

## VERBAL BEHAVIOR AT A PROCEDURAL LEVEL IN THE CHIMPANZEE

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Ape language research has typically employed cognitive descriptions of ape competencies. Recently, Epstein, Lanza, and Skinner (1980) attempted to simulate some of the ape findings with pigeons. They also used cognitive terms to describe their results, but with "tongue-in-cheek." In the hope of bringing about a better understanding of the ape research, this paper describes the main aspects of one ape language project, using a behavior-analytic framework. It then briefly compares and contrasts, from that perspective, the training programs used with pigeons and with apes. It is concluded that the behavior-analytic framework, and the procedures devised to produce language skills in apes, provide strong support for several of the major positions set forth in Skinner's (1957) *Verbal Behavior*.

*Key words:* verbal behavior, tacts, mands, listener, speaker, verbal episode, awareness, pigeon, chimpanzee

Ape language research began outside the domain of behavior analysis and has remained apart from it, even as researchers with operant backgrounds (Premack, 1976; Terrace, 1979) have entered the field. Ape language research, by virtue of investigating a highly complex, typically human phenomenon in a closely related nonhuman species, should help serve to bridge the gap between cognitive and be-

havioral psychology. This paper is an attempt to build that bridge by describing ape language training procedures within a behavioral framework. This framework should enable more accurate comparisons to be made with other animal studies that have also reported language-like phenomena.

Of particular interest in this paper is the comparison between the verbal behavior of two chimpanzees, Sherman and Austin, and the behavior of two pigeons, Jack and Jill (Epstein et al., 1980). Prior to the publication of the finding of intraspecies symbolic communication between Sherman and Austin (Savage-Rumbaugh, Rumbaugh, & Boyson, 1978a), previous instances of symbolic communication between animals (Bastian, 1967; Mason & Hollis, 1962) had inevitably been compromised by the fact that although the animals' behavior could be said to transmit information, the animals themselves did not evidence any knowledge of this fact. That is, it could not be shown that these animals were, in any sense, "aware" (Crook, 1983) of their communicating, and hence it was concluded that they transmitted signals that served the purposes of communication quite *unintentionally* (Bastian, 1967; Mason & Hollis, 1962). For this reason, all previous animal-communication studies have been viewed as involving a distinctly different form of communication than that found in humans; that is, their com-

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This research was supported by grants from the National Institute of Child Health and Human Development (HD-06016) and from the Division of Research Resources, National Institutes of Health (RR-00165). Jack Michael helped me immeasurably with a number of drafts of this paper. His thoughtful, patient, and detailed comments were invariably made with understanding and sympathy as he tried to educate me in the ways and language of *Verbal Behavior*. My gratitude is also extended to B. F. Skinner, who, though he did not directly shape the paper, certainly produced the contingencies that brought about its occurrence and the ideas that served as the framework for its present form. Murray Sidman's well reasoned and considered critique of the original manuscript enabled me to produce a far better paper than I could have otherwise. Evelyn Segal was the kind and constant impetus to write such a paper, reminding me often that I did have something to say to behaviorists. Duane Rumbaugh encouraged me to persevere through the many drafts and critiques that this paper received and always made me feel that its completion was both possible and worthwhile.

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munication has been viewed as unintentional, whatever this may mean.

Skinner (1957) dealt with the concept of intentionality in his book *Verbal Behavior* by stating simply that it "may be reduced to contingencies of reinforcement" (p. 41). However, he does not describe the nature of the contingencies that surround and define intentionality, nor does he discuss what sort of behavioral contingencies might be used to differentiate an intentional from a nonintentional exchange. It is important to note, however, that Skinner does not deny the existence of intentionality in human linguistic communication as a phenomenon; his opposition is rather to the use of this concept as an explanatory mechanism.

Recent work dealing with the issue of intentionality in developmental psychology (Bates, 1979; Bruner, 1974/75; Lock, 1980) has described a series of developmental phases through which each human infant passes as his or her communicative skills move from self-oriented, opportunistic behavior to stylized intentional communicative patterns. The term *intentional*, in the framework of modern developmental psychology, is not used to refer to the child's internal needs, wants, and desires. Rather it is used to refer to an observable and measurable complex sequence of monitoring responses in which the child (a) observably determines that there is a listener prior to emitting a communicative signal, (b) observably engages the attention of the listener prior to emitting this signal, (c) emits a signal that requires a specific behavioral or verbal response on the part of the listener, (d) visually and auditorially monitors the listener's response, and (e) if the response is not in accord with the stylized "meaning" the child has learned for that signal, modifies and re-emits the signal. This modification may or may not be said to reflect the child's "original intent" (depending on who is using the term); however, there is general agreement that it is not the elusive "original intent" that is important, but rather it is the inter-individual contingent nature of the behavior. That is, the behavior of the speaker is clearly a function of the response of the listener and of the speaker's having closely monitored that response and its relationship to his or her signal. Thus, there is an observable inter-individual sequence of events that must exist before the term *intentionality*

is applied by the modern developmental psychologists who work within the framework first laid out by Bruner (1974/1975).

Once human individuals become involved in verbal exchanges in which the behavior of each speaker is dependent upon the preceding behavior of the listener, both the speaker and the listener, being *Homo sapiens*, typically engage in a process of "interpretation" of each verbal act. This means that no definite one-to-one relationship exists between the verbal behavior of Speaker A and Speaker B such that Statement A<sub>1</sub> will always evoke Statement B<sub>1</sub>. This can be seen even in the elementary example of a sentence such as, "I want to go outdoors," uttered by Speaker A and followed by the comment, "No," by Speaker B. If Speaker A simply repeats Statement A, Speaker B is not likely to repeat the response ("No"), but rather to ask, "Did you hear me?", thereby revealing a sensitivity to A's lack of reaction to the previous "No" reply and altering the ensuing remark accordingly.

Once such inter-individual inferential verbal behavior appeared phylogenetically in the repertoire of the human species, it was inevitable that human conversations would be characterized by constant attempts by both speakers to determine the "intentions" of the other. Such interpretations of a speaker's intent go far beyond the specific words that are uttered in any exchange and are an inextricable part of all our verbal processes. Although it may be staunchly argued that behavioral science can explain nothing by attributing intentionality or inference to speakers, still it must be asked, how can we otherwise accurately describe such conversing behavior? Must we simply present a verbatim transcript of each spoken word throughout each subject's life? If we do not describe the activities of speakers and listeners as if they were conversing with "intent to convey meaning," we will be forced forever to echo the words "reinforcement history" to explain each and every different interpretation of a given string of words. It may be true that the "reinforcement history" can theoretically explain behavior of concern, but it is not clear that it is a useful explanatory concept; it says simply, without supplying the particulars, that the speaker says what he does because it was reinforced in some way in the past. How can reinforcement history not explain the occurrence of any learned behavior if we cite enough

of each organism's past experiences (millions in the case of our human speakers)?

Similarly, the words *reproductive success* seem to tell us all we need to know about biological evolution, while, like the words *reinforcement history*, they clarify very little about evolution. This is because both reinforcement history and reproductive success state that what is here is here because it worked. They are accurate but somewhat unsatisfying statements of fact. Why did things work as they did? Why did something else not work? What were the biological, ecological, and sociological variables that set the stage for the behavior to "work"? These are, I submit, the more intriguing questions. They do not deny the value of reinforcement history and reproductive success; they simply move us a step beyond the obvious statement of fact implicit in those terms. Concepts like "intentionality" permit questions (and consequently answers) that are stifled by the constant use of the term *reinforcement history* as the ubiquitous explanation.

It is not clear that the sort of intentionality that pervades human communication is present in nonhumans. Animals rarely, if ever, request other animals to act on objects for them, and many of the communicative signals between animals seem more genetically predisposed and tied to specific social contexts than do human learned signals. When animals are taught stylized signals by human beings, a real question arises: Do they use these learned signals—with a mutual presumption of intentionality similar to that exhibited by human beings—or do they simply emit them in a manner that is more relevant to their own motivations than to the monitoring of the signal's effectiveness in communicative interactions with others?

An example of the way in which an uncritical appeal to reinforcement history restrains the manner in which research issues (such as those raised above) are approached is found in the study entitled, "Symbolic Communication Between Two Pigeons (*Columba livia domestica*)" (Epstein et al., 1980). This study demonstrated that pigeons' behavior could be shaped into sequences that mimicked the appearance of intentional transmission of information. Moreover, the tongue-in-cheek style that characterized the reporting of this work was used to imply that previous work with

chimpanzees had similarly shaped the appearance of communicative behavior in apes and that consequently both species were engaging in behavior of comparable complexity—though the pigeons were dealing with fewer items. The issue of cognizance of one's own communicative acts was cast aside along with the issue of intentionality. Presumably both issues were viewed as being beyond the bounds of scientific endeavor.

The previous distinction between communication with "awareness" and communication without "awareness," which had so carefully been dealt with by others and which had been shown to be present in the chimpanzee work, was simply cast aside. Yet the demonstration of such awareness was the central theme of the chimpanzee report and the purpose behind the numerous nontrained control-test paradigms that were carried out (Savage-Rumbaugh et al., 1978a). Had the purpose of the chimpanzee work simply been to show that the responses of chimpanzees could be made contingent one upon the other, irrespective of communication and awareness of that communication, there would have been no reason to publish a report of such an unremarkable fact. By ignoring the reported training, testing, and control conditions of the chimpanzees study, Epstein et al. (1980) produced some behavior which simulated that of the chimpanzees. In so doing, they ignored the central issue of the chimpanzee research and the important fact of species differences.

If, in search of scientific generality, we cast aside real and reliable species differences, we will find, not surprisingly, that the species do not differ, by our very refusal to study precisely the ways in which they do differ.

The purpose of the present paper is twofold: first, to demonstrate that even if the concepts of intentionality and awareness are dismissed, the pigeons and the chimpanzees were, in terms of overt behavior, still behaving in functionally different ways. Second, the paper argues that the concepts of intentionality and awareness are essential to an understanding of the acquisition of verbal behavior, but they are not to be understood as internal or motivational constructs. Rather, they are to be viewed as terms that describe a range of measurable classes of behavior, classes that are present in the communicative repertoires of *Homo sapiens*, *Pan troglodytes*, and perhaps

some other species. However, such classes do not seem to be part of the natural communicative repertoire of the pigeon. It is these classes upon which the language training tasks employed with Sherman and Austin have been built.

Although we have chosen to use the common term *intentionality* to refer to the monitoring aspects (both of self and others) of communication, we are not bound to this term. Perhaps these concepts can be objectified by calling them the "editorial component" of human verbal behavior, as Skinner does; but in any event, it is argued that behavioral science must come to grips with them as phenomena. We must externalize them, and we must define their contingencies, for without them the verbal behavior of scientists cannot be distinguished from that of an incoherent, but conversant, schizophrenic or the coherent, but incognizant pigeon.

There are important differences between the verbal behavior of pigeons, chimpanzees, and human beings that cannot be reduced to contingencies of reinforcement. This paper is about these differences, and thus, in a sense, the perspective which it adopts is that of behavioral biology. But the behavior of interest is not innate; it is acquired, and the biology of the acquiring organism strongly and irrevocably influences the way in which this happens.

Much of our previous reporting of research with Sherman and Austin has employed the common English vocabulary—as opposed to the more specialized terminology employed by Skinner in *Verbal Behavior*. The present paper attempts to alter this practice and to use the terminology provided by Skinner. I have found this somewhat difficult because Skinner wrote his book with human behavior as his central focus, and his examples of tacts, mands, etc. are taken from human behavior alone. Some researchers have applied his terms to animal work (E. Segal, personal communication, 1983; J. Michael, personal communication, 1983) but their application of the terms seems to me to alter Skinner's intended usage, because the definitions that he applied to human verbal behavior falter when they are applied to species such as macaques and pigeons that have no counterpart of learned signals in their natural communicative repertoires. Nor do macaques and pigeons naturally communicate about ac-

tions upon objects. By contrast, although chimpanzees do not acquire "language" spontaneously, they do possess a large repertoire of learned communicative signals that vary among groups of chimpanzees (McGrew, 1977; Menzel, 1973a, 1973b; Menzel & Halperin, 1975; Savage, 1975). For this reason, Skinner's definitions are more straightforwardly applied to natural communicative behavior of chimpanzees than to the behavior of pigeons or even of monkeys. However, the capacity of human language is so great that many definitional problems remain, even with chimpanzees. In order to make some progress, the terminology of *Verbal Behavior* will be used insofar as possible. Portions of this paper will be devoted to a discussion of Skinner's terms, with emphasis upon the manner in which they seem to be directly relevant to procedures that have been employed with chimpanzees.

At times, a term I use to label a particular procedure may not correspond precisely to the terms which other animal researchers have employed when discussing their work in the Skinnerian framework. However, their procedures have typically been quite different from mine. In addition, there is only a limited number of terms in *Verbal Behavior*, but there is an infinite number of procedures one may use when teaching symbolic behavior. For these reasons, I ask that the reader not react spontaneously to a somewhat novel usage of a term, but rather to consider the training procedure itself, its outcome, and the vastly different sorts of human verbal behavior to which the term itself could be used to refer and to which Skinner (1957) himself applies the terms in *Verbal Behavior*.

