

Can Animals Empathize?

Yes

Animals that pass the mirror test are self-aware and thus can infer the states of mind of another individual

by Gordon Gallup, Jr.

I used to tell students that no one ever heard, saw, tasted or touched a mind. There is no way for me to experience your experience, let alone that of a species other than my own. So although minds may exist, they fall outside the realm of science.

I have since changed my mind. A number of years ago I began to study whether primates could recognize themselves in a mirror. Most animals react to their images as if confronted by another animal. But chimpanzees, orangutans and, of course, humans learn that the reflections are representations of themselves--these creatures are objects of their own attention and are aware of their own existence. In the past three decades, I and other researchers have used the mirror test in various ways to explore self-awareness in animals. I conclude that not only are some animals aware of themselves but that such self-awareness enables these animals to infer the mental states of others. In other words, species that pass the mirror test are also able to sympathize, empathize and attribute intent and emotions in others--abilities that some might consider the exclusive domain of humans.

I began exploring self-awareness with mirrors in 1969, when I was at Tulane University. I presented a full-length mirror to preadolescent chimpanzees at the university's Delta Regional Primate Research Center. Initially, they reacted as if they were seeing other chimpanzees, but after a few days they grew accustomed to the mirror and began to use it to make faces, look at the inside of their mouths, and groom and inspect other parts of their bodies that they had never seen before.

The Mirror Test

To determine whether they had learned to recognize their own reflections, I anesthetized each animal and applied red dye to an eyebrow ridge and to the top half of the opposite ear. Later, on awakening and seeing themselves in the mirror, the chimpanzees reached up and touched the red marks on their faces, following this in some instances with looking at and smelling their fingers [see illustration]. Chimpanzees that did not have the benefit of prior experience with mirrors acted as if confronted by another chimpanzee and failed to locate the marks on their faces. These findings of self-recognition have now been replicated with chimpanzees more than 20 times by scientists all over the world. Many other animals, including a variety of primates, elephants, birds and even dolphins, have been tested for self-recognition. But only chimpanzees, orangutans and humans have consistently passed this test. (Marc D. Hauser of Harvard University reported that cotton-top tamarins pass the mirror test when their white tufts of hair are marked, but no one has been able to replicate these results.)

The failure to find self-recognition in other animals is not for want of trying. Susan D. Suarez of the Sage Colleges and I gave a pair of rhesus monkeys, reared together in the same cage, continuous exposure to themselves in a full-length mirror for 17 years (more than 5,000 hours of mirror exposure a year). Despite this extended opportunity to learn about the mirror, neither monkey ever showed any evidence of self-recognition. On the other hand, when I would walk into the room

where they were kept and they saw my reflection in the mirror, they would immediately turn to confront me directly. So it was not that they were incapable of learning to interpret mirrored information about other objects correctly.

Experiments have also failed to uncover compelling evidence of self-recognition in gorillas. After pondering those results, Suarez and I decided to give gorillas the benefit of the doubt, reasoning that maybe gorillas do not care about the superimposed marks. We tested this hypothesis at the Yerkes Regional Primate Research Center at Emory University by applying marks to gorillas' wrists as well as to their faces. We discovered that on recovery from anesthesia all the gorillas touched and inspected the marks on their wrists. But despite extensive prior experience with mirrors, none of the gorillas were able to locate comparable marks on their faces that could be seen only in the mirror.

Gorillas naturally avoid making eye contact with one another, so a possible reason for their mirror-test failure is that they avoid eye contact with their reflection and hence never learn to recognize themselves. Daniel J. Shillito and Benjamin B. Beck of the National Zoological Park in Washington, D.C., and I recently tested this hypothesis, relying on a technique developed by James R. Anderson of the University of Stirling in England. It calls for a pair of mirrors placed together at an angle that renders it impossible to make eye contact with the reflection. But none of the gorillas showed evidence of self-recognition, not even one that had more than four years of exposure to mirrors.

In other tests of learning, problem solving and cognitive functioning, differences in performance among species are typically a matter of degree, not kind. What is to be made of such decisive differences in self-recognition? Maybe the reason most species cannot process mirrored information about themselves stems from an inability to conceive of themselves. Correctly inferring the identity of the reflection presupposes an identity on the part of the organism making that inference.

That conclusion seems reasonable, considering the way members of *Homo sapiens* interpret mirror images. Humans do not begin to show compelling evidence of mirror-guided self-recognition until they reach 18 to 24 months of age--about the same time at which the prefrontal cortex begins to mature in structure and function. Younger infants react to themselves in mirrors as though they were seeing other children, just as most species do. At about the time that children learn to recognize themselves, they begin to show other evidence of self-conception, such as using personal pronouns, smiling after mastering a task and engaging in self-conscious play.

Before about two years of age, no one has experiences that can be consciously recalled in later life. Consistent with my interpretation, this period of "infant amnesia" stops at about the same time that children begin to show self-recognition. As would be expected, the onset of an autobiographical memory only begins with the emergence of self-conception.

