an NSF Science Faculty Fellow. Support for the research came from USPHS Grant MH-04202 and NSF Grant GB-2428, both to Richard L. Solomon. I am indebted to Richard L. Solomon for his advice and criticism and to Lucille H. Turner and Donald Hanson for their technical assistance.

2. On the final Pavlovian session, one S in Group E received only 12 trials (6 CS+ and 6 CS), due to apparatus failure.

Negative incentive contrast with sucrose[1]

LAWRENCE WEINSTEIN,[2] University of Maine, Portland, Maine 04103

A decrease in the concentration of a sucrose solution resulted in negative incentive contrast effects. This finding disagrees with many studies in the literature.

When a decrease in incentive size results in a decrement in performance significantly below a baseline defined by Ss trained only at the postshift magnitude, the result is referred to as negative incentive contrast effect. While negative incentive contrast effect has been well documented (e.g., Black, 1968), many investigators have failed to obtain the phenomenon using sucrose as incentive (e.g., Rosen, 1966). Rosen (1966) and Dunham & Kilps (1967) decreased the concentration of a sucrose solution and failed to obtain negative contrast effects. This may be because they selected preshift concentrations not conducive to the production of negative incentive contrast effects. DiLollo & Beez (1966) have shown that the magnitude of negative contrast effects is a positive function of the amount of reward reduction where larger and smaller rewards are defined in terms of whether they produce higher or lower levels of performance, respectively. Guttman (1953) reported maximum and minimum bar pressing to a 16% and 4% sucrose solution, respectively, while 8% and 32% solutions produced intermediate levels of performance. Rosen (1966) reduced the concentration of a sucrose solution from 20% to 3% in a runway.

Dunham & Kilps (1967) reduced the concentration of a sucrose solution from 32% to 11.3% following training in an operant conditioning box. Perhaps larger reductions in amount of reward would produce negative incentive contrast effects. Guttman's (1953) data suggest that a shift in concentration from 16% to 4% would constitute a larger change in incentive size than would the procedures used by Rosen (1966) and Dunham & Kilps (1967) and would, therefore, be more likely to result in negative incentive contrast effects. The present experiment examined a shift in the concentration of a sucrose solution from 16% to 4%.

SUBJECTS

The Ss were 20 experimentally naive hooded rats, 75-105 days old at the start of the experiment and housed in individual cages.

APPARATUS

The 12 x 10 x 10 in. conditioning chamber had plywood side walls, Plexiglas top, back, and door, and a grid floor.

A rectangular hole, ½ x 2 in., was cut in the side of the cage 5 in. above the floor so that the bar could be inserted ½ in. into the cage. Three inches below and 2 in. to the side of the bar, a circular hole, 1 in. in diam, was cut in the wall. Through this opening, S had access to the liquid magazine.

The liquid used was presented to S by a dipper-type magazine driven by a motor. A metal drinking tube, attached to a 3-ft piece of plastic tubing that connected to a plastic cylinder graduated in cc, was mounted 1 in. outside the circular hole in the wall so that whenever S pressed the bar the tip of the tube was presented through the hole for 2 sec so that S could lick the tube by extending his tongue through the hole. During the 2-sec dipper presentation, bar presses were recorded and did not operate the dipper.

Events were programmed and recorded automatically by a BRS solid-state system located in the experimental room. Bar presses were recorded by means of a counter.

PROCEDURE

Ten Ss were assigned randomly to each of two groups. The control group (C) received 4% sucrose throughout the experiment and the other group (S) was shifted from 16% to 4% on the 10th session, after bar-press asymptote was reached.

Following several days of adaptation to a food-deprivation schedule of pellets and water for 1 h at the end of the experimental time, daily, Ss were trained to press the bar for continuous reinforcement (with each depression the bar operated the magazine). Each session lasted for 40 reinforcements (dipper presentation). This regime was continued until performance appeared to be stable, requiring nine sessions (preshift). Concentration was then changed (postshift) and all Ss were continued through the 13th session. Throughout the study, Ss had access to dry pellets and water for 1 h following the experimental period.

RESULTS

Average bar presses per minute (number of bar presses in the session/session duration) were examined in the analysis of the results.

From Fig. 1, it seems clear that, from Sessions 1-9, 16% sucrose produced a higher rate of bar pressing than did 4% sucrose. The mean number of bar presses per minute from Sessions 1-9 differed significantly between the groups by analysis of variance [$F(1,18) = 9.43$, $p < .01$].

Figure 1 indicates that on Session 10, the S group suddenly reduced their bar-press rate below that of the control group (negative contrast effect). A 4 by 2 analysis of variance of the mean number of bar presses per minute over the four postshift sessions and the two concentrations revealed a significant concentration effect [$F(1,18) = 4.72$, $p < .05$] and a statistically reliable interaction [$F(3,18) = 3.19$, $p < .05$].

The mean number of bar presses per minute from Sessions 10-11 differed significantly between the S and C Ss (negative incentive contrast effect) by analysis of variance [$F(1,18) = 4.53$, $p < .05$].