While remaining within the Skinnerian framework, this paper will briefly contrast the procedures used with pigeons by Epstein et al. (1980) with those used with the chimpanzees in the Yerkes project.

Since the purpose of this paper is primarily to elucidate and contrast various verbal behavior training procedures within a Skinnerian framework, extensive data presentation (on both chimpanzees and pigeons) is avoided and is indeed beyond the scope even of a lengthy paper. However, data-based presentations that substantiate the statements regarding each of the chimpanzee capacities discussed here have been presented elsewhere in considerable detail, and the interested reader will find ap-

proprate references. Additionally, an integrated presentation of these data will appear shortly in book-length format.

### DEFINITION OF VERBAL BEHAVIOR

Following Skinner (1957), verbal behavior is defined as a particular subset of general behavior. Verbal behavior is unique in being a class of behavior which is "effective only through the mediation of other persons" (p. 2). By contrast, behavior that is not classified as "verbal" typically "alters the environment through mechanical action, and its properties or dimensions are often related in a simple way to the effect produced" (p. 1). Because of this unique quality of being mediated by the behavior of others, Skinner (1957) felt that in the case of verbal behavior "special treatment is justified and, indeed, demanded" (p. 2). Moreover, he asserts: "The 'understanding' of verbal behavior is something more than the use of a consistent vocabulary with which specific instances may be described" (p. 3). His clearest and most succinct definition of the phenomenon of verbal behavior is to be found in the chapter on the verbal operant:

Verbal behavior is shaped and sustained by a verbal environment—by people who respond to behavior in certain ways because of the practices of the group of which they are members. These practices and the resulting interaction of speaker and listener yield the phenomena which are considered here under the rubric of verbal behavior. (p. 226)

Skinner's emphasis on a "verbal environment" and the mediation of the behavior by others is his constant theme throughout *Verbal Behavior*. It is important to note that this sort of environment is precisely what most of the ape-language projects have striven to provide for the chimpanzee subjects (Gardner & Gardner, 1971; Savage-Rumbaugh, 1979; Terrace, 1979). Sherman and Austin have been enmeshed daily in a communicative verbal environment in which a wide range of their needs—emotional, physical, and intellectual—have been mediated through the behavior of other individuals (both human beings and other apes). Moreover, these needs have been

met largely through symbolic communication that is common to all members of the chimpanzee-human community of our laboratory. Symbol use by Sherman and Austin does not trigger a constant, reliable, mechanical response; rather, it affects the other chimpanzee or human being within a particular ongoing but constantly changing context. The response of the other party is typically dependent upon this context as well as upon a given symbol.

Symbol use is shaped and maintained through its effects upon the chimpanzee's social and physical environment as mediated by both other chimpanzees and human beings. In this sense, there appears to be a close fit between the general domain of what Skinner defines as verbal behavior and the activities that Sherman and Austin engage in as they use their keyboards. But their verbal behavior is distinctly different from that reported for most research with other nonhuman species in which the animal behaves in a particular manner each time it encounters a particular stimulus and is then rewarded in a predetermined manner (as in the Jack-and-Jill study, or as in the Pigeon Parlance Project [J. Michael, personal communication, 1983]). While it can be said that this sort of "verbal behavior" is mediated through a verbal environment—that is, the reward is produced by the experimenter—such an interpretation presses Skinner's definition to the limit and eliminates the distinction Skinner himself carefully delineated between verbal and nonverbal behavior.

After he establishes the domain of study in *Verbal Behavior*, Skinner goes on to divide it in ways which he believed would prove amenable to behavioral analysis. As he does so, he provides some new terms, in a strategy of departing from usages which permit inadvertent lapses into the traditional nonbehavioral, unobjective orientation. The two most important terms that Skinner introduces are the *Mand* and the *Tact*. To fully understand the ways in which Skinner uses these terms with regard to human verbal behavior, it is necessary to read his entire book. Moreover, there is no clear means of directly translating these terms into the ordinary realm of traditional animal experimentation unless one views the experimental regime as the "verbal community"—a practice which I suggest detracts immeasurably from the thoughtful analysis presented in *Verbal Behavior*.

Skinnerian terms readily apply, however, to Sherman's and Austin's behavior, because their behavior is being emitted in, and reinforced by, a Yerkish-fluent verbal community (i.e., the Yerkish symbols used as words in our research methods). Also, their verbal behavior influences and mediates the behavior of other members of this community quite straightforwardly.

### *The Mand*

According to Skinner, the mand is a type of verbal operant that is singled out by its consequences:

A "mand," then, may be defined as a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation. (pp. 35-36)

Moreover,

A mand is characterized by the unique relationship between the form of the response and the reinforcement characteristically received in a given verbal community. It is sometimes convenient to refer to this relation by saying that a mand "specifies" its reinforcement. *Listen! Look! Run! Stop!*, and *Say yes!* specify the behavior of a listener; but when a hungry diner calls *Bread!*, or *More soup!*, he is specifying the ultimate reinforcement. (p. 36)

Following this definition, the mand can be said to correspond to a class of responses taught to Sherman and Austin that have elsewhere been termed "requests" (Savage-Rumbaugh, 1979). This skill is behaviorally defined as the ability to mand a specific food or other item that is in the possession of the experimenter, and it is the first verbal operant that Sherman and Austin were taught (Savage-Rumbaugh, 1979; Savage-Rumbaugh, Pate, Lawson, Smith, & Rosenbaum, 1983). In this paradigm, one of a group of specific foods (presently 33 different foods) is shown to Sherman and Austin and they must ask for the displayed food by selecting the appropriate symbol on their keyboard. (They often accompany such requests for specific foods with the symbol "give," as in "Give orange" or "Give banana," but the use of "give" is not required.)

The requesting chimpanzee must mand only the item that the experimenter displays, thereby demonstrating a unique relationship between the form of the request and the item requested (Figure 1). More than one food is always visible to the chimpanzee in this paradigm; however, only one food at a time is shown to him (i.e., the one is held up and pointed to). Without the restriction that the chimp must be able to mand only that which is shown to him on any given trial, we would have no way of ascertaining whether or not the effective relationship was that between a symbol and its specific consequences. In fact, evidence suggests that without such contingencies, chimpanzees would not learn these correspondences (Savage-Rumbaugh & Rumbaugh, 1978).

As a direct result of learning a unique relationship between each verbal mand (request for food) and the reinforcing consequences present in our verbal community, the chimpanzees generalized from these specific mand-training instances to the general mand rule that each food must be manded in a specific way. Thus, when we introduced the new food, pudding, both chimpanzees spontaneously used a new symbol to mand this new food. Moreover, they abstracted the principle inherent in all verbal communities: In order to be maximally mutually reinforcing, the same specific operants must be used in the same situations. Thus, when new mands were selected, the chimpanzees observed one another's mand usage and settled upon a single symbol for pudding. These observations of spontaneous and consistent mand assignment were repeated with other new symbols (Savage-Rumbaugh, in press).

As the procedural definition of the mand (Figure 1) illustrates, the behavior of symbol selection is constrained by the type of food (or stimulus) that is displayed by the experimenter and by the experimenter's practice of giving the chimpanzee that particular food if the correct symbol is selected. This procedure is comparable to the example of a hungry diner crying "Bread!" The listener gives bread only upon hearing this food name and not upon hearing the name of some other food. Likewise, the teacher gives Sherman and Austin bread only upon seeing the "bread" symbol lighted. Thus there is a unique relationship between the form of the response (in this ex-

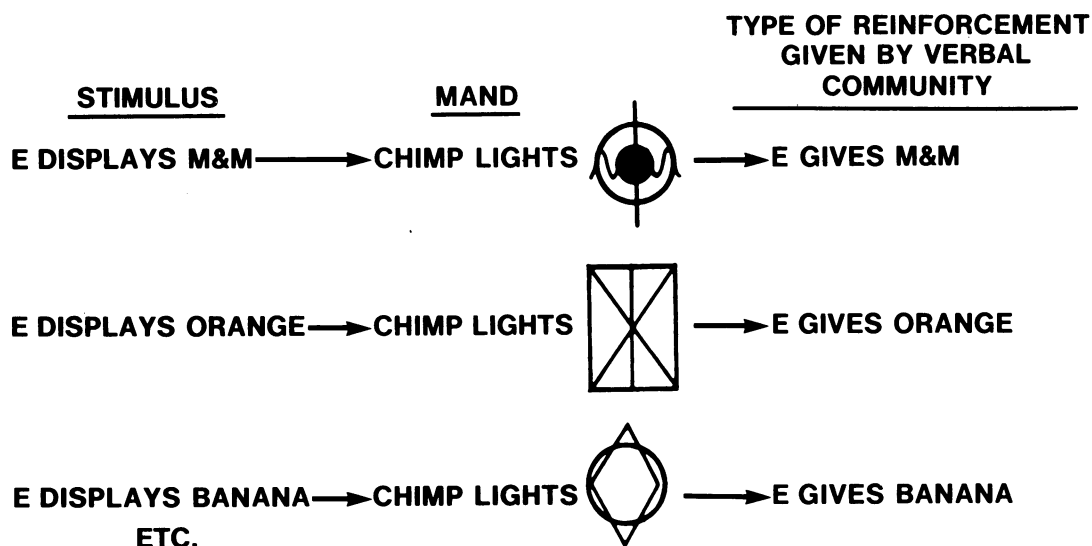


Fig. 1. The first verbal operant which Sherman and Austin learned. The experimenter (E) displays a number of foods to Sherman and Austin, using offering gestures that indicate available foods. As the experimenter holds up each food, the chimpanzee, to receive it, must light the symbol that corresponds to that food. After the correct symbol is lighted, that food is transferred to the chimpanzee. Manders for other than the displayed food are ignored during this training procedure.

ample, selection of the symbol "bread") and the reinforcement characteristically received in the verbal community (in this case, the transfer of a baked flour-yeast food item). The chimpanzees learned this unique relationship between their use of the symbol bread and the ensuing practice of bread-giving by members of their community. They came to mand bread (and 32 other items) upon seeing it offered or upon seeing it in the possession of another.

Once the chimpanzees had acquired the ability to mand any food that was shown to them, they were presented with an array of 5 to 15 foods. They could then mand any food which they chose, one at a time, until the whole array had been consumed. The chimpanzees readily adjusted to this multiple-mand situation. Order effects of manding the array did not appear, because the size and type of portion, the quality of food type, and the amount of that food which the chimpanzee received were varied. Thus, although bananas might be preferred on one day, they were usually not preferred on the following day if the chimpanzees had already consumed 20 of them, if they were not ripe, if the pieces of banana were small and the pieces of other foods were large, etc. When presented with such arrays, the chimpanzee could mand any food available, and the experimenter responded with the reinforcing

practices of the community by giving the specific food that was manded. If a food was not present in the array when the mand was executed, the experimenter responded by searching the array for the requested food and then encouraging the chimpanzee to mand another food. The array paradigm produced a setting that is much closer to Skinner's definition of the mand than did the display of individual foods, because in the array paradigm, it is the chimpanzee plus the array that determines which symbol shall be produced on any given trial, rather than the experimenter's food-displaying behavior.

The procedural manifestation of the mand in the array task is synonymous with Skinner's original concept of a mand as a form of verbal behavior that has a specific and unique consequence for each response. In the array paradigm, illustrated in Figure 2, it is not the M&M, the orange, the juice, etc. per se that determines the behavior of the speaker on a given trial, as was the case in Figure 1; rather, it is the reinforcing practices of the community, the presence of a given food coupled with its present reinforcing value to the chimpanzee, that determine his symbol selection on any given trial. It is worth noting that the chimpanzees do not always mand all of the items in the array. If they do not like the way a food

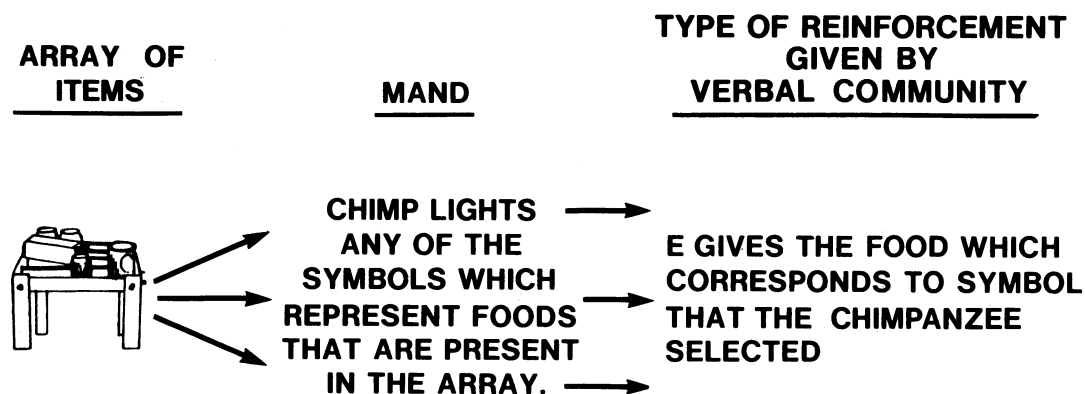


Fig. 2. The way in which the mand (Fig. 1) was altered to provide the chimpanzees with more options for symbol usage. The experimenter (E) no longer singles out a food and displays it to the chimpanzee. Instead, a table of foods is placed in front of the chimpanzee and he may mand any food which is on the table. The state of the table changes with each mand, because once a food is given it is no longer available to be manded. Mand for nonpresent foods are scored as errors during this procedure. See text for a discussion of the way in which order effects are precluded.

is prepared, or if they have eaten a lot of that food lately, they do not mand it.

