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Do Apes Use Language?

One research group considers the evidence for representational ability in apes

Ape-language work is having profound effects on the fields of linguistics (Brown 1973; Mounin 1976), psychology (Limber 1977), anthropology (Hill 1978), zoology (Griffin 1976), sociology (Meddin 1979), and neurobiology (Steklis and Raleigh 1979). The broad impact of this work lies not in a cross-disciplinary approach by the ape-language researchers themselves—all are psychologists—but in the ubiquitous question that underlies the endeavor: is man unique? If human uniqueness were not an important presupposition underlying research in a variety of scholarly fields, the ape-language work would not attract such broad attention. As Hill points out, this work "may imply a paradigm shift, with Plato finally giving way to Darwin or perhaps 'an identity crisis for *Homo sapiens*' (Gallup et al. 1977, p. 303)" (Hill 1978, p. 89).

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Any endeavor of such import should be cautious regarding its methods, findings, and conclusions. Unfortunately, reports of ape-language work have dealt with many of the fundamental aspects of language in a rather cursory manner. The acquisition of symbolic-representational skills has been presented as a rather simple task for the chimpanzee, and the issue of exactly what constitutes symbolic or representational function has been given minimal attention. Although a few initial critiques of the work questioned whether or not chimpanzees understood the symbols they were using (Lenneberg 1971; Sebeok 1972), these issues were bypassed rapidly (Dingwall 1979) and interest quickly focused on syntactical phenomena (Mounin 1976; Limber 1977).

Ape-language projects

There have been three basic approaches to the teaching of language skills to apes, each of which has employed a different communication system and training philosophy. Beatrice and Allen Gardner, who worked initially with a chimpanzee named Washoe and more recently with four other chimpanzees, have chosen to rear their subjects as much as possible like human children and to use American Sign Language of the Deaf (ASL) as the medium of communication. Work with Washoe began when she was one year old and continued for five years, at which time she was said to have acquired a vocabulary of 132 signs, based on her production of each sign over a certain number of days. She was reported to be able to form a variety of novel combinations, such as "you me hide" and "you me go out there hurry," and the Gardners concluded that Washoe compared favorably with children at Brown's Stage III and beyond (Gardner and Gardner 1969, 1971, 1972, 1973, 1974 a and b, 1975, 1978 a and b).

Following this initial work, a student of the Gardners, Roger Fouts, began teaching ASL to six chimpanzees at the University of Oklahoma. Fouts also continued to work with Washoe intermittently. Fouts used the same approach in teaching these apes signs that had been used with Washoe—molding the apes' hands into the proper physical configuration with less and less precision and force until the animal placed its own hands in the proper position. Fouts, unlike the Gardners, permitted spoken English in the presence of the chimpanzee (Fouts 1972, 1973, 1974; Fouts, Chowin, and Goodin 1976; Fouts, Chowin, and Kimball 1976; Fouts and Mellgren 1976).

Shortly after Fouts began his work in Oklahoma, Penny Patterson (1978) began a similar study with a gorilla named Koko. Like Fouts, she molds the gorilla's hands into signs, and she permits spoken English. Both Fouts and Patterson use a criterion of word acquisition similar to that of the Gardners.

Herbert Terrace began a signing project with the chimpanzee Nim (born in Oklahoma) in 1974. He, like the Gardners and Patterson, raised Nim as a human child and attempted to encourage communication regarding all aspects of daily life. Nim was taught to sign by a method modeled after the techniques of Gardner and Fouts. Terrace made the first

permanent video record of any signing study; and this video record of Nim's progress ultimately forced him and his coworkers to reach conclusions regarding the signing capacities of apes that were at odds with those of the other researchers in this area (Terrace 1979; Petitto and Seidenberg 1979; Seidenberg and Petitto 1979).

Because all these ape signing projects followed the procedures laid down by the Gardners, we will discuss only the accomplishments of Washoe in detail, as she is the most widely known of the signing apes. Similar statements, however, are applicable to the other signing apes, for their training histories share the methodological problems described for Washoe.

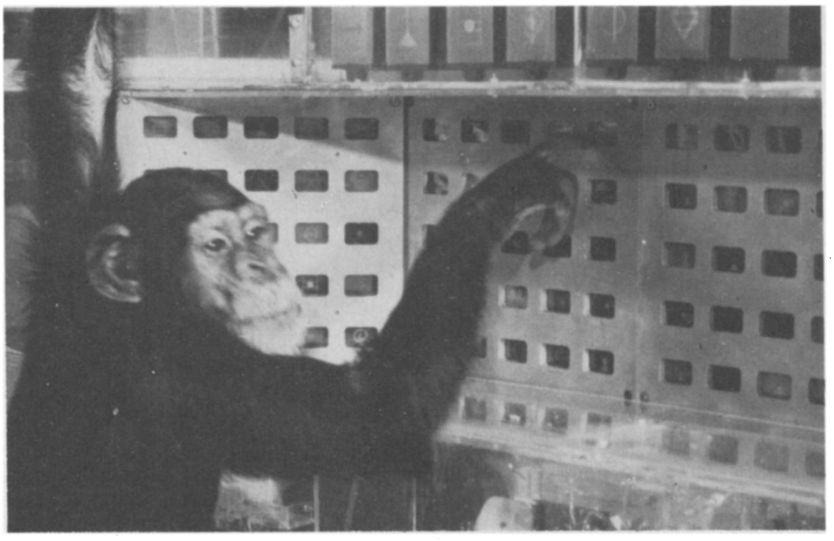

Figure 1. Lana, the chimpanzee used in the authors' initial ape-language experiment, sits in front of the keyboard by which she produced symbols. The authors question whether Lana and other apes have truly used symbols to represent things.

David Premack taught the chimpanzee Sarah to select, under certain conditions, a variety of plastic chips that he glossed with English words. Sarah was typically required either to select one chip from a set of two or to arrange four to five chips in given sequences. Sarah's chip selection was considered by Premack to be analogous to speaking words. For example, Premack would place in front of Sarah a candy and three plastic chips. He called these chips food names such as "candy," "banana," and "orange." When Sarah selected the chip that Premack called "candy," she was said to have named and asked for the candy. Premack went on to perform similar chip-selection tests with more complicated sets of English terms; one test, for instance, involved the selection of chips said to represent the plural indicator in the presence of other chips glossed as "red yellow ? ? color."

Rumbaugh, Warner, and Von Glasersfeld (1977) set out to develop a method of studying ape-language acquisition that would combine the better aspects of the approaches taken by the Gardners and Premack and would at the same time avoid the pitfalls of both these projects by devising a medium of symbolic communication that would permit the gathering of a complete utterance corpus, the individual items of which would not be open to interpretation. The communication medium developed could also completely eliminate cueing problems by relaying symbol selection through computer signals. Unlike the "words" in former projects, the "words" in this system were composed of a limited number of elements that were recombined in various ways to produce geometric figures (e.g. ⊕ = M&M, ⊕ = juice, ⊙ = pudding, ⊕ = sink).

