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The Capacity of Animals to Acquire Language: Do Species Differences have Anything to Say to Us?

E. Sue Savage-Rumbaugh, Rose A. Sevcik, D. M. Rumbaugh and Elizabeth Rubert

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The capacity of animals to acquire language: do species differences have anything to say to us?

By E. Sue Savage-Rumbaugh, Rose A. Sevcik, D. M. Rumbaugh and Elizabeth Rubert

Language Research Center, Yerkes Regional Primate Research Center, Emory University, Atlanta, Georgia, 30322, *U.S.A.*

Following the Gardners' discovery that an ape named Washoe could learn to produce and combine a number of hand movements similar to those used by deaf human beings, a variety of 'ape-language projects' sprang up. Some projects used different symbol systems, others used different training techniques, and others used different species of apes. While debate still rages regarding the appropriate way to interpret the symbolic productions of apes, three species of great apes (gorilla, orangutan, and chimpanzee) have now been credited with this capacity while no lesser apes or monkeys have been reported, at present, to have acquired such communicative skills. Among all of the claims made for the various animal species, the philosophers have entered the fray attempting to define the essence of what it is about language that makes it 'human'. This paper will compare and contrast the above positions to arrive at behavioural definitions of symbolic usage that can be applied across species. It will then present new data on a fourth ape species *Pan paniscus* which is proving to be the first non-human species to acquire symbolic skills in a spontaneous manner.

Ape-language began with what seemed to be a very simple and intriguing question: can apes learn to talk? This question has fascinated a number of psychologists ever since the discovery of apes by western civilization. The behaviour of these animals seemed so intelligent that many scientists were repeatedly puzzled as to why they could not learn to speak. A number of people tried to induce speech in young apes with relatively little success (see Kellogg 1968 for a review). The Gardners' breakthrough using a non-speech mode with Washoe was a major success (Gardner & Gardner 1975). Shortly thereafter, both Premack (1976) and Rumbaugh (1977), also using non-speech modes, reported linguistic breakthroughs. Once it became apparent, however, that chimpanzees were gesturing, using magnetic forms, and selecting lighted symbols with surprising agility, three major questions arose:

(i) what exciting thing will they say next?
(ii) How do we know if they know what they are saying?
(iii) What is language?

The first question was fuelled by popular accounts of the work, which appeared in newspapers and magazines regularly; each additional report sought to make some new and spectacular assertion. The second question, raised more slowly, initially came from academics who were somewhat incredulous regarding the initial claims. The third question was completely new. The human species had not previously bothered to determine exactly what language was and was not. Given that only human beings had language, it had not seemed especially important to determine which sorts of behaviours were to be judged 'linguistic' and which were not. With Washoe's first words, the definition of language suddenly became an issue of the first order.

Ape-language reports, regardless of the extent of language skills claimed for the apes, present both a challenge and a problem for psychology as a field. The problem is that none of the ape-language studies fits neatly into the extant categories of research. They are not 'animal learning' studies, in that they do not look for basic principles or for laws of learning; nor do they fit appropriately within the traditional matrix of ethologically based studies of animal communication, wherein a limited repertoire, consisting of a maximum of 100 'social signals' is the domain of study (Eibl-Eibesfeldt 1975).

While such technical issues as the presence or the absence of syntax and the role of conditioning are often the focus of public discussions of the phenomena, the critical issue that seems to fire the public imagination, and consequently fuel the research, is actually whether or not a species, other than man, can purposefully and consciously communicate, either among themselves or with humankind. Can they really tell us how they feel and what they think? Can we ask them questions? Can they ask us questions? And if they can talk, what sorts of things will they say? Most people refuse to believe that the answers to these questions should be complicated; after all, would not everyone know it if their dog suddenly began talking to them? Why then should scientists have a difficult time deciding what it is apes are doing?

These seemingly simple questions lead deep into the heart of psychology, to the point where it merges with philosophy. As psychologists, we have not clearly determined what is involved in 'telling someone something', nor do we know exactly how to ascertain that it is actually happening since 'telling' implies a special set of events between two entities. Is our dog 'telling' us that he wants to go out when he scratches at the door, or is his scratching 'conveying' to us that he wants to go out? It makes a difference. 'Telling' involves behaviour that is mediated not by the self, but by the actions of others; here one brings about consequences indirectly, by talking, or by conveying a message, as opposed to executing a direct action.