It is also worth noting that this behavior of manding is not limited to the training context of food or array presentations. The experimenter's presence alone is sufficient to induce manding. That is, whenever the experimenter is present, the chimpanzees will use symbols to ask for specific foods if they are hungry. These nonprompted mands are usually, though not always, complied with.

The paradigm of linking a specific symbol to the receipt of a specific food (receipt of activities, objects, etc. has also been linked to specific symbols) is characteristic of all the ape-language projects but differs dramatically from the procedures used with pigeons and monkeys (Epstein et al., 1980; Richardson & Kresch, 1983; Straub, Seidenberg, Bever, & Terrace, 1979; J. Michael, personal communication, 1983; E. Segal, personal communication, 1983). Typically when symbol relationships are taught by giving the animal not the symbol-correlated item, but rather some other desired tidbit, the resulting procedure has been termed "tacting." However, recent work with pigeons by Peterson (in press) suggests that a "mand-like paradigm," in which each response is linked to a different consequence, can be used with pigeons. Moreover, such "differential consequence" paradigms frequently result in far superior discrimination learning.

### *The Tact (of Sorts)*

Having brought the mand under the joint control of the array and the reinforcing practices of the community with respect to arrays (arrays of tools and of foods), we then altered these paradigms by introducing new reinforcing practices. Instead of responding to the lighting of a specific food symbol by giving that food, the teacher now gave a different food, plus social praise, as reward for correctly "naming" the displayed food. Thus, "naming" in this case could be described as a procedural alteration that replaced differential reinforcers with generalized reinforcers (Figure 3). Elsewhere, we have referred to the shift between these two procedures as "requesting" to "labeling" (Savage-Rumbaugh et al., 1978a, 1978b).

This procedural shift was attempted by simply having the teacher display the food and wait for the chimpanzee to select the proper symbol. However, when the correct symbol was selected, the teacher no longer gave that food to the chimpanzee; instead she gave the chimpanzee another food. (This "generalized reinforcer" was always the same within a given session regardless of the displayed food, which differed from trial to trial.) This procedural shift quickly revealed that the previous reinforcing practices of the community had been a powerful controlling element in the chimpanzee's behavior, because breakdowns in food-



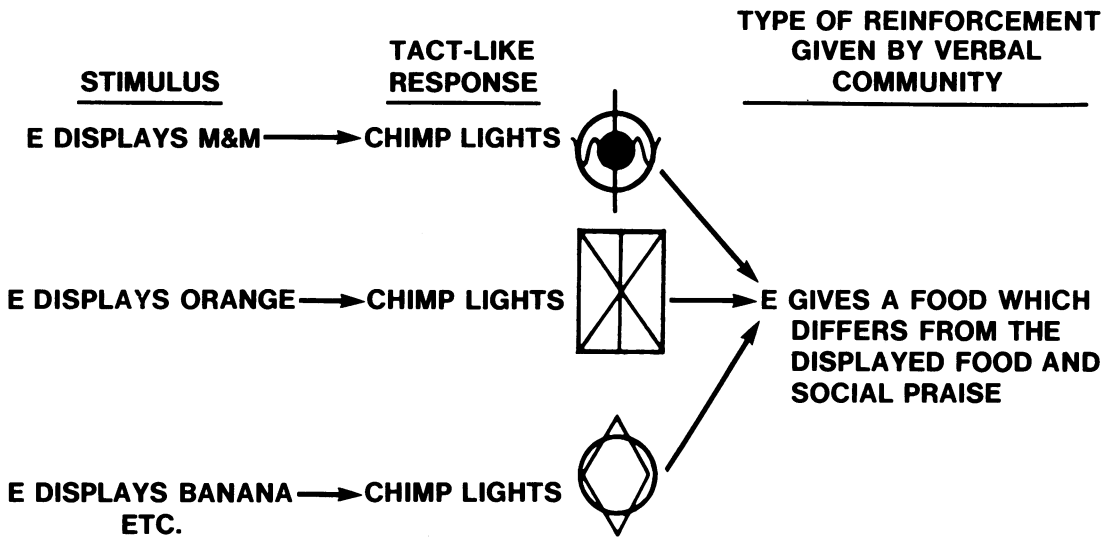


Fig. 3. In this tact-like paradigm, the chimpanzee no longer receives the food that corresponds to the symbol which he lights. Instead, he receives a common set of reinforcers for all responses. The experimenter's behavior of displaying the food is identical to that shown in Fig. 1; however, instead of gesturally indicating that the chimpanzee will receive the displayed food, the experimenter (E) gestures to a bowl containing the other food that the chimpanzee will receive if he correctly "tacts" the displayed food. See text for a description of the initial difficulties that the chimpanzees experienced with these altered reinforcing practices.

symbol correlations occurred repeatedly with this new procedure.

Usually, the first five to ten trials would proceed well, with the chimpanzee correctly selecting the appropriate symbol as each food was displayed. However, when the experimenter then proceeded to give the chimpanzee a food other than the labeled food, the chimpanzee displayed overt frustration—pilo erection, whimpering, gesturing toward the food that he had just "labeled" while pushing the other food away, etc. After five to ten trials, with the experimenter giving something other than the labeled food, the chimpanzee's performance altered markedly. Symbol selection deteriorated rapidly, until it became essentially a guessing and/or random selection of keys. In guessing, the chimpanzee seemed to be attempting to determine which key would now get the teacher to supply the displayed food and thus maintain the previous reinforcing practices of the community. Attempts to alter the procedure in this way were continued for 2 weeks, with no progress. Even plastic encased foods were used in the hope that the chimpanzee, not wanting to eat a food encased in plastic, would simply label it and then eat the "reinforcer food" that was produced by correct

labeling. This procedure likewise failed. The problems were not motivational, as the chimpanzees clearly desired the foods being used as reinforcers and would eat them in large quantities if they were given ad lib.

This strong and persistent resistance to attempts to alter our reinforcing practices led to the adoption of a fading procedure that focused on the reinforcing practices themselves. Instead of giving the chimpanzee only the reinforcing food, we also gave the "manded" or "labeled" food, plus social praise. By so doing we maintained the previous reinforcing practices but expanded them to include the additional practice of giving a different food in addition to the manded food. (Social praise was really not new as we had always included it in our procedures.) We then faded out the manded food by giving smaller and smaller bites of this food until the pieces were too small for the chimpanzee to bother with. This fading procedure (Figure 4) produced an immediate performance difference. Within 200 trials, the chimpanzees were able to "tact" three of their foods accurately when receiving only the generalized reinforcer. We then tested for transfer of this ability, presenting the remaining food names in their vocabulary and

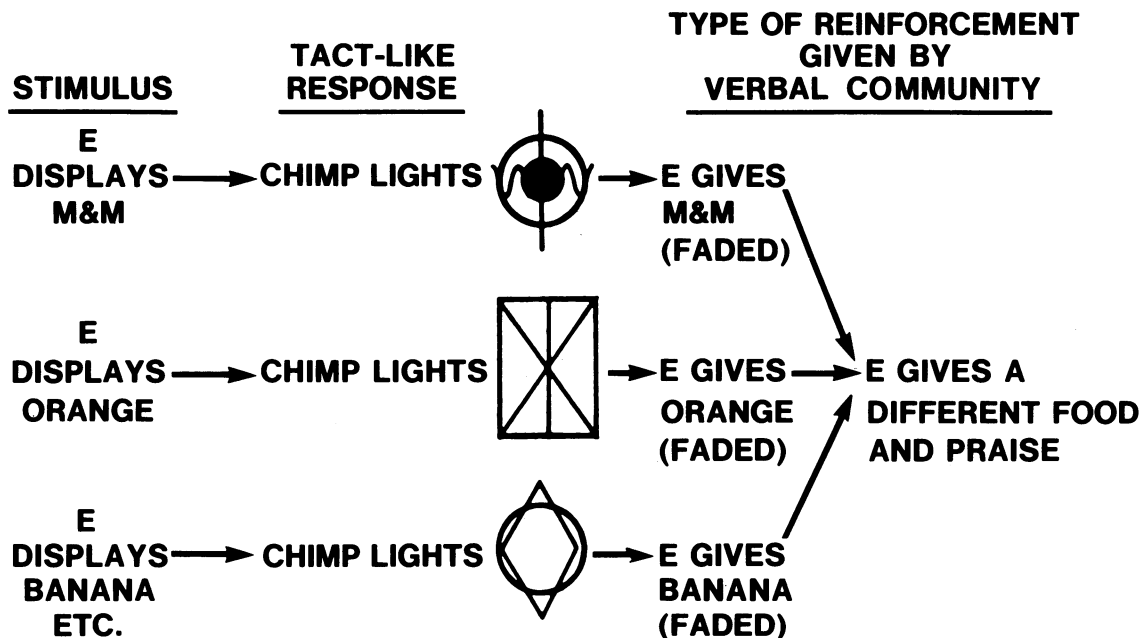


Fig. 4. The fading procedure that was used to enable Sherman and Austin to switch from the mand paradigm in Fig. 1 to the tact-like paradigm in Fig. 3. It is important to note that it was not the stimulus that was faded, but rather the reinforcing practices of the community. That is, the experimenter (E) gave smaller and smaller bites of the displayed food until it was no longer necessary to give any at all, leaving the performance intact and maintained by a different food.

found immediate and completely accurate (100%) transfer to all remaining food symbols (Savage-Rumbaugh et al., 1978a).

This rapid acquisition, coupled with the equally rapid and accurate transfer, was clear confirmation that the previous manding had been directly under the control of the reinforcing practices of the community. The success of the fading procedure that was adopted to change these practices strongly suggested that what had happened was not that we had now taught "tacting," but that the old reinforcement practices had been replaced with new ones and that this new behavior was still being controlled by the reinforcing practices of the community—albeit different ones. Our initial failures, prior to introducing the fading technique, showed that simply displaying the item as a stimulus object did not itself evoke correct symbol selection. It was the alteration of reinforcing practice, through fading, that produced the correct behavior. Nothing was done to the stimulus.

However, it is important to point out that the new reinforcing practices (using a generalized food reinforcer for the behavior of

labeling) did not actually replace the old practices in the sense that the old practices no longer were effective. They remained effective and the chimpanzee could and did "request" foods in one context and "label" foods in another context. The differences between these contexts were denoted by gesture. That is, in the request context the teacher displayed the food with an offering gesture, while in the labeling context the teacher displayed the food, but held the food with a possessive gesture. These gestures were bases for conditional discriminations, setting the occasions for different reinforcement practices; symbol selection could produce different outcomes (specific reinforcers vs. generalized reinforcers) in discriminably different situations.

This paradigmatic distinction, conveyed gesturally, posed no continuing difficulty, once the second reinforcing practice had become established via the fading procedure discussed above. No special training was required to enable the chimpanzees to switch back and forth between these two sorts of contingencies (from requesting to labeling or from the procedures illustrated in Figure 1 to those illus-

trated in Figure 3 and back again); they did so readily. Similarly, they continued to request foods accurately when presented with an array and responded to the changing nature of the array as it decreased trial by trial (Figure 2).

