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OPENING REMARKS

Welcoming Remarks: DORIS AARONSON, *New York University*
GEOFFREY LOFTUS, *University of Washington*
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SESSION II
INVITED ADDRESSES

PETER G. POLSON, *University of Colorado, Presider*

Chimpanzee language research: Status and potential

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The impact of ape-language research upon current thought pertaining to language and man in relationship to the apes is discussed within an evolutionary framework. Studies of apes can reveal certain requisites to the language skills of humans. Social adaptations are thought to be important to the evolution of those requisites. A review of ape-language research is made, with emphasis given to the problems of controls where work is done *en face* with the subjects, as where Ameslan (signing) is the system employed. The need for careful definition of what is a "word," and the need for tracing through experience how responses come to acquire meaning, hence "wordness," is emphasized. Levels of wordness are discussed which emerge initially from basic operants and performatives. Evidence is reported in support of the conclusion that it is through direct experience, through the pragmatic application and use of instruments, and through important social relationships that word learning is facilitated. Finally, it is noted that an important step of validation in our own work is in the successful application of methods emanating therefrom to work with mentally retarded children.

Man's egocentric view that he is distinctively unique from all other forms of animal life is being jarred to the core by research reports of this decade. On the one hand, biochemistry reports reveal that the macromolecular relationship between man and chimpanzee is much closer than was thought to be the case even 10 years ago (King & Wilson, 1975; see also Washburn, 1977, for a perspective). On the other hand, behavioral primatological studies systematically continue to defrock man of his trappings that would serve only to defend his uniqueness. No longer can he claim to be "the" tool user, as Benjamin Franklin initially noted. A variety of birds, mammals, and primates (notably the chimpanzee, e.g., Goodall, 1964; Teleki, 1974) use materials with a high degree of plasticity and adaptability. No longer can man claim that only his species transmits behavioral innovations, basic to culture, across successive generations. The Japanese monkey's innovations of washing sand from potatoes and of using tidal pools to separate, by flotation, wheat from sand, and the transmissions thereof through vectors of social communication have served to tarnish that brass tenet (Azuma, 1973). Now the ape-language projects of the past decade serve to question the conclusion that man alone is capable of language.

Language might yet prove to be the eternal bastion for man's egocentric need to define himself as distinctively unique from other animals: He alone normally acquires language, and notably speech, through the normal course of his development. The walls and plaster of the bastion have been seen to shower a bit of dust here and there, however, and to give evidence of perhaps even a crack or two through the course of recent years, for there is mounting evidence that although language per se might be unique to man, not all the requisites thereto are unique to man: Given systematic exposure to nonspeech linguistic alternatives that are marked by "openness," great apes (*Pan* and *Gorilla*, notably) have mastered the rudiments of language. The "openness" that characterizes human natural languages stands in marked contrast to all known descriptions of animal communication systems. So far as has been determined, no animal form in its

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feral state either adds new signals or words or alters signal meanings through mutually agreed upon rules of combined usage. However, the rich use of gestural signals seen in apes, particularly pygmy chimpanzees, suggests that considerably more openness exists in the communication systems of these primates than was initially perceived (Savage-Rumbaugh, Wilkerson, & Bakeman, 1977).

Although the origins of human speech and language might have been in radical mutations in early hominids, it is not likely that this was the case. The comparative perspective suggests that adaptations–physical and behavioral–have an evolutionary bedrock that can be mapped through studies of closely related animal forms, ideally, ones that are phylogenetically related.

Unfortunately, the precursors of modern man have vanished. They became extinct, either in fact, due to natural causes, or in principle, as their gene pools became hopelessly diluted by the intrusions of more advanced hominid forms. Apart from inferential studies of early man's artifactual and natural remnants (e.g., Marshack, 1976), the only approach to the evolution of language that is at all direct is through the behavioral studies of man's nearest living relatives, the great apes (Pongidae: *Pan, Gorilla,* and *Pongo*). Although the present day apes are branches of the evolutionary course that has led to man (*Homo*), they are, of course, not his phylogenetic antecedents. Man is neither a descendant nor an ascendant of the modern day apes. Both have evolved from some common root that they shared, perhaps as recently as 5 to 20 million years ago–just time for a brief catnap in terms of the geologic clocking of events. Consequently, it is reasonable to study the apes with the view that they might have carried through the courses of their own evolution the behavioral processes and potentials that are the underpinnings, the requisites, to the fantastic language skills of modern man.

What might those underpinnings be? We believe that they relate, to a considerable extent, to adaptations of cooperative abilities on the social scene (Rumbaugh, Savage-Rumbaugh, & Gill, 1977, Note 1). The richness and complexity of chimpanzee social behavior is, perhaps, several orders of magnitude greater than that of the lesser apes (*Hylobatidae*) and monkeys (*Cercopithecidae* and *Cebidae*). Many students of primate social behavior have retreated from the complexities of the apes' social behaviors to the relative simple-mindedness of the simians, only to find that even still, the problems of description and prediction are incredibly great.

What allows for the complexities of ape social behavior? It seems reasonable to us that it is because they have met important challenges of survival through cognitively mediated social behaviors, rather than through alternatives such as camouflage and nocturnalism. The pressures for the evolution of flexible, plastic, complex social behaviors were likely numerous, but they surely included the need for cooperation to enhance prospects for the procurement of food, security, and shelter, and the need for the differentiation of roles and "duties" as offspring became increasingly dependent upon prolonged maternal care for survival and as the associated span of years for their socialization became greater and greater.

Mason, Davenport, and Menzel (1968; also Mason, 1970) consider ways in which advanced cognitive competencies might have evolved in response to the social milieu. A primate that intermixes with several dozen or hundreds of its kind must be highly perceptive. It must be able to rapidly identify important units of information in an ever-changing social milieu, it must be able to calculate the odds of various consequences to alternative behaviors of which it is capable (and it must know those capabilities well), and it must generally succeed in the execution of decisions that it makes. Failure to do so threatens access to the nourishment and companionship essential to life. Additional threat comes from other animals, whose power and aggressivity may be expressed as though some code of conduct is at issue.

REVIEW AND ASSESSMENT OF LANGUAGE WORK WITH APES

Cognition, the one ability absolutely essential to language, is held by the authors to be an advanced form of intellectual function that provides for the perception of relationships among the attributes of diverse things and events. All learning holds the potential for enhancing adaptation through behavioral alterations. But, whereas classical and instrumental learning result in behavioral alterations through the selective reinforcement of certain behaviors, at times in combinations or chains, the behaviors so "learned" are essentially basic to the response repertoire of the organism. Conditioning can and does alter the morphology of responses and the occasions for selected responses to be manifest; however, conditioning does little more than to rearrange the basic response elements of an organism's capacity and their probabilities. By contrast, cognition can and does result in major alterations of an organism's behavior patterns, not through the arduous selective reinforcement of certain responses at the expense of others, but rather because of new comprehensions or understandings that come about through the emergence of perceived relationships. Based on generalized experience and a history of discerning similarities and differences among the attributes of things and events, an organism becomes cognitive in its functioning as some positive function of the complexity of its central nervous system and brain (Rumbaugh, 1970). The emergence of cognition and its attendant functions serves to expand an organism's options for behaviors that might prove adaptive, particularly when the challenge is essentially novel and where old established response patterns are not likely to be appropriate.

