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How Do You Tell a Chair from a Cat? Scientists Say You Could Ask a Pigeon

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In behavorial psychology experiments at the University of Iowa, Dr. Edward A. Wasserman and his colleagues have turned up what he called surprising evidence that ''the conceptual abilities of pigeons are more advanced than hitherto suspected.''

The pigeon mind, moreover, probably offers important clues as to how the human mind evolved and functions, Dr. Wasserman said in an interview.

''Darwin raised the possibility of a continuity in mental development from animals to human beings,'' he said ''And it certainly looks as though he was right.''

In a series of related experiments, the Iowa group is investigating the ability of pigeons to assign pictures of objects to such logical categories as ''cats'' or ''automobiles.'' After being familiarized with the testing apparatus, the pigeons respond to questions by pecking at keys representing possible answers. A computer controls and records all experiments, and when a pigeon pecks a correct answer the bird is automatically rewarded with a pinch of grain.

''Pigeons commit new images to memory at lightning speed,'' Dr. Wasserman said, ''but the remarkable thing is that they organize images of things into the same logical categories that human beings use when we conceptualize.''

Experiments devised by Dr. Wasserman, his former graduate student, Dr. Ramesh S. Bhatt, and others in the Iowa group have built upon pigeon research begun in the

1960's by Dr. Richard J. Herrnstein of Harvard University. Dr. Herrnstein and other investigators have shown that pigeons can distinguish between images that contain some type of object and images that do not.

Dr. Wasserman carried this discovery a step further by showing that pigeons can distinguish among at least four categories of objects and, he said, ''probably vastly more than that.'' He also found no difference in a pigeon's ability to distinguish ''natural'' objects like flowers and artificial ones like chairs.

In this, his finding differed from that of Dr. Herrnstein, who suggested that pigeons were better able to recognize categories for natural objects rather than artificial ones. ''The difference in our results is probably the result of some variation in experimental technique,'' Dr. Wasserman said.

Dr. Herbert S. Terrace, a psychologist at Columbia University who conducts conceptualization experiments with pigeons and chimpanzees, said all such experiments have failed to settle a major controversy.

''The big question is what the pigeon really sees when it is presented with these two-dimensional images,'' Dr. Terrace said. ''Whether or not it can make the connection between an image and reality is a question that remains unanswered and not much work is being done to answer it.''

Critics of all experiments of this type contend that no experiment can demonstrate unequivocally that an animal associates the image of an object with the real thing. However persuasive the evidence may seem, Dr. Wasserman acknowledged, ''no one can get inside a pigeon's head.'' Different Perspectives

The four categories Dr. Wasserman's group used in the experiments, which were recently reported in the Journal of Experimental Psychology, were cats (or in some cases, human beings), chairs, automobiles and flowers. Objects were shown from different perspectives, in altered lighting or settings and sometimes partially hidden.

In one test, 500 slides from each category were mixed in random order and shown to pigeons. Ten images from each category were repeatedly flashed on the screen until the subjects had learned to classify them correctly. The remaining slides were then presented with no repetitions. If a pigeon pecked the key corresponding to the correct category, it was rewarded; otherwise, the next slide was presented.

Dr. Wasserman said the birds achieved an accuracy rate of about 70 percent in this test. Since random pecking at the keys would have yielded a score of about 25 percent, he regards the result as highly significant.

''It's not just a matter of rote learning,'' he said. ''Once a pigeon has realized that various objects resemble each other enough to constitute a category, the bird can accurately identify new pictures of different objects that belong to that category.''

Experiments of this kind, Dr. Wasserman believes, may shed light on one of the principal debates in behavioral psychology: whether animals, including pigeons and human beings, conceptualize categories of things in terms of average ''prototypes'' or by reference to a huge file of similar stored images referred to as ''exemplars.''
Skinner Box Is Main Tool

''Our experiments have not settled the debate,'' he said, ''but I think the evidence is growing that the richer a memory is in stored images the more capable it is of distinguishing categories. I feel the exemplar explanation is probably closest to the truth.''

The main tool in Dr. Wasserman's experiments is the Skinner box, a device named for B. F. Skinner, the trailblazing psychologist who demonstrated in the 1930's and 1940's that behavior can be modified in complex ways by reinforcing desired behavior with judicious rewards. Among Dr. Skinner's achievements was teaching pigeons to play table tennis.

The variant of the device invented by Dr. Wasserman and his group is a box about the size of a microwave oven with a three-inch-square frosted-glass projection screen at one end. A slide projector controlled by a computer is mounted outside the box and projects images on the screen.