Initially, Lana was required to learn strings of symbols in order to manipulate food vendors and mechanical devices in her environment (e.g. *please machine give M&M* and *please machine make window open*). She came to realize that the machines had to be stocked by humans, and she readily transferred the use of such strings to the manipulation of her human teachers (*please Tim give milk out room*). Lana executed these requests by depressing keys embossed with geometric symbols and arranged on a large wall panel (Fig. 1). The keys could be relocated to preclude simple position learning.

Sherman and Austin, two young male chimpanzees, were added to the Yerkes project in 1976. Their training differed from that received by Lana in that they were not taught to produce strings of symbols, they were not constrained by the same grammar, and they were reared and trained in a social preschool-like setting. Emphasis was placed on interanimal communication early in training, which led to a development of receptive and indicative skills not seen in other apes. Unlike Lana's, Sherman and Austin's medium of communication has not been limited to the keyboard. Spontaneous human and chimpanzee gestures (not ASL), vocalizations, and even tasks similar to Premack's have also been employed with them. A detailed description of this project is not possible here, but it should be noted that the training difficulties encountered with Austin and Sherman have led to many of the insights in this paper (Savage-Rumbaugh and Rumbaugh 1976, 1979, in press; Savage-Rumbaugh 1979; Savage-Rumbaugh et al. 1979 a, b, in press).

Signs, lexigrams, and plastic chips have been accepted as elements of the ape's vocabulary if the ape can produce the correct behavioral label in the presence of the correct exemplar. This basic assumption has been made by the three initial ape-language projects and by the three offshoots of the signing work.

But is labeling *per se* tantamount to symbolic representation? Does the ape inherently *know* that a sign, a lexigram, or a plastic chip can stand for an object that may be absent in time and space? Does the ape inherently know that a *name* can be used to convey information to another animate about that object? Does a simple association between specimen and response lead to symbolic repre-

sentation? Whether associative labeling in apes is equivalent to representational naming in children is the issue of fundamental concern. The issues of combinations, syntax, and novel usage are all subordinate to that of reference.

What is symbolic representation?

Developmental linguists and developmental psychologists have begun to address the issue only recently, but there is virtually complete agreement among them regarding the referential aspects of naming. Pylyshyn (1977) notes that

> animals can learn to produce behaviors, or as Skinner calls them, MANDS, that are instrumental for obtaining specific objects. But this is only a small part of what is involved in naming. To name an object implies that the object has been conceptually singled out or wrenched from its context and is available for arbitrary cognitive activity. Thus, for a child to acquire even something as apparently simple as the name of an object is already a highly cognitive activity. What seems to give this relation (the relation of name and object) a status distinct from that of simple association is that it is formed in a special context in which attention is being focused on *referential* (not associative) relationship. [1977, p. 40]

Representation, or symbolization, is viewed by linguists as a system that permits referral to objects and events which are not present, thereby providing the user of such a system with communicative capability that goes far beyond the nonverbal action-gesture schema (Nelson, in press; Bruner 1973, 1974/75). A wide variety of messages may be communicated by pointing and gesturing, but the accurate interpretation of such messages is entirely dependent upon the proper embedding of the message in the extralinguistic nonverbal context. For pointing to be effective, the object must be physically present. If a symbol can be used in place of the object, however, then the object can be *represented* by means of a shared, stored knowledge from the brain of one party to that of another without the object being present. This is the essence of language—"the translation of meanings, that is, knowledge of people, objects, events, and their relations into words; and the expression of these meanings to a social partner for some functional purpose. Reciprocally, it involves the interpretation of the meaning expressed by others to the child and the appropriate response to the functional purpose of the utterance" (Nelson, in press).

Thus, any given instance of true linguistic representation involves at least four components: (1) an arbitrary symbol that stands for, and can take the place of, a real object, event, person, action, or relationship; (2) stored knowledge regarding the actions, objects, and relationships relating to that symbol (this stored knowledge will not be identical for all users, but the greater the degree of overlap, the more precise the communication); (3) the intentional use of that symbol to convey this stored knowledge to another individual who has similar real-world experiences and has related them to the same symbol system; and (4) the appropriate decoding of and response to the symbol by the recipient.

There is, to be sure, representational thought that is not symbolic representation. Representational thought involves an internal cognitive representing of an object, action, etc., in its absence, which allows for the performance of cognitive operations on objects and actions in the absence of sensory-motor operation. This ability to re-present (to oneself) allows the organism to solve problems by a process which has been termed "insight" rather than by trial and error. In other words, the trial and error process becomes internalized and alternatives can be tested covertly—that is, in a nonobservable manner.

Symbolic representation differs from the simple re-presentation of experiences in that it is a form of interindividual representing. It entails the existence of symbols, preferably arbitrary ones. A nonsymbolic pictorial system could allow individuals to represent things (as perhaps early men represented hunts to one another in cave paintings); however, such a system would be slow and cumbersome, making conversational give-and-take very difficult.

We do not have evidence of symbolic representation unless it is demonstrated that cognitive operations proceed even when an individual is presented only with symbolic information. The existence of such cognitive operations may be inferred if and only if internal reorganization or restructuring is necessary in order for an organism to achieve the final behavioral act observed.

Researchers and critics alike have presumed too readily that when an ape uses a symbol, it has some referential reason for so doing. For example, when Washoe signs *drink* without being asked what a drink is, it is assumed that Washoe has the referent, a real drink, well in mind and that she is attempting to convey a message regarding drinks (Fouts, pers. comm.). If it is true that Washoe understands her utterance "you more drink" and that she utters it for the same reason that a human being would utter a similar phrase—namely, to produce a repetition of the recently occurred act of drinking in a companion—this would imply (1) that Washoe can produce symbols without the object being displayed or indicated by the experimenter and even without the object being present; (2) that the goal of Washoe's symbol production is to convey information to a listener/receiver about Washoe's internal "thoughts" or decisions; (3) that Washoe anticipates that the use of this symbol will cause an image or representation of some form in the brain of the receiver; and (4) that when this symbolic information is imparted to the brain of the receiver it can cause him to alter his ongoing behavior in accordance with her request. It is important to realize that these presumptions have never been proved—or even tested.

In fact, no theoretical framework has been developed within the field of animal psychology to distinguish between conditioned discriminative responses and symbolic representational responses. A single label or name produced by a child has been presumed to be representational and available for use in a variety of semantic communications (request, statement of intent, announcement, etc.), but the capacity for such symbolic representation has generally been assumed to be species-specific, and theories explaining the acquisition of this capacity have not usually been considered applicable to animals. The ability of a pigeon to selectively peck red keys for food and green keys for water, as in the Jenkins and Moore (1973) study, was never presumed to indicate that the pigeon was pecking the red key to *represent*

food and that it could peck this key to request food, to announce that food was present, to ask if food was present, and so on.

But the researchers who began to teach apes language did so with an inherent bias toward a set of presumptions formerly reserved for children. Simply stated, these presumptions were that (1) for a chimpanzee to learn language, it must first learn which members of a set of arbitrary symbols are to be associated with which real-world events and objects; (2) as the chimpanzee learns these associations, he will bring to the task an inherent capacity for representational and symbolic communicative ability that will enable him to use these symbols in a variety of ways; and (3) the most important determinant of whether or not the chimpanzee is actually learning a language will be his ability to form novel combinations.

