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Discrimination learning and extinction in the black rhinoceros *(Diceros bicornis)*[1]

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A series of three studies support the possibility of working with large nonlaboratory animals in a zoo setting. Position responses were quite strong and performance curves tended to produce straight lines.

There are numerous animals which have not been subjected to any systematic or even to any sketchy experimental behavioral research. Such is the case with rhinoceroses. Information available is based on scattered field observations, descriptions of behavior in zoos, plus assorted stories of gamekeepers and hunters. This hardly represents adequate information regarding these animals. The present work represents an attempt to develop suitable techniques for working with rhinos and to gather some basic data regarding their discrimination learning. The work is presented in the same sequence as run.

Preliminary Work

A seven-year-old black rhinoceros from the Ft. Worth Zoo was the only S used for the preliminary work.

The first problem was to determine a proper reinforcer. Carrots, peppermint candy, sugar cubes, cabbage leaves, and white bread were tried; all were eaten readily and with apparent relish. White bread was found to be very suitable and one-half slice, per trial, was sufficient to sustain performance. A rhino will eat up to six large loaves of bread in one session without a noticeable decrease in responsiveness.

Ten sessions of approximately 45 min each were spent taming the S. Five sessions were spent in allowing the S to become accustomed to the presence of the Es and learning to come when called. Five sessions were spent timing the S on runs from the back to the front of the cage when called and fed. Timed runs did not prove to be a satisfactory measure. The animal is quite sensitive to unusual sounds, movements, or anything new, so that times were quite variable. Considering the conditions under which the research took place, measures other than timing seem superior.

The third stage of the preliminary work was a black-white discrimination problem. It was determined that the problem was well within the rhino's capacity; also, that this particular rhino often responded on the basis of position. At the beginning of the discrimination problem it was necessary to allow the S some time to become accustomed to the stimuli since the first exposure to these stimuli led to responses that could reasonably be interpreted as a mixture of fear and belligerence. The preliminary study at Ft. Worth was run in an effort to work out suitable techniques. These data are not presented, although they are compatible with data from the other experiments. In addition, one other study was run with the Dallas rhinos, but is not included here due to space limitations. The results were compatible with those presented in this paper.

EXPERIMENT 1

This was a simple black-white discrimination problem.

Subjects and Apparatus

The Ss in Experiments 1-3 were a male and a female black rhinoceros in the Dallas Zoo. The female is estimated to be nine years old and the male three years old. These rhinos have a large, common enclosure and individual pens. Since the experiments were carried out in the individual pens, only these will be described. The pens were 21 x 16 ft, with a door of heavy bars between the pen and common enclosure. There were three openings between the "I" beams at the front of the pen. Each opening was 40 in. long x 17 in. high.

The stimulus cards were 16 x 24 in., one painted black, the other white. During the test period the cards were placed in the openings approximately 8 ft apart.

Procedure

The Ss were fed, tamed, and trained to come when called for approximately 1 h per day for seven days.

For the discrimination problem in this and succeeding studies, the stimulus cards were changed from side to side according to Gellerman (1939) orders. Each S was given 15 trials per day throughout each experiment. Each trial consisted of E1 calling the S to the end of the cage away from the cards and feeding one-half slice of bread. E2 then called the S to the end of the cage with the cards. If S responded correctly, E2 hand-fed 1½ slices of bread. The black card was the correct stimulus for both Ss. A noncorrection procedure was used. During the first three days of training E2 stood behind the correct card on each trial, called S to it, and gave the reward. These days are not included in the data presented in the Results section. After the 3rd day E2 withdrew approximately 8 ft from the guard rail midway between the two cards. When S responded to the proper stimulus E2 advanced and offered the bread. If S's response was incorrect, E2 remained in place, E1 called S to the other end of the cage and another trial was begun.

Results

One of the most striking aspects of the data in Fig. 1 is that the learning curve could be very well described as approximating two straight lines. Lines shown in Fig. 1 and succeeding figures were fitted using the method of least squares. The Ss started slightly below chance and reached a plateau at slightly under 80% correct responses. After reaching the plateau the Ss remained close to this level for 12 days or 180 trials.

EXPERIMENT 2

Apparatus and Procedure

The apparatus was the same except for the stimulus cards. Each card used had a white background with a black figure centered on it. One figure was an equilateral triangle 25 cm on each side. The other figure was a circle 9.2 cm in diameter. The figures themselves were formed of black lines ¾ in. wide.

