

17 Self-recognition and self-awareness in lowland gorillas

Francine G. P. Patterson and Ronald H. Cohn

Self-recognition in mirrors is considered an indicator of self-awareness, a capacity once assumed to be present only in human beings. Gordon Gallup's initial studies using the face-marking test, and the work they stimulated, have clearly demonstrated mirror self-recognition (MSR) in only three species: humans, chimpanzees, and orangutans (Anderson, 1983; Gallup, 1970; Platt & Thompson, 1985; Suarez & Gallup, 1981). Nevertheless field studies and laboratory tests, including simple discrimination learning, learning set, discrimination-reversal training, and oddity concept formation, have demonstrated that the cognitive abilities of all three genera of great apes are closely comparable. Gorillas and orangutans were ranked slightly above chimpanzees with respect to intelligence as measured by the transfer index, a refined measurement of learning-set ability in which species and individual differences in motivation and perceptuomotor skills are controlled (Rumbaugh & Gill, 1973). Piagetian studies also indicate that gorillas, chimpanzees, and orangutans undergo similar cognitive development (Chevalier-Skolnikoff, 1977, 1983; Mathieu & Bergeron, 1983; Redshaw, 1978). Nevertheless, the apparent inability of six gorilla subjects to recognize their mirrored images has led researchers to conclude that gorillas are the only great apes to lack the capacity for self-awareness (Ledbetter & Basen, 1982; Suarez & Gallup, 1981). Our current study with the female lowland gorilla Koko, which considers linguistic evidence as well as that provided by self-recognition tests, challenges this assertion.

Koko became the subject of an ongoing language study in July 1972, when she was 1 year old (Patterson, 1978b). She was taught sign language and continuously exposed to spoken English. Her rearing environment was similar to that of a human child. Other gorillas were not a part of this environment until a 3-year-old gorilla named Michael joined the language study when Koko was 5 years old. Mirrors, however, were a part of Koko's environment from the start of the study, although no training of any kind was associated with them. When she was about 3½ years old (January 1975), Koko began consistently to exhibit mirror-guided self-directed behaviors. Similar behaviors are exhibited consistently by human children before 2 years of age (Lewis &

lunn, 1979), by chimpanzees at 2½ (Custance & Bard, *SAAH12*; *AAH3*), and by an orangutan at 3½ years (Miles, *SAAH16*). Koko combed her face and underarms, pick at her teeth, and examine her reflection studying her reflection. She would also comb her hair, make herself up, and adorn herself with hats, wigs, and makeup in front of the mirror. In contrast to Koko, the gorilla Michael has had only limited and brief exposure to mirrors, we have also documented him exhibiting such behaviors on videotape.

Koko was 19 years old, a variant of the mirror mark test used by Gallup (1970) was administered to her to provide data strictly comparable to self-recognition studies done with other great apes. For Koko, this experiment was designed according to a procedure devised by Anderson (1983) so that Koko would not have to be anesthetized.

A mirror (0.6 m × 0.76 m) mounted on a plywood panel of the same size was used. Koko had direct access to this mobile mirror. As a control, to ensure that the actual marking procedure would be unobtrusive, Koko's brow was wiped with a damp washcloth at the beginning of each of three preliminary sessions. For the marking session, her face was marked with a mixture of white clown paint that approximated the color of the washcloth. The clown paint (containing stearic acid, P.P.G. 76, water, triethanolamine, and a yellow color) was chosen because it is nontoxic, unscented, and water-soluble.

Koko's exposure to the test mirror was restricted to six 10-min videotaped sessions recorded during 4 days (July 1–3 and 6, 1990). The mirror was placed in front of her and propped in a upright position on the floor, providing a full view of her body when she was sitting on the floor. Koko was able to move the mirror during all sessions. She became adapted to the mirror during the first session. At the beginning of the second, third, and fourth sessions, Koko's brow, the target area, was wiped with a clean, damp washcloth that was approximately body temperature. At the beginning of the fifth session, her brow was wiped with an identical damp washcloth that had been marked with the clown paint. Three days later (July 6, 1990), Koko was tested in a control session in which her brow was wiped with a clean, damp washcloth. Two experimenters, one who wiped Koko's forehead and one who wiped her brow, were present in the room with Koko during all sessions. Both experimenters had worked with Koko since she was 10 years old, and had similar direct contact sessions with her every day. Koko's responses were frequently videotaped, and Koko was quite familiar with the mirror.

The videotape of the mirror sessions was analyzed by two independent observers. They scored the number of times during each session that Koko touched the target area (and had 97.9% agreement). During the marking session, Koko touched the target area 47 times. Koko turned her head quickly, with the result that the actual area touched included not only the brow, but also a spot over the right ear and a spot on the side of the head. For scoring purposes, this complete area that was