When the ape-language work began, these assumptions reflected prevailing acceptance of the idea that the *learning* of individual words could probably be explained through relatively simple associationistic processes but that the learning of labels by children *implied* the presence of representational and functional symbolic communicative skills. This position—a pervasive one in psychology—was first put forth by Skinner (1953, 1957) and is exemplified by Jenkins and Palermo (1964), who state, "We believe that associative correlates between verbal behaviors and events in the world around the beginning speaker rapidly appear through simple S[timulus]-R[esponse] laws and that labeling or naming in its broadest sense ought to be one of the earliest forms to appear" (p. 62).

Because all three ape-language projects set about, from the outset, to demonstrate that their animals could do much more than name objects, they devoted almost no attention to the process of naming itself. They made no attempt to determine what semantic skills the ability to name an object implied and, with a few minor exceptions, no attempt to show that individual symbols or signs actually referred to objects, events, or motivational/intentional states.

It is our view that representation or symbolization is not inherent in the chimpanzee's capacity to select a symbol when presented with an object, action, or state, though such capacities may be inherent in the case of the human infant (Greenfield 1979). This is a more fundamental criticism of ape-language work than that recently set forth by Terrace and his colleagues (1979), who concluded that syntax, as we know it in human beings, does not exist in the symbolic communications of apes. Had Terrace's chimpanzee, Nim, understood the referential components of all the symbols he used, his syntax might have been quite adequate. However, an investigation of syntax when there is little evidence of semantic comprehension will inevitably lead to negative conclusions regarding the similarity of ape and human sentences.

Our own recent work indicates that the ability to use symbols representationally can be acquired by the chimpanzee, but evidence for representation or symbolization cannot be found in a simple association between label and object, and the ability to label is not sufficient criterion for a symbol to be viewed as a word or as an element of a chimpanzee's symbolic vocabulary. Unfortunately, because scientists working with chimpanzees have interpreted the behavior of their subjects too liberally, there exist among researchers significant misunderstandings about what chimpanzees can do linguistically, what they have done, what their accomplishments reflect, and how they acquired their languagelike skills.

The evidence for ape language

Premack (1976) appears to be aware of the problem of determining what plastic chips mean to a chimpanzee. He states that for a chimpanzee to be using the chips as words, the animal must show three abilities. The chimpanzee must be able to use the plastic chip to request the referent that has been associated with the piece. It must be able to select the piece when asked to name the referent. And the chimpanzee must be able to give what amounts to a description of the referent in the presence of the plastic chip alone.

Although we view this list as incomplete, it recognizes, at a minimum, that a simple association between item and referent is not sufficient for an experimenter to conclude that a response equals a word. But there are several problems with the way Sarah's possession of even the three abilities listed was tested. For example, Premack does not clearly distinguish procedurally between naming foods and requesting foods. When naming foods, the subject should be able to select the appropriate symbols without being allowed to consume the referent as a reward—otherwise, naming does not differ from requesting. Sarah was apparently allowed to consume the named object if it was edible. This procedural distinction between requesting and naming is an important one, and the ability to request does not imply the ability to name in the chimpanzee.

Sarah is credited with the ability to form a variety of sentences, but all that was required of her was the reconstitution of a learned symbol sequence. Thus, in a sentence such as *Mary give Sarah apple,* the words *Mary, give,* and *Sarah* did not vary within a training session. Sarah's real task was to select the plastic chip associated with the food displayed by the experimenter. This was essentially an associative-naming exercise, in which the selection was made from two symbols, with a 50% probability of being correct on any given occasion. Since neither syntactical nor representational skills were needed for Sarah to select successfully the four symbols to which Premack assigned the meanings "Mary give Sarah apple," the most simple explanation is that Sarah merely combined ordering and association strategies to produce such sentences.

It is difficult to determine from Premack's reports (1971, 1976) the size of Sarah's vocabulary, the number of vocabulary items that have been tested in blind-controlled settings, and which vocabulary items were used to demonstrate which semantic capacities. When it is possible to reconstruct the exact task presented to Sarah, it is questionable whether "Premack has correctly interpreted how his subjects perceived the symbols and the sequence of symbols they were required to use" (Terrace 1979, p. 166).

Sarah's ability to describe the referent of a plastic chip when presented

with the chip alone was tested with only two vocabulary items, apple and caramel. The basic test paradigm Premack used was that of match-to-sample. When an apple represented the sample, Sarah was to choose from two color swatches the one that most closely matched the apple. Tests were also made for matches with differently shaped pieces, with red pieces with and without "stems," and differently shaped pieces with and without "stems"—a square with a "stem" and a circle without (the fourth set was ambiguous, as were Sarah's choices). For the three nonambiguous pairs, Sarah made the correct match-to-sample choice. The real apple was then replaced with the symbol for "apple," a blue triangle. Sarah repeated her match-to-sample choices on the nonambiguous pairs.

But as we have argued elsewhere, Sarah need not have known that the blue triangle represented "apple" to accomplish this task (Savage-Rumbaugh et al. 1978b). She needed only to recall her earlier choices with the same three sets of alternatives when the real apple was used as the sample. Since none of these alternatives resembled the blue triangle (the word for "apple") along any dimension, she could not, of course, match the alternatives to the sample. Thus, even if she did not see the blue triangle as representing "apple," when presented with the same three paired choices for a second time, the most reasonable and conservative selection from Sarah's viewpoint would have been to select the item which she had selected previously in the presence of the real apple. Chimpanzees can recall three such paired choices easily (Savage-Rumbaugh et al. 1978b).

Furthermore, Premack did not demonstrate that Sarah could use the two symbols for apple and caramel, when given with a wide range of alternatives, to request the food when it was visible, to name the food if asked to do so without being given it to eat, or to select these foods from among others and give them to the experimenter in response to the experimenter's use of the symbols. In short, he presented no data to support the contention that Sarah attained semantic comprehension of the words for "apple" or "caramel."

Premack (1976) recognizes that match-to-sample and recall might account for Sarah's performance in this test and notes that later, in another test, Sarah selected the symbols for "round" and "red" from pairs of alternatives rather than round and red objects. However, reliable performance on the symbols representing "round" and "red" was never established by Sarah. In her last test with color "names," Sarah was performing at 76% on a dichotomous task, and in the only reported data on tests with the "names" round and square, Sarah performed at 69%. In neither case was this data collected in a manner that controlled for social cues. Premack (1976) himself states that "property names gave Sarah more difficulty than any other lexical class" (p. 185). It seems gratuitous to credit Sarah with the ability to select the symbols for "round" and "red" in response to the word for "apple" when, in fact, she could not even select these symbols reliably to represent actual instances of roundness and redness.

A careful review of all reports of the Gardners' initial Washoe project revealed only two controlled tests of Washoe's skills: naming tests that apparently used the same group of 33 vocabulary terms, though the particular terms themselves were never specified. Washoe's scores on these two tests were 53% and 71%.

Before she left Nevada for Oklahoma, Washoe reportedly was able to label 132 things (actions, objects, and states); however, since only 33 of these signs were subjected to controlled tests, it is not clear how accurately Washoe labeled the other 99 items. The remaining body of data collected during the Washoe project was basically observational, interpretative, and potentially open to cueing (Seidenberg and Petitto 1979).