Thus, it must be recognized that the real issues involved in ape-language go far deeper than words and syntax. They involve the very nature of inter-individual relationships as we as human beings know and experience them, for a most distinctive human characteristic is that we do 'tell' each other things, whether it be in words, gestures, or pictures drawn in the dirt. We do knowingly, and with intent 'tell' each other things that allow us to transmit indirect experiences from generation to generation, to produce myth from fact, to build and to maintain unique cultures, and to know other human minds in ways that we do not know the minds of other species on this planet. It is no small thing, therefore, to assert that apes are 'telling' people things, or that they are 'telling' each other things.

Confusion between human and animal communication often arises over the application of different paradigms to the study of human behaviour, as opposed to animal behaviour. The paradigm problem is compounded and amplified by the restriction of specific terms to the description of human communicative patterns alone. For example, when used in reference to human communication, the term 'awareness', implies something that is not generally attributed to animals. That 'something' is the human knowledge that communicative acts are not simply another form of behaviour, rather they are *behaviours about intended future alterations in the behaviours of others*, or 'verbal behaviours'.

An easy way to visualize the distinction between behaviours that exist in their own right and behaviours that are 'verbal', or about the behaviour of others, is to consider the prespeech 'conversational babbling' of human infants. During such 'conversational exchanges' between mother and infant, there is a reciprocal exchange of roles and the intonation patterns of the

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infant typically follow those of the mother in a responsive manner. At this stage, however, it appears that the infant is not, in fact, saying anything, rather he or she is producing the vocal exchange as a behaviour in its own right. Later on, when the infant is several months older, the mother will comment that the infant now knows what he or she is saying (see, for example, Locke 1978, 1980). At this stage, the vocalizations may still be unintelligible to a novice observer, and they may even be unintelligible to the mother herself, yet as a result of the surrounding behavioural context, the vocalizations will be recognized as intentional communications, albeit rather poor in quality. That is, the act of uttering alone will no longer fulfil its own function; the infant will insist that specific sorts of action be taken in response and thus utterances will be judged to have become behaviours about behaviours, or intentional communicative acts.

Along with the appearance of such intentional communicative acts comes the concomitant awareness that other individuals also produce verbal behaviours and that they too make choices about engaging in a behavioural response to the verbalization of others. Thus, others may offer a response to the infant's communicative acts or elect not to do so. If they do not respond, the infant may perceive their lack of response as resulting from one of two events: either the other party did not understand nor perceive his or her intentional communication, or the other party received the communication, but chose not to respond. When the adult chooses not to respond, it will typically be made apparent to the youngster because the adult will first acknowledge receipt of the communication and then indicate his or her unwillingness to comply. Premack & Woodruff (1978) have termed the ontogenetic appearance of intentional communicative capacity, the achievement of a 'theory of the mind', meaning the development of the capacity to attribute mind to other individuals.

Nothing quite so esoteric as the mind, however, needs to be evoked. What we do need to suppose is the evolutionary advance of an ever-increasing ability to monitor the results of one's actions. First, only immediate effects would be monitored, then more indirect long term effects, and eventually the effects of one's own behaviour on the behaviours of others. Finally, we would begin to have an ability not only to monitor the effects of one's own actions, but also the effects of the actions of others. From this capacity would grow quite naturally a desire to control the actions of others for personal ends, and from this desire a need for a communicative system capable of representing to others the actions one would have them take.

Generally, one can determine the effectiveness of one's own behaviour by the ensuing events which affect the individual directly. Intentional communicative acts, however, must be monitored by judging a change in the behaviour of another and determining whether or not that change corresponds with the alteration which the intentional communicative act was intended to achieve. The phylogenetic onset of this skill remains to be adequately traced as strong evidence for this capacity is presently extant only in apes. It is possible, however, that species with highly developed brains in other orders, such as the Delphinidae, may also have developed this level of intentional communicative capacity. Observations of these animals in an interspecies communicative setting strongly suggests this (L. Herman, personal communication).

We wish to assert here that:

(i) apes are capable of intentionally telling one another things, and probably do so more in the wild than we yet realize;

(ii) apes who have been taught to communicate with human beings, and to use an arbitrary

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symbol system can, and do, tell each other, and their human companions, far more than apes who have not been so trained;

(iii) the type of training which the apes receive determines the degree to which their communicative behaviour becomes symbolic and abstract;

(iv) very large species differences with regard to communicative capacities exist between even the two most closely related great apes, *Pan troglodytes* and *Pan paniscus*.