In *Verbal Behavior*, Skinner (1957) describes an almost identical process of transfer of control for human verbal behavior, noting that first the mand comes under narrower and narrower control, and then the behavior of the mand is reinforced with a generalized reinforcer, thereby releasing the response from its specific controlling conditions of deprivation or desire:

Instead of using a great variety of reinforcements, each of which is relevant to a given state of deprivation or aversive stimulation, a contingency is arranged between a verbal response and a *generalized conditioned reinforcer*. Any event which characteristically precedes many different reinforcers can be used as a reinforcer to bring behavior under the control of all appropriate conditions of deprivation and aversive stimulation. A response which is characteristically followed by such a generalized conditioned reinforcer has dynamic properties similar to those which it would have acquired if it had been severally followed by all the specific reinforcers at issue. (p. 53)

Skinner does not explicitly declare that mands must be acquired before tacts; indeed he deals very little with the emergence of language from either an ontogenetic or phylogenetic perspective. Still, the organization of his presentation does suggest that manding is the more basic and preliminary skill, while tacting is the basis of the majority of the complex language used by adult speakers. For example, he describes the process of moving from the behavior of manding to that of tacting by noting:

In destroying the specificity of the control exercised over a given form of response by a given condition of deprivation or aversive stimulation, we appear to leave the form of the response undetermined. Previously we could produce the response *Water!* by depriving the organism of water

and the response *Food!* by depriving the organism of food. But what is to take the place of deprivation in controlling a response which has achieved a generalized reinforcement? The answer, of course, is some current stimulus. In destroying the specificity of one relation, we make it possible to set up another. We may use our generalized reinforcer to strengthen response *a* in the presence of stimulus *a*, response *b* in the presence of stimulus *b*, and so on. Whether the speaker emits response *a* or response *b* is no longer a question of deprivation but of the stimulus present. It is this controlling relation in verbal behavior which proves to be of great importance for the functioning of the group. (p. 54)

It could be said that the labeling procedure depicted in Figure 3 represents precisely the sort of situation that Skinner is describing in the above passage; that is, the response *a*, selecting lexigram (◊), is strengthened in the presence of the stimulus "banana" even though no banana is received, and thus banana deprivation is not an issue. However, it must be pointed out that it is not the stimulus-response relationship that gave difficulty as we introduced this paradigm; it was the altered reinforcing practice of the teachers. On the other hand, once the new reinforcing practice was established—with just three foods—the stimulus-response relationships between all learned symbols and foods spontaneously transferred to the new situation. The chimpanzees did not have to be trained with generalized reinforcers for other than three foods; spontaneous transfer produced highly skilled and accurate tacting for all other items.

Others who have used paradigms virtually identical to that shown in Figure 3 without having first employed the paradigms in Figures 1 and 2 (J. Michael, personal communication, 1983; E. Segal, personal communication, 1983) have viewed the procedure in Figure 3 as one that produces tacting, because in this procedure symbol selection is being controlled by the presentation of the stimulus. However, it should be pointed out that in Sherman and Austin's case, it was only the reinforcing practices of the verbal community that were altered from the form they took in the mand paradigm of Figures 1 and 2. Everything else re-

mained the same. This clearly implies that, at least in this case, the "labeling" or "tacting" response is really multiply controlled in that it is a function of the conjoint events of the stimulus complex plus the new reinforcing practices of the verbal community.

That the response was clearly not under the control of the stimulus object alone was self-evident because if a number of stimulus objects were simply placed in front of the chimpanzee—without the experimenter singling out and holding up a particular food to be "labeled"—no labeling behavior occurred. Recall that this was not the case with mands. Foods were manded spontaneously by hungry chimpanzees even if the experimenter did nothing at all. However, foods were not "tacted" spontaneously at this point in training. Spontaneous tacting did appear later, after training on other verbal skills yet to be discussed.

These first three training paradigms thus required that Austin and Sherman acquire mand and tact-like skills, and that these skills exist simultaneously but distinguishably for a single set of symbols. Mands or specific relations were acquired first, and these skills were then modified, by altering the reinforcing practices of the community, to produce tact-like performance. Why was it important that mands be established first and be maintained while other skills were acquired? If mands were not established first and maintained in the repertoire as distinct from "labels," then all symbol-related responses would always produce identical consequences; that is, there would be no specific contingencies that would reinforce the occurrence of different words. Each symbol would have, from start to finish, essentially the same meaning—"give me food *x* and social praise"—because this single generalized reinforcing practice would be all that was correlated with any given symbol. As such, there could be no language and, indeed, even no words, because every word would be followed by the same set of contingencies. "Wordness" would devolve to a single set of contingencies, with any word being spoken simply to evoke the ubiquitous generalized reinforcer.

I have used the term *tact-like* to refer to the behavior of Sherman and Austin in the labeling paradigm shown in Figure 3 because although this sort of behavior meets the definition of a tact in that the response is controlled by a particular stimulus and is reinforced by

a generalized reinforcer, it lacks (in contrast to classes of behavior to be described later) many of the characteristics of tacts as Skinner (1957) describes them. In Skinner's view, the set of events that controls tacting is:

nothing less than the whole of the physical environment—the world of things and events which a speaker is said to "talk about." Verbal behavior under the control of such stimuli is so important that it is often dealt with exclusively in the study of language and in theories of meaning.

The three-term contingency in this type of operant [the tact] is exemplified when, in the presence of a doll, a child frequently achieves some sort of generalized reinforcement by saying *doll*; or when a teleost fish, or picture thereof, is the occasion upon which the student of zoology is reinforced when he says *teleost fish*. (p. 81)

Researchers studying the emergence of such tacting or naming skills in human children (Bates, 1979; Greenfield & Smith, 1976; Lock, 1980; Nelson, 1978) have noted that when children point at and label items or photographs, they also solicit the attention of others to the object upon which their attention is focused, and, in fact, the reinforcing event seems to be the focusing of the attention of another individual on that same specific object—not just the receiving of praise for pointing and labeling. In fact, the child will monitor the response of the adult and continue to point and vocalize until the adult attends to the object being labeled. Such behavior implies that it is not generalized social reinforcers that are maintaining the labeling (or tacting), but rather the adult's response of attending to the precise object that the child is labeling.

Typically, when a tacting paradigm is employed with animals, the animals do not monitor the experimenter's visual regard, nor do they single out an object from the environment and draw the experimenter's attention to it, as is the case with the human child. For this reason, the human behavior that Skinner refers to as "tacting" and the behavior that has been termed "tacting" in animal work are distinct in more than just a definitional or superficial manner. Thus the term "tact-like" is cautiously applied to Sherman and Austin's

behavior, as shown in Figure 3, to indicate that this behavior is not viewed as entirely equivalent to tacting or naming in the human sense.

### MANDING AN ABSENT OBJECT

According to Skinner, mands may come to be emitted even when the manded object is absent. In his view, mands that occur in the presence of a weak stimulus, or even with the stimulus absent, are extended mands inasmuch as the behavior is extended beyond the original context in which it was acquired and the "listeners" cannot possibly reinforce the behavior in characteristic fashion. Skinner (1957) observes:

A thirsty person may "pretend" to drink from an empty glass. Many gestures appear to have originated as "irrational" extension of practical responses. The traffic officer extends his hand, palm outward, toward an oncoming car, as if to bring the car to a stop by physical means. The gesture functions as a verbal response, but it exemplifies the extension of a practical response through stimulus induction to a situation in which normal reinforcement is impossible. Verbal behavior may more easily break free from stimulus control, because by its very nature it does not require environmental support—that is, no stimuli need be present to direct it or to form important links in chaining responses. (p. 47)

Manding of absent objects does occur in Sherman and Austin, as we pointed out earlier. However, when a chimpanzee mands an absent object, the conditions that occasion this behavior are often very difficult to discern. Moreover, if the chimpanzee is manding a food item, all of the observable antecedent conditions may in fact be identical whether the chimpanzee mands banana, apple, coke, etc. Thus it becomes procedurally important to determine whether there is indeed any definite relationship between the items that the chimpanzee mands and the item that we would say he in fact desires. If, for example, the chimpanzees have seen a variety of foods in the refrigerator and they are hungry, can they request a specific food even if it is not displayed? Do they then retrieve the exact food they requested if they are given the opportu-

ity to go to the refrigerator and select it themselves?

The requesting of visually absent foods appeared rapidly in Austin and Sherman and with no specific training. When an audience was present, they readily began pressing food keys and looking back and forth between the audience and the refrigerator. This behavior was interpreted as a request for the audience to act upon the refrigerator so as to retrieve the manded food, which the audience usually did.

However, in order to determine whether or not the mand of the absent object was, in effect, being determined by a specific want, it was necessary to alter the procedure of giving the manded item. This was done by replying to a mand for food  $x$  with a statement, "Yes, you may have food  $x$ ," and then gesturally encouraging them to go to the refrigerator and select for themselves the food that they had manded (Figure 5). If the food key they pressed corresponded to the food they selected when all foods were available, it was concluded they were able to mand objects which were not visible to them and that they knew which food they were manding.

Correctly *selecting* the requested food did not appear without specific training. Initially, when the chimpanzees were allowed access to the refrigerator, they appeared quite overwhelmed and tended to grab the first few items in front and run away with them. However, by reorienting them to the keyboard (the symbol that they had selected remained lighted) and pointing first at the keyboard (for example to the symbol for beancake, which they had just lighted) and then to the beancake in the refrigerator, the correct execution of mands for absent objects came about relatively quickly. The most difficult part of this training was to teach the chimpanzee to reach across a food that he liked in order to take the specific food that he had manded. It was, to speak colloquially, difficult for the chimpanzee not to "change his mind" just as he was reaching across a delicious-looking food. But this problem disappeared with training and the choices of the chimpanzees soon came to correspond with their selections 95 to 100% of the time (Savage-Rumbaugh et al., 1983).

A critical factor in the procedure used to assess mands for absent objects is that even though the listener provided the same sort of

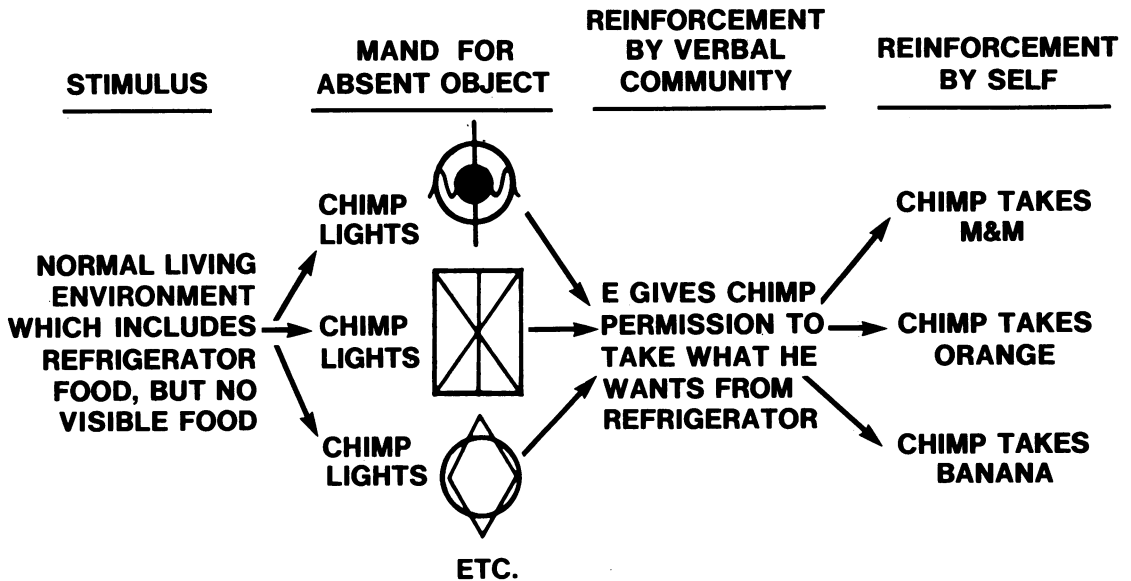


Fig. 5. In the procedure for manding absent objects, each specific response is preceded by the same stimulus and followed by the same generalized reinforcer on the part of the verbal community. However, the chimpanzee himself provides the specific reinforcer that corresponds to the manded item. Thus it is only the chimpanzee's behavior—both the mand and the self-produced reinforcement—which differ from trial to trial. Everything else remains the same from trial to trial.

generalized reinforcer (i.e., giving permission to go to the refrigerator) regardless of the chimpanzee's specific mand, the chimpanzee himself provided the specific consequences of the verbal response that he himself had just emitted. The manding of absent objects is the logical extension of the request and labeling procedures discussed earlier in that it combines the features of generalized reinforcement and specific contingent reinforcement, requiring both, but from different individuals in the speaker-listener dyad. Thus, as Figure 5 illustrates, the chimpanzee is maintaining his own manding behavior by providing his own reinforcement. This reinforcement is, moreover, specific and distinct for each manded item.

### THE LISTENER

While Sherman and Austin were acquiring the verbal operants described above, we were also attempting to develop in their repertoires the role of the listener and all of the mediating operants that are identified with this role. Skinner (1957) has emphasized the importance of the listener:

The action which a listener takes with respect to a verbal response is often more

important to the speaker than generalized reinforcement. The behavior of the alert, mature speaker is usually closely related to particular effects. Generalized reinforcement is most obvious and most useful in the original conditioning of verbal behavior. In some measure, the verbal community continues with such reinforcement into the mature life of the speaker, but upon any particular occasion the speaker is most concerned with "letting the listener know about something"—that is, the strength of his behavior is determined mainly by the behavior which the listener will exhibit with respect to a given state of affairs. (pp. 151-152)

Both in the above passage and at many other points throughout *Verbal Behavior*, Skinner emphasizes that the speakers are using verbal behavior to alter not their physical environment but the behavior of other speakers (i.e., listeners) and that it is the alteration of the listener's present and future behavior that maintains the speaker's behavior.

