

# What Chimpanzees (Might) Know about the Mind

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In this chapter I review the results of an ongoing comparative research program designed to determine whether primates differ phylogenetically in their ability to attribute mental states to others. I focus on chimpanzees, *Pan troglodytes*, for two reasons. First, they are the only species of great apes that have undergone systematic experimental tests for these abilities (Premack 1988a; Povinelli 1993; Whiten 1993). Second, a theoretical reason exists for this focus. Over a decade ago, for reasons that will be described later, Gallup (1982) predicted that chimpanzees (and orangutans) ought to differ markedly from other nonhuman primates in their natural inclinations to attribute mental states such as intention and knowledge to other organisms. In addition to attempting to reconstruct the evolution of mental-state attribution in general, much of my own research has focused on testing Gallup's idea. Although our results are somewhat ambiguous, it is fair to conclude that chimpanzees, but no monkey species tested to date, have provided intriguing evidence that they may be reasoning about more than just the observable world.

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## Monkeys, Apes, Mirrors, and Minds

Gallup (1970) reported that after several days of exposure to mirrors, chimpanzees show evidence that they successfully identify the sources of their mirror images. Initially, the four chimpanzees he tested (separately) behaved as if they were in the presence of other chimpanzees. By day two or three, however, these social behaviors declined and were replaced by efforts to use the mirror as a tool to explore themselves in ways they had never done before, such as making exaggerated facial expressions and using

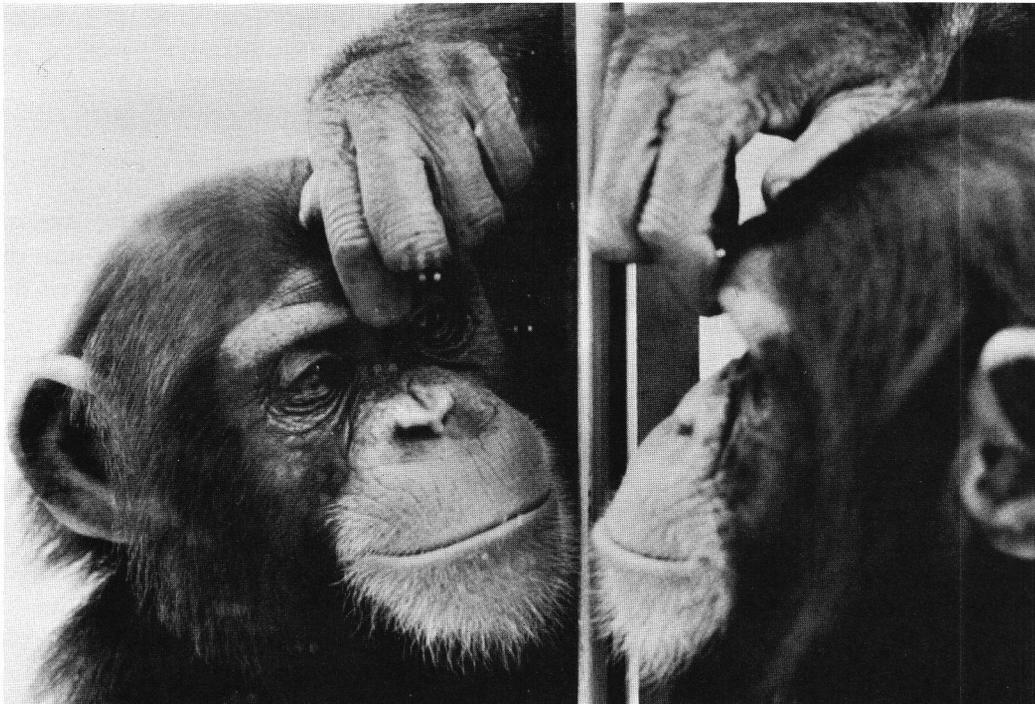


their fingers to inspect their teeth, eyes, and anal-genital region (see figure 1). After 10 days of such exposure, Gallup anesthetized each subject and applied an odorless, red dye that could not be felt to an upper eyebrow ridge and the opposite ear. Upon recovery, the subjects were observed for 30 minutes without the mirror present. The chimpanzees made virtually no attempts to touch the surreptitiously applied marks, presumably because they were unaware of them. The mirror was then reintroduced, and the subjects made a number of attempts to touch the marks that they could now see on themselves with the aid of the mirror. Gallup (1970) concluded that the chimpanzees had recognized themselves and that this recognition seemed to imply the presence of at least a rudimentary self-concept. Several years later the phenomenon was extended to include orangutans (Lethmate and Dücker 1973; Suarez and Gallup 1981).

