much of the work on the cognitive effects of unilateral cerebral damage as well as the need for future investigations to take into account the sex of the patients studied.

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"Self-Awareness" in the Pigeon

Abstract. *Each of three pigeons used a mirror to locate a spot on its body which it could not see directly. Although similar behavior in primates has been attributed to a self-concept or other cognitive process, the present example suggests an account in terms of environmental events.*

The chimpanzee has been said to show signs of "self-recognition," "self-awareness," and a "self-concept" because it can use a mirror to locate an object on its body which it cannot see directly (*1, 2*). According to Gallup (*1*), four chimpanzees showed a variety of self-directed behavior after having been exposed to a large mirror for several days. After 10 days of exposure (approximately 80 hours), "self-awareness" was tested as follows. A chimpanzee was anesthetized and a red odorless dye was painted onto the top of an eyebrow ridge and the upper half of an ear. After recovering from the anesthesia, the animal was observed in the absence of a mirror for 30 minutes and in its presence for 30 minutes. There were few "mark-directed responses" during the first period and between four and ten such responses during the second.

After hundreds of hours of exposure to mirrors, primates other than man and the great apes have shown no such self-directed behavior. This has been said to indicate a "qualitative psychological difference among primates" (*3*). Monkeys fail the task reportedly because they "lack a cognitive category that is essential for processing mirrored information about themselves." More specifically, they are said to lack "a sense of identity" and "a sufficiently well-integrated self-concept" (*4*).

We have found that a pigeon (*Columba livia domestica*) is also capable of using a mirror to locate an object on its body which it cannot see directly, and we offer a nonmentalistic account of this behavior. The subjects were three adult male White Carneaux pigeons, each of which had had a variety of laboratory experience but no previous exposure to mirrors. The pigeons were maintained at about 80 percent of the weight they achieve when feeding without restriction. Sessions up to 2 hours in length were conducted daily in a small (32 by 36 by 42 cm) chamber. A mirror (34 by 21 cm) was positioned about 4 cm behind the right-hand wall, which was made of clear Plexiglas. Blue dots could be presented from behind three openings in the left-hand wall, which was painted white. A dot could also be presented from behind one opening in the rear wall, which was painted gray and white. The pigeon could be given access to mixed grain through an opening in the center of the left-hand wall. The Plexiglas front allowed us to see the bird at all times. We could also insert a clear rod, at the end of which was a blue dot, through a gap at the base of the front of the chamber. We used the rod to present dots at various positions on the left wall and floor of the chamber.

Two repertoires were established over a 10-day period. First, with the mirror concealed, we placed small (1-cm-diameter) blue stick-on dots one at a time on the wings, breast, neck, and abdomen of the bird. We shaped movements of the head toward the dots and then reinforced pecks at them on a rich variable-ratio schedule (between one and five pecks had to occur before food was presented). Having pecked at dots placed in a number of different positions, the pigeon would readily scan its body, locate a dot, and peck it.

Second, with the mirror exposed, we reinforced pecks at blue dots presented one at a time on the left and rear walls and the floor of the chamber. After a few minutes of such training, we presented a dot only briefly and reinforced pecks at the spot where it had been. Finally, a dot was flashed only when the pigeon could see it in the mirror. Food was presented if it then turned and pecked the place where a dot had been flashed. The pigeon now readily faced the mirror and responded appropriately to certain visual stimuli that appeared in it by turning and pecking the corresponding position in real space. Dots were never placed on its body during this condition.

The two repertoires were established in only 3 or 4 hours. The animals were exposed to the mirror for less than 15 hours over the 10-day training period.

We then conducted the following test. A blue dot was placed on the pigeon's breast and a white bib (note that the birds were white) was placed around its neck in such a way that, with the pigeon standing fully upright, we could just see the dot. The bib made it impossible for the bird to see the dot directly. If it lowered its head even slightly, the bib covered it (Fig. 1, A and B). In a control condition (3 minutes for one subject and 5 minutes for the others), the pigeon was placed in the chamber with the mirror covered. If the pigeon could see the dot or locate it using tactile cues, it presumably would peck it at this point. None of the subjects did so. When we uncovered the mirror, each pigeon approached it and, within a few seconds, began repeatedly moving its head downward toward the position on the bib that corresponded to the dot (Fig. 1, C and D). The second bird we tested continued to bob and peck in this fashion for more than 6 minutes (approximately 23 dot-directed responses occurred over this period). The number of dot-directed responses occurring during the last 3 minutes of the control period and the first 3 minutes of the experimental period were scored by three independent observers from video tapes (Table 1) (*5*).

To control for the possibility that movements toward the bib were produced simply by the uncovering of the mirror, before beginning the test described above, we placed the third subject into the chamber wearing the bib but without the dot on its breast. The mirror remained covered for 5 minutes and was then exposed for 5 minutes. During neither period did the bird bob or peck at the bib. It is therefore likely that the movements toward the bib that occurred during the subsequent test were indeed under the control of the dot.

Note that no food was presented during the tests and that before this time the birds had never had dots on their bodies when exposed to a mirror.

Table 1. Number of dot-directed responses in the control and experimental conditions (median scores).