Interest in the question of the apes' abilities to learn

language probably dates back to those times when their identities first became known. So long as language and speech were viewed as identical, the ape would have to speak as though it were human for the question to be answered in the affirmative. But even in the 18th century, La Mettrie (1748, published in 1912) speculated that although apes might fail to learn to speak, they could possibly master a gestural language system. To La Mettrie, it was language that set man apart from the beasts, and should one succeed in teaching language to the ape, he would become gentled and would no longer be "a wild man, nor a defective man, but he would be a perfect man, a little gentleman. . . ."

The early part of the 20th century witnessed at least three serious attempts to teach apes to speak (Furness, 1916; Witmer, 1909; Yerkes & Learned, 1925); however, none of these resulted in more than one or two crude approximations of words. The most intensive effort was made by Keith and Cathy Hayes between 1947 and 1954, with Viki, a chimpanzee of the Yerkes Primate Center, then in Orange Park, Florida; but even that effort resulted in the learning of only four voiceless approximations of "mama," "papa," "cup," and "up." A few other vocalizations seemingly functioned as words (clicks of teeth, etc.), but as with all other chimpanzees, Viki appeared totally compromised in facile reproduction of speech sounds. The limited success with Viki serves to support the premise of Yerkes and Learned's (1925) statement that "an animal which lacks the tendency to reinstate auditory stimuli–in other words to imitate sounds–cannot reasonably be expected to 'talk.'"

The first successful efforts that demonstrated the probability that apes are able to acquire rudiments of language, if speech is obviated, were by Gardner and Gardner (1971) and by Premack (1971). The Gardners employed what they view as a natural human language, the American Sign Language for the Deaf (Ameslan), to establish two-way communication with their chimpanzee, Washoe. Premack used a synthetic language in which words were plastic tokens of various shapes and colors. His main goal was to study chimpanzee intelligence and to attempt a functional analysis of language through studies with Sarah, a chimpanzee. Both of these efforts yielded evidence in support of the tentative conclusions that the ape (1) can master responses that suggest that it has at least a minimum sense of wordness, and (2) tends to combine these seemingly symbolic responses into primitive phrases, which suggests the potential for sentences.

The Gardners started their work with Washoe in 1966. A trailer in the backyard served as the laboratory, and Washoe was given 24 h of attention in an Ameslan-enriched environment each day to promulgate her language learning. Because she was feral-born, her age at the start of training can only be estimated at about the 1-year level. With the intent of making Ameslan the major medium of communication, persons neither talked to Washoe nor to each other when in her presence. The importance of this step is difficult to assess, but it probably had no major effect by way of influencing Washoe's attitudes toward her language training. (Perhaps it served to emphasize the importance of skillful signing to her teacher-assistants, but that, too, is a moot point.)

During the first 7 months' training, Washoe mastered four signs. In the next 7 months, she learned 9, and then 21 in the next 7 months. At the end of 3 years, she had acquired 160 signs. Quite interestingly, Washoe started to emit more than one sign at a time, that is, she started to "string" signs together, very early in her training.

She also reportedly extended the use of her signs to a variety of contexts (e.g., she used the sign for "open" to a variety of doors, drawers, lids of briefcases, etc.), and she also extended the use of certain signs in ways that suggested alteration of their meanings (e.g., she used the sign for "flower" in response to the odor emanating from a tobacco pouch and to cooking food). Her human companions used these signs in a variety of ways and it is impossible in Washoe's case to determine whether such use represents an extension based on the uses she observed in the humans around her, whether they were mistakes that were richly interpreted and reinforced by her human companions, or whether they were Washoe's own generalizations. Interesting variations in composing requests do suggest that other than strict operant conditioning principles were dictating Washoe's productions (e.g., faced with locked doors, Washoe was reported to sign in various ways: "gimme-key," "more key," "open key help hurry," etc.).

The Gardners have demonstrated that Washoe does significantly better than chance on naming familiar objects presented through use of double-blind control procedures. Washoe was also "better than chance," although not highly accurate, in appropriately naming novel objects for which she had names (e.g., new examples of insects were better than chance named bug/insect). Interestingly, Washoe seemed unwilling to cooperate with naming trials when presented at a pace determined by the experimenters; however, she reportedly worked better, although still at fairly low levels of accuracy, when allowed to control or initiate the onset of a trial. That she was both uncooperative and well below 100% accuracy suggests that Washoe's training had produced only a ritualistic and context-specific learning of motor responses that worked well in context, but that could not easily serve as symbolic referents devoid of context. At best, it suggests that the situation was highly artificial and not conducive to Washoe's use of the signs in a fashion that would suggest her signs were equivalent to children's words, as Gardner and Gardner (in press) imply.