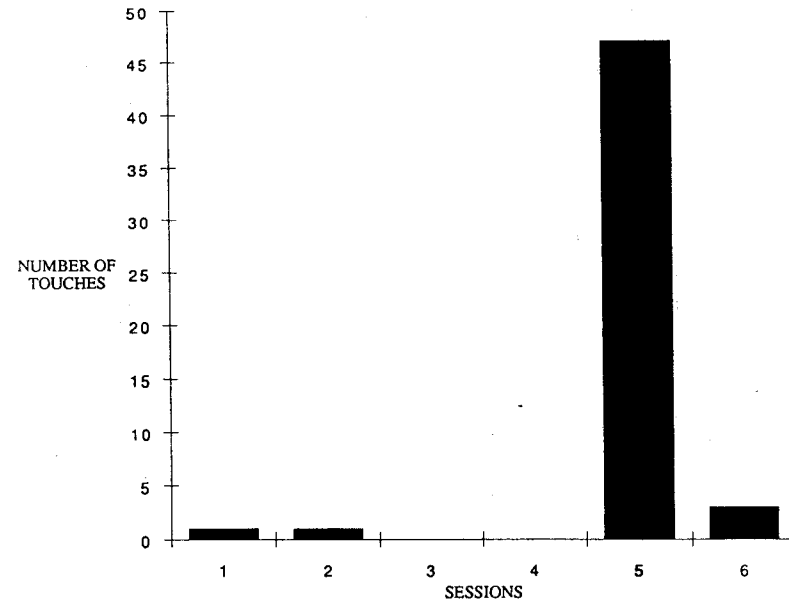


Figure 17.1. Mirror test target touches.

marked in the fifth session was considered the target area for all unmarked sessions as well. For each session the observers also scored the number of seconds Koko spent viewing her reflection (98.4% agreement) and the number of self-directed mirror behaviors (95.0% agreement). Self-directed mirror behaviors are defined as "actions directed toward one's own body" (Brooks-Gunn & Lewis, 1982, pp. 353–354).

In the four sessions in which she was unmarked, Koko touched the target area an average of once per session, but in the fifth session, in which she was marked, she touched it 47 times (Figure 17.1). The time Koko spent viewing her reflection in each session adds support to the interpretation that she recognized that the paint spot she saw in the mirror was actually on her own body. She spent an average of 48% of the time viewing her reflection in the sessions in which she was unmarked. During the fifth (marking) session Koko's mirror viewing time increased to 88% of the session (Figure 17.2). Although this increase in viewing time during the marking session is characteristic of chimpanzees tested for self-recognition, previously no gorillas had shown an increase in attention to the mirror when marked (Gallup, 1987).

Her self-directed behavior in front of the mirror provides further support for self-recognition by Koko. Gallup (1987, p. 8) has argued that "the mark test serves merely as a means of validating impressions that arise out of seeing animals use mirrors spontaneously for purposes of self-inspection." That Koko exhibited any self-directed behavior at all is in itself significant,

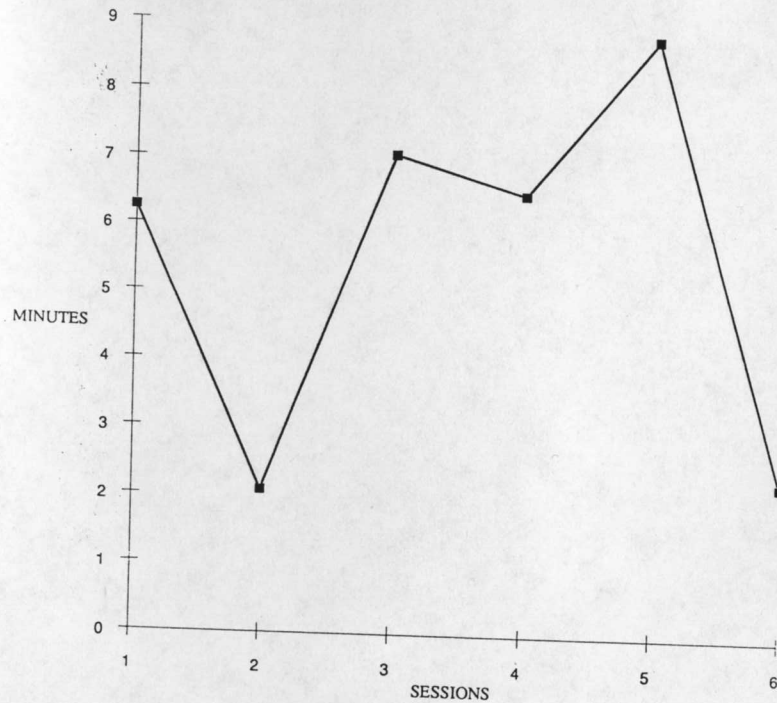


Figure 17.2. Mirror test viewing time.

rilla in previous formal studies has clearly exhibited any such behavior (Ter & Basen, 1982; Suarez & Gallup, 1981). There have, however, been formal observations of gorillas engaging in self-directed mirror behaviors. Riopelle, Nos, and Jonch (1971, p. 88) reported that the gorilla while sitting in front of a mirror, "lifted one leg and looked at his reflection, inspecting the parts of him that he ordinarily could not see." Washburn (1974; also personal commun., Jan. 24, 1992) found indications of self-recognition in some of the gorillas he tested informally. Of six gorillas tested for mirror-guided, self-directed behaviors, one groomed his teeth while watching the mirror. Another groomed his head while watching the mirror. Four gorillas had marks on the forehead with white paint while their keeper disoriented them with tickling. The marked gorillas were subsequently confronted with their mirror images. Of the four, two touched the mark, one while looking at the mirror and the other after turning away from the mirror. In every mirror session, Koko frequently showed self-directed behaviors such as grooming her underarms, making faces, and picking at her teeth with her fingers (see Figure 17.3). As one would expect, the incidence of these behaviors, including mark-directed behaviors, was highest during the session in which she had been marked. Whereas in the other

