Probing Primate Thoughts

Questions arise about the mental lives of apes and monkeys

By BRUCE BOWER

Photos: Donna T. Bierschwale/USL

What do a chimps' mirror antics mean?

In a series of popular children's books, Curious George, a monkey, lets his raging inquisitiveness lead him into all sorts of trouble. George knows when he has erred, though, and always makes amends. The puckish primate also senses that an inner world of thought and emotion pulses around him. For instance, George recognizes that the firemen coming through his door are angry with him for ringing the emergency telephone number, and on another occasion he tries to cheer up a sad-looking girl he meets in a hospital.

Scientists who suspect that real-life apes and monkeys maintain at least a modicum of Georgelike insight into mental lives—their own and others'—have received some setbacks of late. Recent evidence suggests that such mental feats may elude even our closest evolutionary relative, the chimpanzee. What's more, a widely recognized method for studying primate thinking may yield much fuzzier results than its proponents have contended.

The suspicion that nonhuman primates can to some extent discern motives, plans, and strategies behind observed behaviors won a number of converts during the past 25 years. Reports that apes could express themselves with simple languages invigorated this view.

In addition, researchers noted that chimpanzees and orangutans, like human toddlers, turn as curious as George when they gaze into a mirror and see themselves in an unexpected light. If an experimenter places dye marks or stickers on their faces and then puts a mirror in front of them, these creatures notice the decorative additions and proceed to use their reflected images to guide their touching of their own faces and then the rest of their own bodies.

Gorillas, on the other hand, tend to pay mirrors no heed. Monkeys react angrily to their own reflections, apparently mistaking them for competitors.

Mirror-wielding investigators generally concluded that self-awareness and a basic appreciation of what others may or may not know arise only in humans, chimps, and orangutans.

Critics now argue that what an ape or monkey does in front of a mirror provides a distorted view of their mental landscape. Some who see merit in the mirror test still doubt that self-awareness and a penchant for mind reading in social situations characterize any species except humans.

"In the last few years, I've become much more open to the possibility that chimps may not develop a mental understanding of themselves and others, at least not to the extent that preschool children do," remarks Daniel J. Povinelli, a psychologist at the University of Southwestern Louisiana in New Iberia. "You can train chimps to use a language, but it's unclear whether they understand themselves as mental agents or have a mental disposition toward that language."

The mirror test has served as the gold standard for establishing the presence of self-awareness in primates. Gordon G. Gallup Jr., a psychologist at the State University of New York at Albany, first reported its use in 1970.

Gallup's procedure consisted of applying brightly colored dye marks to the eyebrows and ears of anesthetized chimps that had become accustomed to seeing their mirror reflections. After the numbing medicine wore off, a video camera recorded the chimps' behavior in front of a mirror.

Dye-marked chimps stared at their reflections, touched themselves on the colored patches, and inspected the inside of their mouths and other body areas. In contrast, marked chimps who saw themselves in a mirror for the first time made no effort to inspect dye marks or any other physical features.

Animals that learn to use mirrors to monitor changes in their appearance and to examine their bodies possess knowledge of their own mental experience, Gallup argues. A creature displaying a self-conception of this type can take into account what others may or may not know, he says.

So far, Gallup's mirror procedure has consistently evoked self-inspection only from human children older than 18 months, chimps, and orangutans. However, there may be less to the mirror test than meets the eye, asserts Marc Hauser, a psychologist at Harvard University.

As expected from prior results, members of one monkey species—cotton-top tamarins—glanced only briefly at their reflections when adorned with the facial dye marks used in previous mirror tests. After the distinctive tufts of white hair on top of their heads were dyed a bright color, however, these monkeys avidly inspected their bodies in mirrors, Hauser and his colleagues report in the Nov. 5, 1995 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Such behavior may not signify self-awareness. Considerable research, both in the laboratory and in the wild, had already suggested that monkeys conduct their daily affairs without regard for possible motives or other mental states in themselves and others, Hauser notes. Dorothy L. Cheney and Robert M. Seyfarth, both of the University of Pennsylvania in Philadelphia, describe this work in *How Monkeys See The World* (1990, University of Chicago Press).

"The mirror test may address whether members of a species are capable of self-recognition, but it apparently says nothing about self-awareness," Hauser contends.

Gallup rejects this conclusion. In an unpublished follow-up to Hauser's cotton-top tamarin study, he and Povinelli find that marmosets, another monkey species, show no interest in inspecting themselves in mirrors after their white, elongated mustaches have been dyed in attention-getting hues. Gallup now plans to examine videotapes of the mirror-intrigued monkeys in Hauser's experiment.

While the mirror test may or may not tap into an awareness of one's body, a new experimental tactic delves deeper into animals' capaci-

ty for mental self-knowledge, according to J. David Smith, a psychologist at the State University of New York at Buffalo. Smith and his coworkers exploit a reaction that humans find all too familiar—uncertainty about what one has heard or seen.

In initial sessions, five human volunteers indicated whether a series of computer-controlled tones was lower or higher in pitch than a target tone that they had heard in preliminary trials. Correct responses earned points toward cash prizes, whereas errors resulted in delays before the presentation of the next tone.

Participants could also signal that they were uncertain whether a tone was higher or lower than the target. Uncertain responses, like correct responses, earned points. As the former choices increased in number, however, delays before the next tone became progressively longer.

Considerable accuracy in tone discrimination emerged, the researchers report in the December 1995 JOURNAL OF EXPERIMENTAL PSYCHOLOGY: GENERAL. Volunteers opted for uncertain responses only when confronted with a narrow range of frequencies that nearly matched the target tone.