More recent reports of Washoe's performance in

response to an array of "Wh" questions (e.g., Who you?, Who go out?, Who's that?, What color?, What that?, What want?, Where we go?, Where shoe?, etc., where 7 of the 10 dealt only with who and what) were used for "test of the hypothesis that Wh questions exert grammatical control over replies" (Gardner & Gardner, 1975, p. 252). On the basis of detailed analyses, the Gardners concluded support for that hypothesis; however, several factors lead us to question that conclusion. First, there was no systematic control for the effect of the Wh sign per se within the 10 question frames used (Gardner & Gardner, 1975, p. 250). For example, if the second sign was "you," the first sign of the Wh frame was always "Who," never "Whose," "Where," or "What." If either the second or third sign was "go," the first sign for the Wh question frame was always "Who" or "Where," never any other of the Wh signs. Only in one fortuitous instance can it be concluded that there might have been opportunity for the Wh sign per se to have a determining effect upon Washoe's response, and that entailed the use of the sign for "that" in conjunction with the signs for "Whose" and "What," for composition of the question frames "Whose that?" and "What that?"[1] Consequently, the pervasive confounding between the specific Wh signs with the signs that followed in the 10 question frames makes it unwarranted to conclude anything at all as to the grammaticality of Washoe's responses; that is, that the Wh signs per se controlled the categorical appropriateness of her responses. Second, the demonstratives used (books, shoes, fruits, etc.), notably those used for the question frame, "Whose [item name, e.g., shoes] ?", were familiar to Washoe, allowing for the real possibility that her answers in this study (which sampled her behavior across questioners and days) might have been conditioned through prior training. Third, there was no control for "Clever Hans" effect–cuing by the six questioners. All Wh questions were addressed to Washoe with her being face to face with a given questioner, the very condition in which persons run maximum risk of cuing the subject, subtly and unwittingly, as to the response that will be adjudged correct, or appropriate to the Wh question frame in the case of this study. Quite contrary to the Gardners' affirmation that "productive tests of competence leave the subject free to respond with any and all items . . ." and that "this effectively eliminates the problem of Clever Hans cueing that haunts the forced-choice tests because any hints given in a productive test must contain as much information as the correct replies" (Gardner & Gardner, 1975, p. 256), the risk of cuing is at a maximum in any test situation in which the subject and experimenter (Washoe and questioner, in this study) address each other face to face and in which the majority of the responses are single signs (270 out of 500 = 54%). Cuing need not contain as much information as the response that it controls; rather, it might only index a response or serve to encourage some signs and to inhibit others. That the Gardners are so cavalier about their notion that the production of signs by Washoe serves to control for Clever Hans effects is not consonant with the experimenal method, which dictates that controls must be implemented, not just concluded. Fourth, grammar subsumes the effects of word order; however, in no way did Washoe's ordering of her responses serve to modulate meaning or correctness of the answer. For that matter, in no instance has data from Washoe been reported that she appropriately decodes, in the absence of rich contextual cues, novel questions or commands and responds with equally appropriate answers in which word order modulates meaning in an unequivocal precise manner.

Project Washoe has contributed the following: (1) evidence that a chimpanzee might acquire something similar to the "words" of a natural human language; (2) evidence of a readiness to emit a string of responses as an answer, where many of the responses relate to the context; (3) evidence of an ability either to emulate the signs of others in new problematic situations or to extend use of signs so as to suggest logical selection of one signing alternative as the best among others or to suggest redefinition of the sign. Equally important, Project Washoe has not provided the basis to conclude any of the following: (1) that Ameslan signs, when used by a chimpanzee (*Pan*), are the symbolic and functional equivalent of words used by humans; (2) that a string or chain of signs is other than the chimpanzee's emitting all responses that are singularly appropriate (e.g., that they are not to be taken as primitive phrases or sentences); (3) that a chimpanzee is reliably able to decode novel messages or requests expressed through Ameslan and to respond with new, appropriate, and correct answers, independent of contextual and nonverbal cuing.

That Project Washoe, through the dedication of the Gardners and their assistants, helped to open a new area of research–language studies with chimpanzee (*Pan*) subjects–is of great credit. Nonetheless, because of the extraordinary importance of the questions addressed through that line of research, it is mandatory that we be disciplined in our conclusions and unwilling to conclude liberally and richly on the basis of a modicum of data. It is important that we know with confidence whether the signs of Washoe are a reflection, a flash of genius of one *Pan*, or only mindless flashes in the proverbial pan.

Essentially concurrent with Project Washoe was the initiation of Project Sarah by David Premack, then of the University of California, Santa Barbara. Premack's (1971) goal was quite different from that of the Gardners. Whereas they were interested in determining whether two-way communication between man and chimpanzee might be established through use of what

they viewed as a natural language (Ameslan), Premack was interested in the operations of chimpanzee intelligence. His approach was to define the basic operations of language and then define training procedures to teach them. In his view, it is possible to inculcate language through a variety of response systems and sensory channels in any of a variety of animals because language is a simple set of operations. His techniques were more consonant with traditional laboratory procedures. Except for a time during her infancy, Premack's subject (Sarah) was maintained in a rather traditional laboratory facility. She was trained on a discrete-trials basis with limited options for response and expression, for Sarah's words were pieces of plastic of varied shapes and colors. Only to the degree that they were available to her for assignations on a metal board might Sarah "speak." By contrast with Washoe's access to Ameslan, Sarah's access to a lexicon was consistently limited not just to her ability to learn, but to the experimenter's option to extend or to deny availability to the plastic word units, that option being predicated by the task of training and testing at hand.

It can be concluded (Gardner & Gardner, 1977) that Premack's Sarah did what she did only because of learning sets and rapid new learning in a situation where the option to be in error was delimited by the number of plastic word units available to her. This is not necessarily to the embarrassment of either Premack or Sarah, for that matter, for the purpose of the research was quite different than that of Project Washoe. Recall that Premack was attempting an operational analysis of language and how small segments thereof might be taught to a chimpanzee, or any other animal subject. His goal did not include that of establishing two-way communication, skillfully, logically, and engagingly sustained. Although the hard data in support of Premack's (1971) conclusions regarding an array of Sarah's "linguistic" skills might be relatively lacking, there is no doubt that Premack, with Sarah, contributed significantly to theoretical perspectives as to what language might be, what its basic behavioral and cognitive operations might be, and how programs for its instruction might be written and assessed.

YERKES LANGUAGE PROJECT

Description of System

Language work with apes began at Yerkes Primate Center in 1970, with one young female chimpanzee, Lana. She was to serve as a pilot animal and the immediate goal of the initial Lana Project was to advance the state of the art for research methods in the emerging field of ape-language research (Rumbaugh, 1977). The intention was to bring computer science and technology to bear upon work with the apes to objectify the effort, to remove doubts as to the words and order of words expressed by the ape subjects. Expressions in Ameslan leave no record for reference, and while the plastic tokens used by Premack (1971) do leave an empirical residue or product of their use, there is no efficient manner of recording it if there is a high rate of usage. Expressions in Ameslan are also subject to errors of interpretation; subjects differ in crispness, the definition of their signs, and this factor coupled with "dialects" and drift in the formation of signs and the production of them in series can make for equivocation and confusion. Plastic word tokens avoid this problem but they have other shortcomings: They can be dropped and mismanaged by the subject, and only if they are accessible can they be used to formulate expressions.

Quite apart from these factors is still another key to initial considerations that shaped Project Lana: If language work with apes were to have logical and meaningful extensions to work with essentially alinguistic mentally retarded children or other persons with profound problems that mitigate against speech and fine motor control, a simplified method of word production and word concatenation was necessary.

