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# VERBAL BEHAVIOR

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The recent history and current status of the area of verbal behavior are considered in terms of three major thematic lines: the operant conditioning of adult verbal behavior, learning to be an effective speaker and listener, and developments directly related to Skinner's *Verbal Behavior.* Other topics not directly related to the main themes are also considered: the work of Kurt Salzinger, ape-language research, and human operant research related to rule-governed behavior.

*Key words:* verbal behavior, operant conditioning of vocal behavior, verbal behavior acquisition, verbal behavior in apes, rule-governed behavior, verbal stimuli and the listener

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A reasonable history *might* have been the following: As a result of major contributions by Darwin, Thorndike, Pavlov, Watson, and important contributions by many others, B. F. Skinner in the mid-thirties developed the approach that has come to be known as the experimental analysis of behavior. At first this consisted largely of laboratory research with lower animals—mainly rats and pigeons—on the relations between behavior and its consequences. Rapid progress was made with these simpler species, whose behavior was found to be affected in lawful ways by reinforcement contingencies of considerable complexity. Laboratory work with other species, especially monkeys and apes, revealed considerable generality of the basic relations. Species differences had to be considered, of course, but turned out to be related chiefly to (1) sensory and motor capacities, (2) the specific events that function as effective consequences, and (3) unlearned behavior related to mating and care of the young.

It soon became possible to extend this type of research to human behavior, which had been the principal goal all along. The most straightforward extensions were obtained with simpler forms of human behavior not involving language. The behavior of preverbal children and of humans who for various reasons fail to develop language was studied under laboratory conditions and found to be governed by essentially the same laws that had been discovered with rats and pigeons.

This laboratory-based science of human behavior gave rise to a vigorous applied approach called behavior modification, dealing at first with young children and institutionalized psychotic and mentally retarded adults, but soon applying the science of behavior to all types of 'clients' and in all types of settings. In this latter respect, it was clear that human language complicated the picture considerably, but extensive laboratory research on language was already under way, and new knowledge in this area would undoubtedly contribute greatly to our understanding and control of human behavior.

Basic research on language was concerned with several major issues: What does the language repertoire consist of? How do children acquire this repertoire? When linguistic behavior occurs, how do the resulting stimuli affect listeners, and how do language repertoires affect speakers as self-listeners?

But this is not the way things actually happened. The first paragraph is reasonably correct. When it comes to the extensions to human behavior, however, there are two clear discrepancies. First, the vigorous applied approach called behavior modification

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developed without the benefit of any appreciable laboratory research with humans. At the beginning (the late fifties and early sixties), it was a direct attempt to use operant, animal-laboratory methods and concepts to alter socially important human behavior. The relevance of these concepts to human behavior was taken for granted by the behavior modifiers, as it was in Skinner's *Science and Human Behavior* (1953), which undoubtedly played a major role in the development of this movement. There were some published studies demonstrating that human behavior is indeed affected by consequences, and in a manner not drastically different from nonhuman behavior, but such demonstrations could hardly be considered a careful laboratory extension. Only with the recent explicit identification of an area referred to as "human operant research" has there been an effective call for human laboratory research (e.g., Hake, 1982; also relevant is the newsletter publication, *Experimental Analysis of Human Behavior Bulletin,* edited by W. F. Buskist of Auburn University).

The second departure from "what-might-have-been" is that a complex and detailed behavioral treatment of human language became available simultaneously with the experimental analysis of behavior. While Skinner was working on the basic methods and relations that would be reported in *The Behavior of Organisms* in 1938, he was already convinced that these same principles were necessary and sufficient for understanding human language. He dates the beginning of his systematic work on language as 1934 (the personal epilogue, "No Black Scorpion," reported in *Verbal Behavior,* pp. 456-460). By 1945 much of the material that was to appear 12 years later in *Verbal Behavior* had been completed, and was the basis of a summer course at Columbia University in 1947. Ralph Hefferline attended that course and a mimeographed version of his transcribed shorthand notes was distributed privately the following year. Another version of this material was the basis of the William James Lectures by Skinner in the fall of 1947, and several hundred mimeographed copies were circulated subsequently. Skinner's analysis of verbal behavior differed quite remarkably from what might have been expected—first, in the richness, complexity, and detail of the treatment; and second, in its empirical base that was either the animal laboratory data of *The Behavior of Organisms* (1938) or "basic facts . . . well known to every educated person" (1957, p. 11). Skinner comments on this issue in *The Shaping of a Behaviorist* (1979) as follows:

