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Adaptation to deprivation and its effect on visual discrimination performance in pigeons

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Following reduction to 80% of their free-feeding weights, each of 20 pigeons was maintained at its 80% weight for 0, 10, 25, 50, or 100 days before receiving training on a horizontal-vertical visual discrimination problem. Upon reaching criterion, the subjects were placed on terminal deprivation. Based on the number of days to death and percentage of free-feeding weight at death, the results suggested that the birds did adapt to their deprivation weights; however, no significant group differences were observed in terms of days to criterion on the discrimination problem. Design limitations and parameters for additional research were discussed.

In research employing infrahumans, it has become common practice to maintain subjects at a constant percentage of their respective free-feeding weights. By maintaining subjects at different percentages of their free-feeding weights, it has been possible to investigate the effects of drive (motivation) level using various performance measures. For example, Dinsmoor (1952) found an inverse relationship between the rate of barpressing and the percentage of free-feeding weight in albino rats, while Ehrenfreund (1960) obtained the same inverse function utilizing a running speed measure. In addition, Azrin (1960) and Azrin, Holz, and Hake (1963) have shown that the suppression of punished keypecking in pigeons varies inversely with drive level.

In maintaining organisms at a constant percentage of their respective free-feeding weights, subjects of different sizes are assumed to be equivalent in terms of drive level and severity of deprivation. However, there is a problem in using this procedure. Specifically, immature organisms tend to increase in weight when allowed free access to food and water. As a result, it would be inaccurate to establish an immature individual's deprivation weight by taking a constant percentage of its free-feeding weight, since the latter weight would not have stabilized at its asymptotic value. Moskowitz (1959) and Davenport and Goulet (1964) have solved this problem in rats by employing a method whereby a subject's deprivation weight is determined by using a constant percentage of the mean weight of a control group of same-aged organisms who are nondeprived.

In research using pigeons, a weight control group has typically not been employed because the birds have almost exclusively been adults whose free-feeding weights have stabilized at asymptote. Recently, however, Fazzini and Lyons (1974) obtained results which suggest that pigeons adapt to their deprivation weights. In their study, adult pigeons were maintained at 70% of their free-feeding weights for 0, 50, or 100 days before being exposed to terminal food deprivation. Their results indicated that the 50- and 100-day groups lived significantly longer and lost a significantly greater percentage of their free-feeding weights prior to death than did the birds in the 0-day group.

Whether this adaptation to the deprivation weight, together with its presumed effect on drive level, would influence the data obtained in a traditional experimental setting has yet to be determined. Therefore, the present experiment was designed to determine if adaptation to the deprivation level would influence performance on a visual discrimination task in adult pigeons. Previewed briefly, subjects were reduced to 80% of their free-feeding weights and maintained at their 80% weights for 0, 10, 25, 50, or 100 days before receiving training on a horizontal-vertical visual discrimination problem. Upon reaching criterion on the discrimination problem, the birds were placed on terminal food deprivation.

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METHOD

Subjects

Twenty experimentally naive male adult White Carneaux pigeons, obtained from the Palmetto Pigeon Plant, Sumter, South Carolina, were housed in individual cages.

Apparatus

A standard three-key pigeon chamber with dimensions of 49.5 x 35.5 x 35.5 cm was located within a sound-attenuating ventilated cubicle. The keys were 2.5 cm in diam and were centered 25.4 cm from the floor and 10 cm apart. Since only the center key was employed in the present experiment, the outside keys were covered with metal plates. The center key was equipped with an Industrial Electronics Engineers display unit, which could be used to illuminate the key from the rear with white light as well as a horizontal or vertical line. The white horizontal and vertical lines on dark backgrounds were 1.9 cm long and .3 cm wide. Operation of the key required a minimum force of .15 N, and responses produced auditory feedback.

The experimental chamber was diffusely lighted from above

Table 1
Summary of Individual Data

Group	Subject No.	Free-Feeding Weight (g)	Days to Criterion	Days to Death	Percent Weight at Death
	5	581	5	9	.55
	8	522	4	10	.54
0-Day	13	597	5	10	.56
	22	517	5	9	.55
	Mean	554.25	4.75	9.50	.55
	4	580	7	15	.50
	15	574	6	16	.51
10-Day	24	578	4	14	.53
	25	533	4	11	.54
	Mean	566.25	5.25	14.00	.52
	3	550	4	16	.54
	14	570	5	14	.50
25-Day	31	580	4	11	.55
	33	560	4	11	.53
	Mean	565.00	4.25	13.00	.53
	7	576	5	16	.51
	9	601	4	12	.55
50-Day	10	555	3	20	.50
	12	580	6	17	.49
	Mean	578.00	4.50	16.25	.52
	28	515	6	23	.48
	29	587	5	19	.49
100-Day	30	570	3	19	.56
	35	560	4	13	.53
	Mean	558.00	4.50	18.50	.52

by a 7.5-W light bulb. The reinforcing event was the delivery of mixed grain for 4.0 sec in an illuminated feeder. The subjects had access to the feeder via a 5-cm-square opening centered 7.6 cm from the bottom of the display panel. A white-noise generator functioned throughout the experiment to mask extraneous sounds, and a blower regulated the temperature inside the chamber. Electromechanical programming equipment located in a separate room controlled the scheduling of experimental events and recorded the data.