At the Language Research Center, a joint venture of Georgia State University and the Yerkes Regional Primate Research Center of Emory University, we are trying to develop and to teach a viable system that permits individuals to interact communicatively and cooperatively with one another. In our efforts to teach language to *Pan troglodytes*, we have found that we have learned as much, if not more, from our failures as from our successes. The chimpanzees' halting acquisition of symbols has taught us that language is not made of whole cloth, but of many pieces. It is not merely symbols, or combinations of symbols, but complex ways of interacting, and complex sorts of inter-individual expectancies that intertwine and coordinate behaviour. Symbols are the medium of language, but not its substance. Its substance is planned, coordinated cooperation achieved only through mutual telling and mutual expectancies regarding that telling. These expectancies must be shaped by common past experiences and such experiences must occur in an atmosphere of trust and cooperation. Language, in short, is a part of culture; it is living, breathing, ever-changing, behavioural culture. It does not leave tangible artefacts, but it changes the behaviour of groups in a drastic manner. It cannot belong to one person; it is the property of inter-individual interactions. Without such interactions, language, as we know it, does not exist.

Our goal of achieving cooperative–communicative behaviour between chimpanzees has been, in a sense, a piecemeal approach to language that has attempted to provide chimpanzees with symbol use skills not already in their repertoire, and to integrate these skills with general behaviours.

We have, bit by bit, dissected the symbol and found it to be composed of a variety of skills which can be and must be taught individually if common chimpanzees are to come to be able to produce anything like human words. Once these individual skills are acquired, they can be integrated in a manner which permits the emergence of true indicative behaviours. We did not intend to begin with such a piecemeal approach as we set out to determine whether or not apes can acquire human-like language skills, yet, we repeatedly found that teaching 'names' was not sufficient and that the communications that resulted seemed to lack certain fundamental properties generally found in human communication. (For a complete analysis of the subskills that proved necessary to develop independently (requesting, naming, comprehending and stating) see Savage-Rumbaugh (1984)).

True indicative word-use involves the skill of 'telling' another, by means of a symbol, what you are going to do, what you see, what you know, etc., as opposed to simply emitting a gesture or selecting a symbol to obtain that which you want and could easily take, if but permitted. We now know that our initial view of what counted as a 'word' in a chimpanzee's vocabulary was naive. It has become clear that knowing that a name stands for something is far more complicated than simply being able to make the correct response in its presence. Far more crucial to language is the ability to predict or to inform, that is, to talk about what you are going to do before you do it, or what you want when you cannot see it. It is also procedurally more difficult to show that this is in fact what a chimpanzee has learned to do.

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We have recently completed a series of blind tests which evaluated Sherman and Austin's ability to produce an indicative statement, that is, to symbolically encode their own actions on objects before the action occurs. (Savage-Rumbaugh *et al.* 1983; see figure 1).

By then evaluating the concordance between what they said they were going to do, and what they actually did, we obtained a measure of their capacity to use symbols in an indicative manner, that is, to indicate to another what it was they were about to do (see Table 1).

Before this test, this behaviour had become a very common part of Sherman's and Austin's spontaneous symbol use capacity. They had begun to say for example, 'GO SINK' and head for the kitchen, or 'SHERMAN M&MS' and drag the bag of candies out of the refrigerator. They had also begun to inform us of things they saw, as when Austin observed an anaesthetized chimpanzee carried past the window and said 'SCARE' while making 'waa' calls toward the window and gesturing for us to look out.

More recently, we have had the opportunity to study a completely new species of ape, *Pan paniscus*. This species has not before been the subject of language studies though it has attracted significant scientific attention for many other reasons (see, for example, Savage *et al.* 1977). It has also been proposed that *Pan paniscus* is more representative of the more generalized anatomical characteristics displayed by human ancestors than other living apes (that is, longer legs, shorter arms, reduced prognathism, etc.) (Zihlman *et al.* 1978).

