores in an intermittently-reinforced operant task than did control injections of distilled water. However, no significant correlation was found between the freezing scores of the drug Ss and their depressed operant rate. These results were discussed in relationship to the amphetamine-induced reduction of freezing which has been observed in the CAR task.*

Kriekhaus et al (1965) have presented evidence that amphetamine reduces the CS-induced freezing in the CAR task thereby facilitating performance. However, such a reduction in freezing by amphetamine is observed in a situation where the pre-existing level of freezing in response to the CS is considerable.

The present report is concerned with the effect of amphetamine on measures of freezing in an intermittently-reinforced operant task. Although such a task differs markedly from the CAR situation, one major difference is of primary interest to the present report. Whereas the effect of amphetamine is observed on a pre-existing freezing behavior in the CAR task, the present report is concerned with the effect of the drug on measures of freezing in a food-motivated task where prior freezing does not normally occur.

## Subjects

Sixteen male albino rats, purchased from West Jersey Biological Supply and approximately 100 days old at the beginning of training, served as Ss. The Ss were housed in a temperature-controlled laboratory and fed ad lib in the home cages.

## Procedure

After initial training in a standard Skinner box (Gerbrands), the 16 Ss were randomly assigned to either a drug or control group. Both groups subsequently received four 30 min trials of intermittently-reinforced operant behavior which were administered one week apart. On Trials 1 and 2, 5 min periods of continuous food reinforcement<sup>2</sup> (R) and nonreinforcement (NR) for bar pressing were randomly assigned to the trial period, and on Trials 3 and 4, 5 min periods of R and NR were successively alternated during the trial period. Fifteen minutes prior to each trial, the 24 h food-deprived Ss received an intramuscular injection of either amphetamine 2 mg/kg<sup>3</sup> (drug group) or a controlled-volume of distilled water (control group). A more detailed consideration of the above procedure is included in a previous report (Cole, 1968).

Measures of freezing, the specific concern of the present report, were determined by an expansion of

the method introduced by Kriekhaus (1965). The original 4 step rating scale was expanded to six steps and included the following characteristics of behavior: (1) normal behavior (preening, sniffing, investigating, etc.); (2) normal behavior with occasional tense or jerky motion; (3) tense or jerky locomotion; (4) tense or jerky locomotion with periods of no locomotion but head and shoulder movement; (5) some head and shoulder movement but no locomotion; (6) no movement at all. Previous general observation of amphetamine Ss in a food-motivated task made such an expansion of the freezing scale seem necessary in order to discriminate differences in the behavior of the Ss over the extended period of the trial.

During each 5 min period of the 30 min trial (R and NR periods), a rating of the S's general behavior was made. The average of the six ratings constituted the overall freezing score for the trial. Both drug and control Ss were individually rated in an identical manner on all four trials. No attempt was made to further determine differences in the ratings of Ss under the R and NR conditions of the trials.

## Results

A trend analysis of the operant data on the four trials indicated that amphetamine significantly depressed the intermittently-reinforced bar pressing ( $F=12.87$ ,  $df=1/14$ ,  $p<.005$ ). For a discussion of these results, the reader is referred to a previous report (Cole, 1968).

The mean freezing scores for the drug and control groups on the successive intermittently-reinforced trials are presented in Table 1. A Kruskal-Wallis analysis of variance by ranks<sup>4</sup> (Siegel, 1956) of the combined trials yielded a significant difference between the drug and control groups ( $H=11.47$ ,  $p<.001$ ). A further analysis of individual trials indicated a significant difference between groups on all trials ( $p<.001$ ). The H values for Trials 1-4 were 11.59, 12.94, 12.10, and 12.50, respectively.

In order to further determine if a significant relationship existed between the freezing scores of the

Table 1. Mean freezing scores on four successive 30-min trials of intermittent reinforcement

Groups	Trials			
	1	2	3	4
Drug	3.00	3.63	3.50	3.88
Control	1.13	1.00	1.25	1.13

drug Ss and their bar pressing performance, a Spearman Rank Correlation Coefficient ( $r_s$ ) was computed for each trial. The  $r_s$  values for Trials 1-4 were -.39, -.21, -.63, and -.12, respectively, with the average correlation between the freezing scores of the drug Ss and their operant performance for the four trials equal to -.34. Although the correlation was not statistically significant on either trial, it did approach the .05 level of significance on Trial 3.

#### Discussion

The results of the present study clearly indicate that amphetamine Ss scored significantly higher on measures of freezing in a food-motivated task than did control Ss. In no instance, however, was the degree of freezing so marked that the drug S actually became immobile. Only one of the drug Ss received an overall trial rating as high as 5 (S No. 21 on Trial 2), although several of the drug Ss received overall trial ratings of 4 on all trials. With few exceptions (one S on Trials 1 and 4 and two Ss on Trial 3) all control Ss were assigned overall trial ratings of 1.

It is of particular interest to note that the amount of freezing observed on the four trials of the present study following injection of 2 mg/kg of amphetamine is similar to that observed by Krieckhaus et al (1965) in the CAR task following administration of the drug in the same dose. The average freezing rating of the drug group over the four trials of the present study was 3.5 (a rating of 3 on the present scale corresponds to one of 2 on the scale presented by Krieckhaus). However, the interpretation of the rating seems to depend quite specifically upon the presence or absence of an existing level of freezing prior to administration of the drug. Whereas such a rating may actually represent a reduction in freezing in the CAR task where a strong tendency to freeze already exists in response to the CS, it represents a significantly greater freezing tendency in the present food-motivated task where freezing does not previously exist or does not occur with control injections of distilled water.

Also of particular interest to the present report are the nonsignificant  $r_s$  values between the freezing scores of the drug Ss and their bar pressing performance. These results suggest that the effect of amphetamine on intermittently-reinforced operant behavior and on freezing are independent, and that the drug does not depress food-motivated performance by merely increasing the interference of such performance with freezing. In contrast to the findings of the present study, Krieckhaus et al (1965) did find significant negative correlations between freezing and avoidance performance following administration of amphetamine.

The present study indicates that the effect of amphetamine on measures of freezing must be interpreted in light of the conditions existing prior to administering the drug, and that the relationship of such freezing (whether greater or less in degree following drug administration) to the performance of a particular task further depends upon the motivational nature of the task. Whereas a relationship appears to exist between freezing and performance in a shock or fear-motivated CAR task, no such relationship was found in a food-motivated task.

#### References

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#### Notes

1. South Jersey campus, Camden, New Jersey 08102.
2. 45 mg precision food pellets purchased from P. J. Noyes Co., Lancaster, New Hampshire.
3. Supplied by Smith, Kline, and French Labs., Philadelphia, Pennsylvania.
4. All Kruskal-Wallis H values and subsequent Spearman  $r_s$  values have been corrected for tied ranks.