Compared with these findings on chimpanzee and orangutan self-recognition, other species tested have provided little in the way of convincing evidence for that capacity. To date, studies of nearly 20 species of Old and New World monkeys, lesser apes, and even gorillas<sup>1</sup> have failed to show compelling evidence of the emergence of spontaneous self-exploratory behaviors using a mirror as a guide. Nor have these subjects detected the presence of experimentally placed marks on their faces with the aid of a mirror (Anderson 1984; Gallup 1991). Although it is tempting to dismiss these results as reflecting species differences in domains other than

**Figure 1**

A four-year-old chimpanzee displays signs of self-recognition by using a mirror to explore parts of herself which are otherwise invisible. Photo by D. Bierschwale.



cognition (i.e., motivation), these kinds of interpretations have not fared well against the often ingenious (but unsuccessful) efforts to prompt species other than chimpanzees and orangutans to display evidence of self-recognition (Gallup 1991).

Reviewing early findings, Gallup (1982, 1983) developed a model to further test his interpretation of the chimpanzee's and orangutan's capacity for self-recognition. Adopting a Cartesian epistemological argument, Gallup reasoned that if chimpanzees possessed some knowledge of self (as deduced from their ability to recognize themselves), then they might be able to infer analogous knowledge in others. Although the extent of self-knowledge possessed by chimpanzees was unclear from his work on self-recognition, Gallup speculated that chimpanzees might use their own experiences as a means of modeling the likely experiences of others, and thus be able to attribute intentions, desires, plans, and knowledge to other individuals.

In search of evidence in support of his theory, Gallup (1982) turned to the landmark set of investigations of a chimpanzee theory of mind conducted by Premack and Woodruff (1978). Their experimental evidence that an adult chimpanzee might be reasoning about unobservable intentions of human actors represented exactly the kind of ability he suspected was widespread in a species showing evidence of self-recognition. But far more startling than Gallup's predictions about chimpanzees were his companion predictions about lesser apes and monkeys. The inability of these primates to recognize themselves suggested to Gallup that they had no access to their own minds and, therefore, had no access to the minds of others. His model thus predicted that chimpanzees and orangutans should succeed on tests designed to tap into an understanding of the mental world of desires, intentions, and beliefs, whereas other species should not succeed.

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## Initial Tests of the Model

Our initial strategy to test Gallup's model was to compare two species using tests related to mental state attribution. We chose chimpanzees because of their widely replicated ability to recognize themselves in mirrors and rhesus monkeys because of their similarly widely replicated inability to do so. We thus set out to test the null hypothesis that there were no species differences between chimpanzees and rhesus monkeys in their abilities to pass tests of mental state attribution.

### **Role Reversal as a Measure of Understanding Personal Agency**

In our first experiments, we tested four chimpanzees (8, 9, 10 and 28 years old) and four rhesus monkeys (14 to 20 years old) to determine whether they could understand other individuals and themselves as intentional agents.

In humans, this requires the ability to understand that others are animate beings who can control their own behavior. This ability may develop from early forms of role playing and empathy and begins to emerge in infants at an explicit level by about 16–18 months and then undergoes further refinement and elaboration (Poulin-DuBois and Schultz 1988).

We reasoned that we could test for this limited understanding of the mental world by pairing each chimpanzee or rhesus monkey subject with a human partner and creating two distinct roles, one an operator role and the other an informant role. The subject and the human partner were seated opposite each other with a cooperative apparatus between them. All the subjects were initially trained to pull handles that controlled movement of food trays, some of which contained a small food reward. Once the subjects could accurately pull the handle corresponding to the baited tray, the chimpanzee and rhesus monkey subjects were divided into two groups (operators and informants). The apparatus was then modified by placing opaque shields that prevented the operators from seeing which trays contained food. From the informant side, the baited trays were perfectly visible, but the informant had no handles to bring the trays within reach. The operators needed to respond to the pointing of their human partner in order to obtain the food reward. Gradually the operators learned to do so with near-perfect accuracy, thus delivering a food reward to both participants. The informants, likewise, gradually learned to produce a pointing or reaching gesture in front of the correct food trays, thus enabling their naive human partners to pull the correct handle. We continued training the subjects (chimpanzee and rhesus monkey alike) until they were performing their operator or informant roles at near-perfect levels.

