

COMMENTS

Communication, Symbolic Communication, and Language: Comment on Savage-Rumbaugh, McDonald, Sevcik, Hopkins, and Rupert (1986)

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Savage-Rumbaugh, McDonald, Sevcik, Hopkins, and Rupert's (1986) description of their pygmy chimpanzees' behavior raises many interesting questions about what they have learned. Their behavior is communicative, but is it symbolic and how does it relate to the child's use of language? Savage-Rumbaugh et al. interpreted this behavior as "symbolic communication." However, this interpretation does not account for significant aspects of the apes' performance. For example, Kanzi's performance on the vocabulary test differed greatly from his performance in naturalistic exchanges, which would not have been expected if he had in fact learned that lexigrams are symbols. The apes' performance is consistent with the hypothesis that they have learned the instrumental functions of lexigrams in the experimental context. That is, they use lexigrams to mediate the receipt of desired outcomes such as food or travel. This behavior, which Skinner (1957) termed *manding*, does not require knowledge of words or symbols at all. The apes' use of lexigrams appears to be more like the nonlinguistic gestural communication of very young children than the use of full lexical items. The dichotomy between the apes' linguistic and cognitive capacities is discussed in terms of implications concerning the possible species specificity of language.

Savage-Rumbaugh, McDonald, Sevcik, Hopkins, and Rupert (1986) reported intriguing results from an ongoing study of two pygmy chimpanzees. We share their excitement over this research, but for a different reason: Their data, together with our own data on children's early communication, put us on the brink of being able to situate the apes' communicative capacities vis à vis those of children. Their behaviors are similar to nonlinguistic gestures used by 9- to 16-month-old children.

Kanzi's behavior raises important questions about *how* he learns; we agree that his remarkable learning abilities distinguish him from other chimpanzees. The study also raises questions about *what* was learned, specifically how Kanzi's "symbolic communication" compares with the behavior of other language-trained apes and with that of children acquiring first languages. Here we disagree with many of Savage-Rumbaugh et al.'s (1986) conclusions. Kanzi's behavior differs from children's use of language in systematic ways; positive comparisons to children can only be sustained by holding underspecified theories of symbolic communication and naming. We also disagree with their characterization of the extent to which Kanzi's communicative behavior differs from that of other language-trained apes. The similarities in the behaviors of several apes, including Kanzi, who have been exposed to very different experimental conditions suggest to us some basic generalizations about the

cognitive and linguistic capacities of nonhuman primates. We see this research as providing another source of evidence that language is an expression of a capacity that is specific to humans; moreover, it suggests that part of this innate endowment includes the capacity to understand that things have names.

What is Symbolic Communication?

Savage-Rumbaugh et al.'s (1986) article raises questions of method and interpretation that are familiar from earlier studies of ape language. The basic problem is to determine how the animals' behavior relates to human communication in general and to language in particular. Savage-Rumbaugh et al. (1986) characterized their subjects' behaviors in terms of a general notion of *symbolic communication*. This is unsatisfactory because the term is not clearly defined and it is not clear what range of behaviors it subsumes. Terms such as *gesture*, *symbol*, and *word* are used interchangeably in describing Kanzi's behavior; however, these entities are not equivalent. Similarly, communication and language are not distinguished from one another. It is not controversial that many species communicate. What is controversial is whether any species other than humans possess the capacity to acquire language, a specific type of communicative behavior. This question cannot be addressed if the researchers appeal only to general concepts such as symbolic communication.

Savage-Rumbaugh et al.'s (1986) strategy was to document a wide range of their subjects' behaviors, establishing as many similarities to the human use of language as possible. Although this method provides useful information, it is not sufficient. Aside from the fact that language has often been construed in

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simplistic ways in the service of comparative studies, the basic problem with this approach is that it makes the hypothesis that the animal's behavior is similar to human language unfalsifiable. Consider an art dealer trying to evaluate whether a picture was painted by Picasso or not. He could acquire a huge amount of evidence supporting the conclusion that Picasso was the artist (by noting similarities between the painting and other works by Picasso) even if the work is a fake. In the case of ape language research, the atheoretical pursuit of similarities has led to fruitless debates of the "is the glass half empty or half full" sort. What is the metric for counting similarities? Which similarities are important and which are not? How many must there be in order to conclude that the animal's behavior does or does not resemble the human use of language in an interesting way?

Because of the emphasis on establishing similarities, there have been few systematic attempts to address alternative hypotheses that do not require attributing linguistic competence to the subjects. Moreover, researchers have not given sufficient attention to the question, what type of evidence would justify the attribution that a sign or lexigram has a particular meaning or function for an ape or child (Seidenberg, 1986; Seidenberg & Petitto, 1979)? Savage-Rumbaugh et al.'s (1986) work represents a great advance over previous research in that they are actively evaluating the bases of their subjects' performance, they have collected and carefully analyzed a large body of data, and they have begun to develop useful verification procedures (e.g., the concordance method). However, the information provided to this point strongly suggests a specific nonlinguistic hypothesis that bears further investigation.

