Coupling Visual Concept in the Pigeon

Abstract. Pigeons were trained to respond to the presence or absence of human beings in photographs. The region of the eye, lip, and the ease with which the training was accomplished suggest greater power of perceiving Rosenthalians than are ordinarily attributed to pigeons.

It is well known that pigeons can acquire one or a few distinguishing features to discriminate specific stimuli such as simple visual arrays differing in size, shape, or color. In the experiment described here, however, pigeons were trained to detect human beings in photographs, a class of visual stimuli to which it is believed simple characterization.

Five male racing (homing) pigeons between 1 and 2 years of age were obtained from a local breeder. Before from the likelihood that they had been housed in outdoor coops, nothing was known about their past histories. All five were given approximately the same training and all performed similarly.

The pigeons were first fed on a mini-

diet until their weights fell 20 percent. They were then fed enough food to maintain them at the desired weight. The pigeons were collected at the end of the flight and placed in a box containing a hinged switch mounted on a wall near to a 5 cm by 5 cm translucent plate and a feeding device. During the first few sessions, the pigeons were trained to eat from the feeding device each time they opened the switch, which was a trigger for the feeder. At first, every peak at the switch operated the feeder, but, after two sessions, the procedure was changed so that peaks were effective only once a minute, on the average. An inconstant schedule of reward of this type produced reliably steady behavior with little satiation of hunger. As a final stage in the primary training the pigeons were taught that only when the transparent plate next to the switch was illuminated with a uniform white light were peaks effective, but not immediately. When the plate was dark, peaks were entirely ineffective. The illumination changed randomly in time, averaging a change a minute, with the sole reservation that
the onset of illumination could not take place within 15 seconds of the occurrence of a peck. In just a few sessions, the pigeons learned to peck when the plate was lit and not to peck when it was dark.

In the terminal procedure, the plate was illuminated throughout each session with projections of 35-mm color slides from a projector that housed 81 slides and that could be advanced by an electrical pulse. Over 1200 unselected slides obtained from private and commercial sources were available. Before each session, the projector was loaded with 80 or 81 different photographs of natural settings, including countryside, cities, expanses of water, lawn, meadow, and so on. For any one session, approximately half the photographs contained at least one human being; the remainder contained no human beings—in the experimenter’s box judgment. In no other systematic way did the two sets of slides appear to differ. Many slides contained human beings partly obscured by intervening objects: trees, automobiles, window frames, and so on. The people were distributed throughout the pictures: in the center or to one side or the other, near the top or the bottom, close up or distant. Some slides contained a single person; others contained groups of various sizes. The people themselves varied in appearance: they were clothed, semi-draped, or nude; adults or children; men or women; sitting, standing, or lying; black, white, or yellow. Lighting and coloration varied; some slides were dark, others light; some had either reddish or bluish tints, and so on.

With the difference that pictures containing people now meant an opportunity to feed and that pictures without people meant no such opportunity, the procedure remained unchanged. Each day the slides themselves, and also the random sequence of positive slides (that is, containing a person) and negative slides (without people), were changed for each pigeon. Many slides were used again in later sessions, but never in the order with other slides in which they had appeared earlier. The pigeons had no opportunity, therefore, to learn groups of particular slides or sequences of positives and negatives in general.

The first test for a concept based on the image of a human being is simply whether a pigeon pecks at different rates in the presence of positive and negative slides. By this criterion, all five pigeons showed some grasp of the concept within seven to ten sessions with the pictures, but performances continued to improve with training over a period of months. Figure 1 shows a typical day’s performance, with 80 or 81 totally new slides, by three pigeons after approximately 70 sessions of training. The rate of pecking in the presence of each slide was calculated. The rates were then ranked, and are plotted against their ranks on log-log coordinates. The three functions, are displaced along the abscissa to facilitate inspection. Slides containing at least part of a person appear as open circles; slides without

![Fig. 1 (left). Rate of pecking in the presence of each picture as a function of the rank order of the rate on logarithmic coordinates. 35-mm color transparencies were used. Open circles represent pictures containing people; closed circles painted by lines, pictures without people. A 3-day session is shown for each of three pigeons with the absicissa displaced as indicated. Fig. 2 (right). One-day sessions for two pigeons looking at black and white pictures. SCIENCE, VOL. 145]
people, as closed circles pierced by a tie. The evidence for a concept is uncontestable: the probability of obtai-
ning by chance a set of ranks with such a degree of separation between positive and negative is exceedingly
low. The performances of the two pigeons not shown here were equally surprising.

Although the pigeons were doubtless
ably responding to something closely
associated with people in the pictures,
it remains to be shown that it was the
visual array that we would ourselves
call a person. It could be that the re-
sults arose from some trivial and un-
expected visual clue in the slides, or
from some nonsensical property of the
procedure. To check the possibility of
some correlation between the presence
of a human being and color distribu-
tion in the slides, a set of slides was
reproduced in black and white. Figure
2 shows the results obtained for two
pigeons with black and white slides.

Despite a slight determinism in discrimi-
nation, the behavior was still unani-
mously negative. To test the possibility
that the pigeons were reacting to some
tonal aspect of the procedure, a session
was conducted in which half the
positive slides were treated as if they
were negative and half the nega-
tive slides as if they were positive.
That is to say, the apparatus had a 50/50 chance of producing the wrong consequence when the pigeon pecked
down under these contingencies. The
pigeons reacted to the presence of ab-


Circadian Leaf Movements in Bean Plants: Earlier Reports

Hoshibaizaki and Huang (1), in pre-
sent writing evidence for a circadian leaf
movement which continues for 4 weeks in Phaseolus under constant conditions, say, "Nowhere in the literature is there
report of a persistent circadian leaf
rhythm in higher plants." However,
there are many such reports. The condi-
tions which allow leaf movements to persist for several weeks in continuous light have been applied at Tôhoku (or
many years, with several species of
Plants (Pfeffer), who published nearly
700 pages on diurnal leaf movements
between 1875 and 1915, described the
presence of leaf movements in Phaseo-
lus for more than 4 weeks. Because of
his special methods, elaborated over a
decade period, he put even much clair-
tier records. One of his figures has been
reproduced more recently (2). Pfe-
ffer's figures also clearly demonstrate
the deviations from the exact 24-hour
period, that is the circadian nature of
described persistence. Persistence of
leaf movements in Cucumis in continu-
ous light for several weeks was de-
scribed in 1929 (4). Hoshibaizaki and
Huang mentioned a circadian period of
about 26 hours, a period of 25.4 hours
(Phaseolus multiflorus, continuous
darkness) was measured in 1930 (5).

Erwin Bonning
Botanisches Institut, Universit/it Tubingen, Germany