WHAT MIGHT BE LEARNED FROM STUDYING LANGUAGE IN THE CHIMPANZEE? THE IMPORTANCE OF SYMBOLIZING ONESELF

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What do you see when you turn out the light?
I can't tell you, but I know it's mine.

—Lennon and McCartney
A Little Help From My Friends

Ten years ago, there was little reason to believe that much could be learned from studying language in the chimpanzee. Earlier reports (e.g. Ref. 1, 2) of a chimpanzee's inability to use language seemed to demonstrate that biological factors limited the extent to which the chimpanzee could learn to use abstract symbols. Thanks to the work of the Gardners,[3,4] Premack,[7,8] Fouts,[9,10] and Rumbaugh and Von Glaserfeld,[11] we now know that a chimpanzee has a much larger linguistic potential than was ever imagined. Once allowance was made for the vocal limitations of a chimpanzee (Lieberman, 1968; Lieberman *et al.*, 1972), it became possible to teach it to use arbitrary gestures, plastic tokens, or the lexigrams of a computer console in a manner that parallels the human use of single symbols. Most provocative have been demonstrations that chimpanzees can use *sequences* of symbols. This suggests a syntactic potential as well as a symbolic one.

In the eagerness to establish whether a chimpanzee can acquire syntactic competence, certain more basic functions of language appear to have been bypassed. Our main purpose in this paper is not only to assess the syntactic accomplishments of Washoe, Sarah, and Lana, but also to delineate other functions of human language that can be studied in the chimpanzee—functions that do not require syntactic competence.

Before considering nonsyntactic functions of human language, it is of interest to digress briefly to compare studies of language in a chimpanzee with studies of language in another currently popular subject, the computer. At present, there is nothing to suggest that computers can simulate the *acquisition* of language. However, language acquisition by another being may illuminate parallel processes in humans. As compared with the computer, the chimpanzee has many obvious advantages. First, because of its biological and social similarity to man, a chimpanzee is a much more likely source of useful contrastive information on human language. Second, a computer can do nothing more than execute the instructions of its programmer. We cannot be sure *what* a chimpanzee will do with symbols once it has learned their meanings.

Human language has two important functions: (1) it facilitates communication (particularly about events and objects displaced in time and/or space) and (2) it structures how we perceive ourselves and the world. The child's tendency to symbolize interpersonal relations between himself and others is obviously a fundamental ingredient of personality development in all human societies—in particular, the concept of *self* bounded on one side by desires and on the other by social patterns. A child's ability to refer to itself, its desires, and the social pressures of its

environment requires little, if any, syntactic ability. Yet this basic function of language has profound effects. We suggest that the mastery of language to express feelings and to encode socially desirable and undesirable behaviors to oneself, may provide sources of motivation for advancing to more elaborate usages of language—usages that do require syntax. A necessary condition of human language may prove to be the ability to symbolize *oneself.* In our own research, we hope to see if this condition is sufficient for an already socialized chimpanzee by teaching it the concept and use of "self."

The assumptions from which our hypothesis derives can be formulated in comparative terms. *All the ingredients for human language are present in other species—they do not become language until an animal learns that it can refer to itself symbolically.* Many animals learn to respond to *symbols*, and to remember them (as in discrimination learning or delayed-response tasks). Many animals also exhibit *hierarchically organized behavior* patterns (e.g. as in Hullian "habit families" or in Tinbergen's analysis of stickleback courtship), and *transformations*, (e.g. shifting from one mode of locomotion to another in maneuvering through a maze, or "displacement reactions" of various animals). Many animals can also perceive and act on *relations* between themselves and other members of their species (e.g. dominance patterns, and courtship interactions). Finally, at least a chimpanzee (and perhaps other species as well) demonstrate a concept of "self" by their ability to deal with their own mirror image.[12]

Our hypothesis is that the potential to attach a symbol to "oneself" is an important factor in the recruitment of preexisting potentials for using symbols, hierarchies, and transformations into "language." The motive for this is clear: once we can think about ourselves symbolically, we can think abstractly about our relations to others and to the world. A basic function of syntax is to express the internal relations between different symbols. This, in turn, facilitates the representation and exploration of relations in the outside world. Accordingly, in the present discussion, we consider how language can be used to demonstrate a concept of symbolized self in a chimpanzee before evaluating the extent to which its utterances have a syntactic structure.