Subject	Mirror covered	Mirror exposed
162 WP	0	9
110 YP	0	16
293 WP	0	4

We have demonstrated that a pigeon can use a mirror to locate an object on its body which it cannot see directly. We should not attribute this, however, to a pigeon's "self-awareness" or claim that a pigeon has a "self-concept." We believe that such constructs impede the search for the controlling variables of the behavior they are said to produce. We suggest that, before they were tested, Gallup's chimpanzees had already acquired repertoires similar to those of our pigeons. They presumably had touched their ears and the upper parts of their eyebrow ridges many times, and over the 80 hours of exposure to a mirror before the test, they should have had many opportunities to discover the contingencies that govern mirror use. A chimpanzee with no prior exposure to a mirror does not make self-directed movements in the mirror test (*1*).

The fact remains that other primate species, such as macaques and rhesus monkeys, have not shown signs of "self-awareness" in the mirror test. For example, Gallup (*2*) reported a negative result with a crab-eating macaque even after 2400 hours of exposure. It may be that the more mobile macaque had fewer opportunities to come under the control of contingencies governing mirror use. In any case, mere exposure presents an animal with only a small subset of possible contingencies. If the contingencies governing mirror use are made more explicit, a macaque or other primate should come under their control, as did our pigeons.

We have shown how at least one instance of behavior attributed to self-awareness can be accounted for in terms of an environmental history. We submit that other instances, including those exhibited by humans, can be dealt with in a similar way (*6*).

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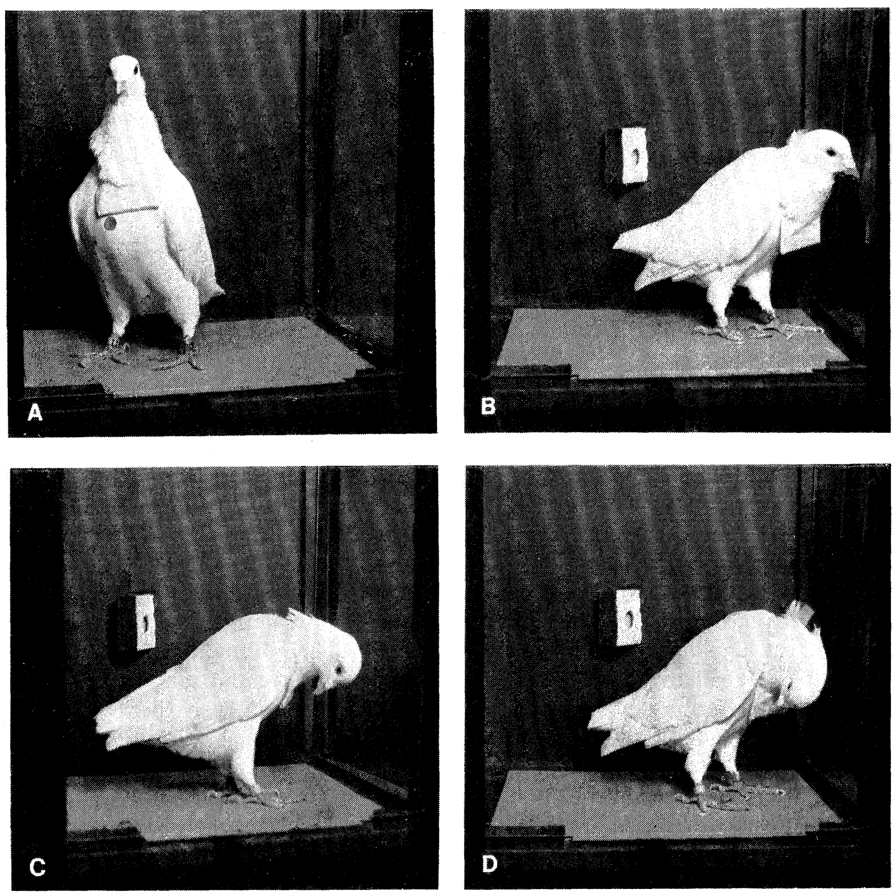

Fig. 1. A pigeon using a mirror to locate a spot on its body which it cannot see directly. (A) With the bird standing fully upright, the spot is just visible below the edge of the bib around its neck. (B) The pigeon faces the mirror (not shown) at right. Note that the bib covers the spot when the bird leans forward. (C and D) The pigeon bobs and pecks toward the position on the bib that corresponds to the hidden spot.

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5. The observers were twice shown a video tape of the six intervals in random order. The second time they pressed a telegraph key whenever they saw what they judged to be a dot-directed response.
6. There is a considerable amount of research on "self-awareness" in humans, some of which makes use of the mirror test [M. Lewis and J. Brooks-Gunn, *Social Cognition and the Acquisition of Self* (Plenum, New York, 1979); B. Amsterdam, *Dev. Psychol.* **5**, 297 (1972); J. C. Dixon, *J. Genet. Psychol.* **91**, 251 (1957); L. Mans, D. Cicchetti, L. Sroufe, *Child Dev.* **49**, 1247 (1978)]. Before children are successful, they are said to go through a phase of "testing" or "discovery," during which, among other things, they engage in repetitive activity while closely observing their mirror image. The contingencies of reinforcement which govern mirror use probably take hold during this period.
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