We have been working with a young male, Kanzi, who was initially exposed to human language at six months old. He remained, however, with his mother until two and a half years old; during the time he was in his mother's company, he showed little interest in using the geometric symbols to communicate, though he was highly communicative gesturally and was exceedingly vocal, even attempting to produce some vocal imitations of speech in terms of pitch and intonation.

When Kanzi was two and a half years old he was separated from his mother so that she might return to the *Pan paniscus* social group and again become pregnant. Kanzi remained at the Language Research Center.

Kanzi's use of the keyboard became prominent immediately following his mother's absence and his symbol usage was completely spontaneous, that is, no training was given. Within a week of his mother's absence, it was determined that Kanzi could proficiently use many of the symbols which we had been attempting to teach his mother during the previous year. Moreover, not only could he use these symbols to request things he desired, he also demonstrated an ability to name things he did not immediately want and he displayed symbolic comprehension when others attempted to use the keyboard to communicate with him. Each of these skills had required separate training in the case of Sherman, Austin, and Lana. Kanzi's linguistic abilities were so astounding and strikingly different from those demonstrated by Sherman and Austin, and he had acquired them with no direct instruction, that the planned programme of instruction for Kanzi was completely revised. We decided that no moulding or training of any sort would be done with Kanzi at any time. In addition, no activity or object would be made contingent upon symbol usage, as had been the case with all previous ape-language studies, both our own, and those of others in the field. Kanzi's symbol usage, from the start, has been quite different from that of other apes. He uses symbols much more spontaneously and frequently directs our attention to places and to things that are not visible or to activities in which we are not, at present, engaged (see figure 2).

For Kanzi, the lexigram keyboard is a means of telling us that he wants to visit the A-FRAME,

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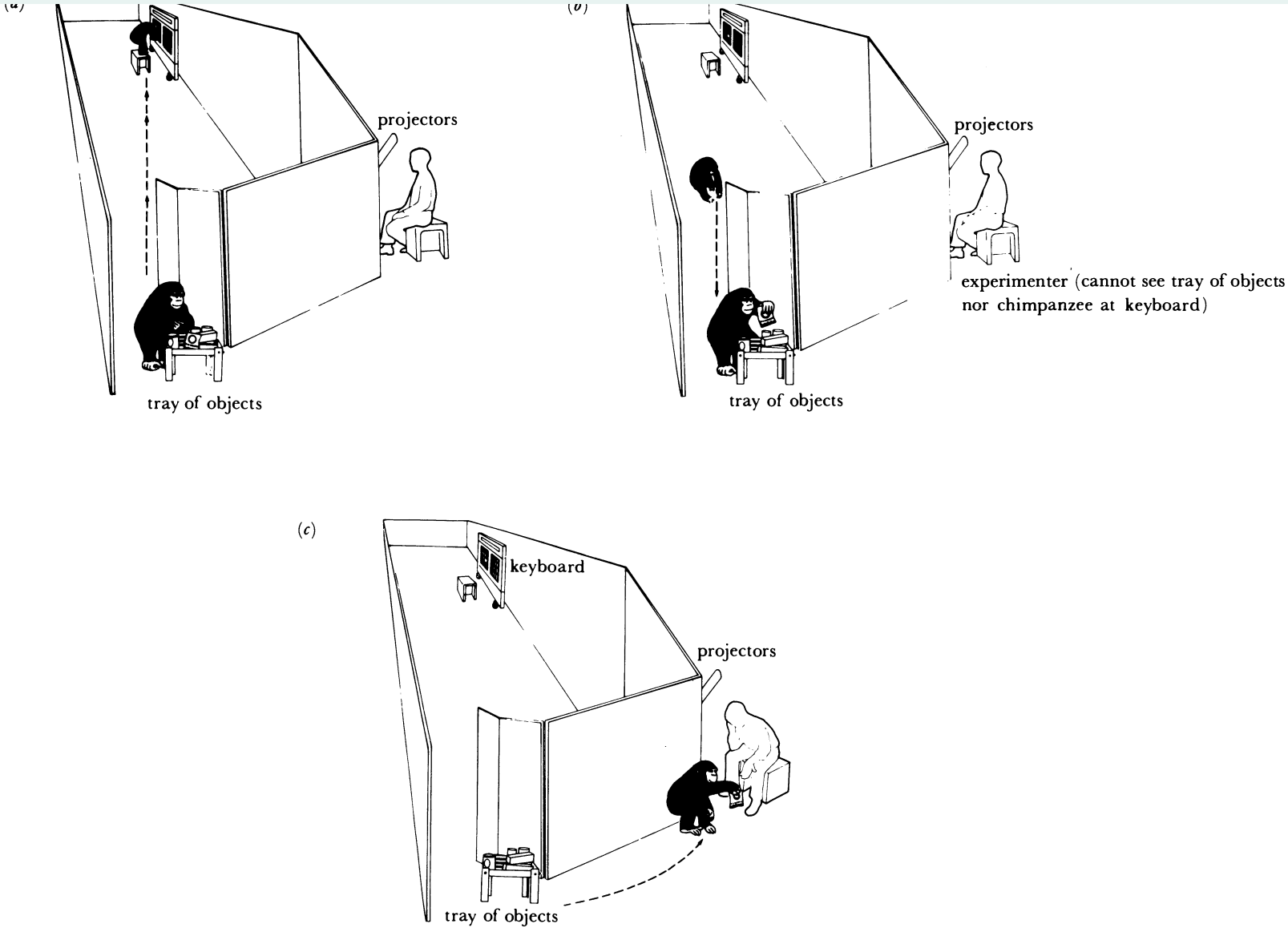