Another important factor in the shaping of the project with Lana was the need for experimental control. The maximum risks of cuing when working with chimpanzees face to face have been discussed in reference to use of Ameslan. The provision for totally obviating such risks was incorporated into our system. That provision entailed the use of projectors for the transmission and reception of messages between man and ape as they work in visual isolation at separate keyboard stations. Isolation of man and ape was not mandatory during training sessions, in which the two frequently worked together at the ape's station; however, such isolation has always been used in formal tests to determine the subject's mastery of specific linguistic skills (as in the naming of objects or declaring their colors, or in the ability to track the experimenter's statements within the dynamic exchange of conversation; i.e., Gill, 1977a). The use of the projectors to effect isolation between man and ape for purposes of control in specific tests has been in conjunction with other standard experimental control methods (novel first-trial tests in the naming of objects and their colors, use of projected materials, novel problems contrived for studies of Lana's conversational abilities, the color naming of hundreds of novel color chips, tests of cross-modal skills, etc.) discussed within the book on the Lana project (Rumbaugh, 1977).

The method decided upon for Project Lana was, then, to use a computer-based system in which distinctively coded keys on a board would function as words. Selection and depression of them would produce visual facsimiles for reference in the formulation of a message and for reading of messages received from other stations. The computer would serve to monitor

all linguistic events, to evaluate their grammaticality, to honor correctly formulated statements of request, and to record all events for future reference and analysis. Grammaticality was to be defined in terms of the correlational grammar written by von Glasersfeld (1977) for the synthetic language, Yerkish, to be used in the research program. Yerkish clearly was not a natural human language, but that is an irrelevant point since Yerkish clearly served as a meaningful approximation of a natural human language. It was, however, simple enough to be brought under computer control–something that is extremely costly even to attempt with the ambiguities and transformations of natural languages. Yerkish did allow for rewrites, for making requests in a variety of ways. Importantly, its grammar could be comprehended by a relatively small computer, a PDP-8E. Thus, the question could be asked, "Would a chimpanzee learn a synthetic language, and would it evidence sensitivity to the rules for word combination written for that language?"

The computer allowed for around-the-clock operations, regardless of the presence of human operators and teachers. It also allowed for the instruction of language functions through interactions between the subject and training programs under contingent control. Although this was not incorporated into the original work with Lana chimpanzee, we are on the verge of being able to have our present subjects (five chimpanzees and six children) interact with the computer in conversational and instructional ways. Thus, what now transpires between human and chimpanzee (or child), each with their own keyboards, might transpire between the subject and the computer under the control of various programs that are sensitive to the dynamics of a linguistic exchange.

Each key is differentiated from the others by a distinctive geometric figure, termed a lexigram, that functions as a word. All lexigrams are composed of one or more of nine basic stimulus elements (a dot, a wavy line, a cross, a diamond, a square, a circle, a triangle, two parallel lines, and a vertical line), with word class being potentially differentiated by background coloration. The keys were designed to allow for their relocation on the board so as to disambiguate key position from its lexical definition or function. Recent developments entail the placement of plastic sheets, each with its own array for lexigrams, over the front of the keyboard, a procedure that expedites the relocation of lexigrams. Keys that are active are backlighted; those that are inactive at a given time are not. When a key is depressed, it becomes more brilliant, a cue that both ape and children subjects soon check as they press keys in a series. Facsimiles of the lexigrams on the keys depressed are produced from left to right on an array of IEE projectors. Thus, the subjects have two ways of verifying their expressions: the brilliance of the keys and the productions of the projectors. Depression of the PERIOD key signals the computer to evaluate and to record and, possibly, to activate a vendor for food, a slide, a movie, or a retractor for a blind so as to avail a view of the out-of-doors.

Language-Relevant Findings

The pilot animal, Lana, was successfully engaged with the computer-based system to a surprising degree. Her accomplishments, which have been described in detail elsewhere (Rumbaugh, 1977), reflected what appeared to be a cognitive and symbolic processing of lexigrams that could only be explained by at least a primitive type of linguistic information processing capacity. However, with only one animal, and a technology constantly evolving, it was impossible to do more than document Lana's accomplishments. Hence, in 1976, the project was expanded to include additional animals, Sherman, Austin, Ericka, and Kenton, so that specific questions dealing with critical issues, processes of language acquisition, and use might be addressed.

Lana's initial language training entailed use of a single key, rewarded by the delivery of an M&M candy. A modified form of holophrastic training was used, which essentially resulted in the depression of one word key activating all words that might be implied in a phrase as used by a child (e.g., "cookie," might imply, "Please give me a cookie, Mother."). Systematically, the word keys of the first sentence Lana learned–PLEASE MACHINE GIVE M&M.–were separated and randomly assigned within a 5 by 5 word-key matrix so as to require that Lana search and serially select words in accordance with the a priori grammar (von Glasersfeld, 1977).

Within the first few months' training, Lana learned a number of "stock sentences," which she used to obtain various foods and drinks and forms of "entertainment" (movies, slides, music, a view of the out-of-doors) 24 h of the day. The meanings of certain words of those sentences were selected for special differentiation; for example, from the stock sentence, PLEASE MACHINE GIVE PIECE OF APPLE, the last word was deleted and the names of other foods (chow, bread, banana, etc.) substituted in association with their availability in the vending devices, which were in her view.

Although Lana came to use reliably the various sentences to obtain the appropriate items, the meanings of these words to Lana, and the process whereby she came to use, for example, "apple" when an apple was in the dispenser and "ball" when a ball was outside her room, were not well understood. Was Lana's use of various sentences to obtain specific items she desired simply a complex set of instrumentally conditioned responses, as has been suggested by others (Gardner & Gardner, 1977; Mistler-Lachman & Lachman, 1974; cf. Rumbaugh, Gill, & von Glasersfeld, 1974), or did

it reflect a symbolic understanding and use of the lexigrams? Because the issue of "wordness" is so crucial to all linguistic processes, and because its emergence was unclear in Lana, as well as in reports dealing with this phenomenon in Washoe and Sarah, we decided to investigate this issue in a much more specific fashion as the project expanded with the addition of new animals.

Were Lana's "stock sentences" simply conditioned responses? The answer, following intensive work with four additional animals (see Savage-Rumbaugh & Rumbaugh, in press, for details of training procedures with these animals), is a qualified no. No, these behaviors were not simple instrumental responses; however, they also were not, at this early point in Lana's training, able to stand as independent symbolic referents regardless of context. This question was addressed by attempting, with intent, to establish instrumentally conditioned associations between single words and their referents in the new subjects. With behaviors that were known to have been developed in this manner, we were provided with a proper baseline from which to assess the effects of known instrumentally conditioned responses.

The association of a word lexigram with a food or drink suggests the course of events through which meaning is accrued. Initially, it was found that the depression of a key is learned because it results in the delivery of an ingestible item. At first, the location of the key on the board, and not the lexigram on its surface, is the most important cue for its selection and use. Only through frequent relocation of that key, along with others, does the subject come to attend to the lexigram, to differentiate it from others, and to actively search for it whenever a specific item is made available.