The young child not only generates verbal behavior, he or she responds to it appropriately and cooperatively (much of the time) when it is generated by others. The type of verbal

behavior oriented toward the child typically consists of expressions of affection, requests for action, and questions—to which the child's proper response is taken as evidence of competence or comprehension of the verbal output of the speaker. Children are frequently asked to carry out simple tasks such as "Put the towels in the hamper," "Bring the truck here," etc. In other societies, the sorts of tasks children are asked to do may vary, but they are still universally asked to do things in response to verbal requests, and the cooperation that is displayed in response to these requests is a mark of acceptance into the verbal and cultural community. The requester typically monitors the child's behavior and sees that the task is completed, adding gestural clarification when the child does not appear to respond properly to the verbal stimuli alone and adding emotional support should the child experience difficulty.

The behavior associated with a particular symbol or group of symbols is quite different for a child who is acting in the receptive mode. In this mode, the verbal stimuli must be turned into a specific set of behavioral actions. It is these actions which then become the focus of the speaker's attention. The speaker often physically guides the child to help the child behave in accordance with the utterance. Thus the child comes to learn the "value" of that utterance for that speaker. "Meaning," in the sense of attributing similar values to the words of different speakers, comes about as the child

learns, through such guidance, the commonality of the values of different utterances for different speakers.

As Skinner (1957) notes, the total speech episode can be explained only by listing all of the relevant types of behavior of both speaker and listener in their proper temporal order. His approach is diagrammed in Figure 6, which illustrates a speech episode in which one person asks another for bread. The problem of motivation is disposed of by assuming a hungry speaker and a listener already predisposed to comply with food requests.

Although Skinner does not explicitly point out that a listener must acquire many of the same verbal operants as the speaker, that such is the case seems to be presumed throughout *Verbal Behavior*. A listener can, in fact, provide the appropriate contingencies for a speaker's verbal operants (e.g., passing the bread in response to "give bread") only when the listener's appropriate nonverbal behavior has been reinforced in the presence of (or in relation to) the relevant nonverbal and verbal stimuli (e.g., compliance with the mand for bread). That is, the nonverbal behavior of the listener must correspond, in a unique way, to the verbal behavior of the speaker. Otherwise, the speaker could say "pass the bread" and the listener would give the salt (or nothing at all). Furthermore, not only must listener and speaker share many specific associations, they must share specific verbal operant skills; that is, if the speaker is executing an *intra-verbal*

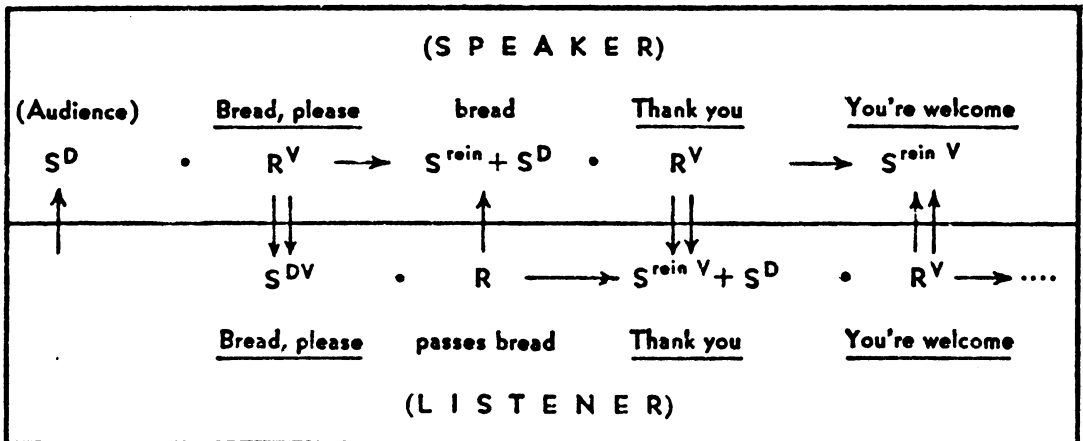


Fig. 6. This figure is taken from *Verbal Behavior* (p. 38) and is Skinner's illustration of the mand process as it occurs between two individuals. It is clear from the figure that Skinner conceptualizes language very much as an inter-individual process in which the behavior of each individual both maintains and serves as the stimulus for the ensuing behavior of the other.

*mand* (a mand for which a specific verbal response is the reinforcer) as opposed to a simple mand, the listener must, on the basis of contextual cues, determine which is being executed and respond appropriately either with a generalized reinforcer or with a specific reinforcer. Without such a capacity, the listener could not properly mediate the consequences of the various verbal operants executed by the speaker, and the verbal episode, as defined by Skinner, could not exist.

We have used the term *receptive competence* to refer to the role of the listener. It is important to note that as Skinner (1957, p. 195) predicted, these listener competencies had to be taught separately to the chimpanzees. They did not appear spontaneously once the chimpanzees had acquired the forms of manding and tacting described above. When the chimpanzees were first treated as listeners instead of speakers, they showed little, if any, inclination to comply with the speaker's mands for various foods. Typically, when the experimenter assumed the role of speaker and he/she and the chimpanzees seated themselves in front of a table of food, the chimpanzees would ignore the experimenter's mands such as "Give beancake" or "Given M&M" and would instead attempt to take the food for themselves. When the chimpanzees did attempt to give the experimenter a food (usually after the experimenter had executed the gestural palm-up "give" mand), it would either be always the same food, or any food chosen at random. Thus the responses of the chimpanzees to the experimenter's expressed mand showed no unique relationship between the particular form of the experimenter's response and the reinforcer selected by the chimpanzee. Although the chimpanzee could be said to be a member of the verbal community with regard to the execution of verbal operants at this point, he certainly was not a member of that community with regard to the way he responded to the verbal operants of other members of his community. Clearly, it would have been quite difficult, without altering this situation significantly, for two or more chimpanzees to engage in verbal episodes with any practical utility.

Since our goal was to achieve complete verbal episodes, we began to design contingencies that stressed compliance with the speaker's mands and made it beneficial for

the chimpanzees to respond as listeners to the verbal operants of others. The experimenter began by accompanying one verbal request, such as "Give orange," with a pointing gesture. This served to focus the chimpanzee's attention first on the symbol and secondly on a specific food. When the chimpanzee picked up the food to which the experimenter pointed, the experimenter then gesturally (extended hand, palm up) requested the food. Upon receiving the food, the experimenter divided it, giving half to the chimpanzee and keeping half for himself or herself. This sharing made food-giving a beneficial activity for the chimpanzee in a very direct sense. The experimenter was able to stop pointing, and to expand the number of foods manded, after the first few sessions. It did not prove necessary to share the food on every trial. Instead of giving the chimpanzee a bite of the food on every trial, the experimenter simply took turns with the chimpanzee being the speaker. The chimpanzee was allowed to mand food of the experimenter, the experimenter complied; then the experimenter manded food from the chimpanzee, and the chimpanzee complied. Switching roles ensured cooperation and attention to the speaker and readily became the only reinforcement needed for the maintenance of cooperation and appropriate listener behavior.

The ability to retrieve items removed in space—that the speaker could not point to while manding—was an extremely important skill to develop. With practice, the chimpanzees learned to attend to symbolic requests, go to adjacent rooms, search through a number of foods and objects, and return with the item manded by the experimenter. In so doing they became not only competent listeners who could comply with mands for present objects (Figure 7), but sophisticated listeners who could comply with mands for absent objects (Figure 8).

Once the chimpanzees became sophisticated listeners, they could sit in front of an array of foods and take turns in the roles of listener and speaker as one chimpanzee manded food and the other gave the manded food. Gestures were spontaneously employed in this situation in accordance with the outcome of mutual visual monitoring. That is, the speaker was attentive to whether or not the listener observed and comprehended his request (lack of comprehension could be inferred from the



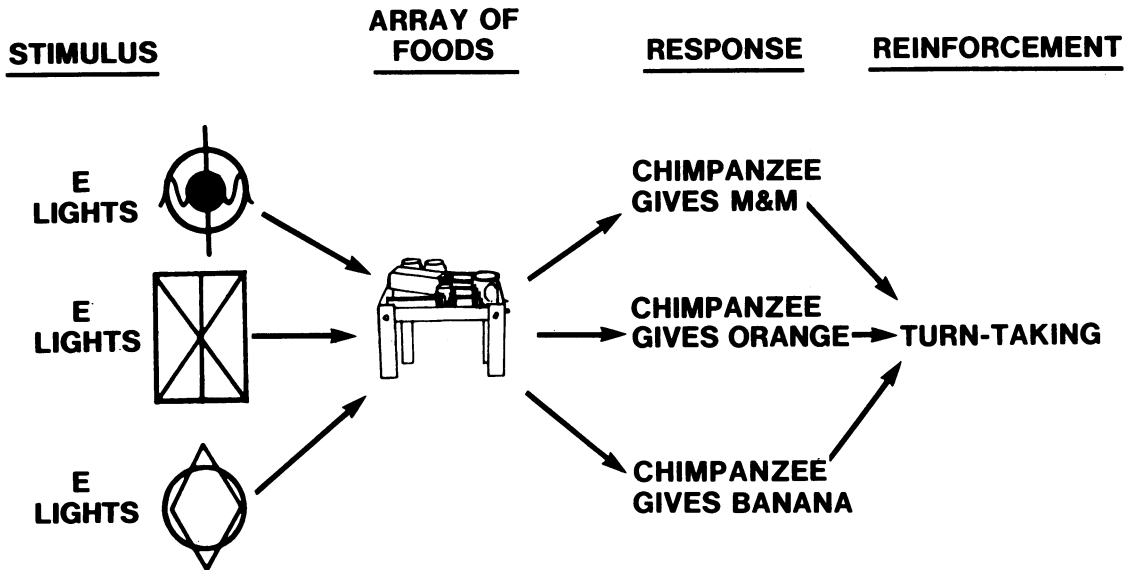


Fig. 7. The procedure used to develop and refine the receptive skills required by a listener, including the ability to decode the stimulus presented by the experimenter, to search an array, to select and give a single item by removing it from the array and thus to alter one's environment in the specific way mandated by the speaker. The behavior is maintained by turn-taking—not on each trial, but after a group of trials.

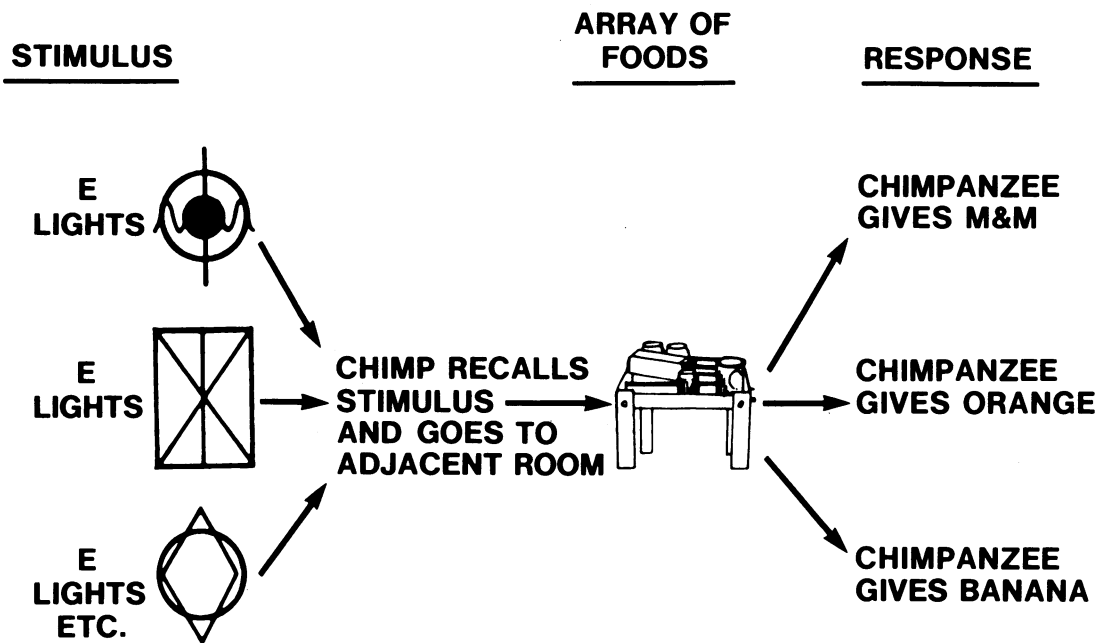


Fig. 8. Responding to mands for absent objects requires all of the skills discussed under Fig. 7 plus the remembering of the mandated item for a period of time and then execution of the appropriate series of actions. The chimpanzees could return for a second look at the mandated item if they forgot, but they could not see the symbol at the time they made their selection from the array. The mandated item, once it was retrieved from the array, was carried back to the first room where the experimenter waited. This procedure was first developed as a control for cueing, because the experimenter was out of sight as the response was made. It was used regularly, however, because it was very effective.

hesitant reaching behavior of the listener) and the speaker would clarify his mand with a pointing gesture on these occasions (Figure 9). It was also possible to replace the food tray with a TV set that displayed an image of the food tray. The food tray itself was located in the adjacent room and the listener now had to go to this room to retrieve the food manded by the other chimpanzee (Savage-Rumbaugh & Sevcik, in press). The real utility of language can readily be seen in tasks such as this which entail an extension of time-space, plus the cooperation and inter-individual monitoring that is necessary to sustain a smooth, coordinated verbal and nonverbal behavioral exchange between two individuals. It is these factors that have enabled language to play the central role it does for the human species.