Throughout the Gardners' work, the unfortunate assumption is made that production means comprehension. Again, while this assumption may be true for the normal human child, it does not hold for the chimpanzee (Savage-Rumbaugh 1979) or for special human populations such as the mentally retarded or brain damaged, the autistic, or the environmentally deprived (Curtiss 1977).

The Gardners make no attempt to separate the nonlinguistic context from the linguistic one. In fact, even traditional nonlinguistic cues, such as pointing at objects or gesturally depicting actions, are termed signs and are treated as symbolic linguistic communicators. Nonsymbolic pointing gestures are variously translated as "you," "me," "go," "there," "this," "that," "look," "listen," and "time." Nonsymbolic directional gestures made with the whole hand are translated as "gimme," "come," "go," and "mine" (Petitto and Seidenberg 1979; Seidenberg and Petitto 1979). While Washoe may have used nonlinguistic gestures to draw attention to "this"

Figure 2. A young chimpanzee named Lilith, who was kept as a pet and was not taught any signs, reacts to the departure of her human surrogate mother. By the Gardners' and Fouts's criteria, she would be executing the signs (*left to right*) for "up," "hug" (one-handed), and "come." (Photos by E. Sue Savage-Rumbaugh.)



Table 1. Stock phrases produced by the chimpanzee Lana over a 2-month period

*Format**	*Total occurrences*†
question / pronoun or noun / give / object name, food name, or proper name / to Lana in room	630
(?you give bread to Lana in room)	
please machine give piece of food name	310
(please machine give piece of bread)	
question you make / door or window / open or shut	35
(?you make door open)	
question / proper name or pronoun / move / in or out / room	53
(?Lana move out room)	
question / proper name or pronoun / tickle or groom / proper name or pronoun	116
(?you tickle Lana)	
common or proper name / name this / color	1,181
(shoe name this red)	
single symbols	465

* Variable elements given in shaded blocks; example follows each format.

† Total number of times variants of stock format—including incomplete versions—were produced.

object or to "that" person, such gestures should not be translated as the words *this* and *that*.

The social and contextual cueing problems that existed in the initial signing work continue to be overlooked as new claims are made (Gardner and Gardner 1978a). It is quite possible to cue the chimpanzees in a variety of ways, even without knowledge of so doing. Some critics have even suggested that all ape-language results can be relegated to the "Clever Hans" domain (Sebeok and Umiker-Sebeok 1979). Clever Hans was a horse who confounded scientists at the turn of the century with his apparent ability to count, solve arithmetic problems, and answer other questions. Eventually it was discovered that he was picking up inadvertent cues from his trainer and others who examined him. But although this comparison underlines just how subtle cueing can be, it oversimplifies the ape-language problem. Clever Hans demonstrated only one behavior, stamping one front hoof, and the only cues necessary were "start" and "stop." The chimpanzee behaviors in question here—even if they are meaningless—are far too complex to be controlled by a simple "go" or "no go" cue.

Nevertheless, a more complex and sophisticated cueing can take place. Both the chimpanzee and the experimenter typically know, given the context, which subset of signs or symbols is appropriate, though the chimpanzee does not know which particular symbol within the subset is the correct one to execute. It therefore hesitantly or sloppily or repetitiously or hurriedly executes some hand movement while closely watching the experimenter's face. When one is trying very hard to teach a chimpanzee a symbol it is quite difficult not to show displeasure or pleasure as it starts to fail or to succeed. One may thus cue a chimpanzee by showing approval as it starts to make the correct sign or select the correct symbol. Because the chimpanzee does not have an inherent predisposition toward referential learning, it readily becomes dependent upon the experimenter's help, and as the experimenter tries to give the chimpanzee less help, the chimpanzee looks for more minimal cues.

Our own perspectives regarding the use of symbols have altered considerably across the seven-year span of the Yerkes language project, and views stated here contradict some views offered earlier. Our data base is now far larger than previously: we have worked with five additional chimpanzees and with nine mentally retarded children. We have found that production must not be taken as the sole index of language comprehension and ability, and we have learned to look at the chimpanzee's total performance, instead of primarily the interesting and unusual behaviors. We have also found that, while it is relatively easy for chimpanzees and mentally retarded children to achieve skills that bear a superficial similarity to language, it is quite difficult for them to achieve the functional symbolic communicative ability and the reciprocal receptive behaviors that reflect the essence of language. We offer here a critique of Lana's linguistic productions (Rumbaugh 1977) in the same vein as our critiques of other language projects.

Lana has a reported vocabulary of 75 items, but blind-test data in controlled situations have been presented for only 21 items (Rumbaugh 1977). Lana's performance on these tested items was 79.6%. In some cases all symbols were available to Lana during testing; in others only two symbols, such as *more* and *less*, were available. In each instance, only labeling skills were required of Lana. Many of Lana's sentences, like Sarah's, were formed by filling in the blanks of redundant strings. To be sure, Lana's sentences were identified as "stock" sentences, and it was not implied that Lana understood all the individual elements of these stock sentences. In many instances, however, Lana was reported to form novel strings that appeared to be both contextually and syntactically appropriate, such as *?you move cabbage out of machine,* or *?you move machine out of room* (Gill 1977). From statements such as these and others, we concluded that Lana was operating within the domain of language and that she possessed "conceptual meanings" for many, if not all, of these constructions (Rumbaugh and Gill 1977). It is true that Lana's representational capacity was not directly tested, and because the majority of intriguing and appropriate novel combinations occurred during

en face exchanges between Tim—a trainer—and Lana, we could not rule out the possibility of unintentional cueing. But we believed the use of such novel combinations implied the existence of representational capacity.

Initially, these combinations were rare, and we were inclined to view them as attempts on Lana's part to express desires we had not taught her to encode and sequence symbolically. As they became more and more frequent (probably because they were responded to with a good deal of enthusiasm and excitement by the experimenters), we were able to construct a more revealing profile of Lana's novel usages. Table 1 shows the stock phrases Lana used—either complete or with omissions—over a period of 2 months, January–February 1979, and Table 2 shows the 174 novel productions formed by Lana during this same period. Clearly, many of Lana's novel combinations fell within one or more stock formats, and a few novel combinations of 5–8 words apparently reflected no semantic comprehension of various individual elements in the chain or of the significance of their location with respect to the rest of the chain. Placing the novel utterances within the entire corpus partly removes the problems of the anecdotal and isolated descriptions characteristic of many ape-language reports. Note that while novel utterances make up only 6% of the total corpus, these utterances generally appear to be semantically correct, and thus the normal English speaker would tend to view them as meaningful statements. Since most of them are requests for food, tickling, or change of location (things Lana always desires), the human English-speaking recipient of such requests would have no reason to presume that they were not meaningful to Lana. But in fact, it is not so much these novel utterances themselves as the absence of numerous nonsensical combinations which suggest that Lana had some comprehension of these symbols and how to combine them.

We can find no definite demonstration that Washoe, Sarah, Lana, Koko, or Nim used symbols representationally. But if these symbols do not represent objects, events, and relationships to the ape, then how have apes come to use the symbols in what seems to be an appropriate fashion in many difficult tasks? We must also ask how referential competency can be validly assessed, and we need to devise means of comparing skills across projects and across symbol modalities.

