Repeated acquisition and extinction of an operant by opossums and rats*

MYRON R. POWELL and JOHN H. DOOLITTLE
Sacramento State College, Sacramento, Calif. 95819

Five Virginia opossums and seven rats were shaped and extinguished on a barpressing response on each of 10 succeeding days. Both opossums and rats made fewer responses during the extinction period over days, indicating that both species show progressive improvement on this task. These results were interpreted as being consistent with earlier studies.

Bitterman (1965) has concluded that for tasks of habit reversal and probability learning, all species of animals can be classified by their performance as either rats or fish. A species is classified as rat if it shows maximizing or nonrandom probability matching and progressive improvement in habit reversal and as fish if it shows random probability matching and failure of progressive improvement in habit reversal. This system has been used to classify the earthworm, cockroach, fish, turtle, pigeon, rat, and monkey. Bitterman (1965) has urged the extension of the comparisons to phyla and classes not yet classified, as has Warren (1965), as a means of assuring that the results are not artifacts of the species selected for study.

Herring, Mason, Doolittle, & Starrett (1966) have pointed out that the Virginia opossum (*Didelphis virginiana*), as a marsupial and transitional form between the reptiles and the mammals, should be the subject of comparative learning studies. Friedman & Marshall (1965) demonstrated progressive improvement by the Virginia opossum in a habit reversal task, leading it to be classified as a rat on this task. Similarly, Doolittle & Weimer (1968) found nearly identical maximizing by rats and opossums on a spatial probability learning task. According to Bitterman (1965), maximizing behavior on a probability learning task and progressive improvement on a habit reversal task indicate superior flexibility and adaptability. Because the observed adaptability of opossums may be task specific and not generalizable, it was decided to assess the behavior of opossums on another task calling for a flexible response, repeated acquisition, and extinction of an operant. This type of task is widely

used in the Soviet Union for comparative learning studies (Voronin, 1962). Wickens & Miles (1954) studied repeated acquisition and extinction of a barpressing habit in rats and found that over acquisition-extinction sessions, there was a sharp increase in the extinction responses, followed by a definite decrease to a relatively low and constant rate.

METHOD

The Ss were five experimentally naive Virginia opossums, two males and three females, and seven experimentally naive Long-Evans rats, all males. The opossums were between 6 and 12 months of age and the rats, 6 months of age initially. The operant conditioning apparatus for the opossums consisted of a 3 x 2 x 1 ft wooden box with a Plexiglas lid and with a Lehigh Valley water dipper (0.25 cc) and a monkey bar installed

at one end. For the rats, a standard Skinner box with a water dipper (0.1 cc) was used.

All Ss were placed on an approximately 23-h water-deprivation schedule, with ad lib dry food for 5 days prior to the beginning of the experiment. Each S was then given ½-h barpress training sessions daily until a criterion of 15 min of continuous responding was reached. Because the rate of acquisition was slow for all Ss, due presumably to insufficient thirst, the deprivation schedule for rats was reduced to 10 min of water per day. Because the opossums could consume a full day's ration of water in less than 10 min, the opossums were given 8 ml of water per pound of body weight per day.

After reaching the criterion, all Ss were allowed 25 reinforced barpresses per day for 3 days to further stabilize the baseline of responding. For the next 10 days, Ss were allowed 15 reinforced barpresses followed by a 10-min extinction period each day. For each S, the number of barpresses during the extinction period was recorded on an event recorder.

RESULTS

For each species, the mean number of responses during each of the 10 extinction sessions was computed and is graphically presented in Fig. 1. Analyses of variance were computed on extinction responses across sessions for both opossums and rats and produced F ratios of 11.61 ($p < .01$) and 13.73 ($p < .01$), respectively. No statistical comparisons were made between opossums and rats.

DISCUSSION

Inspection of the graph indicates that both opossums and rats made fewer extinction responses over sessions. This means that both groups showed progressive improvement on this type of habit reversal task. These results support and extend the finding of Friedman & Marshall (1965) that opossums improve on a spatial habit reversal task. It is not surprising to observe adaptable behavior in a species that has survived in a relatively unchanged form for over 60 million years (Simpson, 1937) and is now extending its range in the United States (Hamilton, 1963).