### THE TACT

The fifth type of verbal operant that Sherman and Austin acquired was the only verbal operant to appear spontaneously, apparently as a result of a synthesis of other skills acquired during the training of the operants described earlier. This operant seems to correspond more closely to Skinner's use of the term *tact* as he employs it to discuss human behavior, than to the earlier tact-like behavior shown in Figure 3. This operant was not intentionally trained; rather, it simply began to appear in Sherman's and Austin's behavioral repertoires following training on the paradigms described earlier.

Skinner's descriptions of tacting in the human species clearly state that the control of the tact is through the stimulus; yet tacts do not occur each and every time a person encounters that stimulus. That is, seeing a green color does not automatically produce the verbalization "green," as is typically the case in animal studies of "tacting" green. The occasions for the verbal response "green" are far more complex in the human community and include something of the notion of "communication" and the recognition on the part of the speaker that his or her behavior has had a particular effect on the behavior of the listener. In reference to the tact, Skinner emphasizes that presence of the stimulus alone is insufficient to guarantee reinforcement of the response.

If a chair, acting as a stimulus, simply made the response *chair* probable, and if a cribbage board, acting as a stimulus, simply made the response *cribbage board* probable, we could deal with the "semantics" of verbal behavior merely by supplying an inventory of tacts. But a verbal repertoire is not like a passenger list on a ship or plane, in which one name corresponds to one person with no one omitted or named twice. Stimulus control is by no means so precise. If a response is reinforced upon a given occasion or class of occasions, any feature of that occasion or common to that class appears to gain some measure of control. (p. 91)

Thus, while the control of the form of the response is through the stimulus in the tact, the control of the occasion for the occurrence of the response rests with the practices of the reinforcing community. According to Skinner, the community defines the occasions on which the stimulus should evoke tacting and when it should not.

Skinner's tact corresponds to the ability in Sherman and Austin that we have referred to as the capacity to make a statement (Savage-Rumbaugh et al., 1983; Savage-Rumbaugh, in press). In our view, this is the most important class of verbal operant in Sherman's and Austin's repertoires because this operant is not (in any clear and obvious manner) under the control of stimuli that are explicitly singled out of the context and presented by the teacher in order to evoke a response. Thus, this operant differs dramatically from the sort of behavior typically found in laboratory-conditioned animals.

Statements are made spontaneously when the teacher does not set the stage for the response to occur. This is not to say that there is no stimulus for the response, only that the behavior of the teacher-experimenter does nothing to set the occasion for the response (as in showing an object, hiding a piece of food, causing the color green to light on a panel, etc.). Additionally, it is often not possible to determine what the particular stimulus for a given response is at any given time. It is equally difficult to determine what sort of reinforcer is operating to maintain this behavior at any given time, unless one concludes that

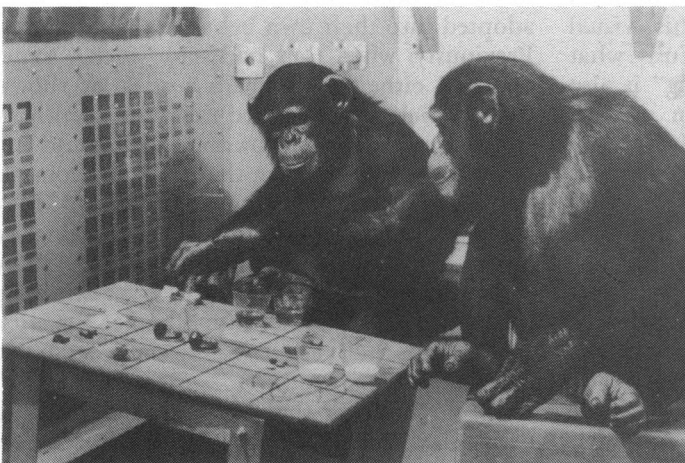
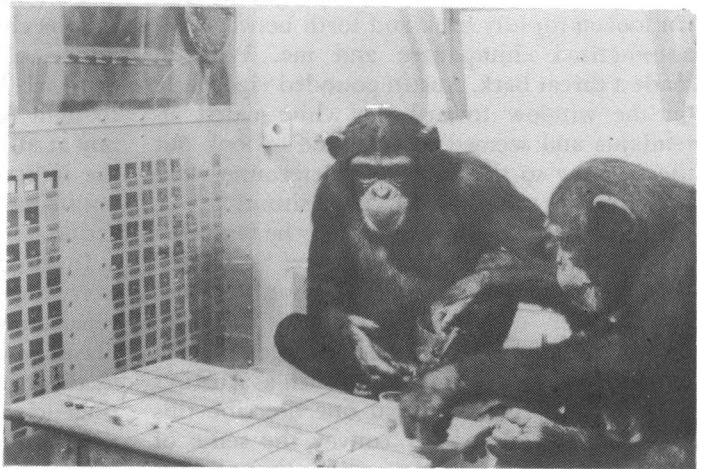
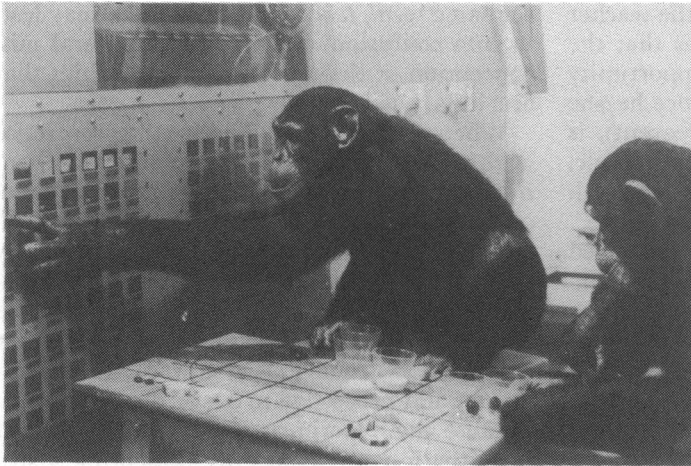


Fig. 9. Top: Sherman (left) uses the keyboard to request of Austin one of the foods on the table in front of them. Middle: Austin picks up the food which Sherman requested and gives it to him (cherry); he also takes a cherry for himself. Bottom: When it is Austin's (left) turn to ask, Sherman sometimes points to food that Austin might request—as shown in this photo (thus, manding a mand). At times Austin complies, but equally often he does not—though he always attends to Sherman's gesture, as illustrated here.

tacts occur to draw the attention of the teacher to certain objects or events. It seems that the attending of the listener, and the opportunity to observe what the listener does (once he/she has attended to the tacted item or event), is often the only viable reinforcer. For example, on one occasion Austin approached me with pilo erection (a sign of anxiety), said "scare," and then gestured out the window. I looked out the window and saw an anesthetized chimpanzee being carried past the laboratory by two attendants in white coats. Why did Austin tact this event? No teacher had ever tacted a similar event, and "scare" had been taught as a request to play a game in which the teacher dressed up in costume and pretended to scare the chimps. As I looked out the window, Austin looked rapidly back and forth between the anesthetized chimpanzee and me. When I made a threat bark, Austin pounded vigorously on the window toward the white-coated attendants and seemed to want me to look out the window so that he could determine what behavior was appropriate for the situation.

As Skinner (1957) notes, "It may be tempting to say that in a tact the response 'refers to,' 'mentions,' 'announces,' 'talks about,' 'names,' 'denotes,' or 'describes' its stimulus" (p. 82). I must "announce" that I have engaged in such temptations, especially in cases such as Austin's use of scare. How else can one describe this behavior and accurately convey the sense of what happened? Simply saying that Austin responded with a tact when the stimulus of an anesthetized chimpanzee entered his visual field somehow seems not to convey fully what happened, particularly when "tacting" is also what a macaque is said to do when a green panel is lighted in his cage, and he presses another panel marked "x" (E. Segal, personal communication, 1983). The green light is all that the macaque sees, and he is shown it for a very specific purpose. He is not monitoring the behavior of the experimenter to see if his tact of "green" is responded to appropriately, though he does note if he receives food or not for having solved the problem correctly on this trial. Austin, however, pulled me to the window and repeated "scare" when, at first, I did not look out the window in response to his gesture. Prior to this occasion, Austin had never gesturally encouraged someone to look out the window. These usages of "scare" and "green" are of such a different order that using

the same term, *tact*, to describe them may lead us into confusion and promote a general misconception of the presence of similarities that are, in fact, not there.

When we first began to notice the occurrence of these statements or tacts, we observed them in situations that prompted the intuitive label of "announcing." For example, the chimpanzees might say "go playroom," and then simply walk there, with no response from the experimenter. They lighted these symbols when we had provided no specific stimulus to evoke that behavior and then looked toward the experimenter and proceeded to execute the behavior. Because the experimenter had not structured the situation in advance by presenting a specific stimulus (such as baiting a tool site, showing the chimpanzee a specific food, pointing to a specific location) and thus had no knowledge of which lexigrams the chimpanzee was about to light (or even that he was about to light any at all), it was difficult, as listener, to avoid the impression that the chimpanzee was "announcing" or "describing" his impending action.

In executing such tacts, the chimpanzees were incorporating behavior into their own repertoires that had heretofore only been played out in the inter-individual domain; that is, they themselves were carrying out the contingencies enforced by the verbal practices of the mini-community in which they had been raised. Now, pieces of the exchange that had formerly been only the role of others were adopted into their own behavioral repertoires. Previously, when they had said "stick," someone had either given them a stick or shown them a stick and rewarded them for labeling a stick correctly. Now, however, they could say "stick," thereby singling the stick out from all the other environmental stimuli, and they could act upon it themselves by showing or giving the stick to another individual. They could also use the lexigram "stick" in directing the attention of another individual to the stick so that this individual would then act upon the stick.

By emphasizing that the events controlling this behavior are no longer in the immediately preceding behavior of the experimenter, we are not implying that no stimuli determine the behavior, only that the stimuli that do determine the behavior are no longer obvious. They lie in the reinforcement histories of the chim-

panzees, not in the experimenter's present behavior. Sherman and Austin do not tact a stick every time they see one, nor do they tact "playroom" every time before they go there. As Skinner (1957) has aptly pointed out, "Familiar objects lose their control because the community eventually withholds reinforcement except under special conditions" (p. 89). It is these special conditions (the context of the naming game, the unusual event, unusual object in usual context) that set the occasion for reinforcement of, and hence appearance of, the tact.

The key ingredients of the statement repertoire as it appeared in Sherman and Austin, are (a) that the general context, as opposed to the specific object-showing behavior of the experimenter, comprises the conditions for occurrence of the tact; (b) that the specific tact that occurs is not already specified by the context, but is instead a property of the reinforcement history of the subject, the vagaries of the moment-by-moment shifting attentional states displayed by the subject (that is, the same physical display and the same reinforcement history *do not* always combine to produce the same response, even in the same subject; thus, some presently unspecifiable variables affect the chimpanzee's choice as to which item to tact at any given moment); and (c) that the subject himself follows the emission of the tact with some behavior toward the tacted object (showing, glancing, pointing, retrieving, etc.).

Others (e.g., H. S. Terrace, personal communication, 1983) have argued that these criteria are insufficient for a response to be classified as a tact because, in a tact, the reinforcer is not a primary reinforcer, but rather the goodwill of the verbal community. In Sherman's and Austin's case, the goodwill of the verbal community is often expressed rather directly, by giving them food, taking them outdoors, tickling them, etc. However, it is not difficult to replace some of these primary reinforcers with generalized secondary reinforcers and to introduce a delay by signaling a forthcoming secondary reinforcer. We have, in fact, used washers as tokens in just this way. Washers then come to represent the ensuing goodwill of Sherman's and Austin's verbal community just as phrases such as "I enjoyed your paper" represent the ensuing goodwill of the

scientific verbal community which the author and reader of the paper inhabit. The position argued here is that the way in which Sherman's and Austin's verbal community reinforces a tact is not sufficiently different from the way the human community reinforces tacting to warrant the exclusion of Sherman and Austin's responses as tacts. The important element is that the control of their behavior is "through the stimulus" and that the stimulus does not have to be singled out by the behavior of another (i.e., experimenter) for the tact to occur.