That may terminate prematurely at the other end of the life span if dementia sets in. Disturbances in self-awareness and impaired structure and function of the prefrontal cortex often accompany this condition. Thus, for some, human development may be bounded at both ends by periods of unconsciousness.

Knowing Mental States

Some practical advantages are derived from being able to conceive of the self. I argue that self-awareness, consciousness and mind are an expression of the same underlying process, so that organisms aware of themselves are in a unique position to use their experience as a means of modeling the experience of others. When you see someone in a situation similar to one you have

encountered, you automatically assume his or her experience will be similar to yours. Although it is probably true that no two people experience the same event in exactly the same way, as members of the same species we share the same sensory and neurological mechanisms. So there is bound to be considerable overlap between your experience and mine. Moreover, given a knowledge of how external events influence my mental states (and vice versa), I have a means of modeling the mental states of others.

To see my point, imagine you have a dog that returns home one day in obvious distress: it has porcupine quills in its nose. You could either have a veterinarian remove the quills, or you could attempt to extract them yourself using a pair of pliers. If you were to opt for the latter, it would be an excruciating ordeal for you. Not that you would experience any pain in the process, but as you pulled the quills from the dog's nose and witnessed its reaction, it would prove virtually impossible not to empathize with the dog. That is, you would use your prior experience with pain to model your dog's ostensible experience.

But how do you think another unrelated dog witnessing this transaction would respond? Pet owners may be surprised to learn--and any veterinarian can tell you--that dogs are empathetically oblivious to pain and suffering in other, unrelated dogs. I suspect that dogs experience pain in much the same way that we do, but because they cannot conceive of themselves, dogs cannot use their experience with pain to model painful experiences in other creatures. (They might, of course, react to the yelping.)

Another way to illustrate this incapacity involves people who have a condition called blindsight experience. These patients have sustained extensive damage to the visual cortex and often act as if they were blind, even though their primary visual system remains intact. Lawrence Weiskrantz of the University of Oxford and his colleagues discovered that such patients can show a surprising ability to "guess" the identity of objects and their location. In other words, vision in such patients has been reduced to an unconscious sensation. Blindsight patients can still respond to visual information, but they are not aware of it. As a consequence, they have been rendered mindless when it comes to vision. I would predict that individuals born with blindsight can grow up using guessing strategies and hence act visually normal. Their condition would become apparent only if they were placed in a situation that required them to make inferences about the visual experiences in other people--understanding how high-beam headlights affect oncoming drivers on a dark country road, for instance.

So back to my main point: I maintain that knowledge of mental states in others presupposes knowledge of mental states in oneself and, therefore, that knowledge of self paves the way for an inferential knowledge of others. Most humans routinely make inferences and attributions about what other people may or may not know, want or plan to do. By the same token, species that fail to recognize themselves in mirrors should fail to use introspectively based social strategies such as sympathy, empathy, attribution, intentional deception, grudging, gratitude, pretense, role playing or sorrow.

Evidence for Empathy

We ought to be able to identify animals that can or cannot recognize themselves in mirrors and their empathetic tendencies in some fairly definitive ways. If you were to cover the eyes of an animal at some point, how would it later respond to a cagemate wearing a blindfold? An animal that is self-aware ought to be in a position to use its prior experience with blindfolds to take into account its cagemate's inability to see. If you were to teach an animal to vocalize for a food reward every time you entered the room and then blocked its hearing with earplugs or headphones, how would it

respond the next day if you entered the room wearing headphones? If self-aware, it should vocalize more loudly to compensate for your impaired ability to hear.

In these kinds of tests, monkeys that fail to show evidence of self-recognition (as distinct from chimpanzees and orangutans, which are great apes) seem completely incapable of taking into account what other monkeys may or may not know. Dorothy L. Cheney and Robert M. Seyfarth of the University of Pennsylvania have found that vervet monkeys give alarm calls on seeing a predator even if other monkeys have already seen it, too. Likewise, they found that Japanese monkey mothers do not distinguish between offspring that know or do not know about food or danger when it comes to alerting their babies to the presence of one or the other.

Monkeys that cannot recognize themselves in mirrors approximate what psychologists call radical behaviorists. Their interactions with other monkeys seem to be based entirely on an analysis driven by the external features of the other monkey and not on what it might be thinking or what it might want to do. Chimpanzees, on the other hand, ought to represent primitive, albeit imperfect, cognitive psychologists--they should be able to respond empathetically and modify their behavior accordingly.

Initial experiments by Daniel J. Povinelli and Sarah T. Boysen of Ohio State University showed that chimpanzees appear to distinguish between what humans may or may not know. When two humans pointed toward different cups, the chimpanzees learned to pick the cup implicated by the human who had witnessed which cup had been baited with food. Although chimpanzees seemed to recognize ignorance on the part of human informants, rhesus monkeys did not. Further evidence for cognitive empathy in chimpanzees comes from a mutual problem-solving experiment in which humans and chimpanzees had to perform different tasks. For instance, a chimpanzee had to pull a handle to bring food cups within reach but could not see which cup had been baited, whereas the human who could not reach the cups had to point to the baited cup. The chimpanzees were able to switch roles with the humans with no decrement in performance. Rhesus monkeys, however, failed to show any evidence of transfer when the roles were reversed. Arguing against self-awareness and empathy of chimpanzees, Povinelli cites experiments that failed to find evidence in chimpanzees for an ability to take into account what another creature sees. He concludes that chimpanzees cannot even conceive of their own mental states, let alone those of others.