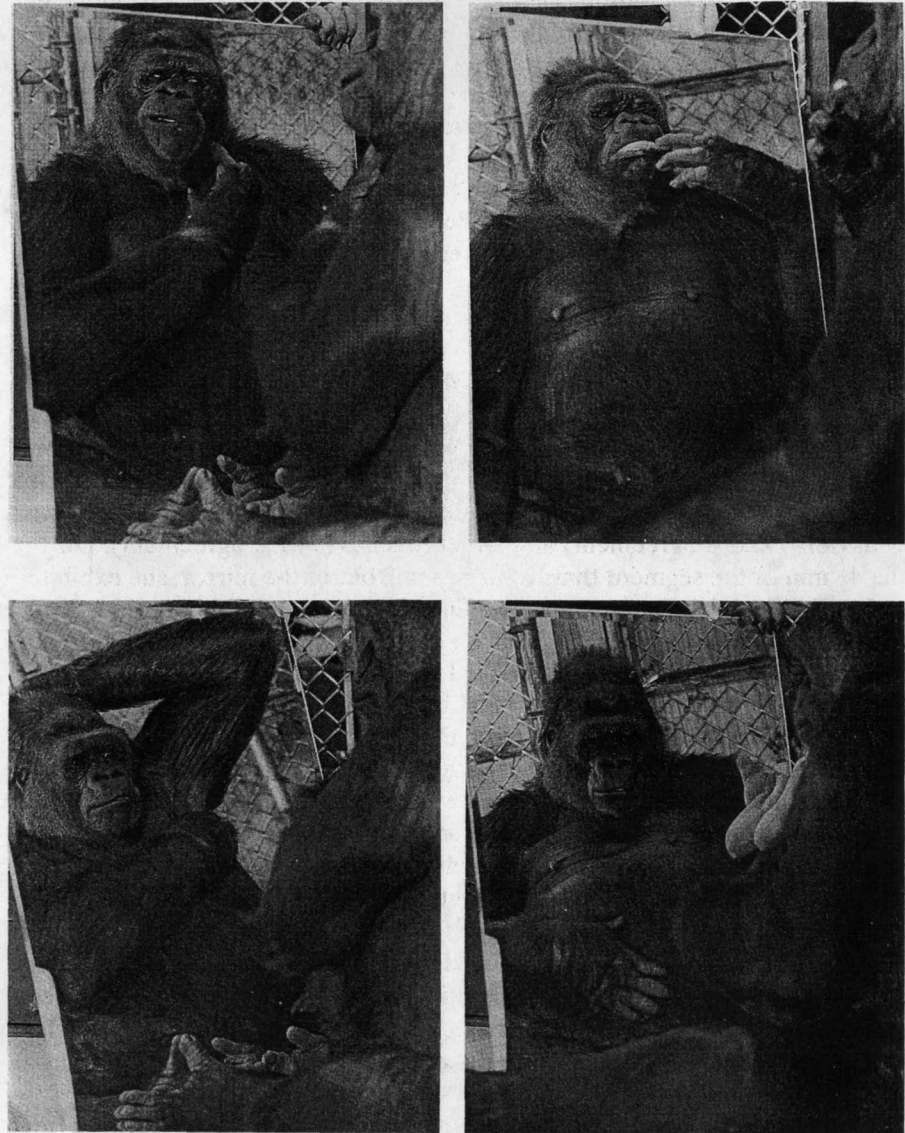


Figure 17.3. With the aid of a mirror, Koko examines parts of her body that she otherwise cannot see.

sessions she exhibited an average of 88 self-directed behaviors per session, in the fifth session she exhibited 202 (Figure 17.4), supporting the conclusion that she recognized the altered image as her own.

In each session, at least 80% of Koko's self-directed behaviors could be

ied as self-grooming. In the unmarked sessions she groomed her arms and teeth most frequently, with some attention paid to her eyes. During the marked session, the majority of Koko's initial selfing behaviors involved removing the paint from her brow. Once most paint had been removed she concentrated her grooming efforts on her and other parts of her face.

ight be argued that Koko sensed the mark's presence because she had been anesthetized. However, on September 6, 1982, when Koko was 11 old, she passed a "mark test" designed by nature in which this possibility was completely eliminated. The incident was captured on videotape

an hour-long sample of Koko's signing recorded by the same two companions. Forty-seven min into the hour, Koko began to inspect a reflection in a Plexiglas mirror (0.53 m × 1.22 m) that was a fixture in her room. A continuous 10-min segment of the hour-long sample (comparable to 10-min sessions of the formal test described above), starting at this point and encompassing all of this serendipitous mark test, was analyzed by two independent observers. They scored the number of Koko's self-directed behaviors (95.8% agreement) and target touches (94.1% agreement). During a 10-min segment of the hour-long sample that Koko was in front of the mirror, she exhibited 11 self-directed behaviors. Three min and 55 sec into this period, Koko discovered a spot of black pigment on her otherwise pink upper right gum.