Up to this point our data could tell us very little. Although members of both species were cooperating with a human partner, we had no evidence that they understood anything at all about what they were doing. Did the chimpanzees and rhesus monkeys understand that they and their partners were acting as autonomous agents, directing and coordinating their behavior to achieve a desirable outcome? Or were they merely responding to the imposed reward contingency of the setup we had devised? We asked them this question by staging two critical sessions of *role reversal*: operators were required to become informants and informants to become operators. The apparatus was set up as usual, but then slowly turned around as the subjects watched; thus, each subject was now confronted with the task from the opposite perspective. Gallup's model predicted that the chimpanzees would understand the reversal and realize that it was now their turn to perform the role originally performed by the human agent. In contrast, the model predicted that the rhesus monkeys would initially respond at chance levels and only gradually learn the new role as the reward contingencies became explicit. These are exactly the results we obtained. Three of the four chimpanzees showed clear evidence of understanding their new

role, whereas none of the rhesus monkeys did (Povinelli, Nelson, and Boysen 1992; Povinelli, Parks, and Novak 1992; Hess et al. 1993). We were thus able to reject the null hypothesis—at least as far as this test was concerned.

### Understanding That Seeing Leads to Knowing

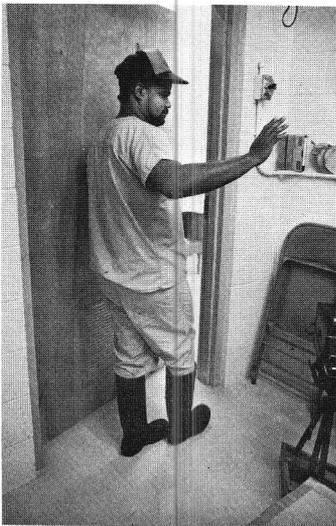
The same subjects were next tested to determine whether they understood that the observable behavioral act of *seeing* creates an internal, unobservable mental-state of *knowing*. We reasoned that we could have the subjects observe two human actors, one of whom (the knower) would hide food under one of several cups, and one of whom (the guesser) would be outside the room during the hiding procedure. The subjects would see that the knower had food and was placing it in one of several cups, but a screen would prevent them from seeing exactly which cup held the food; they would also see that the guesser had left the room. The guesser would return and the screen would be removed. Then, the guesser and knower would simultaneously offer the chimpanzees “advice” (by pointing) at a cup. The knower would point to the correct cup; the guesser would point to an incorrect cup (see figure 2a–c). If subjects understood that seeing results in knowing, they would follow the advice of the knower.

Our subjects were administered 10 trials a day over several weeks in which the roles of the guesser and knower were randomly altered.

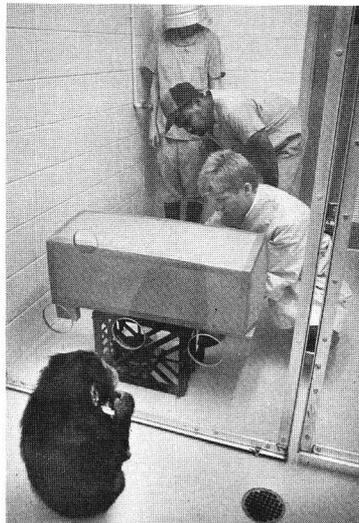
**Figure 2**

This procedure is used to determine if chimpanzees understand the connection between seeing and knowing:

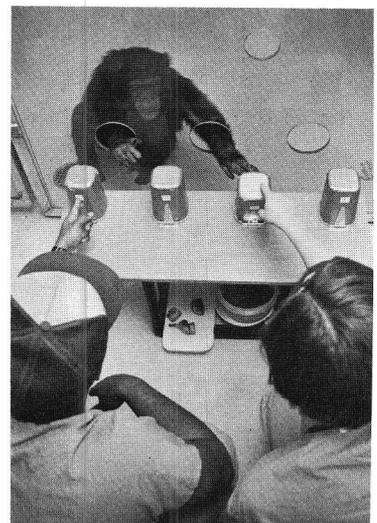
- A. chimpanzee sees guesser leave the room while knower hides food, or
- B. chimpanzee observes as knower watches third experimenter hide food while guesser's vision is obstructed, and
- C. guesser and knower offer advice to chimpanzee.