An Alternative View of Ape Communication

Savage-Rumbaugh et al.'s (1986) view is that lexigrams function as symbols for Kanzi. That is, they are arbitrary signs that are used to refer to categories of objects (such as strawberries or juice) in communicative acts such as requesting and stating. Thus, his behavior apparently shares important properties with the child's use of names. This hypothesis, however, does not account for important aspects of Kanzi's behavior, specifically (a) differences between his performance on the vocabulary test and in naturalistic exchanges, (b) properties of lexigram usage that differ from children's use of words, (c) the fact that lexigrams were primarily used to request, and (d) the high proportion of food-related utterances. The data provided in the Savage-Rumbaugh et al. (1986) article, together with evidence from studies of other linguistic apes and children, suggest to us an alternative account of Kanzi's behavior. The alternative hypothesis is that Kanzi has learned about the instrumental functions of lexigrams in the experimental context. He does not know that lexigrams designate, represent, symbolize, or name objects and events; rather, he knows how to use them in order to effect desired outcomes such as obtaining objects, being allowed to engage in favored activities, or receiving the approval of his trainers. Lexigrams are the means by which he obtains positive responses from the teachers who control these outcomes. This account explains several aspects of the chimpanzee's performance that would otherwise seem incidental or unrelated.

This account of the linguistic abilities of apes is not new. In 1979, we noted that Nim's signing exhibited similar character-

istics; he seemed to know the outcomes associated with producing signs—that is, their pragmatic functions—not the concepts associated with them, or what they named, or that they were names at all (Seidenberg & Petitto, 1979; Petitto & Seidenberg, 1979). We noted that the behavior of other linguistic apes was consistent with this interpretation. Savage-Rumbaugh, Pate, Lawson, Smith, and Rosenbaum (1983) offered a similar analysis in a discussion of some of their common chimpanzees. This account is also consistent with the evidence that Savage-Rumbaugh et al. (1986) have now provided concerning their pygmy chimpanzees. This suggests to us the discovery of a basic generalization because it apparently holds across subjects, ape species, communicative systems, and teaching methods.

Performance on Vocabulary Test Versus Performance in Naturalistic Exchanges

Savage-Rumbaugh et al. (1986) presented two main types of information, descriptions of Kanzi's performance on a vocabulary test and descriptions of his communicative use of lexigrams in naturalistic exchanges. These two sources of evidence are not entirely consistent with each other. The vocabulary test shows that Kanzi can associate lexigrams with pictures of objects and spoken words; conversely, he can associate spoken words with lexigrams and pictures. This behavior is remarkable, and the fact that he learns quickly without the procedures used in previous studies is important. The difficult question is whether this behavior indicates that lexigrams function as symbols or names. The same question applies to the similar, though more limited, behavior observed in pigeons, who are capable of learning to associate an arbitrary response with exemplars of categories such as trees or bodies of water (Herrnstein, Loveland, & Cable, 1976). It also applies to the early communicative behavior of children (Petitto, in press-b).

Were Kanzi's behavior in naturalistic exchanges consistent with his performance on the vocabulary test, it would provide evidence that he could associate lexigrams with categories of objects, a component of the ability to name. It is clear from Savage-Rumbaugh et al.'s (1986) examples, however, that outside the context of the vocabulary test, lexigrams are not simply produced in reference to well-defined categories. For example, Kanzi used *juice* in several ways: (a) to refer to a particular kind of drink, as indicated by Kanzi pressing *juice* and selecting the correct object from a range of alternatives, (b) to refer to the fixed location where juice was located (p. 216), and (c) to refer to the act of going to the juice location (a concordance would be scored if Kanzi pressed *juice* and led the experimenter to the correct location whether he obtained the food or not; p. 217). Similarly, Kanzi uses the lexigram *strawberries* "when he wants to travel to the place where they are found, when he is asking for one to eat, and when shown a photograph of strawberries" (p. 220). Several examples of such broad uses of lexigrams described in the article. Broad use of symbols appears to be a characteristic common to all of the language-trained apes because similar behaviors have been noted in the signing studies (Gardner & Gardner, 1971; Patterson, 1978). These examples are thought to provide positive evidence that the apes' symbols have specific meanings, albeit ones that are more general than those

of adult humans. They show that the ape is not merely associating symbols with particular referents.

These behaviors clearly differ greatly from those in the context of the vocabulary test. That Kanzi reliably associated lexigrams (and spoken words) with pictures of objects from designated categories was taken as evidence that they functioned as symbols. When the constraints of this task are removed, however, Kanzi uses lexigrams with regard to objects or events that are not exemplars of the appropriate category. These differences in performance are not explained by the simple hypothesis that he uses lexigrams in symbolic communication. Moreover, they imply that aspects of the experimental context control his performance in ways that Savage-Rumbaugh et al. (1986) have not explored.

The generalization that accounts for Kanzi's behavior is not that lexigrams function as words or symbols but rather that he adapts in a problem-solving manner to the experimental conditions that confront him. His behavior differs significantly depending on the context, which would not be expected if in fact he knew that lexigrams were symbols for particular types of objects. The constraints of the vocabulary test are such that Kanzi must associate lexigrams with appropriate objects, which he is able to do. When these constraints do not apply, as in the naturalistic exchanges, he used lexigrams more broadly. Kanzi knows something about the outcomes associated with lexigrams and uses them—communicatively—to effect these outcomes. Thus, he has learned to produce *juice* in contexts where his trainers will interpret it as appropriate, thereby facilitating outcomes such as receipt of juice or a trip to the juice location, not because *juice* designates specific objects. Because his behavior is determined by the constraints of the experimental setting, his use of *juice* is not restricted to the relevant objects when the experimental context does not demand it.