> I had collected a lot of experimental data on verbal behavior—on how people learn strings of nonsense syllables, or the nonsense names of nonsense figures, and I had my own results on verbal summation, alliteration, and guessing. They began to clutter up the manuscript without adding much by way of validation. They threw the book as a whole badly out of balance because I could not find experiments for the greater part of the analysis. I was still the empiricist at heart, but I did not think it would betray that position if my book were not a review of established facts. I was *interpreting* a complex field, using principles that had been verified under simpler, controlled conditions. Except for certain aspects of the solar system, most of astronomy is interpretation in this sense, its principles being derived from laboratory experiments. I decided to leave out all experimental data. (An interesting question then arose: what survived to reinforce writing or reading the book? Was not confirmation the be-all and end-all of science? It was a question concerning my own behavior, and I thought I had an answer: "February 2, 1945. What is motivational substitute for thing-confirmation? Pretty important in teaching method to graduate students. Resulting *order* instead of *confirmation*?" My reinforcers were the discovery of uniformities, the ordering of confusing data, the resolution of puzzlement.) (p. 282)

By the early fifties most of the relatively small group of people who were practicing or

teaching about the experimental analysis of behavior knew of the existence of Skinner's soon-to-be-published major work on language, or had actually seen one of the earlier mimeographed versions. The influential text by Keller and Schoenfeld (1950) devoted 25 pages (pp. 376-400) to a consideration of verbal behavior based largely on Skinner's work; the forthcoming book was mentioned in a footnote (p. 210) in *Science and Human Behavior* (1953); some attention to the larger work was also undoubtedly inspired by the article, "The Operational Definition of Psychological Terms," which appeared in *Psychological Review* in 1945. *Verbal Behavior* was finally published in 1957 and was more than twice as long as the mimeographed versions.

So by the end of its first 20 years, the experimental analysis of behavior was well on its way as an approach to basic research in behavior. It had given rise to a rapidly growing applied branch called "behavior modification" (and later, "applied behavior analysis") and also had available an extensive and carefully worked out interpretation of that most complex behavior, human language. A most encouraging beginning. It is now a quarter of a century later. What has happened since that early period of rapid expansion, and more specifically, what has happened to the behavioral analysis of language? At the considerable risk of oversimplification, it seems possible to identify three major lines of development plus some relevant miscellanea.

## THE OPERANT CONDITIONING OF ADULT VERBAL BEHAVIOR

While at Indiana University in the late forties, Skinner's graduate seminars were sometimes devoted to verbal behavior. Joel Greenspoon, a student in the clinical program, was a member of one of those seminars and as a result developed a method for the experimental investigation of the effect of reinforcement on verbal behavior (Greenspoon, 1955). He asked his subjects to say words—but not sentences or phrases; when the subject said a word that could be classified as a plural noun, the experimenter said "mmm-hmmm"—the type of vocal response by a listener meant to encourage a speaker to continue. This increased the relative frequency of plural nouns and was taken as evidence that verbal behavior was sensitive to its consequences, just like the other behavior studied in the operant conditioning laboratory.

Many similar studies soon appeared and from 1958 they were the basis of several reviews (Greenspoon, 1962; Holz & Azrin, 1966; Kanfer, 1968; Krasner, 1958; Salzinger, 1959, 1969). By the late sixties, however, this particular type of research had become infrequent, and there is very little of it taking place at the present time.

Why did so much of this research take place and why did it stop? Three factors may have initiated and maintained this research. Operant research had grown remarkably since 1938, largely, it would seem, as a result of the discovery of a good experimental paradigm. Skinner's use of rate in the free-operant setting, the cumulative recorder providing a form of "already analyzed" data, the discovery of the various effects of intermittent reinforcement—all had led to a rapidly increasing body of important research findings. The possibility of a breakthrough in the study of human language was certainly part of the inspiration for the work in the operant conditioning of verbal behavior. The search for a good methodology for the study of language was the main purpose of Greenspoon's own efforts in this area (personal communication, August, 1984), and the possibility that one had been found was probably important to many of those who followed his lead.

