The pigeon's concept of pigeon*

JEAN POOLE and D. G. LANDER†
Dalhousie University, Halifax, N.S., Canada

Pigeons were trained to discriminate between the presence and absence of a pigeon in photographic displays projected on a response key. Irrelevant cues were reduced as much as possible, while the differences between the objects were of sufficient variety and complexity to ensure that mastery of the discrimination would require the use of a concept. The Ss learned this discrimination very rapidly. On a test given following training, the Ss showed almost complete transfer to new displays containing fancy breeds of pigeons and showed significantly less transfer to new displays containing other species of birds. These results indicate that discrimination was based on a concept of "pigeon."

Pigeons can learn to discriminate between sets of complex color photographs which are distinguished only by the presence of a "human being" in each member of one set (Herrnstein & Loveland, 1964; Siegel & Honig, 1970). Since the human figure in these photographic displays vary beyond simple classification, mastery of such a discrimination implies the use of some general rule or concept relating to the presence or absence of a human. For pigeons, other pigeons are likely to be more salient stimuli than are human beings. The survival of the species depends upon their being able to recognize other pigeons as belonging to a distinct class by virtue of characteristics they have in common. The present experiment investigated the formation of a discrimination requiring some concept of "pigeon" for its mastery. To facilitate stimulus control, each display consisted of a single object presented on a relatively simple background. An attempt was made to obtain additional information on the features of the displays contributing to the discrimination.

SUBJECTS

Three loft-reared homing pigeons, maintained at 80% of their free-feeding weights, served as Ss. Their individual home cages were housed in a room illuminated 24 h per day. All Ss had previous experience of training on a wavelength discrimination.

APPARATUS

The Ss were trained in a standard operant chamber having two 7.6 x 7.6 cm Plexiglas response keys. Only the left key was used in the experiment. Color slides were projected onto this key by a Kodak Carousel AV-900 projector. The right key was unilluminated, and responses on it had no consequences. Reinforcement consisted of 4-sec access to mixed grain at an aperture centered between the two keys and 2 cm below them. Programming equipment was located in a separate room.

STIMULI

Stimuli were color transparencies of side portraits of different breeds of pigeons (positive displays), other species of birds, animals, or inanimate objects (all negative displays). Each slide contained a side portrait of only one bird, animal, or other object. Negative displays were equated with positive displays for color of background, color, and texture of the foreground and color and size of the feature object in the display. Each feature was photographed against a varying blue unpatterned background. All slides of pigeons and other species of birds were photographed from color prints. Positive and negative instances were also matched for the proportional size of the display and its feature. The slide library consisted of 126 different slides (60 positive, 54 negative, and 12 other species of birds) with equal numbers of left- and right-side portraits.

PROCEDURE

The Ss were pretrained to peck the key (illuminated with white light) in daily sessions of 20 trials. Each trial lasted 90 sec and was followed by a 10-sec time-out. Responses were reinforced at variable intervals, the mean of which was 56 sec (VI 56 sec). After 17 of these preliminary sessions, Ss were trained to discriminate between the presence and absence of pigeons in displays. The same trial and time-out durations were employed in this phase. Daily sessions consisted of 40 trials of successively presented displays: 20 positive and 18 negative displays of objects and animals, and 2 negative instances of other species of birds. A random sequence of slides was selected each day. Although Ss saw the same display more than once, displays were never presented in the same sequence or in consecutive sessions. Responses made to a positive display were reinforced on a VI 56-sec schedule, while negative instances were correlated with extinction.

Having reached the criterion of 3 consecutive days with a discrimination ratio greater than 0.80, Ss were given a transfer test administered in extinction. The test consisted of 40 trials which were 30 sec in duration and were separated by 10-sec time-outs. Four categories of slides were used in the test: 10 positive training slides (OP), 10 negative training slides (ON), 10 new slides of "weird" pigeons (fancy varieties having heavily feathered feet, abnormal head, body, or tail structures) (WP), and 10 new slides of other species of birds (OS). Slides were presented successively in a predetermined randomized sequence.

RESULTS

Figure 1 shows changes in discrimination ratios during acquisition for each S. Discrimination ratios were calculated as the proportion of total responding emitted in the presence of positive displays. Although individual Ss took somewhat different numbers of sessions to reach criterion, acquisition was quite rapid in each case. Pigeon 19 achieved a discrimination ratio of 0.9 after only six sessions of training. The number of sessions the three Ss required to reach the criterion was 8, 11, and 20, respectively. As responding came under increasing stimulus control, a greater proportion of responses to negative displays were made in the presence of those containing other species of birds.

Figure 2 shows the proportion of total responses emitted in the presence

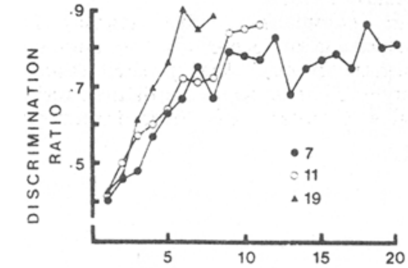

Fig. 1. Discrimination ratios of the three pigeons during acquisition. Ratios were calculated as the number of responses occurring in the presence of positive displays divided by the number of responses in negative displays.