Even so, there is the strong indication that only gradually does the lexigram accrue symbolic representational value for each food and drink in turn; for in early training, it seems that if each item is used only as an exemplar, with the subject being denied direct access to and ingestion thereof, that the subject soon becomes confused, then begins to fail in the selection of the word lexigram that stands for that item.

This observation has been reinforced by a variety of training experiences, but none was more convincing than one in which food items were encased in plastic, the subject was asked "to name" them, and correct naming behavior was rewarded with some other item of food or drink. Initially, the chimpanzees named the items correctly, but very shortly they apparently became confused, we believe because they experienced something other than that named as reinforcement. The chimpanzee is an extreme pragmatist. Foods and drinks as named must be experienced through ingestion, lest confusion overpower discriminative processes of early training.

Eventually, however, word lexigrams do serve as symbols to represent things and events not necessarily present or ongoing in the here and now. It is likely that symbolism results from training experiences that decontextualize a word lexigram and its functional value. Initially, as stated, a given word lexigram might not even have been attended to by the chimpanzee subject, as it seems prone to use location of a key and not its distinctive lexigram, given the opportunity to do so. But gradually, it does come to attend to the various lexigrams in highly discriminative ways: Positions of keys and their lexigrams exchange relative potencies for selection and use, and further, positions and lexigrams become differentiated, a requisite to symbolic operations and representation of referents.

Through training in which the item is dispensed when appropriately requested (GIVE BEANCAKE, POUR ORANGE DRINK, etc.) and through other training in which the subject has to select one of several lexigrams (presented on the projectors above the keyboard or on small placques) that names the item held by the experimenter, or in which the subject must select the one of two or three foods that is named by the experimenter (through use of the projectors), a lexigram becomes a symbolic representative of a thing or event. Too, there is no doubt of the likelihood that the chimpanzees do "learn how to learn" language skills, to attend to certain sets of stimuli (as from the lexigrams) and not others. Facile language learning and use surely rests, in part, on the compatible operations of numerous learning sets (Harlow, 1949), individually activated on some occasions and functioning in supporting concert in still others. Were it not for adept formation of learning sets and their use, performances that suggest language learning by chimpanzees might be nothing more than ethereal signs in the skies of Nevada, bits of flotsam and jetsam on the beaches of California, or immutable operant chains on a computer-monitored keyboard in the peach groves of Georgia. However, to suggest, as Gardner and Gardner (1977) have, that all of these language-like skills (observed in those animals using the Yerkes system) can be explained by learning set principles is a far too simplistic, naive, and unproductive conclusion.

Rather than saying that a chimpanzee "knows" or "has" a certain number of words, it appears that it is more appropriate to speak of "levels of wordness." "Words" may, at first, be simply conditioned associations between symbol and referent. Later, important but generalized correspondences between word usage and environmental occurrences become perceived. At this level, the chimpanzee word usage is most aptly described as "performative" in the sense used by Greenfield and Smith (1976) to distinguish very early word usage in children.

A "performative" is a word that often accompanies

certain events, and by adult standards is properly used in those contexts, but does not really act as a communicator. This is followed in the chimpanzee by the perception of correspondences between word usage and environmental occurrences; that these are more than just happenstance, that word usage can, in fact, be used to mediate and control environmental occurrences, both the actions of others and in the case of the Yerkes animals, the actions of a computer.

Simple conditioned associations between word and referent do not, we have found, lead to such understanding. Thus Lana's proficient use of "stock sentences" to control her environment cannot be accounted for solely through instrumental conditioning.

However, there are still higher levels of wordness. A word, as used by human beings, functions quite adequately even when the referent is entirely absent. Additionally, word symbols can represent a certain set of things easily used in speech while yet a different set of things is actually being handled and experienced.

If a chimpanzee could use symbols in these ways, one would expect that, for example, with symbols standing for various foods, the chimpanzee could do two things. First, it could request a certain preferred food that was unavailable, and in accordance with the reply that the food would or would not be obtained, it should evidence excitement or dejection. Such responses would easily be differentiated from any sort of classical conditioning to the word symbol because they would not be a response to the symbol itself; rather they would be a response to information given about the referent of a symbol, although the referent was not physically present. Second, the chimpanzee should be able to converse and properly answer symbolic questions about certain foods while ingesting others as a reward. The chimpanzee should not confuse the names of food under discussion with the names of the foods being consumed, even though the ingested foods might also, at times, be a part of the discussed foods and vice versa.

There is no evidence that Lana was able to use symbols in either of these ways at the completion of her request (stock-sentence) training. Lana then received specific training on the names of various objects, foods, and later, colors (Essock, Gill, & Rumbaugh, 1977; Gill, 1977a; Rumbaugh & Gill, 1977). To this point, there was no true language function to be inferred; the sentences Lana used had been conditioned through operant principles and single-word training was given to her in the interests of giving her a working vocabulary for eventual comment and discussion regarding aspects of her environment.

During this training, Lana learned to name, in a more abstract sense, the objects that she had previously received whenever she requested them if they were available in the machine for vending. Because this training required that Lana only label, not receive, specific objects, there was no connection between symbol usage and environmental occurrences (i.e., use of the word "ball" or "M&M" did not cause either the machine or a human companion to give her such an item). Instead, use of a particular word resulted simply in a judgment of correct or incorrect. Thus, it was required of Lana at this point that symbol usage be independent of general environmental occurrences.

The fact that Lana required 1,600 trials to be able to use words she already knew as labels devoid of context strongly suggests that prior to this training, these words functioned more or less as performatives. The next phase of Lana's training required that she learn to label six new objects and six colors.

Training on these items began using the labeling paradigm, ?WHAT NAME OF THIS, or ?WHAT COLOR OF THIS. No prior training in which these words might first come to be conditioned associations, then performatives, was given. Lana did come to learn these names and colors, although with considerably greater difficulty than was expected.

Later, attempts with additional animals to begin language training at this level (naming colors and objects) was completely unsuccessful. Even after the other animals had progressed through various levels of wordness with many words, initial instruction regarding new words using a name or labeling paradigm proved problematic. Performance was invariably erratic, being extremely high on some days and discouragingly low on others. The animals also evidenced negative attitudes toward and complete disinterest in this type of training. If, however, the words to be learned were allowed to connect with environmental occurrences in a direct, perceivable, and functional manner, learning proceeded rapidly and performance was stable.

Thus, just as food names were initially associated with ingestion of the food, object names were readily learned when a specific function and use was assigned to an object. It was also critical that the function of an object be contingent on the particular properties of that object, that these properties initially not overlap, and that they be understood and perceived by the chimpanzee. As these conditions began to be met and refined, through concentration on those things that animals seemed ready to learn and use and deletion of those things that proved to be problematic, we found that in the end what had begun to take shape was a "tool kit," a group of tools, each with a different form and function. These tools, and their maintenance rather than wanton destruction, were important to the animals to the degree that they were meaningful as food-obtaining implements or as important parts of social interchange.