After this discovery she had touched this target area just twice; after the third try she touched it 14 times. She could not possibly have felt, smelled, or seen this spot, and it was not visible even in the mirror unless her lip was moved. She picked at the pigment with the handle of a toothbrush and with her index and small fingers as if she were trying to remove it. She inspected the toothbrush handle and her small finger after using them to pick at the spot. After studying her reflection, she signed COME to one of the experimenters. Koko opened her mouth while raising her arm toward the experimenter's mouth, as if trying to get the experimenter to open her mouth.

When the experimenter opened her mouth, Koko inspected the very same area on the left side of the experimenter's mouth where she had seen the mark on her own mirror image. The experimenter had not watched Koko's mirror behaviors and therefore did not realize what Koko's intent was at the time.

To take full advantage of Koko's linguistic abilities in this study to address directly the question of self-awareness, as well as to cross-validate the data provided by her responses to mirrors. Two "Who are you?" questions were asked during each of the first four 10-min sessions while Koko was away from the mirror. After the fifth (marking) session, Koko was asked "Who are you?" more while away from the mirror, and also "Who is that?" of her reflection. During the sixth (posttest) session she was asked "Who are you?" more time. Although correct answers to these questions can simultaneously be learned responses, the data argue otherwise in Koko's case. Her responses (see Table 17.1) were all different, multisign utterances (mean length of utterances: 4.4 signs), but had one consistent theme. Each reply

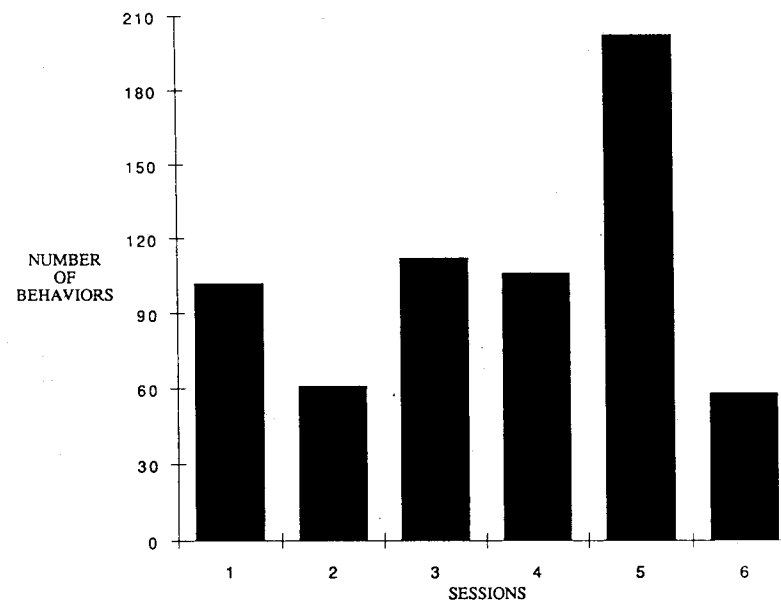


Figure 17.4. Self-directed behaviors during the mirror test.

Table 17.1. Koko's responses to self-identity questions^a

Test session	First response	Second response
<i>"Who are you?"</i>		
1	ME GORILLA NIPPLES ^b TICKLE.	NIPPLES GORILLA.
2	POLITE-KOKO KOKO NUT NUT POLITE.	POLITE DEVIL HAIR HEAD. KOKO SWEET BAD.
3	KOKO POLITE ME THIRSTY.	GORILLA ME.
4	POLITE ME THIRSTY FEEL KOKO-LOVE.	POLITE POLITE-KOKO. KOKO FEEL THIRSTY SORRY.
5	KOKO POLITE SORRY GOOD.	KOKO; PLEASE GIMME BROW-WIPER. ^c
<i>"Who is that?" (to mirror)</i>		
5	ME THERE KOKO GOOD TEETH GOOD.	

^a All responses were recorded on videotape as part of the mirror test July 1-3, 1990.

^b Koko often uses the sign NIPPLE to mean female.

^c Words joined with hyphens here indicate simultaneous signs. BROW-WIPER is an iconic sign invented by Koko, using the handshape and motion of wiper, but on the brow rather than the mouth.

to the questions contained one or more of the following signs: KOKO, ME, GORILLA.

A sample of 200 of Koko's multisign utterances was analyzed to determine the frequency with which Koko uses these three signs in everyday situations.

sample was taken from the daily log of Koko's sign combinations from 1, 1991, approximately the same period during which the formal test was administered. She used the sign GORILLA in 3%, the sign ME in 2%, and KOKO in none of these 200 utterances (mean length of utterances sample: 3.0 signs). The contexts of Koko's uses of these three signs varied. On July 4, Koko signed, GORILLA THIRSTY LIPSTICK to ask her permission for some lipstick. On July 6, she was asked, "Want to play?" and signed, CHASE GORILLA. On July 9, Koko signed GORILLA NUT to herself while playing with small dolls in her nest. During a videotaped session on July 8, sign combinations included THIRSTY ME and TICKLE ME. Although the sign YOU did not appear in the sign sample, on July 23 Koko was asked, "Are you feeling?" and her reply was, FINE KOKO. In these examples, the instances of ME and two of the three instances of GORILLA occurred in response to someone to direct actions toward Koko, and the sign KOKO occurred in response to a question about an internal state, in which the experimenter referred to Koko as "you."