One indicator of a symbolic self in a symbol-learning chimpanzee would be specific reference to its own emotions and feelings. As a creatrure prone to emotional expression of fear, anger, happiness, frustration, like, dislike, sadness, and so on, it may prove possible to teach a chimpanzee to name those states. As far as we can tell, neither Premack nor Rumbaugh has attempted specifically to teach their chimpanzees words describing emotional states. While the Gardners reported that words such as *funny* and *sorry* were part of Washoe's vocabulary, it is not clear that either of these words was used to refer to internal as opposed to external stimuli.

For example, in the Gardners' glossary of Washoe's vocabulary, *sorry* was defined as an "apology, appeasement and comforting; usually the response to *Ask pardon*" (Ref. 4, p. 266). Although Nim, the chimpanzee we are teaching to communicate via sign language, has yet to learn the sign *sorry*, it is clear that he has learned to seek reassurance after having done something wrong (such as touching a forbidden object, or biting too hard). On some occasions, Nim will sign *hug* in order to obtain reassurance. From the Gardners' description of Washoe's usage of *sorry*, and from our own experience with Nim's attempts to make up by signing *hug*, it appears as if these signs may function as requests for reassurance rather than as descriptions of an emotional state.

As the psychological literature on attribution clearly shows, description of emotional states often entails reference to external and internal states.[13-16] It is plausible that chimpanzees can learn to identify emotional expression, as might be

portrayed in pictures. It has been shown that monkeys can learn to discriminate between the expression of different emotional states, as shown on video displays.[17] The Gardners[18] and Fouts[10] have demonstrated that a chimpanzee takes well to the task of naming various pictures with appropriate signs. Thus, learning to label emotional displays may not prove difficult for chimpanzees.

Symbolic discrimination of emotional expressions exhibited by others is easier to demonstrate than reference to one's own emotions. While we have no basis at present for asserting that a chimpanzee could engage in the kind of introspection that is entailed in a description of its own feelings, or emotions, we find this possibility intriguing. Introspection of any kind requires a symbolic consciousness of self that has yet to be clearly demonstrated in chimpanzees.

Language plays a vital role in a child's incorporation of the concepts and values of its environment. Although this may seem obvious, its significance does not appear to have been perceived in previous studies of language in a chimpanzee. An unrecognized obstacle in the path of fully simulating the syntactic features of human language in a chimpanzee may be the absence of the motivation experienced by a child who learns language both to please its parents and to represent its world. Chimpanzees such as Washoe, Sarah, and Lana have obviously been motivated to learn *something*. The question remains, however, whether their motivation and learning have been intrinsically linked to socialization itself.

How human children and chimpanzees learn the names of objects provides an interesting basis for comparing the motivation in each case. Consider, for example, Lana's communication to the computer *what name of this?* when she wanted to learn the name of a box in order to obtain the box, which contained candy. Quite obviously this is an impressive example of a chimpanzee's having learned that things have names. In the case of children, it is commonplace that they ask for the names of objects in their environments. But in the only example we know of in which a chimpanzee asked for the name of something it is clear that learning the name of the box was in the service of obtaining the box and its contents. On the other hand, a child willl persist in asking *what that?* simply to learn the names of objects without any obvious extrinsic consequences. The child seems to be acquiring the names of things to use in social discourse, or in the mastery of its world—a motive fundamentally different from that of obtaining the object in question itself.

With these considerations in mind, it is instructive to consider the three major recent studies of language in the chimpanzee. One purpose is to evaluate the extent to which syntactic competence has been demonstrated in the chimpanzee; it is also necessary to evaluate each chimpanzee's socialization and its motivation for using language. We consider first the cage-reared chimpanzees, Sarah and Lana.