While this fact may have significant implications regarding the origins of language in our own species, we remain, at present, hesitant to draw direct connections. Nevertheless, it is noteworthy that the

importance of function, as regards the learning of names and objects, was not a factor that we had set out to demonstrate, or even one whose import was considered in advance. Its importance was repeatedly emphasized by the animals themselves, in terms of what was easy for them to learn, on the one hand, and what was impossibly difficult, on the other. Also, it has become clear that the reason that function is so important is that it is through joint cooperative action and attention to how objects are used that the chimpanzee acquires the need to communicate with us, so as to cope with the demands placed upon it in language training situations.

It seems that at least initially, in the case of the chimpanzee, the meaning of an object name lies not in the shape, color, or general physical attributes of an object, but rather in its use. Thus "keyness" is the property of making doors openable and is not the small brass oblong object. Attempts to teach "key" by holding one up as an exemplar and encouraging, by various means, the chimpanzee to name it, might go on for weeks or longer to little avail. If, however, one links "keyness" to the operations of opening doors of consequence, then the word is learned in a matter of hours. The same can be said for a number of other items with which we have worked.

The case for the importance of function in name learning is made particularly clear in the learning of names for tools. If the chimpanzee needs a particular tool and needs help in using that tool, then it becomes important that the proper tool from among a set be chosen and that both human and chimpanzee address their joint attention to the selection and use of the tool. If each is choosing and employing separate items, the effort will not be successful. Thus, joint attention and cooperation must be solicited in such an undertaking, and this requires communication.

The sort of communication required is quite different from that of a descriptive labeling of the world, with the main motivation being that of expressing the "correct" word. By contrast, the motivation behind communicative acts that seek to engage mutual attention and cooperation is of a much more pragmatic nature. Interestingly, Bruner (1975) has pointed the way toward a similar view of the process of language acquisition in human children, stating that, "language is a specialized and conventionalized extension of co-operative action. To be understood properly, its acquisition must be viewed as a transformation of modes of assuring co-operation that are prior to language, prior both phylogenetically and ontogenetically" (p. 2). Bruner goes on to note that while most linguists were, in the past decade, concentrating their study upon the structure of utterances without regard for the context or objective of the utterer, a group of philosophers was beginning to examine the way in which ordinary language is used (1975, p. 3). These two factors, (1) the necessity for joint attention and communication, and (2) the importance of the context and the objective of the utterer, are closely linked, we believe, to the chimpanzee's necessity to link object symbols with functional uses. It is the joint orienting of attention of teacher and chimpanzee to the contextual surround and to the implements used to alter that surround in a desired way that promotes effective and meaningful language acquisition and communication.

By contrast, a simple learning of names (e.g., box, bowl, shoe, pants, shirt, etc., to objects as they are held up as exemplars) engages the animal in no form of joint attention essential to coping with a problem. It gives no motive for communication. It merely poses a technical question and, if the description is judged correct, the animal is informed of the correctness of its responses via reinforcement. Such interactions may be symbolic, they may even be termed language in a limited case; however, they can never be termed communication.

The need to select and to use a specific tool does, however, require joint communication and joint attention. Here we find for the first time a nonarbitrary, close, and important link between the processes of symbolization and tool use in the chimpanzee. Is this an artifact of training procedures and biases of the researchers? Or does it reflect a close linkage from the beginning in the origins and functions of tool use and language in our species? We do not yet know, but pursuit of knowledge in this area with chimpanzees as subjects might provide us with unique perspectives and insights.

DIFFERENTIATION OF FUNCTIONS DIFFERENTIATES MEANINGS

Confusion in the chimpanzee's learning of names of things can arise if two or more things have similar functions.

The tool kits for each chimpanzee in our project include an assortment of items, including a small magnet and sponge, each on a long string. Each can be lowered into a tube, 4 ft tall and 3 in. in diameter. Drinks can be obtained from that tube through the chimpanzee's use of the sponge, repeatedly dropping it into the tube, extracting it, sucking the liquid from it, and so on. Metal objects can be extracted from the tube through similar use of the magnet. Thus, both the sponge and the magnet on their strings have similar functions in one sense of the word: They both can be used for extracting things from the tube.

After Sherman chimpanzee had learned to ask for and to use the sponge as described, and after he had learned to ask for and use a key to open a padlock on a door and to ask for and to use money to "buy" pieces of food from a vending device (with the assistance of the teacher), an innovation was instituted. Whenever

Sherman needed money or a key and asked for it, it was dropped down into the tube, not handed to him as before. What to do? With demonstration and encouragement, he rapidly learned to use the magnet whenever it was money or the key, and not a drink, to be extracted from the tube. But then, on October 24, 1977, on one occasion when Sherman by mistake requested, and got, a sponge rather than a magnet, a series of events served to differentiate the functional properties of sponge and magnet.

Sue: ?SHERMAN WANT BREAD. 15:03:42
Sherman: GIVE SHERMAN BREAD. 15:03:45
Sue: YES, SUE MOVE BREAD. 15:03:49
(And Sue went out of the room, cut up bread, and loaded it into the money-operated vendor as Sherman watched.)
Sherman: GIVE MONEY. 15:04:41
(A requisite to the purchasing of the bread.)
Sue: YES, GIVE SHERMAN MONEY. 15:04:17
(Sherman was given more money and bought another piece.)
Sherman: GIVE SHERMAN MONEY. 15:05:28
Sue: SUE MOVE MONEY. 15:05:28
(Whereupon, instead of giving the money to Sherman as before, she dropped it into the vertical tube.)
(Holding magnet:)
Sue: ?SHERMAN WANT THIS. 15:05:42
Sherman: GIVE SPONGE. 15:05:44
(Sherman whimpered as Sue put the magnet back into the tool kit. Sherman seemingly recognized that he needed that magnet, but he had said, "Give sponge.")
Sue: YES, GIVE SPONGE. 15:04:47
(And Sherman went to work with the sponge. He dropped it into the tube, pulled it up, looked at it as though to find the money on it. He lowered it again, shook the cord, appeared to listen for the "click" as heard previously whenever money or the key became attracted to the magnet, pulled the sponge up, and again seemingly looked for the money–which was not there. Then he stuffed the sponge and the entire length of string down into the tube. Sue looked quizzically into the tube, then at Sherman, whereupon he returned to the keyboard.)
Sherman: GIVE SHERMAN MONEY. 15:05:54
Sue: YES, SUE MOVE MONEY. 15:06:01
(And she started to drop another piece of money down the tube. In apparent response to seeing this about to happen, Sherman whimpered and tried to block her hand from so doing through use of his own. He did not try to ask for anything more; consequently, Sue showed him the magnet in the tool kit and asked:)
Sue: ?SHERMAN WANT THIS 15:06:09
(and pointed to the magnet.)
Sherman: GIVE SHERMAN (pause . . .)
WANT BLANKET 15:06:13
(The blanket key was adjacent to the one for magnet on the keyboard, and his selection of it might have been just an error. However, he often does ask Sue for either the blanket or for a tickle when under the duress of executive decision and threat of possible failure. Not knowing what his trouble was, Sue said through use of the keyboard:)
Sue: NO. 15:06:17
(She would not give the blanket.)
Sue: THIS MAGNET. 15:06:18
(And she pointed to it in the kit.)
Sherman: GIVE MAGNET. 15:06:18
(And he quickly used it to retrieve the money for more bread.)