In sum, the Savage-Rumbaugh et al. (1986) have created an experimental context that establishes which uses of lexigrams are and are not considered appropriate. Having raised the chimpanzees in this context, they now report that lexigrams are used in certain ways; for example, *strawberry* is used both to obtain a strawberry and to request being taken along the strawberry route. This behavior is anomalous in terms of the hypothesis that the ape learned that *strawberry* is the name for a category of objects. However, it is not anomalous in terms of the demand characteristics of the experiment. Within this context, it does not matter whether *strawberry* is associated with a class of fruits, a type of event, or both. Kanzi will successfully mediate interactions with the trainers by using the lexigram in both ways.

Our view makes the following empirical prediction: If Savage-Rumbaugh et al. (1986) were to change the conditions of their experiment, Kanzi would modify his use of *strawberry* in response. For example, if they created conditions in which strawberries occurred at multiple locations, Kanzi would learn that he cannot use *strawberry* to indicate both the object and the location where it formerly was found. The "meaning" of *strawberry* would not have changed, just his knowledge of the outcomes associated with using it. If they created conditions in which *strawberry* could be used to obtain both strawberries and rocks, he would use *strawberry* in this way. It also follows from this account that lexigrams could differ greatly in terms the

range of permissible referents (as they apparently do). The constraints of the experiment may be such that some lexigrams are only allowed to be used with a narrow range of referents, whereas others can be used more broadly. The generalization in each case, however, is that the range of referents is determined by these constraints.

Savage-Rumbaugh et al. (1986) interpret the data differently. Their view is that although the lexigrams are used in a broad manner Kanzi knows that a lexigram actually names a specific class of objects:

For example, if Kanzi learns to touch the symbol for strawberries when he wants to travel to the place where they are found, when he is asking for one to eat, and when shown a photograph of strawberries, he will probably extract the one common referent (red sweet berries) from all of those different circumstances, and assign to that referent the symbol, *strawberries*. (p. 220; emphasis added)

Savage-Rumbaugh et al.'s (1986) assumption, then, is that the meaning of *strawberry* for Kanzi is that which they perceived as common to all his uses of it. Whatever the plausibility of this assumption, it requires empirical validation. We agree that in producing *strawberry*, Kanzi recognized something common to all the situations in which it is used, but what? Is the common element strawberries or the fact that these are the situations in which *strawberry* can be used with a positive result?

This empirical question might be addressed in the following way. In experiments by Markman and Hutchinson (1984), a child was presented with a picture of a target object (such as cow), a taxonomically related alternative (pig), and a thematically related alternative (milk). Thematically related items were causally or temporally related to the target; other examples include door/key (object/instrument) and ring/hand (object/location). The experimenters introduced a novel word for the target object (e.g., *sud*). The child's task was to choose the picture that represented another sud ("See this? It is a sud. Find another sud that is the same as this sud."). On approximately 80% of the trials, children chose the taxonomically related alternative rather than the thematically related alternative. Hence, their initial hypothesis about an unfamiliar word is that it refers to a category of objects rather than objects that happen to be causally or temporally related.

In using a lexigram in reference to an object such as juice and to the location where it is found, Kanzi was apparently responding on the basis of temporal and causal relations between these entities. The Markman and Hutchinson (1984) experiment suggests an interesting modification of Savage-Rumbaugh et al.'s (1986) vocabulary test. Give Kanzi the lexigram *juice* and two response alternatives: a picture of a thematically related object (e.g., the location where juice is found) and a picture of a taxonomically related object (e.g., cola). As in the vocabulary test, Kanzi must pick the correct alternative. If Kanzi's use of lexigrams is based on knowledge of their roles in the experimental context, rather than hypotheses as to what they mean, he should tend to pick the thematically related alternative more often than children do. We are not suggesting that this experiment would provide a definitive test of the basis of Kanzi's lexigram usage. His behavior is clearly complex, and no single study of this scope could reveal the extent to which it does and does not resemble children's use of language. The experiment is

offered as an example of the kind of study that would be informative if pursued in a systematic manner.

In sum, Kanzi's performance on the vocabulary test suggests that he is capable of responding systematically to categories of objects, a result consistent with those of other studies (e.g., Premack, 1976). The basis for this performance is not entirely clear. He may have responded on the basis of perceptual similarities among the members of a category such as *strawberry*; he may have grasped the concept of *strawberry*; his performance could have some other basis. Evaluating the kinds of knowledge that underlie this performance represents an empirical issue that could be pursued in future research by systematically varying the foils on the test and analyzing the types of errors that are made. Kanzi's problem does not seem to lie in identifying categories; rather, it appears to lie in grasping the idea that a lexigram designates a class of objects or kind.

Having argued that Kanzi's use of lexigrams in naturalistic exchanges can be explained by an instrumental analysis, we need to consider whether this view also accounts for basic features of children's early use of words. It is possible to extract from child language corpora utterances that resemble Kanzi's. For example, a child is observed to consistently use the word *daddy* in reference to her father and no other person. The child then sees the father's special easy chair when he is not present, points to it, and says "daddy." Therefore, the child is using *daddy* in reference both to a person and to the location where he is often found, much like Kanzi used *juice* in reference to a drink and its location. The comparison between child and chimpanzee turns on whether the same processes and types of knowledge underlie their respective utterances, something that cannot be determined by examining individual utterances. Our claim is that the bases of these utterances are in fact very different. This claim is supported by the observation that children's knowledge goes beyond an inventory of the relations between words and the contexts in which they can be used to effect positive outcomes. Careful studies by Carey (1982, 1985), Keil (1979, 1986), and others indicate that although children's early word meanings are not the same as adult's, they are constrained in systematic ways. For example, the child will not initially use a word such as *table* to refer to the same class of objects as the adult. The child's initial hypothesis as to the meaning of *table* is only partially correct; they will sometimes "overextend" the range of referents for a particular word (they also "underextend" in some cases). However, these overextensions are not arbitrary; there are constraints on the kinds of hypotheses that are formed. As Carey (1982) notes, "The child would never judge *table* to mean something like 'table and meal' because *table* is an object and *meal* is an event: A concept's including just a specific object and a specific event violates certain constraints on conceptual naturalness" (p. 381). In general, the child rarely forms hypotheses that involve entities as disparate as objects and events.