FIGURE 1. (*a*) The chimpanzee scans a tray of objects to see the available array. He returns to the keyboard and activates a symbol. While at the keyboard, the tray is out of the chimpanzee's view; he must therefore recall one or more of the items viewed on the tray.

(*b*) The chimpanzee then returns to the tray of objects and selects the item that he has activated on the keyboard. At this point, he must recall the symbol or object he has indicated on the keyboard since he can no longer view the display.

(*c*) The chimpanzee transports the object to the experimenter. The experimenter has been out of view during the chimpanzee's selection of the object. The experimenter refers to the projectors to verify whether the object delivered to him or her is, in fact, the one that the chimpanzee indicated at the keyboard.

Table 1. Total score and percentage correct of indicative statements under blind test conditions

	total score	percentage correct
Sherman	50/53	94%
Austin	46/53	87%

To obtain a correct score, the object that the chimpanzee selected and gave to the teacher had to correspond with the object the chimpanzee said that it would give the teacher. The array of objects changed in each trial.

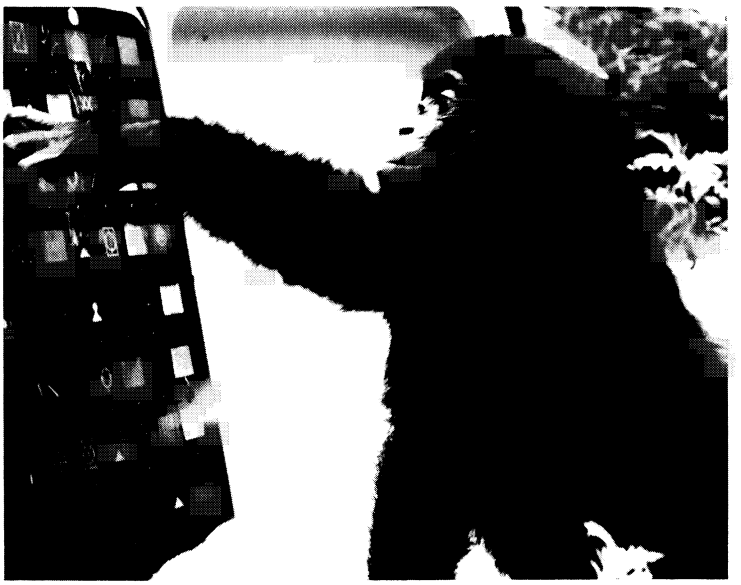

Figure 2. Kanzi, a male infant *Pan paniscus*, communicates using a lexigram keyboard.

to go see the dogs, to go where we keep the m&ms, or to find his beloved ball. Symbol usage in Kanzi's case has not appeared piecemeal; he has not integrated training in many different situations and finally begun to make statements and to use his symbols representationally. Rather, he has displayed all of these skills from the outset quite spontaneously. By the end of the first six months of his mother's absence we had assigned symbols to 60 different keys on his board and he was using nearly half of them appropriately and spontaneously. He would also name or give photographs in response to a teacher's request, thereby enabling us to test his knowledge apart from a communicative context. No food reward nor training was necessary to interest Kanzi in taking such 'tests'. Moreover, he began spontaneously producing combinations of lexigrams and combining lexigrams with gestures, and in some cases with vocalizations. In contrast to Sherman and Austin, he also nearly always responds to our vocal questions with some sort of vocalization of his own, as though he is attempting to 'talk'. Although he cannot produce English words clearly, he does regularly use an 'aaangh' sound as a means of emphasizing 'I want' and uses other sounds to indicate denial or affirmation.