Project Sarah

The initial strategy Premack followed in teaching Sarah to use a symbol system, in which words were represented by plastic chips of different shapes and colors, was to utilize behavioral techniques for demonstrating a list of so-called "exemplars" of human language. These included (1) words, (2) sentences, (3) questions, (4) metalinguistics (using symbols to talk about symbols), (5) class concepts such as *color, shape,* and *size,* (6) the copula ("is"), (7) quantifiers such as *all, none, one,* and *several,* and (8) the logical connectors *if* and *then.* As Premack notes, "This list is in no sense exhaustive, nor are the items of comparable logical order" (Ref. 7, pp. 808–809). In demonstrating a particular exemplar, simple training procedures were used that presumably mapped linguistic knowledge onto discriminations that Sarah

had already mastered. For example, the word *apple* was trained by requiring Sarah to offer the word for apple (a blue plastic triangle) in exchange for an actual apple. The "interrogative" was trained by placing the interrogative symbol between objects that are either the same or different. In this case Sarah is required to replace the interrogative symbol with the appropriate symbol, one that means *same* or one that means *different*.

Most of Sarah's behavior appears to have been motivated initially by food reward. Premack (Ref. 8, p. 200) does indicate that "on one occasion, . . . she stole the test material before the lesson, as she has done from time to time, and went on both to produce many of the questions we had taught her, as well as to answer them." Furthermore, after many months of intensive training, Sarah could learn a new symbol-object relationship simply by observing an experimenter pair them together. In these instances, Sarah appears to have been manipulating the materials without the support of an extrinsic incentive. But, as far as can be gleaned from Premack's description of his experimental procedures, initial training was motivated by food reward, as were actual testing sessions.

The solution of the problems presented to Sarah usually required the simple substitution of one symbol for another. Within a particular training set, most of the problems required that Sarah choose only between two alternatives. For example, if she was tested on her ability to identify objects that were the same or different through her use of the sumbols *same* and *different*, these were her only choices. In other problems, requiring the naming of colors, symbols for numerous colors were provided. However, it was still the case that the only alternatives from which Sarah could choose were symbols designating different colors, i.e., of the same class of answers.

During a typical day, Sarah was given as many as four brief sessions, each containing about 20 problems. All of the problems in a given session were of the same type. Thus, one session might concentrate on same-different problems, another on color-of problems, another on shape-of problems, and so on. Accordingly, it is an open question whether Sarah's usage of these exemplars constitutes a simulation of human language. Training procedures that allow for only one type of problem could establish a "set" for that type of problem and accordingly, may not elicit a "natural" use of language. A related limitation of the results is that during any session the set of symbols that define the answers to that problem (often just two) were all of the same linguistic category. This also is not representative of a human language.

Of course, the most important question is whether Sarah shows evidence of having mastered structural rules governing sequences. The strongest argument that Sarah is sensitive to the structure of sentences comes from the demonstration that she could respond appropriately to a sentence such as *Sarah insert banana pail apple dish*. In this situation, Sarah was required to place an apple and a banana in the appropriate container. In order to demonstrate Sarah's understanding of this sentence, she was provided with a choice of fruit and a choice of containers. Premack argues (Ref. 8, p. 215) that the organization of the sentence can be shown to be hierarchical. "*Banana* and *pail* go together, likewise *apple* and *dish* . . . *insert* not only applies to *banana* and *pail* but to both cases, and finally, . . . it is Sarah who is to carry out the whole actions." Thus, on this interpretation the response could not occur as a result of simple response-chaining.

This interpretation is uncertain for a number of reasons. Typically, Sarah was tested on only one kind of problem for an entire session. Thus the first two symbols (*Sarah* and *insert*) are redundant. Unless *insert* is contrasted with some other verb, it is not clear how one could demonstrate its hierarchical status in the "sentence." Even though Sarah responded appropriately when *withdraw* was contrasted with *insert*,

one wonders whether Sarah needs to understand the symbol *insert* in order to solve the problem. If the pail and dish were empty before the problem was given, then she need only pay attention to the extralinguistic cue provided by the condition of the container in front of her.

At the very least, we must see many more variations of the sentence *Sarah insert apple pail banana dish*, along with appropriate behaviors, before concluding that Sarah understood the hierarchical structure of a sentence.

For example:

Sarah withdraw apple banana pail insert peach can apple box.