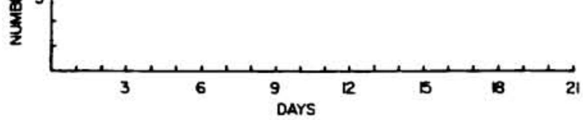

Fig. 1. Mean number of correct responses, by days, in the black-white discrimination problem.

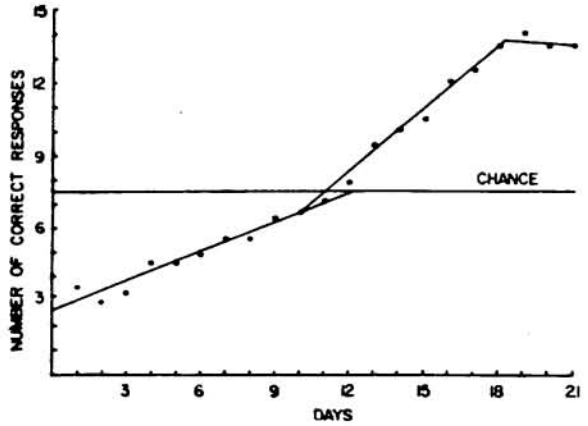

Fig. 2. Mean number of correct responses, by days, in the circle-triangle discrimination problem.

The triangle was reinforced for both Ss. The same procedure used in Experiment 1 was used with the exception of the seven days of taming.

Results

As may be noted from Fig. 2, performance in the first few days was at a very low level; in fact, the first three days are significantly below chance ($\chi^2 = 4.26$; $p < .05$). In Fig. 2 the performance curve could be described as three straight lines; one covering the period from the beginning of training to the chance level; the second from chance level to the plateau; the third along the plateau. This plateau very likely represents an end effect due to the approach to the limiting case. There was a highly significant difference in the final level of performance and a chance level ($\chi^2 = 9.60$; $p < .002$).

EXPERIMENT 3

Apparatus and Procedure

The stimulus cards and procedure during the acquisition phase were the same as in Experiment 1. The last 165 trials were an extinction period.

Results

The number of responses to the black stimulus is shown in Fig. 3. Comparison of the acquisition phases of all three experiments indicates that the final plateau tends to be higher

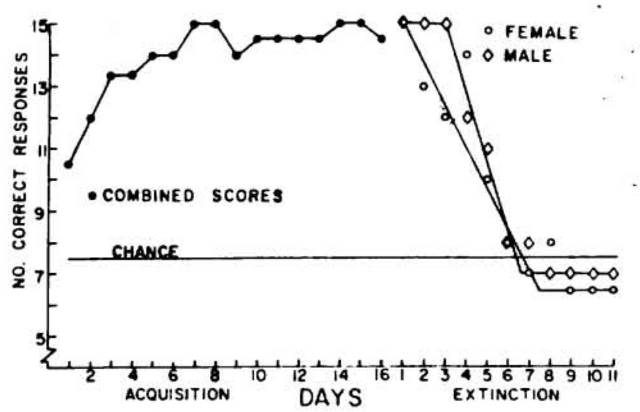

Fig. 3. Correct responses, by days, in the extinction problem.

with succeeding experiments (77, 91, and 97%). The approach to the plateau is rather rapid in Experiment 3 and the acquisition curve more closely resembles a negatively accelerated curve than do data from any of the earlier studies.

Individual data are shown for the extinction period since there was a considerable difference in the number of trials each S received before evidence of extinction was clear. The male S made 45 responses to the black stimulus card before a response decrement was evident. The female S showed a performance decrement after 15 consecutive nonreinforced trials to the black stimulus card. Considered individually, the extinction curves of each S approximate a straight line. If the individual curves are combined, the result is a curve with a slight positive acceleration. In either case this does not fit the usual rat pattern.

In the first two experiments and the acquisition portion of Experiment 3, there was very little difference in the number of correct responses by the two Ss so that the combined curves are representative.

DISCUSSION

One result of these studies has been to indicate the possibility of working with large nonlaboratory animals in a zoo setting. The working conditions present problems, but they are not insurmountable.

The change in performance together with the extremely low variability may be as useful as data from brighter and more variable animals. The variability of these animals around their general trend is amazingly low whether plotted together or singly. The conditions under which the acquisition and extinction data were collected makes the low level of variability even more notable.