Procedure

Upon arrival at the laboratory, the pigeons were weighed, individually housed, and allowed free access to mixed grain, water, and grit until their weights had stabilized. Four birds were then randomly assigned to the 0-, 10-, 25-, 50-, and 100-day deprivation groups. Each bird was subsequently reduced to 80% of his stabilized weight via total food deprivation. Initiation of the deprivation schedule was staggered so that all subjects began training on the visual discrimination at about the same time. Water remained continuously available in the home cages.

Once the birds in the 0-day group reached their 80% weights, they were trained to eat from the feeder via food presentations which occurred on the average of every 20 sec. They were then shaped to peck the center key, which was transilluminated by white light and gradually introduced to a fixed-ratio 30 schedule of reinforcement. Subsequently, subjects were switched to a two-component multiple schedule with identical variable-interval (VI) 30-sec reinforcement schedules operating in both components. The components, which were signaled by the horizontal and vertical line stimuli, were 110 sec in length and were separated by 10-sec periods of complete blackout in the chamber. Of the 10 components presented daily, five were signaled by a horizontal line and five by a vertical line. The order of stimuli was randomized daily, with the singular restriction that a stimulus could not occur more than twice in succession. Training with the horizontal and vertical stimuli was continued for approximately 5 days. Training on the visual discrimination task commenced following training with the two line stimuli. For each organism, the positive stimulus (S+) was that stimulus which was responded to least during the final 3 days of horizontal-vertical training, and the other line orientation became the negative stimulus (S–). During S+, the birds continued to be reinforced according to the VI 30-sec schedule, while no responding was reinforced during S–). Ten components, five signaled by each stimulus, continued to be presented daily with the order of stimuli subject to the restriction mentioned earlier. Discrimination training for each individual continued until less than 10% of his total daily responses were emitted to S– during each of two consecutive sessions. Immediately upon reaching criterion, subjects were placed on total food deprivation until death occurred. Water was available during this time, and the birds continued to be weighed daily.

The pigeons in the other four experimental groups were maintained at their 80% weights via controlled feedings for their respective number of days and then exposed to the training sequence and terminal deprivation described above for the 0-day group.

RESULTS AND DISCUSSION

Table 1 summarizes the findings of the present experiment by providing the free-feeding weight, days to criterion, days to death, and percentage of free-feeding weight at death for each subject.

A one-way analysis of variance was performed on each of these four measures. Results indicated no significant differences between groups in terms of free-feeding weight ($F < 1$), days to criterion ($F < 1$), and percentage of free-feeding weight at death ($F = 1.79$, $df = 4/15$, $p = .18$). However, analysis of the days-to-death measure revealed a significant groups effect ($F = 5.94$, $df = 4/15$, $p < .01$), and subsequent Newman-Keuls tests indicated that the 50- and 100-day groups lived significantly longer ($p < .05$ and $p < .01$, respectively) after the start of terminal deprivation than did the 0-day group. All other comparisons were insignificant.

Since the subjects used here were maintained at their 80% weights during visual discrimination training, and thus could adapt to their deprivation weights during this time, the present groups were not identical to those employed by Fazzini and Lyons (1974). Nevertheless, the results of the present investigation are consistent with the findings of Fazzini and Lyons. That is, both experiments found that the 50- and 100-day groups lived significantly longer than the 0-day group, once terminal deprivation commenced; in addition, the percentage of free-feeding weight at death was lower in the 50- and 100-day groups as compared to the 0-day group in both studies, although not significantly so in the present experiment. These results certainly suggest that pigeons adapt to their deprivation weights.

Although the pigeons in the present study seemed to adapt to their deprivation weights, and thus presumably differed in drive level, no significant group differences were observed in terms of days to criterion on the horizontal-vertical visual discrimination problem. If, in fact, the groups performed under different levels of motivation, these findings would be inconsistent with those obtained using other manipulations of drive and other response measures (Azrin, 1960; Azrin et al., 1963; Dinsmoor, 1952; Ehrenfreund, 1960). However, it is much more likely that the groups in the present investigation did not differ *significantly* in drive level, and/or the behavioral task employed was such a relatively simple discrimination that it prevented the different drive levels from exerting any significantly different effects with regard to the days-to-criterion measure. That the discrimination problem used here was quite easy is indicated by the days-to-criterion scores in Table 1.

Much more research is obviously needed before any valid conclusions can be made regarding the effects of adaptation to deprivation weight. Parameters which need to be studied, both individually and in combination, include the following: (a) species, (b) tasks and performance measures (hopefully sensitive ones), (c) percentages of free-feeding weight, and (d) length of the adaptation period.

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