A procedural outline of the paradigm that we used to test Sherman's and Austin's statement repertoires is shown in Figure 10. A more complete description of this phenomenon and its documentation under controlled conditions can be found elsewhere (Savage-Rumbaugh et al., 1983). It is apparent that there are many similarities between Figures 5 and 10. In both cases, no specific immediate stimulus on the part of the experimenter, such as showing an object, baiting a tool site, gesturing toward a location, precedes the response. That is, in both Figures 5 and 10, the experimenter presents no stimulus to which the chimpanzee is supposed to respond. In Figure 5, the chimpanzee executes a mand and then is given the opportunity to eat a specific food. In Figure 10, the chimpanzee lights a specific symbol and then gives that object to the teacher. Although this behavior does occur occasionally in contexts in which the chimpanzee receives no food reinforcers, it is most reliably produced in the context of "naming games" in which the chimpanzee names an object, then selects and gives that object to the experimenter. In this case, the chimpanzee typically receives food only after he had named all the items in the game. Food reward is not essential to the occurrence of such tacting but is typically used during "dull" sessions to maintain a high level of motivation in a context in which practice, as opposed to communication, is of the essence.

Although Sherman and Austin did not display the Helen Keller phenomenon of seeking to know the names of everything, once having discovered that things have names, they did try to find out what new symbols "meant" in the sense that they searched for and lit new symbols and then looked to the teacher to see what he/she would do.

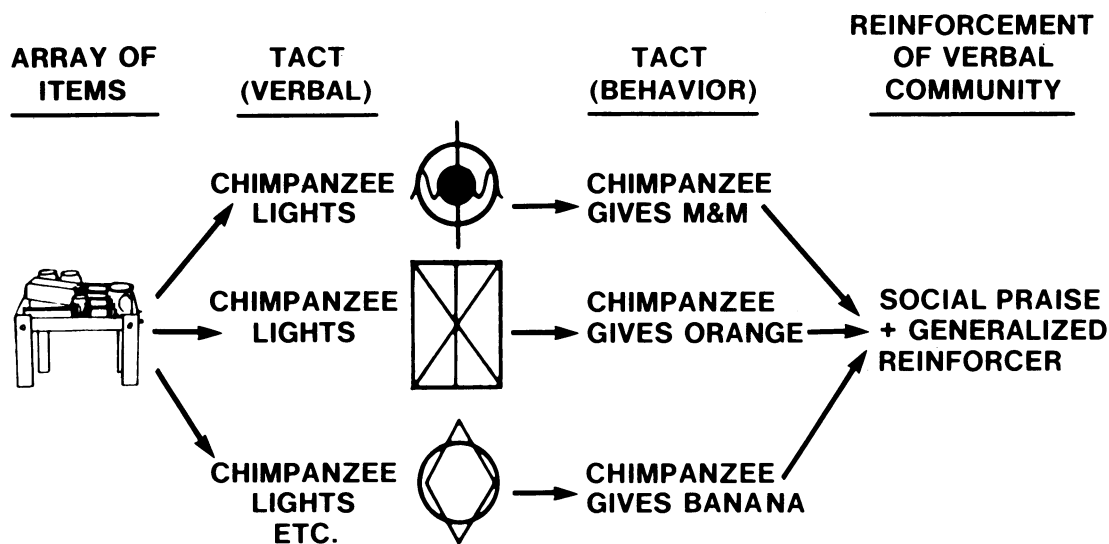


Fig. 10. In this example of a tact, there is no immediate stimulus that precedes the behavior, at least none that is explicitly presented by the experimenter to evoke a particular type of behavior. The chimpanzee simply tacts something and then acts upon it—by retrieving it, eating it, engaging in the tacted action, etc. This capacity is evaluated using the paradigm shown here in which an array of items is placed in front of the chimpanzee. The chimpanzee tacts the particular items he chooses to give the experimenter on any given trial, and then follows this tacting behavior by giving the tacted item to the experimenter. The array is changed every trial so that the chimpanzee cannot simply tact anything and then look for it in the array. Moreover, during blind tests, the array is in a different room from the keyboard so that the chimpanzee cannot see the array as he produces his tact; he has to remember what is in the array on each trial as he tacts his ensuing behavior.

### TURNING TACTS AND MANDS INTO COMMUNICATION

Communication, as process, is not dealt with in detail in *Verbal Behavior*; however, Skinner does note:

The term "communication" also suggests that the speaker is controlled by a stimulating situation and is especially reinforced by the action which the listener takes with respect to it. The term [communication] does not apply to the mand or to echoic, textual, or intraverbal behavior and is not too easily applied to the tact which results from generalized reinforcement. (p. 152)

Unfortunately, Skinner does not go on to provide a vocabulary that does apply to the phenomenon of communication, though he does note:

With respect to a particular speaker, the behavior of the listener is also a function of what is called "belief." We may define this in terms of strength of response. Our

belief that there is cheese in the icebox is a function of, or identical with, our tendency to go to the icebox when we are hungry for cheese, other things being equal. Our belief that there is a substantial table in front of us varies with our tendency to reach for it, place things upon it, and so on. If we have just spent some time in a house of mirrors in an amusement park, our belief in this simple fact may be shaken, just as our belief about the cheese may be quickly dispelled by an empty icebox. Our belief in what someone tells us is similarly a function of, or identical with, our tendency to act upon the verbal stimuli which he provides. If we have always been successful when responding with respect to his verbal behavior, our belief will be strong. If a given response is strictly under the control of stimuli with little or no metaphorical extension and no impurity in the tact relation, and if the speaker clearly indicates these conditions, we will react in maximal strength. In this sense we "take his word for it" implicitly. (pp. 159-160)

Thus Skinner (1957) makes it clear that both the "beliefs" of the listener and the speaker's ability to alter the listener's behavior are important dimensions of reinforcement for the speaker. The dimension of reinforcement for the listener is less clearly spelled out. The change in the listener's behavior must be brought about by indirect nonmechanical or verbal means. In the investigation of communication, it becomes important to address the issue of what sort of changes occur in the listener's behavior as a result of hearing the speaker's behavior. Skinner discusses, with regard to the listener, not only the way in which the listener's behavior is altered as a result of the speaker's comments, but also the listener's assessment of the accuracy of correspondence between real world events and the speaker's verbal operants. The term *belief* in this sense refers not to the inner state of the listener, but to the listener's past history of validation of this speaker's operants and hence to his prediction of the speaker's future operants.

In the symbolic communication paradigm employed with Sherman and Austin, we wondered whether the chimpanzee listener had, in fact, come to form "beliefs" (in the Skinnerian sense) about the chimpanzee's verbal behavior (Savage-Rumbaugh et al., 1978a). The chimpanzees' nonverbal behavior seemed to correspond with their verbal behavior in that when food was hidden in a container (with only one chimpanzee being allowed to see which food was placed in the container), both chimpanzees requested the food and both approached the container eagerly, as though they anticipated that it would hold food. The chimpanzee who had not seen the baiting not only requested the same food as the chimpanzee who had seen the baiting, but also behaved differently on trials when the container was identified as holding a high preference food than when it was identified as holding a low preference food. Thus, upon seeing Austin say "orange drink," Sherman would emit loud and joyous food barks as he approached the keyboard. If, on the other hand, he saw Austin say "chow," he would dawdle around and at times not even bother to mand this food. Moreover, he learned which foods Austin tended to confuse (such as orange drink and strawberry drink) and if Austin requested one of these foods, Sherman would often select the symbol for the other food—even though he himself never con-

fused these foods in other contexts.

It appeared that Sherman had come to discriminate Austin's pattern of errors on some foods and that he attempted to correct for this by selecting the appropriate symbol, as opposed to selecting the one Austin had chosen. Similar occurrences were observed in the food-sharing task described in the previous section. However, it was difficult to judge, from such occurrences alone, whether or not Sherman's belief regarding the container's contents corresponded to that of the hungry person who went to the icebox for cheese in Skinner's example. It could be that other training contingencies were controlling Sherman's behavior and that his behavior simply caused it to appear that he had formed a belief about the container's contents.

In order to assess more accurately what Sherman and Austin believed as listeners in this situation, we queried the listener by presenting him with photographs after the speaker had revealed the container's contents. The listener (who had not seen the food hidden) then manded the food by handing the experimenter the correct photograph. In doing so, the listener revealed that he was doing more than merely imitating the behavior of the speaker. Even though he had not seen which food was placed in the container, as listener he had learned the container's contents as a result of observing the speaker's mand. Furthermore, his ability to switch spontaneously from manding with lexigrams to manding with photos revealed that he had learned the general structure of the manding process because no training was required to execute a completely novel mand response with a completely novel class of stimuli.

It should be noted that Sherman and Austin were not taught to give photographs in response to a lighted lexigram key. In fact, if we simply used keys to ask them to select a photograph, they were—at this time—unable to do so. They were not only unable to select the correct photo if it was manded by the teacher, they were also unable to select the real food items correctly. The reason is that Sherman and Austin had not yet become competent "listeners" at the time the symbolic-communication study was conducted. This listener's skill required separate training, as discussed in the earlier section.

It is important to note that the decoding re-

quirement in the symbolic communication study is quite different from that shown in Figures 7 and 8. In order to determine what food was in the container, the chimpanzees did not have to cooperate with another's request that they search an array and give an item. They had only to mand the item itself. Hence they could use the photo to perform the act of "manding," a verbal skill that was in their repertoires, but they could not respond to the photo as a true "listener." This discrepancy may seem surprising, but it is one that Skinner's (1957) theory of verbal behavior predicts. According to Skinner, each of these verbal operants is acquired separately and is maintained by different reinforcing practices within the community. Because we had not yet taught the appropriate listener response to mands, the chimpanzees should have been unable to give the photo when they saw the lexigram lighted—with no food hidden to be manded. However, when we switched the form of the manding context (food hidden) from lexigram to photo, they should have been able to give the photo, because manding was a verbal skill already in their repertoire.

#### USING VERBAL OPERANTS IN THE GENERAL SENSE

Much of Austin's and Sherman's verbal behavior was explicitly taught, as opposed to the far more spontaneous symbol acquisition characteristic of the normal child. Therefore, we sought to determine whether their verbal behavior is tied to the specific lexigrams that they have learned, or whether they have become able to generalize these verbal skills across symbol systems. Have they learned, in a general sense, about the functions of tacting, manding, etc.? Have they learned "tacting" as a semantic skill that goes beyond the individual tacts they have acquired?

If Sherman and Austin have, for example, learned only particular skills of mutually extending particular environments of the speaker and listener, one would expect little, if any, generalization of these skills to other settings in which verbal operants could be useful. They would have acquired some very complex verbal operants but would not have learned the general function of these operants and therefore could not be expected to conduct verbal epi-

sodes or engage in the construction of verbal operants on their own.

One of the most direct ways to determine whether Sherman and Austin were capable of producing alternative forms of these verbal responses would be to place them in a situation where they could mutually benefit by using verbal operants, but which would, in some way, prevent them from using the particular symbols which they had learned to use to accomplish communicative acts. One would expect that they would quickly react to a non-active keyboard (one in which all the keys are darkened and nonfunctional) that had no effect on the listener, by changing to a more effective means of verbal behavior if such were available to them. They should use that means without any specific training to do so, whenever the keyboard was unavailable.

We designed such a problem by deactivating their keyboards while providing an alternative symbol system. These alternative symbols had never been used in any training paradigm, yet they were familiar. They were the various symbols that manufacturers choose for adorning their products—product trademarks (Coca Cola, M&M, etc.). We obtained them simply by peeling the labels off jars, flattening them out, and taping them onto pieces of Lexan. Sherman and Austin had seen such labels on bottles and cans many times, because they regularly helped in the food preparation for all training tasks. However, they had never been asked specifically to associate a label with a lexigram, nor had they been asked to label empty containers. In fact, the only lexigram typically used with labels per se was "gone," which was used by the experimenter when displaying an empty, but labeled, container. We had observed, however, that Sherman and Austin responded to the sight of a container, such as a large can of Planter's peanut butter, with excitement and food barks long before we ever opened the container or before they had any chance to observe or smell its contents. Therefore, it seemed reasonable to conclude that they had learned which labels went with which foods. We did not want to test them to determine this in advance, however, because such a test could act as a training experience. Consequently, when we began this study, neither Sherman nor Austin had received training of any sort with the 15 food labels used in that



study. Rarely in previous tasks was the label even present when the chimpanzees used food lexigrams because we typically took portions of various foods and drinks out of their original containers while in the kitchen area and then carried unmarked bowls and pitchers of food to the training areas.

In the test for the alternative verbal modes, we simply placed 3 of these 15 plaques (randomly selected with the stipulation that one correspond to the food which had been hidden in a container) near the keyboard. (The chimpanzees were accustomed to having photographic plaques, tools, toys, blankets, and all manner of objects scattered about on the floor near the keyboard.) The conditions that fostered chimp-to-chimp communication were again used. That is, one chimpanzee (C1) was shown the food hidden in a container while the other (C2) waited in another room. C2 sat by a table full of lexigram plaques, and after the window between the 2 rooms was opened, C1 used the keyboard to tact the container's contents; C2 then selected the plaque with the correct lexigram on its face and gave that to C1. C1 in turn gave the plaque to the experimenter, who opened the container and looked to see if its contents matched the lexigram displayed on the plaque.