*This research was supported by Grant APT-102 from the National Research Council of Canada to W. K. Honig, to whom we are indebted for the use of his research facilities and other generous support. The authors also wish to thank Donald Grant, Peter Seraganian, and Ferenz Stefani for their advice and assistance.

†Reprints may be obtained from D. G. Lander, Department of Psychology, Dalhousie University, Halifax, N.S., Canada.

of the four categories of displays in the transfer test. The data were converted to relative scores to enable comparisons between widely divergent absolute response frequencies. In the test, the frequency of responding was ordered, from highest to lowest, through the categories old positive (OP), weird pigeon (WP), other species (OS), and old negative (ON). There was only one exception to this trend: Pigeon 11 made more responses to WP than to OP displays. All Ss made more responses to displays which contained pigeons than to displays which did not. At the same time, all pigeons made many more responses to displays of other species of birds than to those containing objects other than birds. An analysis of variance of these data revealed a significant difference in the proportion of total responses made to the four categories of displays ($F = 44.03$; $df = 3,8$). Using the R technique (Rodger, 1965) and its revised F tables, four tests of comparison were administered to determine the location of significance. These compared old positive to weird pigeons, weird pigeons to other species of birds, other species of birds to old negatives, and old positives to other species of birds. All tests yielded a significant difference, except the first comparison between old positive and weird pigeon displays.

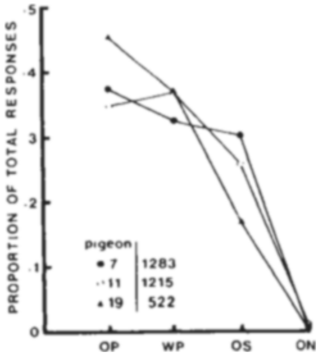

Fig. 2. The proportion of total responses emitted in the four categories of displays during the transfer test. The numbers at the right of the figure key are absolute total numbers of responses emitted during the test by the respective Ss.

DISCUSSION

The results demonstrate the ability of pigeons to discriminate between photographic displays containing pigeons and those containing objects other than pigeons. Discrimination was formed on the basis of a large number and variety of positive and negative instances. The first test showed that this discrimination transferred to new displays of weird pigeons, but transferred significantly less to displays of other species of birds. On this basis, it is suggested that pigeons can use a concept of "pigeon" in the performance of such complex discriminations.

In comparison with studies of discrimination based on the concept "human being," the present results showed a more rapid acquisition and a higher level of discrimination performance. After 36 sessions of training, the Ss of Siegel & Honig (1970) had achieved a mean discrimination ratio of only 0.65. In the present study, however, all the Ss had reached a discrimination ratio of 0.70 after seven sessions. Pigeon 19 reached this level after only four sessions and appeared to have stabilized with a discrimination ratio of 0.88 after eight sessions of training. This approximates the performance of pigeons on simple successive discriminations of color and form. It is likely that both the salience of the stimuli and their relative simplicity, in terms of containing a single object on a fairly uniform background, contributed to the improved stimulus control obtained in the present study. This makes it clear that slow acquisition of discrimination between sets of stimuli depends upon the characteristics of the stimuli and not upon the requirement that a concept be used.

The results show marked differences in responding to the two categories of negative displays. As training progressed, an increasing proportion of negative responses were made to displays containing other species of birds. In addition, there was a significant difference between responses in these two categories during the transfer test. This suggests that all displays containing birds had elements in common which reduced the discriminability of pigeons and other species of birds. At the same time, the significant difference between responses to categories containing pigeons and those containing other species of birds indicates that the concept on which discrimination was based must have been more specific than one relating simply to general characteristics of "birds." The transfer to new displays containing weird pigeons shows that the concept of "pigeon" used was not refined to the extent of excluding pigeons with unusual feather and body structures.

Taken together, these results suggest that the Ss rapidly learned to discriminate on the basis of whether an object had characteristics in common with pigeons in both ON and WP displays. It appears that some, but not all, of these characteristics were common to other species of birds, whereas they were not common to objects other than birds. The procedure employed may serve to narrow the gap between studies using highly controlled sets of simple stimuli and those which use stimuli that approximate the complexity of the natural environment. The number of irrelevant cues was limited by the use of relatively simple displays, yet the stimuli were sufficiently varied to require the Ss to use a concept in mastering the discrimination. The high degree of stimulus control achieved suggests that this may be a valuable technique. Transfer tests like the one used here may also provide a means of analyzing the properties of such concepts.

REFERENCES

HERRNSTEIN, R. J., & LOVELAND, D. H. Complex visual concept in the pigeon. Science, 1964, 146, 549-551.

RODGER, R. S. *Intermediate statistics.* Sydney: University Bookshop, 1965.

SIEGEL, R. K., & HONIG, W. K. Pigeon concept formation: Successive and simultaneous acquisition. Journal of the Experimental Analysis of Behavior, 1970, 13, 385-390.