If-then language learning

Researchers have often failed to specify exactly what is required of a chimpanzee when it is learning a given symbol or sign, although it is precisely these requirements and their associated reinforcement contingencies that represent the animal's real-world knowledge regarding the symbol and its use. If the chimpanzee acquired language without intensive tutoring (as is sometimes implied), then we would no more be able to learn how and why symbolic meaning accrues in the case of the chimpanzee than we are in the case of the human child. But the chimpanzee requires an enormous amount of tutoring (as the budgets of all the ape-language projects show), and the precise contextual contingencies associated with the teaching of each word can be specified.

All researchers in the area of ape language have used remarkably similar training techniques, although the reports of the various projects tend to emphasize differences in modality, criteria, social setting, etc. The basic training paradigm consists of a string of sequential interlocked conditioned discriminations: if conditions a and b occur, then select symbol x. In the case of Lana and Washoe the chimpanzees respond to actions and indicative gestures performed by human beings, rather than to an inanimate environmental stimulus. This means that these sequential if-then contingencies are of an inter-individual nature, such that the response of one individual becomes the stimulus for the ensuing behavior of the second individual (Table 3).

It is important to point out that in the case of ASL training, the chimpanzee does not have to contend with significant degrees of contextual similarity during training. A human experimenter standing by a door and pointing outside is very different from the same experimenter holding the chimpanzee in his lap while making a playface and producing anticipatory tickling gestures. Thus, learning to

Table 2. Novel phrases produced by Lana over a 2-month period

Phrase	*Occurrences*
question you name this	9
question give drink this	8
name this shoe	8
name this cup	8
question drink this	6
out please	6
question you give beancake shut open	6
please milk out room	5
question you tickle Lana go	5
this ball	5
question you tickle Lana behind room	4
want yes	4
question you tickle Lana into room	4
question you tickle Lana in room	4
question you give Columbus in Lana to room	4
you open	3
question you tickle Lana to Lana	3
question you tickle Lana to Lana behind room	3
out room	3
please milk room	3
out room yes	3
to out room	3
question you give milk open	3
question you give milk shut open	3
question you give this orange drink	3
question you give this to Lana in room	3
question you open	2
yes money	2
question Lana you out room	2
give out room	2
open yes	2
question you give Lana Columbus	2
make window open machine	2
milk out	2
please milk out	2
please make machine music window open	2
question you tickle Lana please	2
go please	2
yes out room	2
please out room	2
please you	2
move Columbus	2
bowl name this pudding	2
please machine groom	2
question you give go	2
question Lana Columbus	1
tickle question	1
drink yes	1
hand eye foot	1
window keyboard	1
give Lana chow	1
question you give Lana juice	1
question you give bread to machine	1
orange coke	1
question Lana in room	1
eat yes	1
question you give banana to Lana in machine out room	1
question you give juice to Lana in cup out room	1
question you give bread Lana	1
question Lana give bread to room	1
give Lana milk	1
question you give Lana	1

Table 3. Examples of sequential contingencies, which comprise the basic paradigm for teaching apes language

	*Pattern**	*Gardner experiment*	*Premack experiment*	*Rumbaugh experiment*
CHIMP	1. Nonverbal behavior of chimpanzee indicates that it wants human to perform a given act.	1. Chimp approaches door and tries to open it, signaling that it wishes human to open door.	1. Sarah is willing to work for candy and other special foods (Sarah wishes human being to perform act of giving her food).	1. Lana looks at or gestures toward an M&M or M&M dispenser.
HUMAN	2. Human executes an act or sequence of acts related to what the chimpanzee has indicated it wants.	2. Human also approaches door, points to knob, points outside, partially opens and closes door—with hands moving together and apart in a manner similar to the *open* sign in ASL.	2. Human prepares and makes available to Sarah a display of an apple and differentially colored and shaped plastic tokens.	2. Experimenter places an M&M in low, flat dispenser outside Lana's room.
CHIMP	3. Chimpanzee executes symbol.	3. Chimp signs *open.*	3. Sarah selects one of two tokens	3. Lana depresses a series of symbols chosen from among all familiar symbols and some unfamiliar symbols.
HUMAN	4. Human executes desired act.	4. Human opens door and allows chimpanzee to go outside.	4. Experimenter gives Sarah an apple.	4. Lana is allowed to eat the M&M because the experimenter has programmed the computer to vend it automatically.

* Each action takes place only if the preceding action has occurred.

sign "tickle" in one context and "open" in another should be relatively easy because of the high degree of initial discriminability inherent in these two situations. Such salient contextual differences become increasingly important as the size of the sign repertoire increases because the greater the number of distinctively different cues inherent within the situation, the easier it becomes for the chimpanzee to recall the proper sign.

A review of the Gardners' descriptions of Washoe's sign usage and their descriptions of her errors and combinations supports this conclusion. For example, the Gardners note that the "hurt" sign "can be elicited by" the displaying of cuts and bruises; the "cover" sign is elicited by "games in which Washoe covers herself"; the "spin" sign occurs when "persons . . . whirl as in dancing," and so on (p. 147–57). All of these stimuli are highly distinct contextual multicue situations. The Gardners also point out that errors tend to occur "within meaningful groups." For instance, the sign *hurry* occurs "during meal preparation when the experimenters have a food Washoe desires"; the sign *sweet* "occurred when the experimenter had soda pop or other desirable drinks." In both instances, the experimenters had a highly desirable food, which Washoe wanted to eat. Under these circumstances, combinations such as "hurry sweet drink" (p. 167) would be expected because of this common salient cue.

The contextual distinctiveness that is built into the Gardners' work with Washoe is intentionally absent in Premack's work with Sarah, and therefore the basic learning task required by Premack differs from that required by the Gardners in several ways. First, in the paradigm used by Premack, Sarah is required to respond (by symbol selection) not to the act or actions of a human being but only to the onset of a given display. While this may seem at first glance to be an unimportant distinction, it is actually a consideration that is basic to the very process of interindividual symbolic communication or language. The door, which is always present in Washoe's environment, only becomes part of the communicative context when people or chimpanzees point to the door handle, look out the window of the door, point toward the outside, etc. In Sarah's case, by contrast, the stimulus is not typically present at any time other than when she is presented a plastic-token selection problem. The salient cue for the selection of a given token is the onset of a given chip display, not the gestural behavior of a human experimenter.

Although it is true that the different behaviors of the human experimenter and the changes in the physical environment (such as the presence of an apple) can both be viewed simply as discriminative stimuli, this argument misses the main point. The discriminations must be *between* the behaviors of individuals if they are to be perceived by the participants as communicative. At the very least, it is reasonable to assume that the chimpanzee Washoe could perceive the determinants of her choice of sign as *the behaviors of the experimenter* who stood by the door, not the static presence or appearance of an apple and plastic tokens on her display board. Sarah's symbol selection, however, would be perceived as dependent upon inanimate external states of affairs.