Sarah wash apple red dish insert banana round dish.

Sarah achieved impressive abilities to deal with symbols as such. She clearly "learned to learn" new symbols—i.e., she discovered that things can have a "name." Premack has also shown that Sarah has the cognitive ability to solve problems requiring the use of symbols in a metalinguistic manner. For example, Sarah could respond correctly to questions concerning the shape or the color of an apple when all she was shown was the symbol for an apple—a blue triangle. She could *also* answer questions about the plastic symbol itself. However, she did not show unequivocal evidence of the use of sentence structure, nor did her other usages of symbols occur in the varied contexts that characterize human language.

Project Lana

However we interpret Sarah's achievements in relation to human language, they demonstrate convincingly the chimpanzee's symbolic potential. However, a frequent criticism of Project Sarah is that Premack and his trainers were transmitting nonlinguistic cues during the training procedure that shaped her responses (cf. Ref. 16). Of course, it is just the personal interchanges required by Premack's technique which gives it a naturalistic relation to human-language learning. In order to test for this so-called "Clever Hans" (or Clever Gretel) phenomenon, Premack employed a naive tester who was unfamiliar with the meaning of the symbols used in Sarah's training. Here was a deficit in the level of Sarah's performance. It was, however, still significantly greater than chance. Furthermore, such a performance drop with a strange tester has many interpretations: we might expect to find a similar decrement in a human child's performance in a similar situation. It is reasonable to argue that personal cues in Sarah's interactions may only have strengthened her understanding of the linguistic situation, as it would a child's. Nobody *tricked* Sarah into learning what a symbol is, which we find to be her most impressive skill.

Of course there might be a trivial "Clever Hans" effect in which Sarah was responding each time to an unconscious covert personal cue that was functionally the same for each trainer and tester. Unlikely as this seems, Rumbaugh and his colleagues[11] are employing a computer as an interactive device to avoid the possibility of linguistically irrelevant cues. This not only minimizes the possibility that the subject could benefit from cues in the physical proximity of the trainer; it also provides the possibility of a complete record of all symbolic transactions. Instead of plastic symbols, Rumbaugh's experiment with a chimpanzee, Lana, employs lexigrams, each of which appears on the keyboard of a computer console. The functions of these lexigrams are similar to that of the plastic chips used by Premack.

One major difference between Lana's lexigrams and Sarah's plastic chips is that the lexigrams and the computer are available just about all the time. Thus, Lana has continuous access to a much larger set of alternative symbols than did Sarah. At the same time, many of Lana's performances have been trained and practiced in long

sessions devoted to just one type of problem. As we indicated earlier, this raises problems of "set" and is a basic departure from what happens in the case of a natural language. Indeed, a general cost of using the computer is the reduction of the social interactions that ordinarily provide the context for the use of symbols.

Rumbaugh's initial report on Lana referred to her ability to "read and write" in "sentence completion" tasks[11] that employed the computer's "language." If this was all that Lana had accomplished, it would seem gratuitous to refer to this as "linguistic" behavior. (Indeed, Rumbaugh and his colleagues are appropriately cautious about this—see Glasersfeld, in this volume.) For example, the sequence they gloss as *Please machine give Lana M & M* or *Please machine give Lana piece of raisin* or *Please machine show Lana movie* can be analyzed as a complex X-R chain. In these sentences, the sentence beginning *Please machine* is completely redundant and obviously requires no understanding of what the term allegedly stands for. What Lana has to learn is simply to associate the symbol *give* with the lexigram (secondary reinforcer?) for such inventives as an M & M, raisin or apple, and to associate the symbol *show* with the lexigram for such incentives as movie or slide shows. At best, Lana's ability to discriminate between valid and invalid "sentence" beginnings and to supply appropriate endings for valid sentence beginnings appears to be a weak demonstration of a finite state of grammar, in which possible successive elements of a sentence are determined completely by the immediately prior response. Such two-step chained associations are not hard to demonstrate in many animals. Indeed, this behavior is the formal and pragmatic equivalent of that of a rat in a double T maze.