On the first trial that the keyboard was turned off, both Sherman and Austin, who reversed roles each trial, readily took note of this fact. They tested various keys for several seconds, then glanced at the trademark plaques. Austin (speaker, or C1) on Trial 1 immediately picked up the correct plaque and carried it directly to Sherman (listener, or C2). Sherman glanced briefly at the plaque and then handed Austin the correct lexigram (Peanut Butter). Sherman, on his Trial 1 as speaker, looked at and held each of the plaques and gazed around the room, apparently waiting for the keyboard to come on. When it did not, he then put down the last plaque he had been gazing at, picked up the correct plaque, and carried it directly to Austin. Austin glanced briefly at this plaque and handed Sherman the correct lexigram. They continued to use these food trademarks accurately as verbal operants for all of the 15 foods that came in bottles, can, or jars.

Their easy success with this task revealed that they could engage in the process of communication even if they were denied access to

the system with which they had learned to communicate. They demonstrated that they had learned the functional value of the symbol (that is, the symbol's ability to serve as mand), not its specific form, which gives the symbol its unique properties.

#### VERBAL BEHAVIOR IN THE PIGEONS—JACK AND JILL

What verbal operants were taught to Jack and Jill (Epstein et al., 1980) that were similar to those executed by Sherman and Austin? It is difficult to determine that the pigeons actually acquired any operants. The first problem in the simulation work is that the pigeons were not trained in a verbal environment. There was no red-, green-, and yellow- key-speaking community, nor can the behavior of the pigeons during training of these operants be said to have affected the behavior of the experimenter-listener in other than the most remote sort of way.

Were mands actually taught to the pigeons? It does not appear that they were; the pigeons were not presented with a unique relationship between the lighting of each symbol and the reinforcer that characteristically followed that symbol (as is done with pigeons in Peterson's [in press] differential-outcomes work). Jack and Jill were instead taught a common relationship between red, yellow, green—R,Y,G—and the single reinforcer (grain) that characteristically followed the pecking of each symbol (Figure 11). This reinforcer was not mediated by the behavior of another individual, but rather by an electronic circuit—which makes it quite doubtful that the pigeon viewed food reinforcement as an extension of the experimenter's behavior.

The only operant that Jack and Jill were taught was the tact-like operant illustrated for Sherman and Austin in Figure 3. The Jack-and-Jill version of this operant is illustrated in Figure 11. Jack learned one set of tact-like responses and Jill acquired another set of tact-like responses. By linking these two sets electronically, the researchers produced a sequence of actions that made it appear as if one pigeon was actually telling the other what color it saw behind a curtain. Clearly, far more complex behavior was developed in Sherman and Austin, and the Jack-and-Jill study does not elucidate the behavior of these chimpanzees. Had

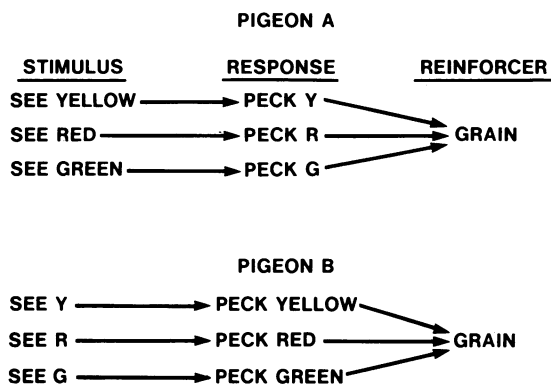


Fig. 11. The training paradigms used with the pigeons Jack and Jill. This procedure is similar to that shown in Fig. 3 for Sherman and Austin; however, Jack and Jill did not receive training on any of the paradigms shown in Figures 1 to 10 for Sherman and Austin. It is important to point out that all of these skills (Figures 1 to 10) were maintained simultaneously by Sherman and Austin and that they could readily switch from tacting, to manding, to receptive responding—all as the nonverbal communicative context dictated, with no special “contextual cueing” explicitly presented by the experimenter.

it been a reasonable goal to link two sets of tact-like behavior together via electronic means, such could have been accomplished with Sherman and Austin in less than five total training trials; in fact, simple observation would be sufficient to produce trial-one behavior of this complexity in the chimpanzee.

In the Jack-and-Jill study, no attempt was made to determine whether or not the “listening” pigeon (the pigeon which had not seen the color projected behind the curtain) had a “belief” regarding the projected color on any given trial—as was done with Sherman and Austin using the photographs of foods. This was a critical aspect of the Sherman and Austin work (Savage-Rumbaugh et al., 1978a), because it demonstrated something about the nature of their performance that could not be shown in the context of the lexigram paradigm alone. Additionally, no attempt was made to determine whether or not the pigeons could actually learn to give objects and thus to become competent “listeners” with regard to object manding and object transfer—as was done with Sherman and Austin (Savage-Rumbaugh et al. 1978a). Although it could be argued that these things could be taught to pigeons, the fact remains that the point of the Jack-and-Jill study was to demonstrate that extremely complex behavior (namely, the types

of behavior exhibited by Sherman and Austin in the information-transfer task) could be accounted for by environmental contingencies. Unfortunately, the Jack-and-Jill study attempted to account for only a small portion of Sherman's and Austin's behavior—presumably a portion that was relatively easy to train in the pigeon. The study did not deal with the whole of the complex behavior that was reported for the chimpanzees, yet it implied that it did and that nothing remained to be explained.

The present paper argues that a good deal remains to be explained and that any apparent similarity between the verbal behavior achieved by Sherman and Austin and the behavior exhibited by Jack and Jill is superficial and reveals little about the nature of mands, tacts, or the process of communication itself. The Jack-and-Jill study, if undertaken from a conscientious comparative perspective, could lead to a better understanding of the phenomenon of communication from an evolutionary perspective. Pigeons surely do have something to tell us about the emergence of language processes, but until the work with them moves beyond satirical simulation, we are not likely to find out what it is that the pigeon can say.

Describing the procedures used in both studies helps clarify the differences between them. It is not surprising that attempts to teach verbal operants to apes should go much further than attempts with pigeons. The considerable behavioral complexity of the ape appears to enable it to accomplish many, though surely not all, of the same ends with verbal operants that humans accomplish.

## CONCLUSION

The procedures that were used to teach chimpanzees verbal operants were not designed to test or prove the views put forth in *Verbal Behavior*. Rather, they were arrived at by trial and error in an attempt to produce social communication between two chimpanzees. This social communication did not appear merely as a result of training simple manding skills. Other skills had to be taught. The repertoires that proved to be effective (manding absent objects, tacting, listening) provide strong support for the analysis of language offered by Skinner in *Verbal Behavior*. Skinner arrived at his conclusions by dissecting language “from

the top down," starting with complex adult language; the procedures described in this paper were arrived at "from the bottom up," starting with language in an organism not predisposed to create it.

Repeatedly, in preparing this paper, I have found the work with Sherman and Austin to be surprisingly close to the framework for language as a behavioral process, which Skinner (1957) so eloquently sets forth in *Verbal Behavior*. However, I am at direct odds with the approach to verbal behavior demonstrated in the Jack-and-Jill study, of which Skinner is third author. I regret this discrepancy, but see no way around it. The Jack-and-Jill study seems not to be a sincere attempt to elucidate the processes of verbal behavior. The book *Verbal Behavior* is, and it made remarkable strides in that direction. Criticism I have made of the Jack-and-Jill study has too often been interpreted as direct criticism of Skinner's ideas as set forth in *Verbal Behavior*. I find this to be an unfortunate state of affairs and hope that my comments here clarify my stance on the issue.

Not only do the procedures developed for apes support Skinner's analysis, but in many respects they help elucidate the early phases of language acquisition and have significant applied value for training mentally retarded humans who have failed to learn language by other means. The normal human child, with greater neural complexity and a propensity to imitate verbal output, needs considerably less tutoring than Sherman and Austin require, but he or she surely goes through a similar learning process, though it is far more rapid and self-propelled. Although previous accounts of the research with Sherman and Austin have described their behavior in more cognitive terms, the procedures themselves have always, of necessity, been strictly behavioral, as there is no other way for one organism to impart language to another. However, the issues of terminology need not stand in the way of developing effective training methods. Whether labels such as "mand" training or "request" training are applied to a procedure, the procedure remains the same. From the common ground of procedural description, behavioral and cognitive approaches can come together and make mutual advances.

## REFERENCES

- Bastian, J. (1967). The transmission of arbitrary environmental information between bottlenose dolphins. In R. G. Busnel (Ed.), *Animal sonar systems* (Vol. 2, pp. 803-873). Jouy-en-Josas, France: Laboratoire de Physiologie Acoustique.
- Bates, E. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.
- Bruner, J. S. (1974/1975). From communication to language—A psychological perspective. *Cognition*, 3, 255-287.
- Crook, J. H. (1983). On attributing consciousness to animals. *Nature*, 303, 11-14.
- Epstein, R., Lanza, R. P., & Skinner, B. F. (1980). Symbolic communication between two pigeons (*Columba livia domestica*). *Science*, 207, 543-545.
- Gardner, B. T., & Gardner, R. A. (1971). Two-way communication with an infant chimpanzee. In A. M. Schrier & F. Stollnitz (Eds.), *Behavior of nonhuman primates: Modern research trends* (Vol. 4, pp. 117-184). New York: Academic Press.
- Greenfield, P. M., & Smith, J. H. (1976). *The structure of communication in early language development*. New York: Academic Press.
- Lock, A. (1980). *The guided reinvention of language*. London: Academic Press.
- Mason, W. A., & Hollis, J. H. (1962). Communication between young rhesus monkeys. *Animal Behaviour*, 10, 211-221.
- McGrew, W. C. (1977). Socialization and object manipulation of wild chimpanzees. In S. Chevalier-Skolnikoff & F. E. Poirier (Eds.), *Primate bio-social development: Biological, social, and ecological determinants* (pp. 261-288). New York: Garland.
- Menzel, E. W., Jr. (1973a). Leadership and communication in young chimpanzees. In E. W. Menzel, Jr. (Ed.), *Symposia of the Fourth International Congress of Primatology: Vol. 1. Precultural primate behavior* (pp. 192-225). Basel: Karger.
- Menzel, E. W., Jr. (1973b). Further observations on the use of ladders in a group of young chimpanzees. *Folia Primatologica*, 19, 450-457.
- Menzel, E. W., Jr., & Halperin, S. (1975). Purposive behavior as a basis for objective communication between chimpanzees. *Science*, 189, 652-654.
- Nelson, K. (1978). How children represent knowledge of their world in and out of language: A preliminary report. In R. S. Siegler (Ed.), *Children's thinking: What develops?* (pp. 255-273). Hillsdale, NJ: Erlbaum.
- Peterson, G. B. (in press). The differential outcomes procedure: A paradigm for studying how expectancies guide behavior. In H. L. Roitblat, T. G. Bever, & H. S. Terrace (Eds.), *Animal cognition*. Hillsdale, NJ: Erlbaum.
- Premack, D. (1976). Language and intelligence in ape and man. *American Scientist*, 64, 674-683.
- Richardson, W. K., & Kresch, J. A. (1983). Stimulus stringing by pigeons: Conditional strings. *Animal Learning & Behavior*, 11, 19-26.
- Savage, E. S. (1975). *Mother-infant behavior in group-*

- living captive chimpanzees. Unpublished doctoral dissertation, University of Oklahoma.
- Savage-Rumbaugh, E. S. (1979). Symbolic communication—its origins and early development in the chimpanzee. *New Directions for Child Development*, 3, 1-15.
- Savage-Rumbaugh, E. S. (in press). *Chimpanzee communication: Verbal and nonverbal*. New York: Academic Press.
- 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.
- Savage-Rumbaugh, E. S., & Rumbaugh, D. M. (1978). Symbolization, language, and chimpanzees: A theoretical reevaluation based on initial language acquisition processes in four young *Pan troglodytes*. *Brain and Language*, 6, 265-300.
- Savage-Rumbaugh, E. S., Rumbaugh, D. M., & Boysen, S. (1978a). Symbolic communication between two chimpanzees (*Pan troglodytes*). *Science*, 201, 641-644.
- Savage-Rumbaugh, E. S., Rumbaugh, D. M., & Boysen, S. (1978b). Linguistically mediated tool use and exchange by chimpanzees (*Pan troglodytes*). *Behavioral and Brain Sciences*, 1, 539-554.
- Savage-Rumbaugh, E. S., & Sevcik, R. (in press). Levels of communicative competency in the chimpanzee: Prerepresentational and representational. In G. Greenberg & E. Tobach (Eds.), *Proceedings of the T. C. Schneirla Conference on Levels of Integration and Evolution of Behavior*. Hillsdale, NJ: Erlbaum.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Straub, R. O., Seidenberg, M. S., Bever, T. G., & Terrace, H. S. (1979). Serial learning in the pigeon. *Journal of the Experimental Analysis of Behavior*, 32, 137-148.
- Terrace, H. S. (1979, November). How Nim Chimsky changed my mind. *Psychology Today*, pp. 65-76.

Received September 27, 1982

Final acceptance December 8, 1983