Examples such as *juice* being used both to obtain a drink and to be taken to the drink suggest to us that the constraints that govern Kanzi's use of lexigrams are different from those that govern children's use of words. The child is developing hypotheses concerning the meanings or intensional content of utterances. The biological constraints on this developmental process are such that only certain types of hypotheses are entertained.

The chimpanzee is learning about the conditions under which lexigrams can be used to effect positive outcomes. In Savage-Rumbaugh et al.'s (1986) experimental context, it happens to be the case that some lexigrams can be used in reference to entities as diverse as an object, a location, and an event. Kanzi's broad use of lexigrams follows from the hypothesis that he behaves on the basis of these outcomes. This hypothesis does not account for the child's behavior, which is constrained in other ways.

Kanzi's Requests

The instrumental hypothesis is consistent with another important aspect of Kanzi's performance. The Appendix describing his behavior during a single day reveals that he uses lexigrams in a particular way, to request. There are some 25 utterances in the Appendix, of which 3 can be excluded as imitations. Of the remaining 22, 18 are requests. The other four are termed "statements." It is apparent that Kanzi's main communicative behavior was that of requesting. In this respect his behavior was strikingly similar to Nim's.

The hypothesis that Kanzi uses lexigrams in symbolic communication does not explain why his behavior should be strongly oriented to a single communicative function. According to the instrumental hypothesis, however, Kanzi requests because what he knows about lexigrams is that they can be used to obtain desired outcomes. The fact that lexigrams are used in this manner provides another clue that the principles that govern the ape's use of lexigrams are different from those that govern the child's use of language.

Savage-Rumbaugh et al. (1986) asserted that Kanzi also used lexigrams to perform a second communicative function, making "statements." However, it is not clear whether there is an empirical basis on which to distinguish between these types of acts. The Appendix suggests that in distinguishing between stating and requesting, Savage-Rumbaugh et al. relied upon intuitive judgments concerning Kanzi's intentions. The validity of these judgments is questionable. Consider the following exchange (from the Appendix):

Utterance. Once the chasing is over, Kanzi indicates that he would like to go back to the lab by touching "play yard" (which refers to the outdoor caging area behind the lab). He then starts off in the direction of the lab.

Coding. This utterance is coded as a spontaneous correct statement because no one had mentioned the play yard before Kanzi and Kanzi seemed to be making more of a statement about his intended actions, rather than requesting to go to the play yard. (p. 234)

Question: Is there any independent, objective evidence that this attribution is correct? Do such attributions provide a basis for establishing that Kanzi made statements? In the context of this experiment, what is a statement and what is not?

The status of the putative "statements" is unclear and in need of further study. These instances do not provide strong evidence against the instrumental hypothesis. They may simply be cases in which the desired outcome is not simply a specific object or activity. Nim's behavior is instructive in this regard. He produced a large number of utterances containing signs such as *me*, *Nim*, *you*, *eat*, *drink*, and *more* in a wide variety of contexts.

These signs were not produced in the service of particular outcomes. Rather, his behavior reflected the fact that he understood that signing itself was highly valued by his teachers; sign production was known to elicit positive responses in general. The trick about these particular signs is that they were likely to be interpreted by his teachers as appropriate in any context, thus rewarded. Kanzi and Mulika did not use Nim's exact strategy. However, some lexigram use may reflect the fact that the behavior itself is highly valued by the experimenters.

In sum, when Kanzi uses lexigrams in natural contexts, he mands (Skinner, 1957). This behavior is surely communicative; the important point is that it does not require knowledge of words or symbols at all. Under the appropriate circumstances, a smile can serve the same function.

Food-Related Lexigram Use

What are lexigrams used to communicate about? A high proportion of the chimpanzees' vocabulary items are names of foods or drinks. In the Appendix describing one day's utterances, the primary topic of conversation was food (16 utterances). Most of the examples used to illustrate Kanzi's behavior involved food (juice, strawberry, tomato, etc.). Food lexigrams were the first ones to which the apes were exposed (Savage-Rumbaugh, 1986, pp. 215-216). Although the exact proportion of utterances related to eating cannot be determined because frequency data was not provided, the available information suggests that it was very high. In this regard as well, the pygmy chimpanzees' communication appears to be similar to that of other linguistic apes described in the literature. The prevalence of utterances related to food or drink is a fact about the chimpanzees' communication that needs to be explained in a principled manner. According to the instrumental hypothesis, this characteristic is simply a consequence of the fact that the apes use lexigrams to obtain desired outcomes, of which receipt of food or drink is the most highly valued.