An important potential of Rumbaugh's approach is inherent to the continuous record it provides of all transactions between Lana and her trainers. It should be possible to have a complete corpus of all of Lana's utterances as well as of all the questions that have been put to her. This advantage should, however, be weighed against a certain unnaturalness of the procedures used to train Lana. This includes the fact that the language is artificial, there is minimal socialization, and the fact that all Lana's training requires the constant support of primary reinforcement. It is also not entirely clear that the expensive utilization of the computer has entirely circumvented the Clever Hans possibility, at least when the computer is used as the basis for "conversing" with trainers. The trainers can vary the time, rate, and choice of presentation, which leaves open the possibility that Lana's performance is still being shaped by uncontrolled factors (which often appear to be unrecorded), e.g., Lana's cage position, her drive state, the trainer's current assessment of her position and state, and so on. Since many of her most striking "utterances" occur with a trainer present, this uncertainty is particularly poignant. However, like Sarah, Lana appears to have mastered the notion that objects can be "named," and that she can ask for the name of a new object if she wants it.

As far as we can tell, a complete corpus of Lana's symbolic sequences has yet to be published. Thus, there is no way of evaluating the novelty of particular sequences (which one would assume are drawn from the best examples). Even in the "showcase" examples, it was apparent that Lana can err in generating a sequence. Until one knows the nature and frequency of her errors, the significance of her "sentences," novel or otherwise, remains unknown.

Despite these limitations, Lana's achievements are considerable, and the potential suggested by the computer technique is substantial. Like Sarah, Lana has clearly learned that objects have names. Indeed, Lana appears to have gone one step further in that she has been observed to ask for the "name" (i.e., lexigram) of new objects (at least when she desires them).

Project Washoe

Unlike Sarah and Lana, Washoe was reared in a highly socialized environment—an environment that contained many of the features of the social environment of a human child. The same procedures are being used in the Gardners' current study of two infant chimpanzees, Moja and Pili.[5] As in Project Washoe, the medium of communication in these studies is Ameslan, a language used by the deaf. The obvious social advantage of this natural language is that both the chimpanzee and its human companions can sign to each other spontaneously, without the support of extraneous devices such as plastic chips, or computer lexigrams. The obvious comparative advantage is that sign is a "natural" human language, perhaps with a semantics as rich and a grammar as complex as in any spoken language (see Refs. 18, 19). In our opinion, socialization and the use of a natural language make the approach of the Gardners conducive to the development of language skills in a chimpanzee that are most comparable to those of a human child.

For this reason, our project uses procedures similar to those used by the Gardners. In some respects, our procedures for socializing our chimpanzee Nim are more intensive than those used by the Gardners. Unlike Washoe, Moja and Pili, Nim lives together with his caretakers and eats at least one meal a day with them. It is our feeling that a high degree of socialization is not only important in that it provides many opportunities for signing, but also in that it may increase Nim's self-control. Additionally, a high degree of socialization should also prove helpful in establishing a linguistic concept of self, if such is possible.

It is too early to report decisive linguistic consequences of our efforts to socialize Nim as one might a child. At 22 months, Nim has an active vocabulary of about 30 signs; his passive vocabulary is somewhere between 50 and 60 signs. Early this year, Nim made his first combination of two signs, and at the end of the summer he was observed to make combinations of three and four signs. We have yet to perform tests to determine whether Nim's multisign combinations show evidence of syntactic structure. In order to do so, we feel that analyses more stringent than those provided by the Gardners will be necessary.

It is mainly on this point that we part company with the Gardners. It is not sufficient simply to compare the performance of a child to that of a chimpanzee. For example, in a recent paper the Gardners note that "the failure of linguists and psycholinguists to devise a behavioral definition of language is an obstacle that we try to avoid by obtaining observations of the acquisition of sign language by young chimpanzees that can be compared with observations of the acquisition of spoken language and sign languages by human children. Any theoretical criteria that can be applied to the early utterances of children can also be applied to the early utterances of chimpanzees. If children can be said to have acquired language on the basis of their performance, then chimpanzees can be said to have acquired language to the extent that their performance matches that of children" (Ref. 6, p. 244).