To demonstrate that Koko does not use these three words in response to "who" questions, she was asked "who" questions about her closest companions. Her responses were different for each individual but consistent for repeated questions about the same individuals, indicating that Koko distinguishes others from herself and from each other on a symbolic level. Her responses to "Who are you?" and "Who is Penny?" were similar in that they included the sign NIPPLE, which Koko uses frequently and consistently to refer to her own female. ("Penny" is the name by which Koko knows the senior experimenter). Her responses to "Who is Ron?" and "Who is Mike?" included signs with negative connotations: DEVIL, TROUBLE, and BAD. Koko's descriptions of her disciplinarian in her life, as DEVIL TROUBLE, and of the gorilla Mike as HEAD and BAD were consistent with her past comments about these individuals (Patterson & Linden, 1981).

Self-aware behavior is often cited as the quintessential activity that implies self-awareness. Through her signing, Koko has shown a number of cognitive signs of self-awareness in both testing and nontesting situations. These signs include the acquisition and use of personal pronouns and proper names, reference to her own internal and emotional states, attribution of mental states to others, self-conscious behaviors, value judgments, self-talk, humor, play, expressions of intentionality, deception, and embarrassment. These signs emerged at about the same time, when Koko was between 3 and 4 years old.

The acquisition and comprehension of personal pronouns, proper names, and signs is indicative of self-awareness in that it implies the ability to distinguish symbolically between self and other. Analysis of vocabulary data from the language project's longitudinal records (Patterson & Linden, 1990) indicates that Koko first acquired reliable use of the signs for ME, MINE, PENNY, and YOU all within a 5-month period when she was 3½ and 4 years old (see Table 17.2). This is the same period during

Table 17.2. Koko's acquisition of personal pronouns, proper names, and possessives

Sign	Date acquired ^a	Age in months
ME	5/74	34
KOKO	6/74	35
MINE	6/74	35
YOU	9/74	38
PENNY	11/74	40

^a For a sign to qualify as part of Koko's vocabulary it must be used spontaneously at least half the days of a month, and its use must be recorded by two independent observers.

which Koko began to exhibit self-directed behavior in mirrors and first responded appropriately to questions about her mirror image. In human children, whether they are learning ASL or spoken language, the use of personal pronouns seems to emerge at the end of the second year, also the same time as the ability for self-recognition (Petitto & Bellugi, 1988).

Koko also shows evidence that she is able to identify herself and Michael in photographs (Patterson, 1978a), although she has not been formally tested for this ability. Koko has been asked specifically about differences and similarities between humans and gorillas (Patterson & Linden, 1981). On January 26, 1991, Koko identified the reason the senior author is not a gorilla as CLOTHING GOOD. On November 11, 1978, she had the following conversation with a companion, Maureen:

- M: What's the difference between you and me?
- K: HEAD.
- M: And how are our heads different?
(Koko beats on her head with her open hands quite hard, harder than a human would ever do.)
- M: What else is different between us?
(Koko moves her hands up on her stomach, a gesture resembling BLANKET.)
- M: Do you mean something about your stomach?
- K: STOMACH GOOD THAT.
- M: Oh, but what were you saying about blanket, different?
(Koko moves her hands up and down her torso, then pulls the hair on her belly. Maureen interprets these new gestures as meaning "body hair.")
- M: Now can you name something the same?
- K: EYE.
- M: Yes, that's right, we both have eyes.

Spontaneous verbal expression of emotion also appeared when Koko was approximately 4 years old. Lewis (1986) has argued that only the self-aware are capable of reflecting on their emotional states. Emotional states are internal, private conditions. Animals cannot reflect on such internal states unless they are capable of reflecting on themselves, that is, unless they are self-aware.

Table 17.3. Internal state words in Koko's early vocabulary

acquired* (months)	Internal state word	Category
	LISTEN	Perceptual
	SORRY	Emotional & affective
	LOOK	Perceptual
	HUG-LOVE	Emotional & affective
	GOOD	Social evaluation/Emotional & affective
	TASTE	Perceptual
	SMELL	Perceptual
	SLEEP	Physiological
	HURT	Perceptual
	THIRSTY	Physiological
	KISS	Emotional & affective
	DIRTY	Emotional & affective
	SMILE	Emotional & affective
	FROWN	Emotional & affective
	STUPID	Emotional & affective
	BAD	Social evaluation/Emotional & affective
	HUNGRY	Physiological
	THINK	Cognitive

* a sign to qualify as part of Koko's vocabulary it must be used spontaneously on at least half the days of a month, and its use must be recorded by two independent observers.

As categorized words in Koko's early vocabulary according to a scheme developed by Bretherton and her colleagues (Bretherton & Beeghly, 1982; Bretherton, Lewis, & Beeghly, 1981) who found that in human children, internal-state words emerge late in the 2nd year and undergo a rapid spurt in the 3rd year. Koko began using such signs when she was just over age 2½, with eighteen internal state signs (see Table 17.3) qualifying as established vocabulary items between this age and 4½. Reflection on her own emotional state is now a daily activity for Koko. When asked, "How do you feel?" Koko will usually respond with THIRSTY, HUNGRY, or SAD. She will often sign FROWN, SAD, when asked why she is crying.