DISCUSSION

The finding that a 16% sucrose solution produces a significantly higher level of performance than does a 4% solution agrees with Guttman (1953) and indicates that Ss can discriminate the difference in concentration.

The demonstration of negative incentive contrast effects with a shift in concentration of a sucrose solution disagrees with many studies in the literature (e.g., Dunham & Kilps, 1967; Guttman, 1953; Rosen, 1966). The discrepant findings may be due to the different (1) deprivation conditions and/or (2) preshift concentrations selected by the present investigation and the three studies previously cited.

In the present investigation, Ss were deprived of both food and water, while Dunham and Kilps, Guttman, and Rosen deprived their Ss only of food. Quite possibly the present more severe

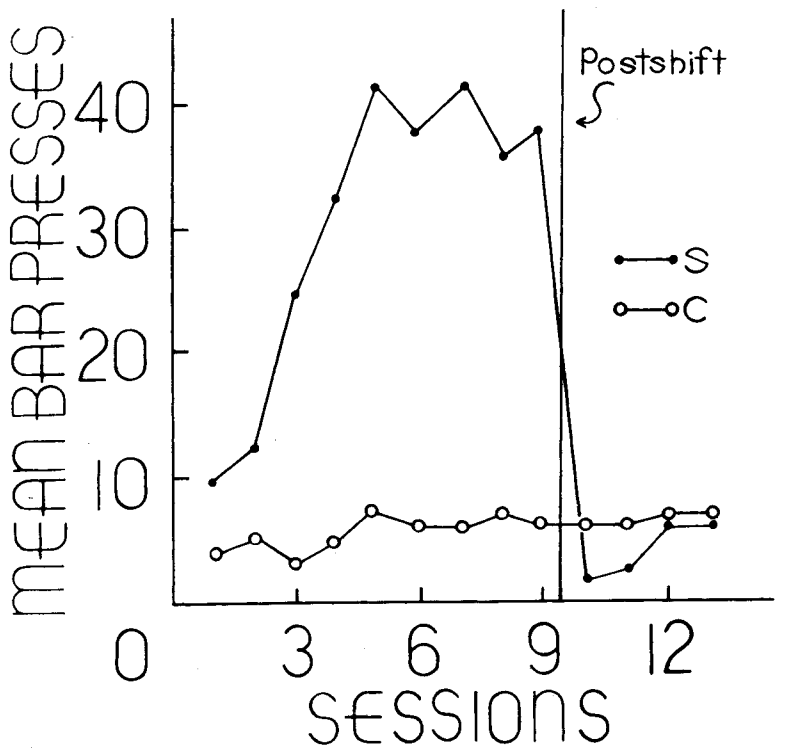

Fig. 1. Mean bar presses per minute. Group S shifted on Session 10, denoted by arrow.

deprivation schedule is more likely to result in negative incentive contrast effects than is food deprivation alone.

While Guttman's (1953) data suggest that a shift in concentration from 16% to 4% would constitute a larger change in incentive size than would the procedures used by Dunham & Kilps (1967) and Rosen (1966), and would therefore be more likely to result in negative contrast effects, Guttman did not test at 20%, 11.3%, or 3% sucrose concentrations, so the question is open for empirical examination.

The demonstration of a rapid performance decrement with a decrement in the concentration of a sucrose solution contrasts with a number of previous reports in the literature (e.g., Ison & Glass, 1969; Rosen & Ison, 1965). The inconsistent findings may be a function of the more severe deprivation conditions and/or preshift concentration differences in the present study as compared to those of previous investigations.

REFERENCES

BLACK, R. W. Shifts in magnitude of reward and effects in instrumental and selective learning: A reinterpretation. Psychological Review, 1968, 75, 114-126.

DiLOLLO, V. D., & BEEZ, V. Negative contrast effects as a function of magnitude of reward decrement. Psychonomic Science, 1966, 5, 99-100.

DUNHAM, P. J., & KILPS, B. Incentive contrast: A replication of Collier and Marx. Paper presented at the meeting of the Psychonomic Society, Chicago, October 1967.

GUTTMAN, N. Operant conditioning, extinction, and periodic reinforcement in relation to concentration of sucrose used as reinforcing agent. Journal of Experimental Psychology, 1953, 46, 213-222.

ISON, J. R., & GLASS, D. H. "Classical" versus "instrumental" exposure to success rewards and later instrumental behavior following a shift in incentive value. Journal of Experimental Psychology, 1969, 79, 582-583.

ROSEN, A. J. Incentive-shift performance as a function of magnitude and number of sucrose rewards. Journal of Comparative & Physiological Psychology, 1966, 62, 487-490.

ROSEN, A. J., & ISON, J. R. Runway performance following changes in sucrose rewards. Psychonomic Science, 1965, 2, 335-336.

NOTES

1. Support for this research was provided by Grant APA 244 from the National Research Council of Canada to M. D. Suboski.

2. This research was conducted at Queen's University, Kingston, Ont., Canada. Requests for reprints should be sent to Lawrence Weinstein, Department of Psychology, University of Maine, Portland, Maine 04103.