A



B



C

At least three of the chimpanzees showed a fairly stable selection of knower's advice during the initial several weeks of testing. However, there was some reason to think that they may have been solving the task another way. Instead of realizing that the knower knew something that the guesser did not, the chimpanzees may have been learning a behavioral role such as "pick the person who stays in the room." To probe their understanding further, we gave them three test sessions in which we altered the relevant behavioral variables but kept the epistemological relations intact: instead of hiding the food, the knower merely watched as a third person hid the food; instead of leaving the room, the guesser stayed inside, next to the knower, but placed a paper bag over his or her head while the food was being hidden (see figure 2b). The chimpanzees who had made the earlier discrimination showed reasonably good transfer into this procedure (Povinelli et al. 1990). Premack (1988a) has briefly reported analogous experimental results with four six- to seven-year-old chimpanzees.

The rhesus monkeys, on the other hand, never made a discrimination between the guesser and knower despite our best efforts to make the cues as obvious as possible. They did try a number of strategies, such as picking the person on the right or left, or picking the experimenter wearing a glove on and so on. But the manipulations that resulted in denying one person visual access to the hiding procedure did not seem to have any significance in terms of guiding their searches for the food (Povinelli et al. 1991). Cheney and Seyfarth (1990), working with Japanese macaques, have reported similar findings using different experimental approaches.

In an effort to understand whether our task was really tapping into an ability to understand the seeing-knowing relationship, we gave the same test to three- and four-year-old human children (Povinelli and deBlois 1992). Previous research by other investigators using analogous linguistic measures had found that young children did not appreciate the seeing-knowing connection until about four years of age (Wimmer et al. 1988; Gopnik and Graf 1988; O'Neill and Gopnik 1991). When we administered our task, the three-year-old performed like the rhesus monkeys described above. In contrast, the four-year-old performed at near-perfect levels from the first trial forward. Thus, we felt reasonably confident that the nonverbal test given to the chimpanzees and rhesus monkeys was measuring the seeing-knowing relationship. On the other hand, our chimpanzees never performed as well as the four-year-olds. Thus, determining whether the chimpanzees had attributed the mental states of knowledge and ignorance to the actors or simply, had learned the difference using behavioral cues, must await experiments with additional controls designed to tease these issues apart.

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## The Ontogeny of Mental State Attribution

As I was conducting these original tests of a chimpanzee theory of mind, I began to reconsider questions concerning the evolutionary history of mental-state attribution. Just as physical anthropologists attempt to determine the timing and order of the development of key morphological traits (brain size, bipedalism, reduced prognathism) important in human evolution, I realized that ultimately our research could allow us to reconstruct (through cladistic inference) the likely psychology of mental state attribution possessed by the ancestor of the great ape-human clade.

In considering how to achieve this broader goal, I realized that our approach (and Gallup's model) suffered from some very serious limitations that needed to be addressed. The picture from developmental psychology strongly suggests that the emergence of mental state attribution in human children does not appear as a uniform package. Rather, individual aspects related to intention and to knowledge may develop at different rates. For instance, although young two-year-olds display some understanding of the mental world—especially as related to desires and, later, intentions—they still do not have a very good understanding of knowledge or belief. [For good overviews of the development of the child's theory of desire and belief, see Astington and Gopnik (1991); Perner (1991); Wellman (1990).]

The fact that components of mental state attributions can be dissociated during development raises several distinct possibilities with regard to their evolution. First, chimpanzees and humans may share developmental pathways related to mental state attribution only up to the point of self-recognition. In other words, human psychology may have been modified from an ancestor that reached a terminal point of conceptual development akin to that possessed by chimpanzees and orangutans.<sup>2</sup> Of course, this possibility assumes that, despite a good deal of morphological evolution, chimpanzees and orangutans have undergone relatively little psychological evolution since their initial divergence. This need not be true. A second possibility is that chimpanzees and orangutans, as well as humans, have undergone unique psychological evolution within their respective lineages, thus reaching derived (and different) psychological terminal points in the different species. A final possibility is that the ancestral condition of the last common ancestor of the great ape-human lineage was more derived than that displayed by children, chimpanzees, or orangutans at the point that they display self recognition. In other words, humans, orangutans, and chimpanzees may share an extensive overlap in their development of mental state attribution as the result of the inheritance of an extensive pleisiomorphic condition.