There are some explanations for the negative results, however. Povinelli's experiments relied on chimpanzees that might have been too young; the onset of self-recognition in chimpanzees does not occur until adolescence. Still another possibility is that we humans categorize our experiences (for example, by sight, hearing or smell). Lacking language, chimpanzees may not distinguish between visual, auditory and tactile experiences. Therefore, inferences they make about attention may be more global.

Also, most studies have focused on whether chimpanzees can take various informational states of mind into account (that is, whether they can figure out what another individual knows). But the data on humans show that children attribute feelings and motivation before they have the ability to attribute informational states of mind. Beginning at about the time or shortly after (but never before) they learn to recognize themselves in mirrors, children start to make primitive inferences about emotional states of mind in others; the more sophisticated ability to infer informational states of mind does not happen until a year or two later. Autistic children, in contrast, have difficulty taking into account what other people may know, want or feel. As expected, self-recognition in autistic children is often delayed or even absent.

Because chimpanzees and orangutans pass the mirror test, Povinelli hypothesizes that they possess a motor self-concept rather than a psychological one. That is, they do not really recognize themselves but simply learn an equivalence between their behavior and what they see in the mirror.

But matters of appearance have little to do with movement. So why should chimps and orangutans seem so intent on using mirrors to look at and inspect parts of their bodies they have never seen before? Why should they bother to respond to strange but motorically inconsequential red marks on their own faces? Suzanne Calhoun and Robert Thompson of Hunter College describe the reaction of a chimpanzee that, on being reintroduced to a mirror a year after learning to recognize herself, became very agitated when she opened her mouth and saw several missing teeth. It is hard to see how this reaction could be understood purely in motor terms.

Self-Awareness and the Brain

Other, more speculative clues about self-awareness lie in the physical makeup of the brain: certain areas seem to be responsible for it. Donald T. Stuss of the Rotman Research Institute in Toronto and I have been collaborating on a long-term project that focuses on human patients who have damage to the frontal cortex, the part of the brain responsible for some of the most complex activities of the mind. Preliminary data show that such patients seem unable to model mental states in others.

Self-awareness may correlate with activity in the right prefrontal cortex. Julian P. Keenan and Alvaro Pascual-Leone of Harvard Medical School, along with my colleagues N. Bruce McCutcheon and Glenn S. Sanders and me, tested how fast humans can recognize faces. When responding with the left hand (controlled by the right hemisphere), subjects identified their own faces faster than the faces of friends or co-workers. In addition, subjects viewing their own faces displayed significant changes in electrical potentials in the right prefrontal cortex. Moreover, when we altered the electrical activity in this brain area with magnetic fields, subjects changed their response rates to their own faces but not to the other faces.

Given this evidence of functional lateralization of self-awareness in humans, it is interesting to note that compared with other great apes, gorilla brains are the least anatomically lateralized. The absence of a highly specialized right hemisphere might explain the gorilla's weak and inconsistent performance in the mirror tests. Povinelli claims that the gorilla's failure here is a "crucial test" of his theory of the motor self-concept. In particular, he speculates that it arose as an adaptation to life in the trees: unlike chimpanzees and orangutans, gorillas spend most of their time on the ground. But at night, gorillas still return to the trees to sleep, even though they are at a greater risk of falling because they are so large. In fact, humans are the ones that have much more completely emancipated themselves from the branches. Therefore, humans and not gorillas ought to fail to recognize themselves in mirrors.

Povinelli's data notwithstanding, I think most people working in this area would agree that the jury is still out on whether great apes can attribute mental states to others. Much of the research in this topic is consistent with the conclusion reached by Nicholas Humphrey of the University of Cambridge that many species may have clever brains but blank minds: clever brains in the sense of learning, memory and problem solving, but blank minds in the sense of being unable to use their experience to take into account the experience of others. As evidenced by the behavior of people who sleepwalk and those who suffer from blindsight, you do not have to know what you are doing in order to do it in an appropriate way. Humans and possibly a few species of great apes appear to have entered a unique cognitive domain that sets us apart from other creatures.

This model of consciousness and mind based on self-awareness has brought me full circle. When I devised the initial test of self-recognition almost 30 years ago, it is apparent that I was using my experience and imagination about how I would respond to strange facial marks to anticipate how chimpanzees might respond to such marks if they could recognize themselves in mirrors. Moreover, if this model or some modified version of it eventually proves correct, it would mean that the ability to conceive of oneself in the first place is what makes consciousness and thinking possible. The famous quote from Descartes would have to be rewritten as "I am, therefore I think."