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Barpress variability as a function of two methods of body-weight control

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Two methods of food deprivation used to control hunger motivation were compared on their ability to control body weight and to control response variability in an appetitive conditioning situation. Percent-weight rats received individually adjusted daily rations to maintain them at 85% of free-feeding body weight. Fixed-food rats each received the average daily ration given the percent-weight subjects. All were given 34 days of training on an FR 10 schedule followed by 15 days on a VI 30-sec schedule. There were no significant differences in mean body weights or mean barpressing rates. Variability in body weight was significantly greater for fixed-food rats, but there was no significant difference in barpress variability. Since experimental error was not reduced by the more costly percent-weight method, it is suggested that the fixed-food method be used for experimental conditions similar to those used in the present study.

Three methods of controlling hunger motivation are currently used in animal learning experiments. The first method involves feeding the animals for a fixed period of time each day (e.g., .5, 1, or 2 h). While this method was once quite popular, it is not in common use today. The second method involves feeding the animals a fixed amount of food each day (e.g., 8, 10, or 15 g). The amount is determined prior to the start of the experiment. Adjustments may be made for the amount of food consumed during training sessions so that all animals are fed the same amount of food each day. This method is commonly used when an experiment involves a statistically analyzed group design and many animals are involved. The third method involves an individualized feeding regimen for each of the animals in an experiment. The amount of food that is fed to an animal each day is calculated to maintain the animal at some fixed percentage of its free-feeding body weight (e.g., 80% or 85%).

Bolles (1967) has shown that a rat's percent body weight is the most accurate predictor of the animal's performance in an appetitive situation. Since the first method is seldom used in current research, our interest was restricted to the comparison of the second (fixed-food) and third (percent-weight) methods. Our task was to devise an empirical method to determine if the more expensive percent-weight method was sufficiently superior to the fixed-food method to justify its higher cost. As an illustration of these costs, assume that 2 min is needed to weigh an animal, calculate its daily ration, weigh the food, and feed the animal. For a typical study involving 60 animals trained for 30 days, the total time in controlling motivation by the percent-weight method is 60 h. The fixed-food method involves approximately 30 sec per rat each day, or a total investment of only 15 h. The 45-h savings from using the fixed-food method can result in several important advantages to the researcher. For example, the savings would allow the use of larger sample sizes or the conducting of more than one experiment for the same cost in money and time that would be expended on a single experiment involving the percent-weight method.

The present report describes an experiment that was designed to assess the relative efficiency of the fixed-food and the percent-weight methods of motivation control. One-half of the animals were fed according to one of the two methods. On the average, both groups of rats received the same amount of food. The animals in the percent-weight group were fed the exact amount required to maintain their weights at 85%. Each day the fixed-food group was fed an amount equal to the average amount fed the percent-weight animals.

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METHOD

Subjects

The subjects were 44 male, albino rats of the Sprague-Dawley strain purchased from the Holtzman Company of Madison, Wisconsin. The rats were approximately 90 days old at the beginning of deprivation. The animals were randomly divided into two groups of 22 rats each. The two groups did not differ in average body weight or in the variability of individual weights at the beginning of deprivation. The mean weight for the fixed-food rats was 245.0 g with a standard deviation of 12.7. The rats in the percent-weight group averaged 244.8 g with a standard deviation of 16.4.

The animals in the percent-weight group were reduced to and maintained at 85% of their individual free-feeding body weights. Each day, all animals in the fixed-food group were simply fed the average amount of food that was given to the percent-weight animals.

Apparatus

Barpress training was carried out in four identical operant conditioning chambers housed in refrigerator housings. All stimulus presentations, contingency programming, and response recording were automatically controlled by a standard, solid state control system located in a separate room. The animals were housed in individual cages in a room with a 12-h-light, 12-h-dark cycle. Experimental sessions were conducted approximately midway through the dark phases of the cycle.