The consideration of these three possibilities has direct and important implications for research into a chimpanzee's theory of mind. It means that comparative ontogeny must become as important a tool in psychological evolutionary reconstructions as it has been in morphological evolutionary reconstructions (Parker and Gibson 1979; Parker 1990). These considerations argue in favor of following cohorts of relevant species (for example, chimpanzees) through critical landmarks in psychological development. If the onset of robust ontogenetic landmarks could be mapped, then tests of mental state attribution could be administered both before and after their emergence. For example, by testing young chimpanzees for mental state attribution both before and after they develop the capacity for mirror self-recognition, we could perhaps determine in a more straightforward manner whether Gallup's interpretation of mirror self-recognition is of heuristic import. In addition, and quite independent of Gallup's model, such tests (if conducted comparatively with young children) could produce a fine-grained picture of the ontogeny of these abilities, as well as a clearer picture of which abilities are shared, ancestral character states and which are exclusively derived in the various lineages.

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## Theory of Mind Ontogeny in Chimpanzees and Children

Recently, we have adapted the strategy described above in a further effort to understand exactly what chimpanzees know about the mind. First, we are utilizing cross-sectional methods with both young children and mature and immature chimpanzees in order to develop additional and more refined measures of mental state attribution. Second, we have been following a cohort of seven young chimpanzees from about 36 months of age.

### Parameters of Self-Recognition

To begin, we have tried to determine the ontogenetic parameters of self-recognition in chimpanzees. As we have discussed, we seek these parameters for both theoretical and practical reasons. First, at what age do most chimpanzees develop the capacity to recognize themselves in a mirror? Second, do all chimpanzees develop the capacity, or just some? Third, how long does it take for mature, mirror-naïve chimpanzees to recognize themselves in mirrors? In order to answer these questions, we have adopted both cross-sectional and longitudinal methods.

The results of our initial, cross-sectional research program, involving over 100 socially housed chimpanzees ranging in age from 10 months to nearly 40 years of age, revealed some surprising patterns (Povinelli et al.

1993). First, in a cross-sectional study of almost 50 animals younger than 6 years of age, only a few (less than 10%) showed compelling evidence of self-recognition. In contrast, nearly 80% of the subjects between 7 and 15 years of age showed very clear signs of self-recognition. Although this finding does not fit with previous results using much smaller sample sizes (Lin et al. 1992), we were able to replicate our findings by intensively studying six three- and four-year-old chimpanzees who (with one precocious exception—a three-year-old female) initially tested negative for self-recognition. Despite weeks of mirror exposure in a variety of settings, the five negative animals displayed no signs of recognition nor did they pass a controlled mark test similar to that described earlier in this paper. In contrast, the single positive (control) subject showed clear self-exploratory behaviors using the mirror and passed the mark test. A longitudinal research program is currently underway, and with only a couple of notable exceptions, the ontogenetic patterns detected in our cross-sectional research program appear fairly robust (Povinelli et al. 1993). It is still too early to definitively state the typical age at which the capacity for self-recognition develops in chimpanzees. Povinelli et al. (1993) discusses factors that may affect the rate of development of this capacity. Nonetheless, it now appears that the onset of the capacity is markedly later than in humans, who show evidence of self-recognition by about 18 to 24 months of age (Lewis and Brooks-Gunn 1979).

In addition, our results reveal that, contrary to the findings of Gallup and his colleagues, chimpanzees do not require two or three days of mirror exposure before they recognize themselves. Most of our chimpanzees that showed clear behavioral patterns indicating self-recognition, did so within 30 to 40 minutes of mirror presentation. This difference may be the result of methodology; our chimpanzees were tested while in their social groups, whereas Gallup's were not. Also, contrary to the data presented by Swartz and Evans (1991), our cross-sectional results suggest that most chimpanzees do display evidence of self-recognition, but that this capacity (or the expression of the capacity) declines in midadulthood. The extent to which this decline can be written off as a motivational difference depends on certain other factors. For instance, one could imagine that adults might simply be less interested in their images in mirrors. However, adults who do not show signs of self-recognition spend as much or more time staring into the mirror as do the younger animals (or even their same-age peers) who do show evidence of self-recognition (Povinelli et al. 1993).

### **Understanding the Perceptual Sources of Knowledge**

Age differences in self-recognition allowed us to test a prediction, derived from the developmental framework, that young chimpanzees who did not

test positive for self-recognition would likewise not show signs of understanding the perceptual sources of knowledge. We thus tested six three- and four-year-old chimpanzees on the seeing-knowing paradigm; these subjects were the five who had previously tested negative for self-recognition and the one precociously positive female. Our predictions for the precocious subject were uncertain because, as discussed earlier, young children do not appear to understand the seeing-knowing relationship until about four years of age, or roughly two years after the onset of self-recognition. Thus, although this young chimpanzee was capable of self-recognition, she may well have developed only marginally (or not at all) past the point of children that are 18- to 24-months old.