Does this difference in perception really matter? If the issue is language then the answer is *yes,* it does matter, for it is pointless for an organism to employ a symbol to communicate with its inanimate environment. Even if a gesture or symbol does not represent the item suggested by the English gloss, it still must be viewed as functionally altering the behavior of another animate being or it will not be deemed communicative by the user. This is why linguistically competent human beings who were given Sarah's tasks did not realize that the plastic chips functioned as linguistic indicators (Premack 1978).

Another major difference in Premack's training paradigm is that the behavior of Sarah herself played a relatively minor role in determining

what sort of successive conditioned discrimination would be presented, or indeed whether one would be presented at all. Washoe, however, could make attempts to go outdoors, to tickle the experimenter, to take food, etc., thereby permitting the experimenter to infer that Washoe would like to engage in such an activity and to structure the situation in order to elicit a sign. Sarah could do none of these things. She simply remained in her cage and, when she was presented with a problem and made the correct choice, she was given something to eat. Thus, even at a nonverbal level, she was prevented from communicating her desires to tickle or to go out because she was prevented from engaging in behaviors to suggest these activities.

The third major difference in the successive discrimination paradigms used by the Gardners and Premack is the number of response alternatives. Theoretically, Washoe, who was free to form any gesture with her hands, always had all known signs to choose from in selecting a response. Generally, however, Sarah was given only two nonredundant alternatives (yes/no, same/different, round/square, etc.). It is probable that Washoe did not recall all of her known signs at all times, particularly since the sign-acquisition criterion was weak, but it is reasonable to assume that on any given occasion, her possible number of response alternatives was considerably greater than two. The limited number of alternatives available to Sarah made it unnecessary for her to organize her potential responses in any systematic fashion. Symbols from the appropriate category of responses (form, edible, color, etc.) were selected for her. Thus, errors within categories—say, confusing *red* and *blue*—reflected neither an internal categorization schema—such as color—nor error responses to similar discriminative cues. They reflected only the limited choices available to Sarah. Since Sarah always worked on a single task in any given test situation, it is difficult to see how she could come to form the categorical semantic concepts Premack attributes to her.

In summary, Sarah's successive discriminations allowed for (1) no spontaneous choice or use of symbols; (2) no gestural indicators (such as pointing) to coordinate the attention of the ape and the experimenter; (3) only simple structured stimulus displays; (4) only dichotomous response choices; and (5) no rewards other than food. Washoe's successive discriminations involved (1) frequent spontaneous choice of and use of symbols; (2) regular nonverbal gestural coordination of attention; (3) multiple unstructured complex environmental situations; (4) numerous response choices; and (5) various rewards.

What of Lana? The basic training paradigm of the earlier projects, with a few minor modifications, can be said to apply to her initial symbol acquisition. Initially, just as with Sarah, the training situation was structured around obtaining food. But just as the doors were ever-present in Washoe's case, the various food dispensers were ever-present in Lana's case. Lana's nonverbal behavior, like Washoe's, communicated the basic message—Lana would like some juice, M&M's, tickling, etc. Like Sarah, Lana was required to select (not form) a symbol, but, like Washoe, her choice regarding the correct symbol (or set of symbols) generally was made from all known symbols, not from just two or three. *Unlike* either Washoe or Sarah, Lana used symbols that were formed by recombining 1, 2, or more of 9 graphic elements, just as English words are written by recombining 1, 2, or more of 26 alphabetic elements. Thus Lana, unlike Washoe or Sarah, was forced to attend to each element within the stimulus complex, not just the overall form.

Following the initial training with M&Ms and juice, additional successive conditioned discriminations were learned that allowed Lana to go outside, to watch movies, to be carried, to be tickled and groomed, etc. Lana was then taught a series of more structured tasks, such as giving the names and colors of objects. In this training, only the object or its color varied, while the rest of the training task, including the keyboard display, remained constant. This task was similar to those typically encountered by Sarah, with two exceptions: Lana was required to give either the color *or* the name of an object, or both; and all color and name lexigrams were available, as well as all the objects themselves. The object to be described at any given time was indicated by gestures of the trainer.

Thus, Lana's basic training paradigm may be summarized as involving (1) frequent spontaneous choice or use of symbols (like Washoe); (2) the use of gestural indicators to coordinate the attention of the ape and the experiments; (3) both multiple unstructured complex environmental situations (like Washoe) and simple structured stimulus displays (like Sarah); (4) numerous response choices; and (5) a wide variety of rewards (like Washoe). Unlike either Washoe's or Sarah's, Lana's response alternatives were composed of abstract recombined elements. Her social environment was neither as varied as Washoe's nor as restricted as Sarah's, and, unlike Washoe or Sarah, she could use symbol production to produce environmental change regardless of whether or not a human being was present.

Protolinguistic communication

At some point in their training, both Lana and Washoe began to use their communication systems to control and regulate the behavior of their human experimenters. In other words, the order of the conditioned discrimination paradigm described earlier was reversed, and thus it was not always the human beings who arranged the contingencies to elicit the signs or lexigrams. The ape began to arrange the contingencies and to produce the signs or lexigrams in order to establish predictable situations in which the experimenter would provide food, outings, or other desirable events. At this point, prelinguistic intentional communication emerges. The same sort of emergence of communicative intent has been reported for human infants at about nine months of age (Clark 1978). It is important to note that no behaviors of this sort are reported for Sarah.

According to Bates (1976) and Clark (1978), prelinguistic intentional communication appears in the human infant when actions become modified and ritualized so that they can serve as communicators. This enables the infant to act upon its environment indirectly by mediating, through gestures, the behaviors of others. Prior to this time the infant is only able to act upon the environment directly, by means of his own actions. As these modes of structured interindividual (or in Clark's terminology, intermental) interaction become in-

creasingly ordered, and as the infant forms expectations regarding his role and the roles to be played by others in such exchanges, he moves from the realm of passive respondent into that of intentional communicator.

In Clark's study of mother-infant giving and taking, he found that infants initially hold their hand out only when they are preparing to grasp an object that the mother is in the process of offering. But these taking and giving interactions become more predictable to both parties, and they undergo a ritualization in which the reaching action of the infant comes to antedate the offering action of the mother. When this occurs, actions stop being simple responses and begin to serve as functional communicators that are capable of directing and controlling the actions of others.

With this newly acquired skill, the human infant or the chimpanzee develops an ever-increasing awareness of the function of gestures and glances in the coordination of interindividual behaviors. Through repeated interchanges the chimpanzee's role becomes defined as that of selecting a sign or lexigram while the human experimenter's role becomes defined as the performance of the associated action, such as opening the door, giving food, or tickling. Thus, the lexigram or the sign becomes a behavior to be produced when the chimpanzee wants a certain act to be performed by the human being. The intent and expectancy is evident because when the human being fails to respond appropriately, the sign or lexigram and other associated acts are repeated, along with attempts to gain eye contact. The same is true of the human child as he begins to hold out his hand to request objects: the gesture persists and is elaborated if the mother is inattentive. Earlier it would simply have been terminated.