The most readily discernible and profound difference between Kanzi and Sherman and Austin seems to lie in Kanzi's ability to comprehend, at a still undetermined level, spoken English. Although others have claimed that chimpanzees comprehend spoken English, they have failed to present adequate data to substantiate these assertions (Fouts *et al.* 1976). In

repeated tests since 1977, Sherman and Austin have consistently failed comprehension tests of spoken English though they constantly have been exposed to it from infancy. Kanzi, by contrast, is displaying marked comprehension of spoken English (see table 2).

Table 2. Total score or percentage correct of receptive trials

	stimulus condition			
	lexigram		spoken english	
	total score	percentage correct	total score	percentage correct
Kanzi	88/93	95%	83/93	89%
Sherman	92/93	99%	47/93	50%
Austin	91/93	98%	55/93	59%

Two (or three) exemplars were available for response on each trial. A total chance score would be 43%.

Early observations of this ability came as we asked him to name an item at his keyboard. (Recall that he was not being reinforced nor trained to do this, merely asked to do it if he could and if he would.) At times he seemed to have trouble finding a lexigram symbol, and we would say 'Kanzi, can't you find apple?'. Shortly after we uttered the word 'apple' in English, Kanzi's eyes would brighten and he would immediately touch the 'APPLE' lexigram on the keyboard. This behaviour was exceptionally striking, since no one who worked with Austin and Sherman could ever recall a single instance in which saying the word in English had helped them find it on the keyboard, even though we had said words many thousands of times across the past nine years of working with them. In no way was our use of English around Kanzi any different than it had been with them. English has been used freely with all of the chimpanzees in combination with the keyboard and with spontaneous gestures.

The symbols and sentences used by Kanzi are wholly learned; yet they are not conditioned through training any more than the words and the symbols used in this paper are so conditioned. The satisfactory explanation of Kanzi's linguistic competency, and its contrast with *Pan troglodytes*, present the current psychological and philosophical views of mankind with a unique and an unprecedented challenge.

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References

Gardner, B. T. & Gardner, R. A. 1975 Evidence for sentence constituents in the early utterances of child and chimpanzee. *J. exp. Psychol.: General* **104**, 244–267.

Eibl-Eibesfeldt, I. 1975 *Ethology. The biology of behavior*, 2nd edn. New York: Holt, Rhinehart and Winston.

Fouts, R. S., Chowin, W. & Goodin, L. 1976 Transfer of signed responses in American Sign Language from vocal English stimuli to physical object stimuli by a chimpanzee (*Pan*). *Learning Motiv.* **7**, 458–475.

Kellogg, W. 1968 Communication and language in the home-raised chimpanzee. *Science, Wash.* **162**, 423–427.

Locke, A. (ed.) 1978 *Action, gesture and symbol: The emergence of language*. London: Academic Press.

Locke, A. 1980 *The guided reinvention of language*. London: Academic Press.

Premack, D. 1976 *Intelligence in ape and man*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

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Premack, D. & Woodruff, G. 1978 Does the chimpanzee have a theory of mind? *Behav. Brain Sci.* **4**, 515–526.
Rumbaugh, D. M. (ed.) 1977 *Language learning by a chimpanzee*: *The LANA Project*. New York: Academic Press.
Savage, E. S., Wilkerson, B. J. & Bakeman, R. 1977 Spontaneous gestural communication among conspecifics in the pygmy chimpanzee (*Pan paniscus*). In *Progress in ape research* (ed. G. H. Bourne), pp. 97–116. New York: Academic Press.
Savage-Rumbaugh, E. S. 1984 Verbal behavior at a procedural level in the chimpanzee. *J. exp. Analys. Behav.* **41**, 223–250.
Savage-Rumbaugh, E. S., Pate, J. L., Lawson, J., Smith, S. T. & Rosenbaum, S. 1983 Can a chimpanzee make a statement? *J. exp. Psychol.: General* **112**, 457–492.
Zihlman, A., Cronin, J. E., Cramer, D. L. & Sarich, V. M. 1978 Pygmy chimpanzee as a possible prototype for the common ancestor of humans, chimpanzees and gorillas. *Nature, Lond.* **275**, 744–746.