On July 7, 1976, 5-year-old Koko referred to her past emotional state of being sad, 3 days after the event:

P: What did you do to Penny?

K: BITE.

P: You admit it? (Koko had earlier called the bite a SCRATCH.)

K: SORRY BITE SCRATCH.

(Penny shows the mark on her hand; it does resemble a scratch.)

K: WRONG BITE.

P: Why bite?

K: BECAUSE MAD.

P: Why mad?

K: DON'T KNOW.

In a formal study parallel to one with human children 5–13 years old by Wolman, Lewis, and King (1971), Koko (age 6) was asked a series of questions about her feelings, with these frames: (1) Do you ever feel __? (2) When do you feel __? The target feeling states were fear, hunger, sadness, anger, sleepiness, happiness, thirst, and nervousness. Koko's responses demonstrated that she was capable of reflecting on her feelings. Like the younger human subjects mentioned by Wolman et al., Koko most frequently reported external events as conditions of emotional arousal (Patterson, 1980). For example, her response to "When do you feel hungry?" was FEEL TIME. A possible explanation of this reply is that Koko feels hungry when it is time to eat. Koko's most frequent and emphatic use of the sign TIME is to tell her human companion that it is time to deliver the next meal. Some of Koko's replies to the test questions seemed to be directly related to the events of the preceding months. During this period she had been directing an unusual amount of aggressive behavior toward a new caretaker named Marjie. Koko's responses to the question, "When do you feel mad?" included KOKO MAD GIRL and KOKO LOVE MARJIE BYE.

A hypothetical question relating to both feelings and self-perception was posed to Koko when she was 14 years old. The second author asked her, "How would you feel if someone said 'you have dirt all over your head'?" Koko's signed response was, GORILLA GOOD HAIR, BRUSH-OFF-TOP-AND-BACK-OF-HEAD.

Koko frequently deceives, using deceptions much like those used by humans, chimpanzees, orangutans, and other gorillas (Miles, 1990; Mitchell, 1991; de Waal, 1986; Whiten & Byrne, 1988). At age 1;9 Koko began to engage her companions in behaviors that would distract them so she could pursue a forbidden activity or stop undesirable behavior on the part of her companion (Patterson, 1980). Koko's use of deception blossomed, so to speak, at about age 3–3½, as did MSR. She has used techniques such as concealment (hiding a contraband toy under her arm to sneak it outside), and creating an image (applying a crayon to her lips like lipstick when her companion asked if she was eating it). More recently, at age 19, Koko was asked to throw one of her small plastic toys (which Michael tends to eat) back into her room before going outside. Koko made a convincing throwing motion toward her room, but kept the toy hidden and did not let go of it.

Koko uses verbal as well as nonverbal tactics for deception. This ability began to reveal itself in a few isolated incidents at about age 3 (Patterson, 1980). At age 3½, during a scolding for stealing a spoonful of butter, Koko signed, TIME ME TOILET GO. She didn't use the toilet, however, after being excused. In May 1974 Koko broke a toy cat while with caretaker Kate. The next day she was asked "Who broke this cat?" Koko's reply was KATE CAT. At about age 5, more frequent and convincing evidence of her use of the lie to get herself out of trouble appeared. When questioned about a sink that she had broken by sitting on it, Koko asserted, KATE THERE BAD. Caught in the act of trying to pry a window screen with a stolen chopstick, and asked what she

oing, Koko replied SMOKE MOUTH, and placed the stick in her mouth as oking it. The "lipstick" incident mentioned above was recorded on tape in January 1978. While the experimenter was busy writing notes, snatched a red crayon and began chewing on it. In response to, "You're ting that crayon, are you?" Koko signed LIP and began moving the crayon cross her upper then her lower lip as if applying lipstick. When asked she was really doing she signed BITE. Asked, "Why?" she replied, RY.

Michael, too, lies to avoid the consequences of his misbehavior. The first led instance was on April 22, 1978, when he was approximately 5 years Michael had ripped a gaping hole in a volunteer's lab coat. When she him, "Who did this?" Michael responded, PENNY. He was told that was g and asked again, but his response was KOKO. Finally he admitted, MIKE. e must be conscious of having experienced an emotional state oneself e attributing such a state to others (Gallup, 1987). Statements in which appears to attribute emotional states to others have been documented ently. On December 27, 1977, Koko heard Mike crying because he n't come out of his room. When asked how Mike felt she signed, FEEL T OUT (Patterson, 1984a). Another such incident occurred November 3, when 6-year-old Koko saw a picture of a horse with a bit in its mouth. igned, HORSE SAD. When her companion asked her why the horse was ie signed, TEETH (Patterson, 1979a). On September 24, 1977, when shown ture of the albino gorilla Snowflake struggling against being bathed, , who also hates getting wet, signed ME CRY THERE, indicating the picture erson, 1980).