Gestures such as these do not really serve to convey information about what should be done, but rather, serve to denote that the initiator of the gesture desires that it be done—*it* being whatever is obvious given the context. Thus, if Washoe approaches the door and tries to pull it open and then signs *open* (or vice versa), the arrested opening action defines the meaning of the gesture. The open sign (an opening-action movement) is the communicative gesture that, by virtue of repeated interaction sequences of this sort, becomes a portion of Washoe's role (or part to play) in this context. The act of opening the door in response to the sign is the human experimenter's role. However, *open* as a sign does not refer to the state of the door, nor can it be used to communicate information about the door once the act of opening has occurred. *Open,* therefore, serves no referential or representational function out of context. It does not conceptually single out an action and make it available for arbitrary cognitive activity as names eventually do in human children (Pylyshyn 1977).

Washoe's vocabulary can be viewed as composed of two types of signs—those which function as contextually embedded prelinguistic communicators (*open, tickle, come, gimme,* etc.) and those which function as learned item-sign associations (*hat, flower, pants, shoe,* etc.). Because the Gardners do not distinguish between the ability to label items such as flowers and pants and the ability to sign a request such as "open" when a door needs opening, they presume that Washoe can use all of her signs to perform the semantic functions of both labeling and requesting. However, the signs used for labeling (*pants, flower, shoes*) do not typically occur in spontaneous requests.

The Gardners (1971) report that the following signs were the most commonly used by Washoe when making spontaneous requests: *come-gimme, please you, go, me, hurry, more, up, open, out, in,* and *food.* All of these signs are appropriate to the two most common request situations—eating or changing location. There are, among these spontaneous request signs, no labels of specific objects. Although food might be viewed as a label of a general class of objects, there is no clear evidence that Washoe could use this sign to label food if not permitted to eat. It appears that Washoe could select a sign when an object was displayed and that she could select a sign or group of signs to be performed when she wished to tickle, eat, go out of doors, or be held. However, no evidence indicates that she could interchange these semantic functions.

Because many of these signs become part of predictable contextual situations that involve sequences and ordered means of acting and cooperating between individuals, they come to serve the function of signaling turns and roles—i.e., of interindividual behavioral structuring, at a presymbolic level. However, as long as such signs continue to be closely linked to context and to derive their inherent meaning from the nature of the context itself and as long as they continue to serve a severely limited semantic function—labeling for some signs and requesting for others—representational function cannot be achieved.

Lana's vocabulary, like Washoe's, was composed of two types of lexigrams, those used for requesting things (*you, give, Tim, Lana, blanket, juice, chow,* etc.) and those used for labeling things (*bowl, box, shoe,* etc.). However, unlike Washoe, Lana was taught to label some (though not all) of the things she requested. She was required, for example, to label examples and slides of M&Ms, juice, beancake, milk, apple, orange, banana, chow, and cabbage without being allowed to eat these items (in this blind food-naming test, Lana gave 61 correct answers out of a possible 65, for a success rate of 94%). She could also request these items if they were offered by the experimenter. Other lexigrams such as *Tim, put, give,* and *you* were used only in request contexts, while lexigrams such as *box, bowl,* and *keyboard* were used only when Lana was asked to label these items. Lana's basic requests were similar to Washoe's in that they centered around the situations of eating, changing location, tickling, and hugging or contact. But the context for lexigram production was relatively similar across situations for Lana, and she produced the requests *?you make door open, ?you give juice to Lana, ?Lana move out of room,* or *?You tickle Lana,* all in one location. Because of this, the contextual embedding shown by Lana differed somewhat from that shown by Washoe.

Lana tended to initiate certain types of requests at certain times of the day. For example, she generally received milk in the morning; when she began to request milk spontaneously (that is, without first seeing Tim in front of her room with a pitcher of milk), she embedded these requests in time, typically limiting them to early morning after Tim's arrival. Because Lana did not have the physical freedom that was permitted Washoe, she could not structure contexts as readily. She often had to get the experi-

menter to look at the projectors and to move into the room before she could engage in a nonverbal tickle invitation such as that described for Washoe.

Lana began projecting partial sentences such as *?you give,* leaving the termination in abeyance until she could get the experimenter's attention. She tried unusual combinations of lexigrams, seemingly in order to catch the experimenter's interest. Combinations that were successful were remembered and used on other occasions. She readily learned to form requests that would cause people to move about in space. However, she could not use, any more than could Washoe, a preposition such as *out* to describe the state of an individual or object. *Out* was a word to be used when Lana wanted another individual to move "out." If a bowl of chow was placed outside her room and she was asked "?where bowl," her responses were at chance.

Both Lana and Washoe, then, produced numerous and varied spontaneous requests. The emergence of these requests was most surely shaped by three important facts. First, the medium of communication (signs and keyboard) was available at all times for structuring interactions with their experimenters. Second, the experimenters behaved as though they attributed intent to behaviors where it did not necessarily exist originally (the same is true of human mothers and is thought by many to be an important factor enabling the infant to move from action-reaction to gestural indication). Third, the interindividual nature of the learning paradigm employed in the Lana and Washoe projects allowed roles to be formed within structured interaction routines. By contrast, Premack's Sarah did not have her symbols readily available, the experimenters interpreted her selection of symbols not as communications but rather as correct or incorrect responses, and Sarah's symbol manipulation served not to alter the behavior of companions but to produce either a reinforcement or another trial.

True symbolization

We see true symbolization as the use of arbitrary symbols to refer to objects and events that are removed in time and space. This implies "a view of the outside world as separable into things which maintain their identity and which can be manipulated in the mind, so that even actions and properties are reified into words" (Bronowski and Bellugi 1970). The ability to use symbolization appears in the normal human child about 1 to 3 months after the primitive stage during which the referents for words are unclear, or at best extremely global, and are more appropriately termed pure performatives (Greenfield 1976; Braunwald 1978; Bruner 1978).

Braunwald (1978) studied the development of her child's speech during the period of transition from context-linked speech to representational speech. She recorded all utterances and their nonlinguistic contexts between 8 and 20 months of age. During the prerepresentational period, her daughter Laura employed a number of single-syllable words in a wide variety of contexts. Braunwald notes that what was missing from Laura's utterances during this period were the arbitrary, culturally defined linguistic and social conventions for encoding objects and events by means of particular utterances, although utterances were used to form intentional requests.

Laura initially used the word *ba* in all the following ways: when she wanted milk, juice, or any liquid in a cup; when she saw her mother carrying a milk bottle; when she wanted to play with the milk bottle lid; when she had finished drinking and her cup was empty; when blowing bubbles in her drink; when looking at a milk carton; when drinking milk; when spilling milk; when milk was poured; when her mother put cups on the table; and when she wanted more to drink. *Ba* seemed to refer to water, cup, juice, more, all gone, pour, drink, cup, bubble, bottle, carton, and good taste, as well as milk. It was used in situations where the linguistic intent seemed to be to describe or comment upon as well as to request.

Within a few months, the words *straw, blow, all gone, cold, cup, bottle, bubble, more, pour, spill, Laura, do, drink,* and *juice* all appeared and were employed in contexts where before only *ba* was uttered. For example, when Laura spilled her milk at 1 year, 4 months, and 1 day, she said "Bye-bye ba. Un-unba." When at 1 year, 7 months, and 28 days she again spilled her milk, she said "Laura spill milk." Thus, in the human child at the prerepresentational stage, there exists a vocal marking of a wide variety of situations with a single vocal element. Later, different words are used for different situations, and increasingly detailed aspects of the same situations become encoded verbally.