This investigation revealed that none of the six subjects discriminated between the guesser and knower in any of the variations we presented to them (Povinelli et al. 1994). Indeed, the overall pattern of results mirrored the pattern we had obtained with rhesus monkeys several years earlier. Thus, consistent with both Gallup's model and with the developmental pattern in children, the absence of self-recognition was associated with an undeveloped understanding of the perceptual sources of knowledge. This finding will achieve far greater importance if, as these subjects mature and become capable of self-recognition, we subsequently obtain data that they are able to understand the epistemological distinction between the guesser and the knower.

### **Assessing One's Own Knowledge**

Although we have yet to obtain definitive evidence that chimpanzees understand *how* knowledge states arise (an ability that would be required for success on the seeing-knowing task), it has occurred to us that chimpanzees (and young children) may first understand less sophisticated aspects of knowledge. For example, even though they may not possess an accurate understanding of how knowledge states arise, they may at least understand that such states exist (Premack 1988b). How might we go about testing them for such ability? Imagine that a subject observes an experimenter hiding food under one of several cups. The subject can see that the food is being hidden but cannot determine exactly which cup is baited because of a screen obscuring the cups. The screen is then removed, revealing the experimenter pointing to the correct cup. The response latency of the subject—that is, the time (in seconds) it takes the subject to look under a cup after the screen is removed—can be measured. We predicted that at some point after young children display evidence of self-recognition, but before they pass the seeing-knowing test, young children (and perhaps chimpanzees) would begin to hesitate on probe trials where the experimenter refrained from pointing. In other words, at some point the young

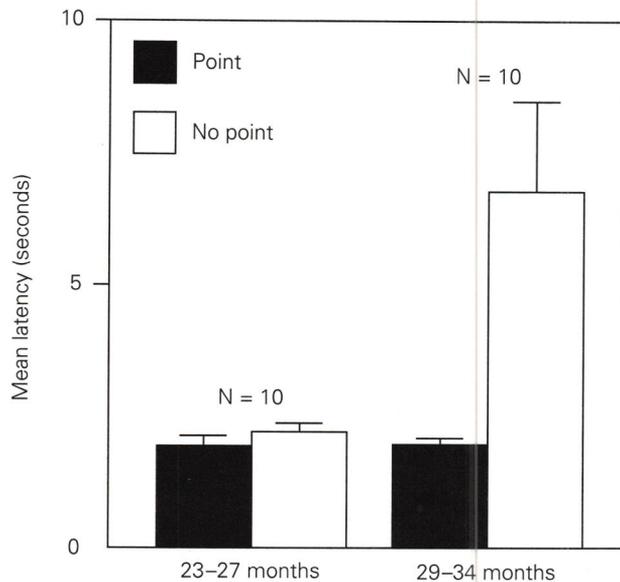
subjects should realize that they are uncertain of the location of the reward and, hence, should show a marked hesitation (latency) before looking under a cup, or perhaps, simply refuse to search altogether. That is, the young child or young chimpanzee will show an ability to assess the state of its own knowledge and act accordingly.