It may be noted that the Wickens & Miles (1954) finding with rats of a sharp increase in extinction responses during Extinction Session 2 was not confirmed by the present study. Methodological differences between the two studies and the small number of Ss in each (nine and seven) make a resolution of the difference in results impossible at this time.

Fig. 1. Mean number of barpress responses for opossums and rats over extinction sessions.

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Food-satiation response functions of albino rats, obtained on a three-valued randomized deprivation schedule

ROBERT L. GOSSETTE

Comparative Animal Behavior Laboratory
Hofstra University, Hempstead, N.Y. 11550

Food-satiation response functions of albino rats, obtained under a three-valued randomized food-deprivation schedule, were analyzed. The method of analysis focused upon transforming response and time measures to a common scale. This revealed a considerable regularity across satiation values. Rate declines typical of satiation would appear to reflect a lengthening of feeding pauses that are interspersed among bursts of feeding responses.

The study of satiation functions,¹ notably those involving food or water consummatory responses, has been of perennial interest for many years. Analysis of such functions is vital not only for the information they provide about the variables controlling feeding and drinking behavior, but also for a more adequate appraisal of the methodological appropriateness of dependent variables that might be employed in the experimental scrutiny of a number of different environmental and organismic variables. For example, one of the most widely used measures is response rate in free operant tasks. If the reinforcement schedule employed approaches continuous reinforcement, variation in response rate may reflect properties of satiation as much as the experimental variables explicitly selected for study. Systematic inflections in rate mistakenly attributed to the experimental variable

may in fact represent characteristics of the satiation function. On the other hand, in the comparative analysis of behavior, obtained interspecies performance differences emerging from methodology utilizing consummatory responses may not reflect differences in, for example, learning ability, threshold sensitivity, or even species-specific repertoires, but rather interspecies variation in properties of satiation. Furthermore, through detailed interspecies comparisons of satiation functions, it may be possible to devise a calibration procedure by which different species may be equated along motivational-incentive variables. Accordingly, analyses of satiation, both across and within species, are of considerable interest. As an initial exploration of the usefulness of the satiation in comparative analyses, a detailed description of satiation behavior of rats was undertaken.

SUBJECTS

The Ss were six albino rats, two female and four males, about 130 days old. Ss were confined in the test chambers throughout the experiment and removed only for daily weighing.

APPARATUS

Apparatus consisted of a single bank of operant chambers located in a well-illuminated windowless room. Each chamber was 8 in. wide, 10 in. long, and 6 in. deep. A bar manipulandum rested in grooved supports attached to the chamber front to permit ready insertion and withdrawal. Two chambers were employed concurrently, with reinforcement consisting of 45-g Noyes pellets released by a Gerbrand pellet dispenser. Water was continuously available. Barpressing was recorded on a four-channel event recorder. One channel received a 15-sec time pulse to permit temporal calibration of barpressing.

Three values of food deprivation were chosen: 2, 11, and 23 h. Deprivation was measured from the last reinforced response of the last satiation to the initiation of the next session. Each S was assigned a randomized schedule containing the three values of deprivation. Following a 6-day habituation period of ad lib feeding, each S was placed on deprivation and trained to barpress for food. Once barpressing was established, food was obtained only through barpressing. Satiation measurement continued for about 2½ months. A S was considered satiated when an interval of 9 min had elapsed without a response.

RESULTS AND DISCUSSION

Conventional analysis of satiation involving total time (T) and responses (R) to satiate and initial rate (IR) of satiation has generally reported that all of these measures are a negatively accelerated increasing function of food deprivation. The data of this experiment are no exception—Table 1. The focus of the present analysis, however, is upon parameters of the

Table 1
Mean Total Responses (R) and Total Minutes (T) and the Initial Rate (IR) Across Three Values of Food Deprivation for Six Ss. Each mean is based on 17 sessions for each S.

Response Measures		Hours of Food Deprivation		
		2	11	23
R	M	84.5	228.6	312.5
	SD	50.3	78.2	55.8
T	M	18.1	41.3	57.9
	SD	10.5	15.4	12.0
IR	M	18.4	27.0	29.9
	SD	8.8	8.4	7.0