The response measured in the three experiments during both acquisition and extinction could easily be assumed to have straight-line functions. This is very obviously different from the usual response probability curves found in rat data. It is not clear at this point why the performance curves differ from the usual mammalian curves. The results from Experiment 3 suggest that emotional or experiential factors may be related to the shape of the curve. In any case, the results support the view that expansion of our experimental populations beyond the usual rat and sophomore groups is well worthwile. Other authors (Breland & Breland, 1961; Hirsch, 1963; Kavanau, 1963) have also questioned assumptions which disregard species differences. Caution in making generalizations across species, in the absence of data, deserves serious consideration.

REFERENCES

BRELAND, K., & BRELAND, M. The misbehavior of organisms. American Psychologist, 1961, 16, 681.

GELLERMAN, L. W. Chance orders of alternating stimuli in visual discrimination experiments. Journal of Genetic Psychology, 1933, 42, 356-360.

HIRSCH, J. Behavior genetics and individuality understood. Science, 1963, 142, 1436-1442.

KAVANAU, J. L. Behavior confinement, adaptation, and compulsory regimes in laboratory studies. Science, 1963, 143, 490.

NOTE

1. These studies were made possible through the generous cooperation of the staffs of the Ft. Worth and Dallas Zoos. Lawrence Curtis and Frank Thompson, both formerly with the Ft. Worth Zoo, and Pierre Fountaine and Elvie Turner of the Dallas Zoo, were particularly helpful. Brian McCain and Norman Stepter assisted in collection of the data. A portion of the data was presented at the 1963 American Psychological Association Convention. A256

Discrimination learning in the South American tapir (*Tapirella*)[1]

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Strong position responses appear related to a high level of emotional arousal. Performance abruptly improved from a chance level after a very extended period.

Over the past several years we have made a number of attempts to work with animals in zoo settings. The object of these studies has been to find means of working with animals in a zoo setting, obtain some knowledge of adequate reinforcers, identify stimuli suitable for the capacities of particular animals, and obtain some information on discrimination learning. The choice of tapirs in the present study was related to earlier use of black rhinoceroses in a series of discrimination studies (McCain & Stepter, 1968). Since rhinos and tapirs are important members of a rather limited order, (*Perissodactyla,* three-toed), at least gross comparisons seem useful.

In the odd-toed order the rhinos and tapirs have a common origin and it seems likely the tapir is the more ancient form. Tapirs have been termed "living fossils" since their modern form is very close to that of the fossil remains from the Miocene period (about 12 million B.C.). Earlier but somewhat smaller forms go back at least 50 million years. Geographic distribution of tapirs is somewhat peculiar in that they are found only in Malaya, the East Indies, and Central and South America. The particular species used in this study (*T. terrestris*) are semiaquatic and although smaller than other tapirs are still the heaviest of wild animals native to South America. They are extremely solid and very strong for their size.

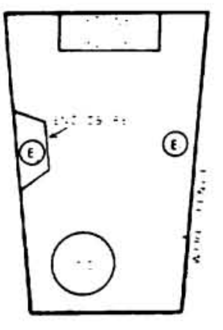
METHOD

Subjects

The Ss were a male and a female, approximately four to six years old. Both Ss were captured as young animals and had spent the majority of their lives in the zoo.

Apparatus

The study was run in the Ss' normal pen, which was approximately 40 ft x 60 ft, with a stone house at the back of the pen. Figure 1-a is a sketch of the pen which also shows the apparatus and Es as they were positioned in the pen.



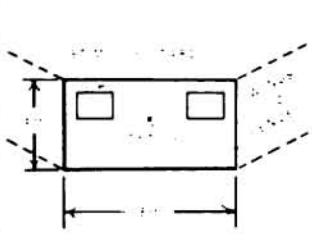


Fig. 1a (left). Sketch of tapir pen showing position of Es during discrimination problem.

Fig. 1b (right). Front view of enclosure.

Figure 1-b is a sketch of the apparatus itself seen from the point of view of the tapir. The apparatus consisted of an enclosure formed by three plywood sides and a fence. The dimensions of the enclosure are shown on the sketch. The enclosure remained in the pen throughout the study. The stimulus cards were 18-in. x 18-in. plywood squares, one black and the other white. The enclosure was painted medium gray.