Of course, children's early vocabularies also include many names for food and other desired objects; however, their vocabularies systematically differ in composition from those of the apes. Much closer comparisons between the vocabularies of apes and children in terms of composition, order of acquisition, and frequency of use would be revealing. It could be argued that some other, incidental difference between the experiences of the apes and children accounts for the differences in vocabulary composition and use; for example, perhaps food is somehow more important to apes than to children. Or perhaps it is simply that the apes talk about what is salient in their environment and that the experimental context happens to emphasize food. These alternatives should certainly be explored in future research; our prediction is that the apes should find it easy to learn to use lexigrams related to any desired outcome and difficult to use lexigrams that have no obvious relation to their needs. Food happens to be salient, both to chimpanzees and in Savage-Rumbaugh et al.'s context, but the same principle applies to favored activities such as chase, tickle, and play; favored objects such as blanket and stick; and so on.

On Naming

Our analysis suggests that the behavior of Kanzi and Mulika has a nonlinguistic basis and that it would be fruitful to begin

closer analyses of their performance in terms of task demands. In order to make this analysis more substantive, it is necessary to say something about what it is that the child knows about naming that the chimpanzee does not. We cannot offer a comprehensive discussion of naming here (see Petitto, 1984, in press-a, in press-b). We can, however, illustrate through two examples what the ape may be missing.

The first example is from Searle (1980), who was concerned with evaluating whether a suitably programmed computer could truly instantiate human intelligence or would merely simulate it in a restricted way. In Searle's *gedanken* experiment, a man is situated in a room and communicates with the world by exchanging written notes. He has been given a felicitous set of rules for generating scribbles on paper. To an outside observer, it appears that the man is communicating in Chinese. The notes he receives are in Chinese, and he responds with notes that are in fact grammatical, contextually appropriate Chinese sentences. Searle's point is that the man is performing as would a computer programmed to communicate in Chinese, but does not in fact know the language; therefore, neither would the computer.

The aspect of this example relevant to the present discussion is simply that although he does not know the language the man has nonetheless learned behaviors associated with communicative exchanges. He does not know what the symbols mean, but he knows how to produce sequences that others will interpret as appropriate. Similarly, chimpanzees such as Kanzi may not know what the symbols mean, but they know how to produce behaviors that observers can interpret; they also know something about the relation between particular communicative behaviors and their effects. As Searle's example suggests, the ability to produce behaviors associated with linguistic exchanges may be dissociated from knowledge of a language.

The second example is from the film, *The Miracle Worker*. Readers will recall the famous scene in which Anne Sullivan, who has come to teach Helen Keller, places Helen's hand in the water coming out of a pump, and fingerspells W-A-T-E-R. Helen suddenly realizes that the movements in her hand are the *name* for water. She has a sudden insight that things have names. She then becomes very excited and wants to know the names of many other objects. It isn't that she learned to fingerspell, or to use symbols to request things, or to respond with appropriate behaviors when someone signed in her hand. She attained an abstract kind of knowledge about the nature of names, which she could then deploy in learning and using names. We are not claiming that children necessarily experience this primal naming scene. Rather, the scene is powerful because it dramatizes in a single moment the child's acquisition of a kind of meta-knowledge about what names are. It is interesting to note that prior to this insight, Keller had learned to produce fingerspelled gestures and could use them instrumentally to mediate exchanges with adults.

It was clear to us from working with Nim that he never achieved this insight about the nature of names. He tried to respond appropriately to names and to produce them in a manner that would effect desired outcomes. However, he did not seem to realize that it was the name itself that mattered to his teachers. This aspect of his performance led us to question whether signing apes had in fact acquired the ability to name

(Seidenberg, 1986; Seidenberg & Petitto, 1979). It was also questionable whether the common chimpanzees in the earlier Savage-Rumbaugh et al. (1983) research had acquired this meta-knowledge; the fact that they had to be trained to use lexigrams over many trials suggested that they had not. Although it is not explicitly stated, it is clear that Savage-Rumbaugh et al. believe that because Kanzi learned to use lexigrams without arduous training, he had, in fact, attained the naming insight. If he knew what names were, he might not have had to be trained to use each one.

We view the data differently. What kind of performance would we expect to observe in a species that had certain kinds of intelligence (e.g., a limited ability to form associations of various sorts, an ability to recognize objects and classes of objects, an ability to attend and respond to the behavior of others in the service of obtaining desired outcomes, etc.) but lacked this meta-knowledge of what names are? We would expect behavior of exactly the sort that is observed in ape language studies, including that of Savage Rumbaugh et al. (1986). Chimpanzees who to a lesser-or-greater extent acquire many of the peripheral behaviors associated with *acts* of naming, but use these behaviors in oddly restricted ways because they do not actually know what names *are*. The degree to which these behaviors resemble those of humans will depend on the intelligence of the animal and the constraints of the experimental setting: Kanzi shows them to a great extent, Nim to a lesser extent, Koko the gorilla probably less still. The animals acquire behaviors such as forming certain arbitrary gestures or using arbitrary lexigrams, associating these behaviors with objects or outcomes, responding in systematic ways when these behaviors are produced, and using these gestures to mediate favorable outcomes (e.g., receipt of food). None of these behaviors are unique to language or to naming in particular. To a degree, the apes' behaviors resemble those of children. Still, they do not know what names are, and closer inspection reveals that their behaviors differ from those of people who do.

Our view is that Kanzi's behaviors are more like the use of tools than the human use of language. Tools are the instruments by which we attain certain outcomes. They are not symbols. It is clear from studies by Yerkes, Köhler, and others that chimpanzees have a rudimentary ability to use tools and solve problems. The instrumental use of lexigrams or signs reflects the adaptation of the ape's native capacities to the novel circumstances introduced in these experiments. In this way, their behavior is continuous with that of chimpanzees who are not language trained. That Kanzi adapted to these circumstances rapidly—and the manner in which he did so—is interesting and important. However, his behavior is consistent with the view that he performs like the man in Searle's room simulating communication in Chinese. To the extent that this meta-knowledge of naming has an impact on the acquisition and use of names, however, the simulation will never be perfect.