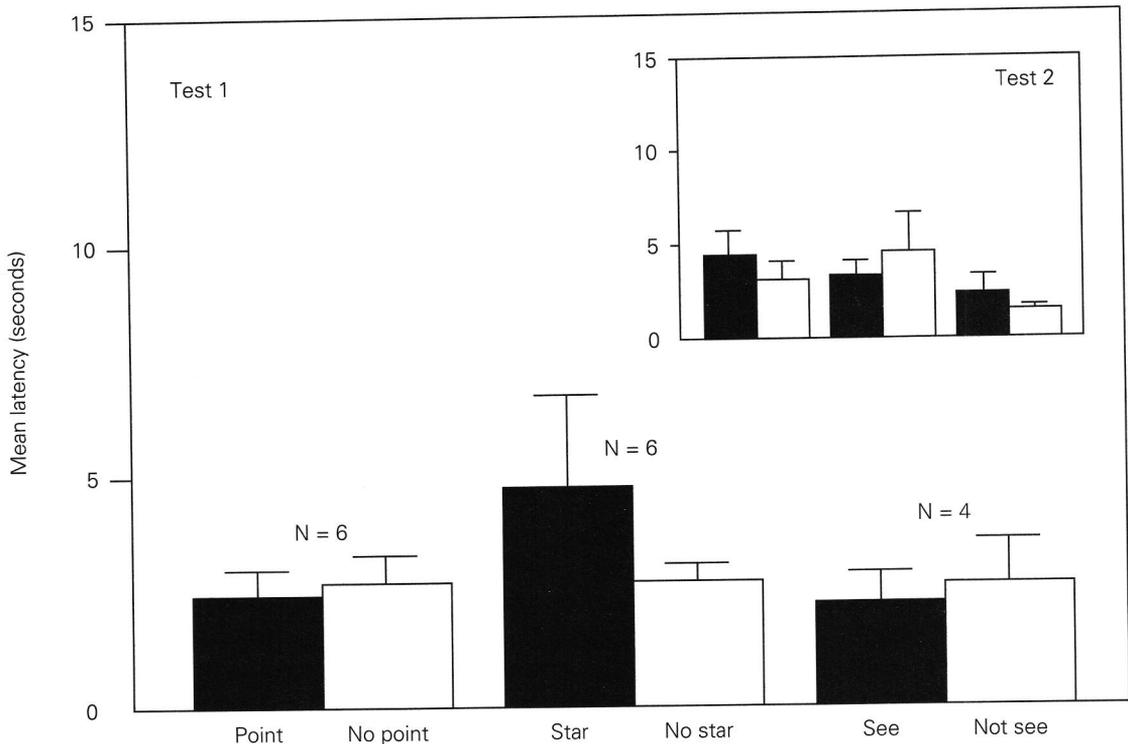
We have tested both young children and young chimpanzees using this paradigm (Povinelli et al. unpubl. manu.). Initially, we tested 48 children ranging in age from 23 to 48 months. Consistent with our prediction, before about 28 months of age, the children did not discriminate between trials in which the experimenter pointed and trials in which he did not. After that age, children began to show much longer response latencies on average, sometimes coupled with verbal inquiries such as, "Where is it?" or "I don't know!" Figure 3 displays the critical age transition—somewhere between 23 and 34 months of age. We have undertaken additional tests to rule out less demanding interpretations of these response latencies.

Thus far young chimpanzees show no evidence of discriminating between conditions in which information is provided about which cup contains food and conditions in which such information is not provided. For example, just like the younger children, chimpanzees showed no increased hesitation on trials in which no pointing was provided to guide

**Figure 3**

Self-knowledge assessment tasks show the development of response latency in young children. Data show the development of hesitation on trials when experimenter refrains from pointing to a cup, "no point trials", thus depriving a child of knowledge as to the location of a reward. Data represent mean period of hesitation (latency) on "point trials", ( $\pm$ SE of the mean) compared to "no point trials". Children appear to begin to discriminate between the conditions by about 28 months of age. N refers to number of subjects.





**Figure 4**

Self-knowledge assessment is absent in young chimpanzees. Subjects did not hesitate longer on probe trials where information necessary to solve the task was eliminated (no point, no star, not see) versus baseline trials when information was provided (point, star, see). N refers to number of subjects.

their searches. Likewise the young chimpanzees did not hesitate longer on trials in which a green star (that they had been reliably using to find the correct cup) was removed from the cups. Finally, they did not hesitate longer on trials when they did not see which cup was baited as opposed to trials when they directly witnessed the experimenter's placement of the reward (see figure 4). We obtained essentially the same results in a second administration of these proceeds. This is not to say that they never will make such discriminations but at this point in their development, chimpanzees do not yet appear to discriminate between situations in which they know the answer and situations in which they do not. This finding is consistent with the ontogenetic pattern detected in our cross-sectional research with young children; for instance even children who recognize themselves may still be too young to assess their own knowledge in this rudimentary manner.