Procedure

The Es spent a total of about 8 h allowing the Ss to become accustomed to their presence and trying several different food rewards. As with rhinos, the tapirs accepted a wide variety of vegetable foods plus candy and white bread. White bread was selected as a reward because of cost and ease of handling. Each S was trained to respond to its name while in the pen described above. In the beginning the Es stood about 6 ft apart, while one would call the S's name and offer half a slice of bread. Gradually the distance between Es was increased and the bread was concealed until the S responded. Next, one E stood in the enclosure, the other outside and across the pen, as shown in Fig. 1-a. After Ss began to approach the enclosure regularly when called, the E in the enclosure positioned himself behind the black card and called S. The black card was shifted from side to side on a schedule taken from the Gellerman (1939) orders. After approximately 60 trials E concealed himself in the center of the plywood enclosure and called S; if S responded to the correct card, reward of ½ slice of bread was given. During acquisition the female S was given 154 trials, the male 168 trials, at 14 trials per day.

RESULTS AND DISCUSSION

Working with a new species does have some possible values other than producing a learning curve. Techniques were developed to cope with these Ss. While the procedure sounds rather straightforward, the actual operation was more poorly controlled than even the usual rat study.

The results in terms of the percentage of correct responses for each S are shown in Fig. 2. As may be noted, both Ss had a relatively long period of responses at approximately a chance level. This period covers 70 trials for the male S and 98 trials for the female S. The figure does not tell most of the story. Both Ss started the problem with a very strong position response. Happily, one responded left, the other right. The male S broke the position response after 70 trials and, as may be seen in the graph, improvement in performance was extremely rapid from this point. The situation with the female S was even more extreme; she made 98 successive left responses. At this point she was given *one* forced trial to the right side. Her change of behavior was sudden; she made only five errors in the succeeding 56 trials. While learning in this case seems to proceed very rapidly, a description of the actual events may be useful. During the long period of position responding the Ss gave some signs that they, too, were impatient with the situation. On trials in which the white card was on their response side considerable emotional behavior was observed. The Ss would refuse to respond or make responses to the position preference without slowing down long enough for the reward to be given. Other behaviors such as crying, defecating, biting E, chasing leaves and running away from the experimental area seemed to indicate some sort of emotional arousal. It appears likely that the emotional arousal interfered with response flexibility.

There is at least one other point to be made. A serious

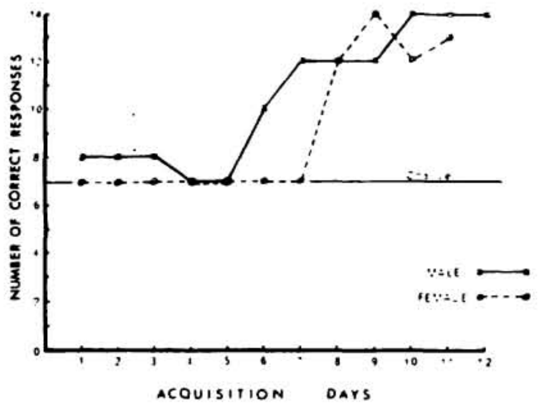


Fig. 2. Number of correct responses by days, on black-white discrimination problem.

mistake appears to have been made when it was assumed that the pretraining had effectively transferred to the acquisition situation. Note that during the first stage of pretraining E plus calling the S's name became very effective stimuli which elicited a reliable approach response. During a latter stage when E stood behind the stimulus there was apparently little or no association between the stimulus card and reward, in spite of the fact that reward was given about 6 in. in front of the stimulus card. It appears that E had become such a potent stimulus that a later added stimulus had little or no effect. Stimuli impinging upon the receptors may or may not acquire any ability to evoke a response when another stimulus has been previously established as the critical stimulus.

As in the earlier studies on rhinos, the tendency to fixate on a particular position response was quite evident. Previous experience with the rhinos has indicated the presence of highly emotional behavior in a simple discrimination problem. In a series of studies with rhinos the tendency to give a position response decreased over problems.

REFERENCES

GELLERMAN, L. W. Chance orders of alternating stimuli in visual discrimination experiments. Journal of Genetic Psychology, 1933, 42, 356-360.

McCAIN, G. Learning in the Black Rhinoceros (*Diceros bicornis*). Paper presented at American Psychological Association Convention, September, 1963.

McCAIN, G., & STEPTER, G. Discrimination learning and extinction in the Black Rhinoceros (*Diceros bicornis*). Psychonomic Science, in press.

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1. This study was made possible through the generous cooperation of the staff of the Ft. Worth Zoo. Lawrence Curtis, formerly with the Ft. Worth Zoo, was particularly helpful. Thanks are due Terry Hawles and Brian McCain who ran the Ss. Some of these data were presented at the Southwestern Psychological Association Convention, 1968.