e ability to take the perspective of another, which human children de- at about age 4, also requires knowledge of self and other (Astington & ik, 1991). Koko demonstrated this ability in a videotaped sequence on 22, 1991, in which she spontaneously answered a question first from the ective of her "baby," a stuffed orangutan doll, and then from her own ective. Koko asked to have the doll, cradled it like a baby and kissed d then signed DRINK. Penny asked, "Where does the baby drink?" In nse, Koko molded the doll's hands to form the signs DRINK MOUTH, with oll's hand indicating the doll's mouth. Then Koko pointed to the doll's h with her own finger and held the doll out toward Penny. From the perspective, drinking occurs in its mouth. Penny then said, "The baby 'Drink mouth.' That's right, but where on you?" Koko put the doll to east. Penny commented, "Right, on your chest. Your baby signs!" As o continued to hold the doll to her breast she signed TOILET NIPPLE DRINK DRINK NIPPLE. From Koko's perspective, a baby drinks from her nipples. oko has displayed evidence of her ability to take another's perspective in humor as well (Patterson, 1986). While nesting with white towels, Koko ed to one of the towels and signed, THAT RED. Her companion, Barbara, cted her, telling her that it was white. Koko repeated her statement with ional emphasis: THAT RED. Barbara stated again that the towel was white.

After several more exchanges, Koko picked up a tiny piece of red lint, held it out to Barbara, grinning, and signed, THAT RED. Koko's typical incongruity-based humor is similar to that of children between the ages of 3 and 6. In this earliest form of humor, children may laughingly apply different names to familiar objects or use one object as if it were another (McGhee, 1980). Asked outright what she thought was funny, Koko signed THAT NOSE, indicating a toy bird's mouth, and HAT, referring to a rubber key she had placed on her head.

Koko has also made verbal jokes based on her self-identity. On October 30, 1982 Barbara showed Koko a picture of a bird feeding its young.

K: THAT ME. (Pointing to the adult bird.)

B: Is that really you?

K: KOKO GOOD BIRD.

B: I thought you were a gorilla.

K: KOKO BIRD.

...

B: Can you fly?

K: GOOD. ("Good" can mean "yes".)

B: Show me.

K: FAKE BIRD, CLOWN. (Koko laughs.)

B: You're teasing me. (Koko laughs.) What are you really?

(Koko laughs again and after a minute signs:)

K: GORILLA KOKO.

It has been suggested that there are certain emotional states that only the self-aware can have (Lewis, 1986). One such state is embarrassment. In order to be embarrassed, animals must be capable of reflecting on their own behavior and comparing it to standards set by society or by themselves. Koko seems embarrassed when her companions note that she is signing to herself, especially when the signing involves her dolls and animal toys: She will abruptly stop the activity, often turning away from the observer. Although clear instances of embarrassment have been observed only rarely, one incident recorded when Koko was 5 years old provides an example. A companion observed her create what appeared to be an imaginary social situation between two gorilla dolls. She signed, BAD, BAD, while looking at one gorilla and KISS, while looking at the other. Next, she signed, CHASE TICKLE, hit the two dolls together, and then wrestled with them. When she was through she signed GOOD GORILLA, GOOD GOOD. At this point, Koko noticed that her companion was watching the play session. She immediately put the dolls down (Patterson, 1979b).

The evidence provided by both the formal and serendipitous mirror tests leaves little doubt that Koko is capable of self-recognition. The verbal measures provide evidence that goes beyond this to give us glimpses of a gorilla's self-concept. Previous observations of self-inspection indicate that other gorillas also have self-recognition.

Why, then, have others failed to find convincing evidence of self-recognition in gorillas through formal testing? There are a number of possible explanations,

ing the rearing histories, lack of motivation, and sensitivity to anesthesia of a few gorillas tested (see Patterson, 1984b, and Povinelli, 1987, for discussions of these possibilities). However, a likely explanation is that the gorillas' behavior was inhibited by the presence of unfamiliar experimenters. It has been our experience that the presence of strangers profoundly affects gorilla behavior. We have found that it can take from several months to a year for Koko and Michael to habituate to the presence of a new experimenter. Hence, when we performed the mirror study on Koko we chose to have only two experimenters present who had known Koko for 18 years. In the previous formal self-recognition studies with gorillas, experimenters were not the gorillas' caretakers were in the room with them in very close proximity to the mirror (Ledbetter & Basen, 1982; Suarez & Gallup, 1982, p. 308) state that they had been informed by the zoo staff, who presumably familiar to the gorilla subjects, "that the animals had been used to small mirrors on several occasions in the past and it was their expectation that both animals 'recognized themselves.'" Ironically, it may have been the gorillas' very capacity for self-consciousness that prevented them from exhibiting behaviors indicative of self-recognition in the testing situations. Lack of appreciation of these factors has led to the assumption that the gorillas failed tests of self-recognition because they lacked the requisite capacity (Gallup, 1987; Ledbetter & Basen, 1982; Suarez & Gallup, 1982) method that works with one species may be totally inappropriate for another species. It also may be that animals who are self-aware will not exhibit self-recognition behavior in mirrors, even under ideal circumstances.

In May-August 1991 we tried a mark test with the 18-year-old gorilla Michael whose mirror-guided, self-directed behaviors had already been documented on film. Although it seemed to the experimenters at the time, and independent observers reviewing the videotape later, that Michael did not recognize himself in the mirror during the test sessions, the results were inconclusive. This failure illustrates some of the special problems in testing gorillas for mirror self-recognition.