An 18-year-old bottlenosed dolphin tested at a Florida research center performed nearly identically on a comparable tone discrimination task, Smith's group asserts. Underwater, the dolphin listened to tones on the same frequencies that the human volunteers heard. He responded by pressing one of three paddles (for higher, lower, or uncertain). Rewards for correct responses consisted of praise from his trainer and extra fish.

Difficult trials elicited signs of indecision from the dolphin, such as a slow approach to the paddles, sweeping his head from side to side, or opening and closing his mouth rhythmically.

In an unpublished study, Smith and his coworkers also find that humans and rhesus monkeys perform comparably on a visual discrimination task that allows for uncertain responses. The task requires participants to identify whether each in a series of illuminated computer screens is more or less bright than a target screen.

Humans, dolphins, and monkeys may consciously think about sensations that come into play when making decisions, at least in ambiguous circumstances, the researchers propose. Further research is needed to clarify whether such a state of indecision fosters self-awareness, they add.

Still, humans operate in a mental realm that may stay off-limits to apes and other animals, argues Povinelli. By 3 to 5 years of age, children conclude that their peers behave according to unseen beliefs, intentions, and other mental states (SN: 7/17/93, p. 40), whereas studies directed by Povinelli now indicate that chimps may not try to decipher others' minds in this way.

In an upcoming Monograph of the Society for Research in Child Development, Povinelli and Southwestern Louisiana colleague Timothy J. Eddy describe 15 studies they have conducted with preschool children and 5- to 7-year-old chimps to explore knowledge about the connection between the mind and the eyes. They have examined more than 100 children and more than 100 chimps.

For instance, chimps apparently fail to grasp that another's eyes provide cues as to where that individual's attention is directed and what knowledge he or she may have gained as a result.

In one investigation, chimps watched as one experimenter left the room and another hid food under one of several cups. Both experimenters later sat in front of the chimp and each pointed to a different cup.

Chimps trying to find the hidden food chose randomly between the experimenters, indicating that they made no connection between seeing and knowing. Three-year-old children also made random choices in comparable studies involving stickers hidden under cups. But 4-year-olds routinely opted for the cup indicated by the experimenter who had seen where a sticker was hidden, Povinelli notes.

Chimps, however, do show a keen sensitivity to where others look, he adds. Just as humans do by 18 months of age, chimps rapidly follow the gaze of a nearby individual. For instance, if an experimenter suddenly looks behind a chimp, the ape turns and looks in the same direction.

Nevertheless, chimps appear not to understand that the eyes can be deployed to signal a mental state of attention, Povinelli says. In further studies, chimps learned to approach a transparent partition and stick an arm through one of two holes to receive food. When an experimenter stood in front of one of the holes, the chimps chose that hole. Next, the chimps could see two experimenters, one positioned in front of each hole.

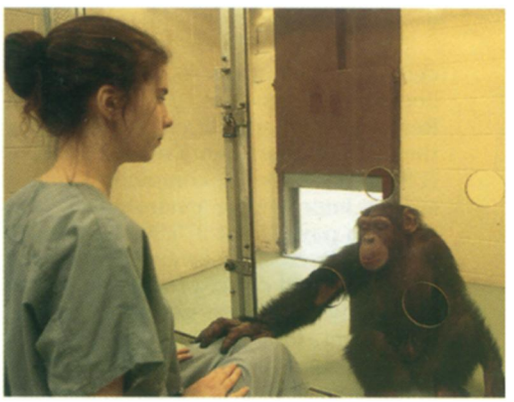
There was a catch, though—only one experimenter at a time could see the chimps and respond to food requests. In some trials, one experimenter wore a blindfold over his or her eyes and the other wore a blindfold over his or her mouth. Other trials employed one forward-facing and one backward-facing experimenter or one experimenter with open eyes and a partner with closed eyes.

Chimps chose experimenters on a random basis, regardless of whether the potential food givers could see them. In contrast, by 2 1/2 years of age, children consistently point to the experimenter who can see them.

Chimps older than those in the study might develop an ability to understand seeing more in the way that children do, Povinelli acknowledges. Or perhaps the apes assume a mental state of attention determined by a person's proximity and physical orientation, regardless of sensory cues such as gaze direction.

The possibility also looms that chimps do not reflect on the mental experiences of those they encounter, despite wielding a sophisticated intelligence, Povinelli contends.

A capacity for focusing inward on one's own mental states may nonetheless exist in chimps and orangutans, perhaps fostering their self-exploration in the mirror test, Povinelli suggests. An early form of self-conception may have evolved more than 5 million years ago in ancestors of great apes and humans, only to be lost in some groups, according to Povinelli and John G.H. Cant of the University of Puerto Rico School of Medicine in San Juan.



Chimps do not take into account whether an experimenter can see them.

Ancient, large-bodied apes spent most of their time in the trees and needed to plan and execute their movements with great care, the scientists propose. Falls due to clumsy swings from one branch to another, inept landings, or other miscues could have had deadly consequences.

Orangutans continue to use self-reflective planning to maneuver their heavy frames safely through treetop canopies, Povinelli and Cant theorize in the December 1995 QUARTERLY REVIEW OF BIOLOGY. Chimps and, in particular, humans cashed in on their evolutionary endowment of self-awareness to underwrite complex social strategies, they propose.

A sense of self may have evaporated over time in gorillas, however. Those burly creatures not only left the trees but formed relatively small groups, compared to chimps and humans, the researchers hold.

Increasingly sophisticated methods of unveiling what nonhuman primates know about the mind are in the works, remarks Hauser. In unintended homage to Curious George, scientists show every sign of indulging their inquisitive urges to discover how apes, monkeys, and other animals think. □