As stated, similar function can produce confusion; however, clarification of that confusion, as through the kind of episode just presented, serves to define important differences between both functions of things and the words that represent them.

LEARNING THE NAME OF AN INFANT CHIMPANZEE

It has been argued that if an object has a well defined function that will facilitate the behavior of the chimpanzee subject, name learning will be facilitated. An experience that centered around the introduction of an infant chimpanzee to one of our subjects, Sherman, strongly suggests that social relevance might also be a powerful determinant of name learning. It should come as no surprise if such proves to be the case, for the chimpanzee is perhaps the most social of the nonhuman primates.

The second author, hereafter referred to as Sue, was carrying the 2-week-old infant chimpanzee, Columbus, ventrally as she entered the room where Sherman was working on language. The purpose was to get Sherman acquainted with Columbus, an important step, because from infancy Columbus was to receive exposure to Yerkish and its use by other chimpanzees. Sherman's intense interest in Columbus had not been anticipated. Sherman appeared to want to hold Columbus. To distract him, Sue tried to interest him in a highly preferred food and asked, "?SHERMAN WANT PUDDING." (10:11:27).

Sherman ignored the offer, a surprise in view of the fact that never before had he rejected pudding–one of his favorites. Moreover, Sherman kept trying to pull Sue's hands back from Columbus so as to gain closer contact with him. Sue decided to tell Sherman his name, so through use of the keyboard she said, "THIS COLUMBUS." (10:11:36), to which Sherman responded by repeatedly pressing that key: COLUMBUS, COLUMBUS, COLUMBUS, COLUMBUS, COLUMBUS," (10:11:36 to 10:12:48). Sue replied, "YES, COLUMBUS," (10:12:50).

Sherman also tried continually to gain more intimate contact with Columbus by pulling, tasting, smelling, and feeling him whenever he could. In another effort to distract him, Sue said, "?TICKLE SHERMAN." (10:13:22).

Sherman almost always wants to be tickled, but this time replied only, "COLUMBUS." (10:13:23). Sue answered, "YES, COLUMBUS." (10:13:28). Once again she tried to distract Sherman by asking him if he wanted to be tickled: "?TICKLE SHERMAN." (10:13:50). With suggested disinterest, if not frank indifference, Sherman responded, "TICKLE" (10:13:52), to which Sue confirmed, "YES, TICKLE SHERMAN." (10:13:56).

As stated, Sherman usually enjoys being tickled, as suggested by the fact that he typically responds with the statement, "GIVE SHERMAN TICKLE," rather than just "TICKLE," as he did on this occasion.

Also, he generally assumes a pronounced play face and begins to bounce around the room in apparent anticipation of being tickled; but this time, he did not do so. Rather, he just accepted the tickling and did not return any play to Sue.

Unable to get Sherman to eat or play, she asked, "?WHAT SHERMAN WANT." (10:14:54). Sherman responded, "COLUMBUS." He clearly wanted to hold Columbus. He pulled firmly on his hands and feet and whimpered for him. Sue was hesitant to give Columbus to Sherman, for Sherman was inexperienced and Columbus was so very young. Sue's continued efforts to distract Sherman failed; but he persisted, "COLUMBUS." (10:14:29). Sherman continued, "COLUMBUS. YES COLUMBUS. YES COLUMBUS. YES THIS COLUMBUS. COLUMBUS" (10:15:31 through 10:19:52). Sue acknowledged, "YES SHERMAN [this is] COLUMBUS." (10:19:10). To clarify that Columbus was his name, she also pointed to Columbus.

Sherman confirmed, "COLUMBUS." (10:19:52). But he continued to whimper louder and louder for Columbus to be given to him. As Sherman had indicated so much positive behavior, Sue finally decided to let him hold Columbus for a few minutes. She said, "YES, GIVE SHERMAN COLUMBUS." (10:19:57). Sherman promptly replied, "GIVE SHERMAN COLUMBUS." (10:20:12) and "YES GIVE SHERMAN COLUMBUS." (10:20:12) and " YES GIVE SHERMAN COLUMBUS." (10:20:17). The transfer of Columbus from Sue to Sherman's ventrum was made very carefully, with Sherman cooperating in every way. He promptly cradled the infant low on his ventrum, supporting it with his thigh and hand. After a few seconds, Sue took Columbus back from Sherman and Sherman immediately asked, "COLUMBUS–GIVE SHERMAN KENTON." (10:20:33). (Kenton is one of the other chimpanzees in the project; perhaps Sherman's use of the name was just a simple error, but interestingly, the name is that of another animal.) Sue responded, "NO KENTON." (10:20:36). Sherman corrected himself, saying "GIVE SHERMAN COLUMBUS." (10:20:36). Each time Sue retrieved Columbus, Sherman requested, "GIVE SHERMAN COLUMBUS."

Upon receipt of Columbus, Sherman exhibited the behaviors of building a nest with blankets, diapers, shirts, and a spare tire (remarkable for the fact that he is about 5 years old and a male). He repeatedly vocalized to Columbus as he inspected him closely. The support that he extended to Columbus was excellent; however, he did tend to move too rapidly, with apparent excitement about holding the infant. Sue feared that this might be too much for the infant, so she began to refuse Sherman's persisting requests that Columbus be given.

Sherman:	GIVE SHERMAN COLUMBUS	10:28:48
Sue:	NO	
Sherman:	BEANCAKE SHERMAN COLUMBUS	10:28:58

(The key for beancake was in the location on the board where "give" had been for several days. Sherman's use of it was probably just a "typo.")

Sue:	NO
Sherman:	GIVE SHERMAN COLUMBUS.
Sue:	NO
Sherman:	GIVE SHERMAN COLUMBUS.
Sue:	NO

Columbus was then removed from the area, since it became clear that Sherman's desire to have him was not going to abate. Although Sherman did at times confuse Columbus' name with the names of other animals for several days, the point remains clear that he had learned about it rapidly on the first day of its use–that rapid learning possibly facilitated by the fact that it was in reference to a social stimulus that was of great attraction to him, a young chimpanzee infant named Columbus.