The procedure used to test Michael was similar to that used with Koko, but differences required several significant differences. Due to his destructive tendencies, Michael could not be given free access to the test mirror, which was wiped or held up outside his room approximately 2 ft from the mesh. The experimenters also remained separated from Michael by the mesh. In both cases, both experimenters had cared for Michael since he was 3½, their close together in his quarters with a video camera was not a part of his daily routine. Perhaps the most important difference, however, was Michael's prior experience with the marking procedure. On June 5, 1990,

Michael's brow had been marked as a pretest before Koko's test to ensure that the clown paint would not be tactilely detectable, but would be clearly visible on black gorilla skin. During the pretest Michael did not respond to the marking until he saw his marked brow in a pocket mirror. He then turned his head sharply away from the mirror with a startled look. Next, he removed some of the paint with a finger and licked his finger. He repeated this several times. At the time of his own mirror test, more than a year later, whenever one of the experimenters touched Michael's brow with anything he immediately brushed his hand across his brow. Others have demonstrated that chimpanzees who have passed the mark test once may lose interest and fail if retested (Thompson & Boatright-Horowitz, 1982). This observation and Michael's behavior suggest that the subject's memory of previous mark tests is also a factor to consider.

During each of the first four sessions in which his brow was wiped but unmarked, Michael spent a few casual seconds making faces, displaying his teeth and wagging his tongue while watching himself in the mirror. He also watched himself eating, drinking, and signing in front of the mirror. He spent relatively little time viewing the mirror, however, preferring to interact with the experimenters, attempting to obtain treats or to be let outside. In the fifth and final sessions, Michael's right brow was marked with white clown paint while he was peering into a white cardboard roll containing a kaleidoscopic pattern. (This procedure was used because he proved to be too suspicious of the washcloth wipe method.) Michael appeared to be unaware of the mark at first, but less than a minute after the marking he brushed his finger over his brow where the tube had touched it and discovered the paint before the mirror was presented. The marking process also got a dot of paint in the center of Michael's nose. While he continued to remove the paint from his brow with his finger and then a cloth, the conspicuous white dot on his nose remained undisturbed and apparently undetected.

When the mirror was presented, Michael approached casually as before and began signing to the experimenter holding the mirror. He glanced at the mirror, began to rub at the paint on his brow, then suddenly "froze" and leaned forward, staring intently at his reflection. This time he did not display the same playful teeth-baring and tongue-wagging faces as in the previous session, but only stared with a serious expression. He rubbed the fading mark on his brow again with his finger, then sniffed and licked the finger, but did not touch the more obvious spot on his nose. He leaned close to the mirror again and turned his head from side to side, looking at his face from different angles. Then he leaned back from the mirror and asked in sign for the experimenters to turn the lights off. During the remainder of the session he asked several more times for the lights to be turned off and the drapes to be closed, but neither request was granted. He wiped his brow again with his finger and with a cloth, but still did not touch his nose. After moving around the room for a few minutes he returned to the mirror, looked closely, looked away and picked at his left eye, brushed his right brow, then looked back at

or. Finally, he moved into a corner of the room and rubbed his nose all. He repeated this in the opposite corner. Perhaps if Michael could be tested while alone in his room, with a hidden camera, the results may have been different. The presence of even very familiar observers may have distracted him and may also have severely inhibited his mirror

did not begin to exhibit MSR and other behaviors indicative of self-awareness until age 3½–4 years. This may or may not be typical of her species. The age of acquisition of a self concept is undoubtedly affected by such factors as early social experience and general health. Koko's natal group at the San Francisco zoo included her mother, her father, two other adult females, and a male infant (her half-brother). She saw these gorillas continuously from birth to age 6 months, when she and her half-brother were removed from the zoo for a long time because of serious illness. (Her half-brother died.) From age 6 months until 5 years, when Michael arrived, Koko had some very limited contact with other gorillas. Before leaving the zoo at age 3 she was taken to the zoo to see her parents, and between the ages of 3 and 4 she had two visits with a young male gorilla. She was also exposed to films and photographs of gorillas. But from 6 months to 5 years her social companions were exclusively adult humans. Between the ages of 1 and 2 years she was taken to a wide variety of human faces while on display in the zoo nursery, and many visitors observed her through glass windows. Thus the face she saw in the mirror was quite different from the faces with which she was most familiar, and this may have caused delayed recognition of her own gorilla features. Another consideration is that a life-threatening illness at the age of 6 months may have caused some delay in her overall cognitive development. Studies with Koko and Michael indicate that we must be wary of our assumptions about an animal's cognitive abilities based solely on the results of the mark test. There are clearly many problems with the administration and interpretation of this test, especially when it is applied to apes and self-conscious animals such as gorillas. Nor should self-recognition be considered synonymous with self-awareness. The many behaviors in mirror self-recognition discussed earlier in this chapter, such as playing, symbolic play, and naming of internal states, would indicate self-awareness even if the gorillas failed to show MSR. There are other possible behavioral correlates of self-awareness not discussed here, including games, problem solving, showing off, cheating, grief, gratitude, grudging, sympathy, empathy, aggression, sorrow, saving face, denial, argument, definition, representation, and dance, and concern about one's image. Other types of tests, especially those that make use of interspecies communication, are potentially more informative for exploring self-awareness than tests of MSR in that they provide more direct information about an individual's self-concept. Further studies will be necessary, concentrating on the behavioral correlates to self-recognition and self-awareness, before we can claim to know which individuals of which species are self-aware.

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