This analysis of Kanzi's behavior has the potential to explain key characteristics of ape language and cognition. There is now considerable data about the cognitive and linguistic abilities of apes in need of a unified account. Two specific features of the apes' performance need to be explained. The first is the dichotomy between their cognitive capacities—which are very good—and their linguistic capacities—which are evidently poor. The

second is the apes' specific lack of knowledge concerning names and naming. A direct account of both of these findings can be derived from the theory that language is the expression of a capacity that is specific to humans (Petitto, in press-a, in press-b; Seidenberg, 1986).

Apes present a paradox: Why should an animal so demonstrably intelligent exhibit such dismal linguistic abilities? Despite his ability to rapidly adapt to the experimental context, Kanzi's use of lexigrams falls into the instrumental pattern familiar from other studies. Studies by Savage-Rumbaugh, Rumbaugh, Premack, Menzel, and others have shown that apes possess a remarkable ability to solve problems and conceptualize the world, yet their behavior is quite rudimentary when carefully evaluated in terms of human language. In our view, the dichotomy between the apes' cognitive and linguistic capacities is the single most important finding to have emerged out of modern ape research.

This dichotomy provides strong evidence against the view that human language is only one of many expressions of very general capacities to think and learn (Bates, 1979; Bruner, 1975; Piaget, 1955). In terms of general cognitive capacities, the apes compare favorably to young children: for example, Chevalier-Skolnikoff (1976) has suggested that gorillas achieve the sensorimotor level of intelligence. The apes fail to acquire rudimentary linguistic skills despite their intelligence and despite the experimenters' best efforts to provide appropriate linguistic input. The disparity between the apes' cognitive and linguistic capacities can be explained in terms of the hypothesis that language involves a distinct mental capacity that is species specific. If language is the expression of a domain-specific faculty—universal grammar in Chomsky's theory—the ape lacking this faculty would fail to show the ability to use language even though its other cognitive capacities could be quite sophisticated. The ape might then draw upon these general cognitive capacities to simulate linguistic behavior to some degree. We believe that this is what studies such as Savage-Rumbaugh et al.'s (1986) show. In addition, they provide evidence that part of the human language faculty includes the capacity to understand that things have names. We see no other explanation for the fact that although we literally cannot stop children from using symbols to name objects, we cannot stop apes from using symbols differently, as tools.

On Gestures

Although we have focused on the use of lexigrams, Savage-Rumbaugh et al. (1986) provided another source of information concerning the apes' capacities that is suggestive: descriptions of their gestures. They considered both gestures and lexigrams to be examples of symbolic communication, and gestures were sometimes glossed as words. Again, however, other analyses are possible. Several types of communicative gestures have been identified in studies of hearing and deaf children (e.g., Petitto, in press-a, in press-b). Children's early communication consists of pointing, showing, and giving gestures that are used in a wide variety of contexts. These gestures are indexical; they are not used in reference to particular objects, but rather to index objects, locations, and events in general. A second type of gesture is instrumental (around age 12–16

months). These are universal, unlearned, context-bound gestures such as a child raising his or her arms to be picked up, extending an outstretched hand (palm up) to be given an object, or pounding the high chair table to get more food. Like the chimpanzees' use of lexigrams, the child's instrumental gestures have a very powerful effect on adults, who respond with desired actions. The indexical and instrumental types account for nearly all of children's empty-handed gestures (the most frequent gestures are those with objects in hand). A later, more advanced type of gesture is iconic (around age 16–20 months); these gestures contain a representational component: for example, a child makes twisting motions of the wrist as in opening a jar.

The contrasts among these types of gestures can be seen as follows. The pointing gesture (indexical) is literally part of the act of picking out an item for notice. The give-me gesture (instrumental) is literally the behavior used in the act of receiving (or taking), rather than a schematic representation of it. However, the twisting gesture is iconic because it preserves partial information about actions that are associated with opening jars but is not literally the jar itself or an enactment of the designated activity (i.e., the child does not actually open a jar.). The iconic gestures are important because they provide evidence that children are beginning to represent activities such as opening, not merely engage in them; however, they are still closely tied to action.

Petitto's analyses reveal some critical ways in which these gestures differ from names. One characteristic common to all the gestures is that they are used in reference to objects from different categories; that is, they do not pick out kinds (Macnamara, 1983). Pointing, for example, is the canonical behavior of this type; the same form is used in regard to an unrestricted class of referents. Other gestures are used in a similar manner. For example, a child will use a spoon with a stirring motion with cup in hand; according to some theories (e.g., Bates, Bretherton, Shore, & McNew, 1983), this motion is a gestural name for spoon. However, the child will also stir with a hammer, comb, and mirror (Petitto, in press-b). Thus, the stirring motion is not used with respect to a class of objects that forms a kind; hence, it cannot be a name for spoon. Even the child's early use of words differs from these gestures in terms of the range of referents considered. The child does not consider the possibility that the word *spoon* refers to an eating utensil, combs, and mirrors. Several other factors distinguish iconic gestures from words and signs. The use of iconic gestures is a relatively late development (around 16–20 months) compared with children's first words and signs (around 12 months). More important, iconic gestures without the relevant object present typically do not occur until after the child has acquired the corresponding lexical item. Finally, they occur with low frequency and nearly always to supplement a verbal or sign message during requests; this is wholly unlike children's words, which serve several semantic and communicative functions.