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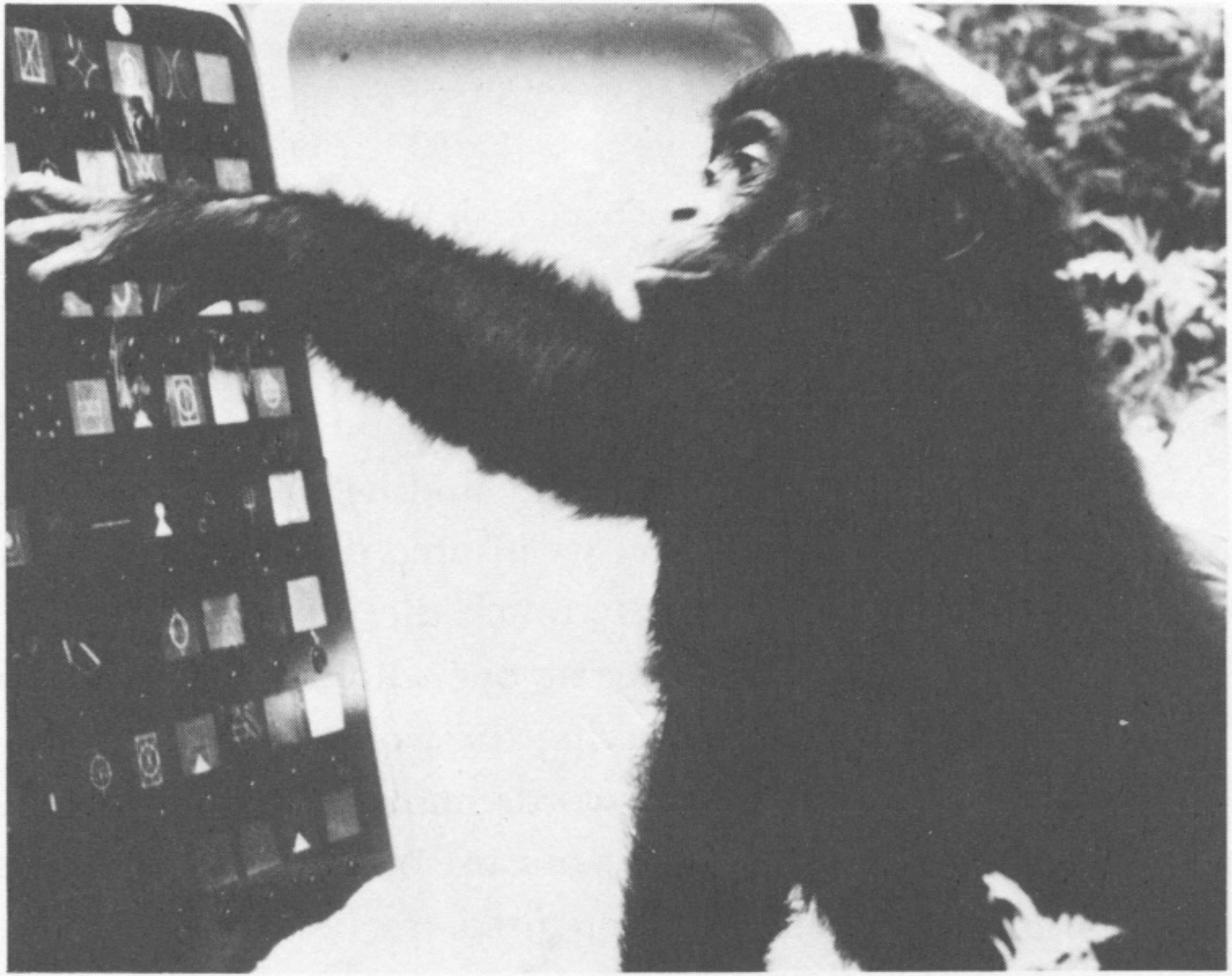

GURE 2. Kanzi, a male infant *Pan paniscus*, communicates using a lexigram keyboard.

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