Near each corner of the screen are four round keys, each a different color. Behind each of the keys and the projection screen is a sensitive electrical switch that sends a signal to the computer if the key is pecked.

Just below the screen is a tray of grain that remains retracted out of reach of the pigeon unless the computer controlling the experiment recognizes that the bird is due a reward. The tray then pops out for about two seconds, gives the bird a quick snack, and then retracts to keep the bird interested in the experiment.

The pigeons themselves, trapped on Iowa farms, are fed only 85 percent of what they would normally consume. They are therefore always hungry and eager to hop into the box to work for rewards.
'Seed of Intelligence'

As Dr. Wasserman explained his work to a visitor, wild pigeons that had nothing to do with his experiments perched on the windowsill of his laboratory and looked in. ''Pigeons are not just opportunistic creatures like rats,'' he said. ''They're really part of the human environment and they have some striking features in common with us,

acute vision, for one.''

Many psychologists have theorized that the development of the visual area of the brain in animals is closely related to intelligence.

''Intelligence is really dependent on sensory organs like the eyes that operate over distance and permit an organism to plan what it will do before it makes contact with something,'' Dr. Wasserman said. ''An amoeba can only sense its immediate chemical environment and cannot plan ahead. The evolution of long-distance sensory receptors was the seed of intelligence.''

Pigeons also have a keen ability to distinguish the relative size of numbers and the duration of time, he said. In one set of experiments the birds were trained to register their answers by pecking the projection screen a number of times corresponding to a category. Shown a cat, for instance, the bird was supposed to peck about 20 times, or shown a chair, the bird was to peck 140 times.

''Pigeons can't count,'' Dr. Wasserman said. ''But they slow down when know they will have to peck many times before getting their reward. By timing the pecking rate we find that they give answers consistent with the relative size of the numbers.''

One peculiarity of pigeon perception, he said, results from the fact that their eyes have two foveas rather than the one in human eyes. The fovea is a light-sensitive region at the back of the eye that converts images into electrochemical signals.
Looking for Life Vests

The double fovea gives the pigeon a good stereoscopic view of objects straight ahead as well as another view taking in a much wider angle that does not offer stereoscopic vision.

Whatever pigeons see, their visual acuity may be useful to humans. In a Coast Guard experiment Dr. Wasserman described, pigeons were trained to peck a key when they spotted the bright orange color used for life vests. Three of the birds were placed in a transparent box suspended from a helicopter flying over the ocean. Dr. Wasserman said the birds were adept at spotting the vests.

The legendary navigational abilities of pigeons, believed to be largely dependent both on keen vision and a superlative memory of topographic details, are still useful to humans. Although they are rarely used to carry messages any more, the birds are sometimes used for emergency flights in London to carry blood samples from hospitals to laboratories.

Dr. Wasserman sees his work with pigeons as closely related to somewhat similar

experiments with chimpanzees and human infants. In particular, he believes pigeons exhibit some of the abilities of chimpanzees that were reported by Dr. R. Allen Gardner and his wife, Dr. Beatrice T. Gardner.

In experiments in 1985 the Gardners trained chimpanzees to make sign language gestures of the kind used by deaf people. The primates were then trained to use the gestures to identify categories of objects they were shown, and to classify and identify new objects.

The title of the Gardners' paper, ''A Vocaulary Test for Chimpanzees,'' helped to fuel a controversy among psychologists as to whether animals really use the equivalent of words in the same way people do. Similarity in Teaching

Dr. Wasserman is undecided on the issue. He suggested that the Iowa pigeon research ''formally resembled the chimpanze study,'' and that this could imply that ''pigeons also acquired a vocabulary.'' But, he added, ''it is important to note that this 'vocabulary' may differ from the kind associated with human languages.''

At the same time, he said, ''there is a striking resemblance between the way pigeons learn the equivalent of words and the way we do.''

''We teach pigeons in the same way I teach my baby daughter with the help of a picture book,'' he said.

Dr. Wasserman believes it is foolish to anthropomorphize pigeons or to imagine that they have anything approaching the mental capacity of humans. ''We don't name our test birds,'' he said. ''We just give them numbers.''

At the same time, the pigeon's brain, ''smaller than a fingertip,'' can perform some tasks that remain far beyond the ability of any existing or planned computer, he said.

''We're a very long way from explaining how either a pigeon brain or a human brain can do the things they do,'' he said. ''But by studying their modes of mental behavior we are getting closer to knowing what intelligence is and how it came into existence.''