Procedure

During the first 2 days following body-weight stabilization, all animals were given two magazine training sessions. Each animal received 30 Noyes pellets (45 mg) at 30-sec intervals. Barpresses occurring during these sessions were reinforced, but only 16 of the rats pressed the bar and only 1 of these animals pressed the bar more than six times. On the day following magazine training, each animal was shaped to press the bar with standard shaping procedures. During the remainder of the experiment, each animal was given daily 15-min sessions of barpress training. Each barpress was reinforced on the first day following shaping, but the fixed-ratio (FR) response requirement was gradually increased to FR 10 over the next 4 days. Thirty-four days of training was given on the FR 10 schedule, followed by 15 additional days on a variable-interval (VI 30-sec) schedule.

RESULTS AND DISCUSSION

Fixed-Ratio Phase

The rationale of the present study assumed that barpressing behavior is partially determined by the level of motivation. Our deprivation procedures were designed to equate the two groups on average amount of food intake and hence on average level of deprivation and motivation. The within-groups variability, on the other hand, should not be equivalent for the two groups. The animals in the percent-weight group should all be maintained at or near their 85% target weights, whereas the animals in the fixed-food group should show greater variability around their 85% target weights.

Each animal was weighed daily and the deviation from its target weight was calculated. These data showed that the fixed-food rats missed their target weights by a mean of 1.91 g, while the average discrepancy for the percent-weight group was 2.57 g. These means were not significantly different [$t(42) = .52$, $p > .05$]. Our two deprivation procedures, then, were successful in equating the two groups with respect to mean body weight. As a result, we expected the two groups to show approximately equal mean rates of barpressing. The asymptotic barpress rates for the two groups (Days 30-34) confirmed this expectation. The mean responses per minute (RPM) for the fixed-food group was 65.01, and the percent-weight group averaged 57.51. A t test performed on these means [$t(42) = 1.39$, $p > .05$] did not reject the null hypothesis.

These results were expected, of course, and the deprivation procedures were designed to insure them. Our interest was in the variability of motivation within the groups and the effect of this variability on barpressing behavior. While the average discrepancies between actual and target weights were quite similar for the two groups, the variances of these discrepancies were quite different. The mean daily variance for the fixed-food group was 62.26, while the mean variance for the percent-weight group was only 4.11. The hypothesis of equal variance was rejected ($F_{MAX} = 15.15$, $p < .05$). These data demonstrate that the percent-weight method was successful in reducing the within-groups variability of body weight when compared with the fixed-food method.

Although the precision of maintaining body weight was better for the percent-weight method, the barpressing results did not show less variability for the percent-weight group. The mean daily variances for the RPM measure were 242.46 and 352.80 for the fixed-food and percent-weight groups, respectively. This difference was within the range expected for the null hypothesis ($F_{MAX} = 1.46$, $p > .05$).

Variable-Interval Phase

The final 15 days of training were given with a VI 30-sec schedule because of our assumption that a VI schedule might be more sensitive to small motivational differences than a FR schedule. The deprivation procedure remained the same as during the FR phase, and the results continued to indicate more precise control of body weight in the percent-weight condition. Nevertheless, the barpress results failed to show a difference in response variability between the two groups. The mean daily variances for the RPM measure were 502.03 for the percent-weight group and 481.89 for the fixed-food group. Again, the variances were within the range expected for the null hypothesis ($F_{MAX} = 1.04$, $p > .05$).

The results from both phases of the study show that the percent-weight method results in more precise control of body weight than does the fixed-food method. Nevertheless, the better control achieved by the percent-weight method was not of sufficient magnitude to reduce the variability of the RPM measure relative to the variability obtained with the fixed-food method. Within the context of the present study, then, the better body-weight control achieved with the percent-weight method did not reduce the within-groups variance of the barpress measure. Since the estimate of experimental error (i.e., within-groups variance) would not be lower for the percent-weight method, we suggest that the fixed-food method is to be preferred when the experimental conditions are similar to those used here.

It should be mentioned at this point that the rats used in the present study were relatively homogeneous with respect to body weight when the experiment began. If the rats had been more variable in body weight at the onset, greater differences in body-weight variability would have been expected. The percent-weight method would continue to control percent weight precisely. However, the fixed-food method would allow greater variability in percent body weight as the weight variability in the original sample increased. Obviously, at some degree of original sample variability, the percent-weight method should result in less variability in the barpress measure than the fixed-food measure. Nevertheless, the present rats were ordered from the supplier following normal procedures, and no attempt was made to obtain a sample of lower than normal weight variability.

REFERENCE

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