TRANSFORMATION OF "WORDS" INTO LANGUAGE

In spite of the considerable understanding of language-relevant processes we have now gained through study of the chimpanzee, the most important and dynamic aspects of the phenomenon still remain a puzzle; and when we do speak of it, we are forced to resort to subjective and anthropomorphic descriptions.

There is a phenomenon that occurs at some undefined point of training and even then waxes and wanes. It is a feeling that one has started to communicate, to discuss, albeit in a limited way, with a chimpanzee.

An important prerequisite to this phenomenon seems to be the emergence of insight on the part of the chimpanzee as to the power of words. It is with this insight that the first attempts to control, or at least to orient the behavior of others through words and not actions, appear. The power in such control is subtle but far reaching, for it sparks unexpected word usage and linguistic innovation in the chimpanzee.

In our view Lana began the process of moving into a behavioral domain that suggested true language function at a maximum or, at the least, the operation of language-like skills when she started to use words and stock sentences for other than the originally intended purposes. She seemingly redefined "no" from "it is not true that . . ." (e.g., "the door is open"), to include "don't do that" and "there is none of what you say there is in the machine for vending." She also spontaneously used her stock sentence, "[person's name] MOVE BEHIND ROOM," to direct attention to equipment failures (improperly functioning vending devices), from having been trained to use that sentence to get people to move behind the room so as to position themselves as visual incentives that might be viewed when the use of another stock sentence, PLEASE MACHINE OPEN WINDOW, lowered the slide covering the window.

That names seemingly supported the correct execution of judgments in a cross-modal paradigm also encouraged the view that the lexigrams as used by Lana had semantic properties and value. But the main evidence for that view was afforded by the fact that without specific training to do so, Lana engaged herself in exchanges, first with Timothy V. Gill, her main tutor, that suggested conversational qualities.

The first of hundreds of these exchanges occurred about 1-1/3 years into training. Tim was drinking Coca Cola, and although she knew the name for it as a result of prior training, she asked "?LANA DRINK THIS OUT OF ROOM." Subsequent exchanges led to Tim's asking, "?DRINK WHAT," to which Lana responded, "?LANA DRINK COKE OUT OF ROOM." Lana had drawn from other stock sentences and naming training to compose her novel and seemingly logically relevant sentences in response to the context.

At a later point in training (Gill, 1977b), the potency of the communicative interchange factor became even stronger, as evidenced in the exchange below.

Tim:	?LANA WANT WHAT EAT.	9:08
Lana:	(No answer)	
Tim:	?LANA WANT WHAT EAT.	
Lana:	(No answer)	
Tim:	?LANA WANT WHAT EAT.	
Lana:	(No answer)	
Lana:	LANA WANT DRINK.	9:09
	?YOU PUT MILK IN MACHINE.	
Tim:	YES.	
Tim:	?LANA WANT MACHINE MAKE MUSIC.	

(Before proceeding to put milk in the machine.)

Lana: NO MUSIC.

(To have music would have deferred the capacity of the machine to vend milk, if requested.)

(Tim started to load milk in the machine and found that the dispenser was malfunctioning. He then poured the milk back into the pitcher, picked up a cup, and showed this to Lana as he stood outside of her room.)

Lana:	?YOU MAKE DOOR OPEN.	9:39
Tim:	YES.	

(He opened the door.)

Lana:	YOU GIVE CUP OF MILK.	9:40
Tim:	YES.	

(He gave her half the milk.)

(After finishing the milk given her:)

Lana:	?YOU GIVE CUP OF MILK.	9:41
Tim:	NO MILK IN CUP.	

(There was more milk in the pitcher, but none in the cup.)

Lana:	?YOU GIVE.	
	?YOU PUT MORE MILK IN MACHINE.	
Tim:	NO MILK IN MACHINE.	

(It was broken.)

Lana:	YOU PUT MORE MILK IN CUP.	9:42
Tim:	YES.	
Lana:	?YOU GIVE MILK OF.	9:43
	?YOU GIVE CUP OF MILK.	
Tim:	YES.	

While such exchanges are simple in one sense, they nonetheless reflect an awareness on the part of Lana of her ability to control and manipulate the actions of others through language. Were it not for this skill, even the simple desires expressed above would remain in a sense hidden, and only by observing Lana avidly drink a glass of milk could we infer that she specifically wanted milk.

SUMMARY AND CONCLUSIONS

Apes are capable of language-relevant, if not true language, behaviors. The final assessment of a claim that these behaviors are true language will be determined only by how language itself is defined. But at a minimum, there is no question that ape-language research is delving into the transitional zone: from the operant lowlands to the linguistic highlands.

The future productivity of ape-language research will depend upon methods maturing to increased definitiveness and objectivity. Of increasing importance will be the fact that wordness, the property that distinguishes a response that we call a "word" from other responses, will be brought into clearer focus. There are all levels of wordness. A word emerges through experiences, and in a primitive sense these must be pragmatic, highly functional and adaptive, and social. As the nature of these experiences becomes better understood, profound insights into the origins of language itself might be gained.

The justification for our continued work with chimpanzees does not hinge on the traditional simplistic questions of transformational grammar, rewrites, and so on, as posed by linguists. The main justification is that as we succeed, and fail, in teaching apes language-like behaviors, we learn a lot about training methods that work when applied to alinguistic, mentally retarded children in one of our projects at the Georgia Retardation Center.

Interestingly, we believe that the ultimate test, the ultimate validation of the claim the projects in reference deal with language and use apes as subjects, will be in the application of findings to mental retardates who have language acquisition and functional problems of expression. Time will tell.

To be sure, still another "ultimate" test will be the day—if ever it comes—when man and ape, as coinvestigators, join forces in field research. Attendant problems of coauthorship, credits, the writing of progress reports, and even of invitations to address learned societies must and will be overcome—if all of us can manage to be great apes about it.

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NOTE

1. The materials for these examples are taken from a limited number provided by Gardner and Gardner (1975, p. 250). Nowhere in their article did they claim to have controlled for specific Wh signs as used with other signs to form their question frames. Such control might have been effected either by deleting the Wh signs from a set of "questions" or through a factorial combination of all Wh question words with those signs that follow specific Wh questions. For example, the frame "What color?" for control purposes might have been "Where color?", "Whose color?", and "Who color?" to determine if Washoe was, indeed, attending to the control words, the Wh words that stood at the beginning of each question frame. Under test conditions of this type, it would be appropriate for the subject either not to respond or to be totally unpredictable in response given nonsensical control questions (e.g., "Whose want?", "Where now?", "Who color?", etc.).