What struck us most about Savage-Rumbaugh et al.'s (1986) detailed descriptions of Kanzi's behavior is that lexigrams appear to have been used with referents as diverse as an object, a location, and an event. This suggests that his lexigram usage was more like the child's early use of gestures than the use of words. Moreover, there is a hypothesis that accounts for this behavior:

The positive outcomes associated with the use of a lexigram do not form a kind. They include such things as getting juice and going to the juice location. Kanzi's behavior would result if he were responding to these outcomes.

In providing examples of their apes' gestures, Savage-Rumbaugh et al. (1986) conflate the indexical and iconic types, terming both iconic (p. 218). The cited gestures include pointing (which is actually indexical) and making "twisting motions towards containers when they needed help in opening twist-top lids" (possibly iconic). Although these gestures differ from words, their status is very important. The characteristics of the apes' gestural communication cannot be established on the basis of these examples or those in other sources. However, there may be limitations on the chimpanzees' use of gestures that shed some light on their capacity to use symbols. Consider first the iconic gestures. Children produce iconic gestures such as eating with a spoon or bouncing a ball without the relevant objects in hand. In order to produce these gestures, the child must mentally encode or represent the relevant actions and objects from which they abstract the stylized gestures that are then used communicatively. Even children reared without the benefit of regular language exposure have been observed to generate such gestures (e.g., Goldin-Meadow & Feldman, 1977). To our knowledge, neither common chimpanzees nor gorillas have ever been shown to possess this capacity; in particular, they do not pantomime. The absence of iconic gestures and pantomime raises questions about the apes' capacity to mentally represent objects, actions, and states of the world. According to most theories, symbols index such mental representations rather than physical objects or states of the world. If the absence of iconic gestures and pantomime derives from an inability to form such representations, this would imply a limitation on the apes' capacity to use symbols. For this reason, it will be important to study behaviors such as "making twisting motions towards containers" more closely, examining whether they are imitative, or produced without the relevant objects at hand, or used communicatively.

Similar issues arise in connection with pointing. Most studies of "linguistic apes" describe indicating gestures and the use of pointing, but the precise inventory of such gestures is not known. Both Premack and Premack (1983) and Savage-Rumbaugh et al. (1986) report that language-trained chimpanzees were trained to point. However, there are several types of pointing (Petitto, 1984; Werner & Kaplan, 1963), the most complex of which are (a) denotative pointing to an object in order to draw another individual's attention to it and (b) instrumental pointing to obtain a goal (e.g., pointing to bottle and then pointing to mother to indicate desire to obtain the bottle). These types of pointing entail the capacity to designate or pick out an object or location with the intent of focusing an observer's attention on it. It is thought that wild apes do not produce these gestures (Parker & Gibson, 1979, p. 373). For example, they will not indicate the location of food to a conspecific by pointing or point to their mouths when they want to eat. Whether Kanzi's "outstretched arm and hand" gesture (Savage-Rumbaugh et al., 1986, p. 218) or manually indicating the correct alternative on the vocabulary test is similar to the more complex forms of pointing is unclear but worth investigating more closely. Constraints on the use of pointing may reflect the apes' inability

to designate or pick out objects or a failure to understand the communicative act of bringing another's attention to an object. If apes lack these capacities, it would greatly limit their ability to use symbols.

In sum, gestures are in some respects simpler, more basic forms of communication than symbols, yet even the chimpanzees' gestures appear to be more limited than those of children. The chimpanzees produce some gestures similar to those observed in 9- to 16-month-old children but seem to be limited in their use of pointing and iconic forms. The cognitive and communicative competences underlying the use of these gestures may approach the upper limit of the apes' capacities.

Conclusions

Behaviors such as Kanzi's are those that would be expected given the view that the capacity to understand that things have names is innate and specific to humans, but that many of the behaviors associated with *acts* of naming involve general kinds of cognitive abilities that are specific neither to humans nor to language. The view that language is simply an expression of general capacities to think and learn fails to account for the disparity between the apes' cognitive and linguistic capacities. Obviously these issues are far from closed; one of our main points has been that the available data simply do not discriminate among a range of possibilities. We do not mean to appear to be setting absolute upper limits on what Kanzi can do; we will just have to see.

In closing, we offer two general suggestions. First, the key issues in language acquisition research cannot be decided on the basis of individual utterances. There is a principled reason for this. Researchers (and parents) respond to utterances on the basis of their own knowledge of language. The problem, however, is to establish the meaning (or function) of the utterance for the child or ape, not the parent or researcher. Typically this requires evaluating the systematic aspects of the child or ape's performance across a wide range of utterances, carefully analyzed in terms of the contexts of occurrence. At best, provocative examples suggest fruitful areas for systematic research.

The fact that parents interpret their children's utterances in terms of their own knowledge of the language plays an important role in the acquisition process. The parents' goal is not to establish that particular gestures or utterances have particular meanings or functions. Rather, by responding as though these behaviors are meaningful, intentional utterances, parents ensure that children receive the input necessary for the eventual acquisition of full linguistic forms. A problem only arises when we take these attributions as primary data (as in the method of "rich interpretation"). Savage-Rumbaugh et al. (1986) are aware of this issue (p. 219) and have begun to develop empirical methods for verifying hypotheses about Kanzi's behavior. We have simply pointed to areas where additional evidence of this type is needed. Clearly, Savage-Rumbaugh et al.'s (1986) research represents a great advance over previous ape language studies in terms of the breadth of data that are provided. Although we have been critical of some aspects of their research, we hope it is obvious that this detailed analysis was only possible because of the wealth of information Savage-Rumbaugh et al. (1986) provided.