### Mature Versus Immature Self-Recognition

Finally, although chimpanzees may have some awareness of mental states in themselves and in others, do they conceive of themselves (and others) as enduring entities through space and time? Although they may well possess some kind of on-line, or moment-by-moment, representation of certain

aspects of themselves (for example, of themselves as intentional agents), do they, like humans, conceive of themselves as enduring and changing through time? Consider the following paradigm as one method of determining this. Imagine that a chimpanzee, sophisticated in recognizing and exploring herself with a mirror, were to witness a trainer approaching her cage for an annual physical examination. And imagine that the event was unusual in some fashion; perhaps the trainer is wearing a bright orange costume. Imagine further that the trainer sedates the animal for the examination, and while the animal is under anesthesia, the animal's hair is dyed pink. Finally, the animal recovers, none the wiser about her new hair color. Suppose now that the chimpanzee is given the opportunity to view a short videotape of the entire procedure, beginning with the trainer's approach to the cage in the strange costume and ending with the hair dye. How would the chimpanzee react to witnessing such a video later that same day? Upon observing the result of the hair dye, would she reach up to inspect her head? Would she realize that what she was witnessing on tape happened just that morning and that her hair might still be pink?

Although we have begun to pilot aspects of this procedure with chimpanzees, we realized that first we needed to know how young children would react to such a manipulation. The children, of course, were not sedated, but an analogous paradigm was used. Forty-two two-, three-, and four-year-old children were videotaped while playing an out-of-the-ordinary game with an adult. During the game, the experimenter surreptitiously placed a large sticker in each child's hair, just above the forehead, in the context of praising them. After an observer made certain the children were not aware of the sticker, they were invited to watch a videotape of what they had just been doing. Despite their capacity for mirror self-recognition, none of the two-year-olds, and only about 25% of the three-year-olds (the older ones) reached up to search for the sticker when they saw it being placed in their hair, despite the fact that the whole scene occurred just several minutes earlier. In contrast, nearly all the four-year-olds reached up

**Table 1**  
Results of mature self-recognition with young children.

Age	Children who passed test			
	Videotape		Photo	
	%	N	%	N
2	0	(0/10)	—	—
3	25	(4/16)	25	(4/16)
4	75	(12/16)	100	(12/12)

*Notes:* Age ranges: 2-year-olds = 22–34 months; 3-year-olds = 35–46 months; 4-year-olds = 47–60 months. Age transition is highly significant for both tasks (videotape task, Fisher's exact test,  $p < .001$ ; photo task,  $\chi^2 = 16.56$ ,  $df = 2$ ,  $p < .001$ ).

within seconds of seeing the marking event. We have replicated this same effect using Polaroid pictures.

Although it may be tempting to think that children simply cannot recognize things in photos or on videotape, all the children were capable of identifying themselves in the photos or videotapes when the experimenter asked, "Who is that?" Do the children simply not understand the physical technology of these media? Probably not, but they do not understand the physical properties of mirrors either, yet this does not prevent them from using them appropriately. We speculate that the difference is a conceptual one, related to other broader shifts in their representational systems. The result is that children younger than about three-and-a-half have a very good on-line representation of themselves, and they also have access to previous memories of themselves, but they are very poor at integrating the two. As a profound corollary, they may not yet understand their own ontology. Obviously, testing chimpanzees of various ages on this task is a high priority because a subject's performance appears to be quite a robust marker of a more mature representation of self than mirror self-recognition alone.

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### **Summary: Do Chimpanzees *Really* Attribute Mental States?**

At present it is impossible to say with much definitiveness what chimpanzees really know about the mind. They clearly act *as if* they understand intention, knowledge, and possibly belief; but the extent to which that behavior is supported by learned or inferred behavioral rules remains uncertain (Cheney and Seyfarth 1990; Premack 1988a; Whiten 1993; Povinelli 1993). Data collected from spontaneous social interactions in captivity and in the field suggest that chimpanzees as well as other primates possess a very complex psychology that may take into account the motives, intentions, and the knowledge possessed by competitors and allies (de Waal 1982; Whiten and Byrne 1988). Ultimately, experimental approaches of the type pioneered by David Premack and Gordon Gallup, which we have been attempting to elaborate and extend, will help us to place constraints upon the kinds of interpretations that make sense in such contexts. These investigations, coupled with parallel research using young children and other primates, will provide a more meaningful answer to the question implicit in this chapter's title.

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### **Endnotes**

1. Gorillas may require special explanation. Povinelli (1993) has argued that gorillas may have undergone a secondary reversal in important aspects of their cognitive development as the result of selective pressure favoring early, rapid

physical maturation. This shift in development may have important implications for their typical failure to express evidence of self-recognition.

2. This does not assume that such modifications were tacked on to the end of the existing developmental program of the last common ancestor of the greater ape-human clade. Human language, for instance, was clearly not simply a terminal addition to the primitive, cognitive developmental program of humans and apes, because children begin to utter simple words and sentences before they display evidence of self-recognition.

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