By the time Laura was 1 year and 7 months old, she was uttering phrases such as "pretty Nestor cup," "Laura spill milk," "cold milk," "all gone," "Mama straw blow," "pour juice," and "Laura do," all in contexts where her only previous utterance had been "ba." These utterances, all within the feeding context, are quite different from those which have been reported for apes in a similar context (Laidler 1978). For example, Terrace and his colleagues (in press) report that Nim, in the context of feeding, formed utterances such as "eat me," "drink Nim," "eat drink," "banana me," "tea drink," "grape eat," "eat me Nim," and "grape eat Nim." All of Nim's utterances were essentially requests. By contrast, Laura commented on the attributes of eating utensils, her own actions of spilling and her mother's actions of pouring, the attributes of the food she was eating, the implements used by her mother, and the state of having consumed all her milk. Comments of this sort are not found in any linguistic productions of chimpanzees. This is a dramatic and significant difference between symbol use in children and in chimpanzees, and it is obvious even at the earliest stages of language acquisition.

The vocabularies and symbol use of Nim, Washoe, and Lana suggest that chimpanzees tend to use symbols when making nonspecific requests for contact, play, food, and change of location. But as the human experimenters attempt to teach symbols denoting more specific attributes of each of these situations (who is eating, what they are eating, the differences between eating and drinking, the act of transferring food from one individual to another, the pace of the transfer, etc.), the ape has difficulty comprehending the referents of these symbols and in understanding why the use of these additional symbols is now required in order to obtain food. Because of this comprehension difficulty, the chimpanzees begin to chain together all symbols that have been appropriate in previously similar situations, and combinations such as

"give orange me give eat orange me eat orange give me eat orange give me you" appear (Terrace et al., in press).

In fact, signs such as *you, me,* and *give* are correct in virtually all the contexts in which the ape might use them, and any occurrence of them would probably be encouraged by the experimenters. One or more of these generally appropriate signs (*you, me, more, give,* and the chimp's own name) combined with other signs will produce what seem to be meaningful combinations, but these combinations lack the referential specificity of children's combinations. The data on spontaneous requests from both Washoe and Nim support the view that the apes are using certain words more as "free cards" than as syntactic elements. For example, 17 of Nim's 25 most frequent 2-sign combinations contained 1 or more such words (Terrace et al., in press).

Another indication that apes may not understand the symbolic communicative significance of the symbols they have learned to use is that at no point do they begin to engage in conversational turn-taking. Conversationlike vocal turn-taking between mothers and infants is reported to follow the onset of babbling. Terrace (1979) notes that Nim did not engage in similar turn-taking, even after 46 months of constant sign training. He interrupted his teachers frequently, appearing anxious to produce either a sign he had seen them produce, or a flurry of signs, in an attempt to get food. Although this was not obvious to Nim's trainers while they were working with him, it became obvious as taped sessions with Nim were studied closely. Similar interruptions were seen by Terrace in films of Washoe and Koko. This type of interruption stands in direct contrast to early child-adult exchanges. The human child, unlike the chimpanzee, makes attempts to gain attention prior to an utterance in order to highlight the fact that an important signal is about to be emitted and to establish the expectancy that the utterance of this signal is to be met with an alteration of ongoing behavior.

Apes, then, like children, learn to use symbols as part of social-interaction routines. They are able to discern various sets of circumstances in which the production of particular symbols is deemed appropriate and results in obtaining a goal. They, like children, also learn to initiate these social interaction routines by producing symbols. Unlike children, however, apes do not seem to have moved beyond this point. To date, there is no evidence that Washoe, Sarah, Lana, Koko, or Nim achieved symbolization proper.

In fact, most ape-language studies have not really gone beyond the basic communicative level of the chimpanzee. In the wild, chimpanzees do have a natural gestural communication system, through which they can seek reassurance; ask for permission to take a bit of food; and initiate tickling, chasing, grooming, and sexual interactions. Chimpanzee mothers can indicate gesturally that others should stay away from their infants, and any individual can gesturally solicit aid from another during aggressive encounters. But these gestures are limited to social interactions, and none of the gestures conveys information about behaviors related to anything not immediately present. No wild chimpanzee has been observed to indicate gesturally an action it would like another chimpanzee to perform upon an inanimate object for its benefit. It is precisely such object-directed requests that form the majority of early mother-child linguistic interchanges (Bruner 1978).

While experimenters have been able to teach apes to gesture or use symbols to initiate such interactions as tickling, grooming, or hugging, these gestures or symbols have merely served to replace or accompany nonverbal gestures the chimpanzee would otherwise employ. The attempts to gain specificity of referent within a situation have resulted in the simple stringing of symbols as the chimpanzee has learned more symbols for what to him is the same general contextual situation. Because of this, chimpanzees have tended to form five- and six-word utterances such as *you me sweet drink give me,* while children form six-word utterances such as *Johnny's mother poured me some Kool-Aid.* Chimpanzees have used symbols only as indicators of desired food transfer, while children readily encode and describe a variety of aspects of past occurrences. Thus, it appears that chimpanzees, even with intensive linguistic training, have remained at the level of communication they are endowed with naturally—the ability to indicate, in a general fashion, that they desire another to perform an action upon or for them when there exists a single unambiguous referent.

To be sure, ape-language studies may have failed to achieve symbolization proper partly because they have concentrated almost exclusively on *production.* Washoe, Lana, and Nim all received regular naming drills, but none was required to demonstrate equal *receptive* competence. The simple giving of an item in response to a symbolic request requires that the ape move beyond the ritualized performance of given symbols for particular goals. It requires that the ape attend to and coordinate its behaviors toward objects in accordance with the symbolically expressed wishes of others. This implies both a conceptual orientation alien to the ape's natural level of communication and an alien social orientation. Cooperating, attending to, and giving specific objects from a set, each upon symbolic request, are not behaviors normally found in apes. Thus, to the extent that the receptive half of symbol use is important to the emergence of symbolization proper, this skill must also be taught to apes. Furthermore, it is not only symbol recognition that is involved, but an elaborate object-giving complex that must be developed with a social framework alien to the chimpanzee in its natural state. The lack of attention to such skills may have greatly hindered the apes' comprehension of the symbols they have been reported to employ.

Moreover, in the majority of ape-language work, the gestures or symbols have generally conveyed no more information than that which was given by the context and the nonverbal actions of the participants. Only when a symbol is used to convey information about specific foods or objects or to refer to absent food or objects does its information value add to that already inherent in the interaction context. We believe that Sherman and Austin are the only apes for whom the ability to use symbols this way has been demonstrated (Savage-Rumbaugh et al. 1978 a, b).

Ape-language researchers must not be content with describing what apes say. They must look at the entire nonverbal context, and they must

evaluate the informative value of symbols *per se*. This will require permanent video documentation of all aspects of training and testing. The complexity of interpreting and recording, in any other way, all relevant aspects of the behaviors and tasks defies the limits of check sheets and tape recorders. Methods of investigating the semantics of various symbol productions and the sociobehavioral linguistic conditions therein must be developed. Experimenters must stop looking for superficial similarities between apes and children and must instead investigate the cognitive competencies that underlie symbolic processes.

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