Finally, theoretical accounts of language and communication, and studies of child language, play an important role in evaluating animal communication. However, this research presents a double-edged sword. It would be useful if ape language researchers would draw more fully upon theories of language and communication. Much is known about the nature of words and symbols and their acquisition, but little of this research has penetrated studies of animal communication. At the same time, this research must itself be evaluated with a critical eye. One of the positive results of the studies by Savage-Rumbaugh and other animal language researchers has been to expose the limitations of our knowledge of the acquisition process in humans and the methods used in studying it. Alas, this makes it difficult to answer important questions concerning the communicative capacities of animals.

References

- Bates, E. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.
- Bates, E., Bretherton, I., Shore, C., & McNew, S. (1983). Names, gestures, and objects: The role of context in the emergence of symbols. In K. Nelson (Ed.), *Children's language* (Vol. 4, pp. 59-123). Hillsdale, NJ: Erlbaum.
- Bruner, J. (1975). From communication to language: A psychological perspective. *Cognition*, 3, 255-287.
- Carey, S. (1982). Semantic development: The state of the art. In E. Wanner & L. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 347-389). Cambridge: Cambridge University Press.
- Carey, S. (1985). *Conceptual change in childhood*. Cambridge: MIT Press.
- Chevalier-Skolnikoff, S. A. (1976). The ontogeny of primate intelligence and its implications for communicative potential: A preliminary report. In S. Harnad, H. Steklis, & J. Lancaster (Eds.), *Origins and evolution of speech and language. Annals of the New York Academy of Sciences*, 280, 173-211.
- Gardner, B. T., & Gardner, R. A. (1971). Two-way communication with an infant chimpanzee. In A. Schrier & F. Stollnitz (Eds.), *Behavior of nonhuman primates* (Vol. 4, pp. 117-184). New York: Academic Press.
- Goldin-Meadow, S., & Feldman, H. (1977). The development of language-like communication without a language model. *Science*, 197, 401-403.
- Herrnstein, R. J., Loveland, D., & Cable, C. (1976). Natural concepts in pigeons. *Journal of Experimental Psychology: Animal Behavior Processes*, 2, 285-311.
- Keil, F. C. (1979). *Semantic and conceptual development: An ontological perspective*. Cambridge, MA: Harvard University Press.
- Keil, F. C. (1986). The acquisition of natural kinds and artifact terms. In W. Demopoulos & A. Marras (Eds.), *Language learning and concept acquisition: Foundational issues* (pp. 133-153). Norwood, NJ: Ablex.
- Macnamara, J. (1983). *Names for things*. Cambridge: MIT Press.
- Markman, E., & Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive Psychology*, 16, 1-27.
- Parker, S. T., & Gibson, K. R. (1979). A developmental model of the evolution of language and intelligence in early hominids. *Behavioral and Brain Sciences*, 2, 367-408.
- Patterson, F. G. (1978). The gestures of a gorilla: Language acquisition in another pongid. *Brain & Language*, 5, 72-97.
- Petitto, L. A. (1984). *From gesture to symbol: The relationship between form and meaning in the acquisition of personal pronouns in Ameri-*

- can Sign Language*. Doctoral dissertation, Harvard University. (distributed by Indiana University Linguistics Club)
- Petitto, L. A. (in press-a). "Language" in the prelinguistic child. In F. Kessel (Ed.), *The development of language and language researchers*. Hillsdale, NJ: Erlbaum.
- Petitto, L. A. (in press-b). On the autonomy of language and gesture: Evidence from the acquisition of personal pronouns in American Sign Language. *Cognition*.
- Petitto, L. A., & Seidenberg, M. S. (1979). On the evidence for linguistic abilities in signing apes. *Brain & Language*, 8, 162-183.
- Piaget, J. (1955). *The language and thought of the child*. Cleveland, OH: World Publishing.
- Premack, D. (1976). *Language and intelligence in ape and man*. Hillsdale, NJ: Erlbaum.
- Premack, D., & Premack, A. (1983). *The mind of an ape*. New York: Norton.
- Savage-Rumbaugh, S., McDonald, K., Sevcik, R., Hopkins, W., & Rupert, E. (1986). Spontaneous symbol acquisition and communicative use by pygmy chimpanzees (*Pan paniscus*). *Journal of Experimental Psychology: General*, 115, 211-135.
- Savage-Rumbaugh, E. S., Pate, J. L., Lawson, J., Smith, S. T., & Rosenbaum, S. (1983). Can a chimpanzee make a statement? *Journal of Experimental Psychology: General*, 112, 457-492.
- Searle, J. R. (1980). Minds, brains, and programs. *Behavioral and Brain Sciences*, 3, 417-457.
- Seidenberg, M. S. (1986). Evidence from great apes concerning the biological bases of language. In W. Demopoulos & A. Marras (Eds.), *Language learning and concept acquisition: Foundational issues* (pp. 29-53). Norwood, NJ: Ablex.
- Seidenberg, M. S., & Petitto, L. A. (1979). Signing behavior in apes: A critical review. *Cognition*, 7, 177-215.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Werner, H., & Kaplan, B. (1963). *Symbol formation*. New York: Wiley and Sons.

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