To date, the Gardners have shown that semantic interpretations of two-sign utterances (irrespective of order) match those that have been found in children. In a recent publication, they also argue that Washoe responded to *wh* questions in a manner similar to that of a Stage III child. In neither of these demonstrations, however, do the descriptions of performance derive from a model of the linguistic structure necessary to capture the complexity of all the children's utterances (cf. References 18–20)—a complexity that requires structural analysis, not merely behavioral criteria. To use an analogy, the fact that a horse can walk on its hind legs does not prove that it has the walking capacity of a two-year-old child.

Conclusion

To summarize, chimpanzees have proved themselves to be an important source of information regarding the development of language. To date, there is no demonstration that the chimpanzees have learned to generate strictly ordered syntactic sequences. Rather, they appear to "speak" by combining semantically related symbols, in most cases, according to preset schemata. The difficulty in proving that they use syntax lies partly in the training procedures used to produce evidence of syntax. If one wants to maximize the chances of producing an approximation of human language, it will not suffice to drill a chimpanzee in separate tasks that represent certain features of human language. It is also necessary to show that these features of language occur under conditions similar to those that obtain for humans. At minimum, linguistic ability should not be specific to particular training situations and the use of language should not be solely in the service of acquiring an external object. We should also like to emphasize that a concept of self whereby a chimpanzee is able to conceptualize its feelings, intentions, and so on, in relation to other individuals in its environment, may be a crucial step in motivating the chimpanzee to acquire the syntactic competence characteristic of human language. As far as we can tell, neither Sarah nor Lana developed a linguistic concept of self; the evidence in Washoe is at best equivocal.

Just as there is no clear answer to when a child "knows" language in a syntactic sense, there is no clear answer to this question in the case of a chimpanzee. Indeed, our willingness to attribute syntactic competence to a young child is often based upon little more than an extrapolation backwards from the anticipated state of adult affairs. Unfortunately for the chimpanzee, this type of extrapolation is not yet possible. Accordingly, evidence that a chimpanzee can generate and understand sentences, as humans do, will necessitate comprehensive demonstrations that a chimpanzee cannot only string symbols together, but that such sequences reveal syntactic structures and that they function as they do in human languages. A single demonstration would fall short of the mark just as it would in the case of human children. A convincing case that a chimpanzee uses language in a human manner will require numerous demonstrations that lengthy sequences are used systematically in order to enable the chimpanzee to describe something about itself in relation to others, to deceive others, to contrast ownership of objects, to describe relations in space and time, and so on. In short, if you want to teach a chimpanzee to use language as humans do, make sure it socializes with humans, and make sure that it uses language to refer systematically to itself in relation to its human companions.

Of course, this leaves open the possibility that any training procedures with chimpanzees will elicit only a "natural" *chimpanzee* language that differs from human language because of intrinsic differences in chimpanzee cognition. To test for this possibility it is also true that a great variety of constructions and symbols will be required to delineate any difference between "human" and such a potential "chimpanzee" language.

It is worth elaborating the notion of "species—specific natural language" at this point. In this view, the capacity for symbols cannot be *taught*, but can be trained if the species has the potential for them. It is entirely possible that every primate species has the capacity for some symbolic behavior, but that the effects of learning symbols differ according to the cognitive context of the species. There may be many kinds of language, just as there may be many covert representations and organizations of the world. This makes irrelevant the question of how similar to human language a primate symbol system is. Rather, the question becomes: what is the structure of the primate language itself, and how does it reveal how a primate manipulates symbols?

Whereas it is of interest to see to what extent a chimpanzee can use language as do humans, it is of equal interest to see whether they may seek to use language in their own manner.

This view might seem inconsistent with our emphasis on the acquisition of the linguistic concept of "self." After all, if an animal's cognition determines the kind of language it can have, how could an autonomous linguistic development have general effects? In our view, symbols provide an important mode of explicit internal representation of the world, a kind of "private scratchpad." Once such a facility is developed, it may *release* a variety of otherwise latent capacities, even if it does not *cause* them. Our contention is that the symbolization of "self" is such a releaser.

Of course, if we succeed in eliciting a true human language in a chimpanzee, we will face Kafka's question—*Have we taught a chimpanzee to talk or have we released a human being?*

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