Dollard and Miller's *Personality and Psychotherapy* (1950) provided an analysis of the psychotherapy situation that emphasized the reactions of the therapist as reinforcement for the client and thus an important factor in changing the client's behavior. The operant conditioning of verbal behavior in the Greenspoon experiment was amusingly similar to popular presentations of the interaction between nondirective therapist and

client, a similarity that was not lost on the increasing number of students of behavior and professors of clinical psychology. So a number of the studies during the late fifties were directly aimed at understanding or improving the clinical psychologist's procedures, and understanding the development of abnormal behavior.

Many cognitively oriented psychologists questioned the validity of the operant conditioning of verbal behavior. They argued that in these studies human subjects were simply aware of the nature of the experiment and, when it suited them, cooperated with the experimenter. From that point of view, the experiments were not demonstrating operant conditioning, but rather a more complex cognitive process. The data with subjects who were not aware of the contingencies, then, became the focus of much of the later research, with behaviorists trying to demonstrate conditioning in unaware subjects, and cognitivists trying to show that only when the subjects were aware did any "conditioning" take place.

Why did this general line of research come to an end? A simple answer is that the breakthrough did not take place, and beyond showing (although this is still disputed by cognitivists) that verbal behavior is operant behavior and thus affected by its consequences, there was not much additional yield. The development of behavior modification in the late fifties and early sixties, with its emphasis on direct manipulation of the environment, may have detracted from an interest in traditional psychotherapy. It also detracted from the significance of Dollard and Miller's (1950) analysis, which merely reinterpreted psychodynamic therapy.

The awareness controversy may have had detrimental effects, in that the issue did not seem methodologically resolvable. A more subtle difficulty was identified by Holz and Azrin (1966): "Perhaps, because of the polemic regarding conditionability of verbal response, the experiments have been forced into strict parallels of basic motor conditioning experiments. As a result, no distinctly 'verbal' characteristics or effects seem to have emerged from these experiments" (p. 815). This is probably due to the fact that in the experimental analysis of behavior the usual laboratory dependent variable is the rate of response, defined by operation of some mechanical device, such as a microswitch. Verbal behavior achieves its uniquely verbal effects by consisting of a sequence of multiple but functionally separate topographies that until recently could not be identified by automatic recording equipment. It may not be possible to force the verbal dependent variable into the typical operant research mold and have anything verbal left over. Of course the sequence of multiple topographies could have been studied as a dependent variable, but only by using a human observer to identify the different response units. However, this research procedure was unattractive.

There is a strange incongruity between Skinner's elaborate analysis of verbal behavior in terms of operant and respondent conditioning and an attempt to show only that verbal behavior is affected by its consequences. Skinner showed no doubt about the operant nature of verbal behavior, and in fact mentions Greenspoon's experiment in Chapter 6 of *Verbal Behavior* (pp. 148-149), treating it as a special case rather than fundamental to the analysis.

In summary, this thematic line did not lead anywhere and has died out. In laboratory characteristics it resembles recent work on the effects of such things as rules and instructions on human schedule performance, but the latter approach has a verbal independent rather than dependent variable. With the advent of computer technology, it should be possible to overcome the difficulties of studying verbal behavior as an operant dependent variable, and this thematic line may be revived. But the same computer technology makes possible so many other unanticipated ways to study verbal behavior that any new developments probably will not appreciably resemble the older research.

## LEARNING TO BE AN EFFECTIVE SPEAKER AND LISTENER

Having arrived at basic principles describing the way environmental variables alter the repertoires of individual organisms (respondent and operant conditioning, extinction, stimulus control, etc.), the next step is to see what repertoires are developed. In humans the verbal repertoire is highly significant. Understanding the behavioral processes by which an individual becomes an effective speaker and listener is important and will have great practical value in making possible an effective technology of education. This should include preventing and remediating defective verbal repertoires, as well as improving on normal acquisition.

There is a large body of literature on language acquisition. Much of it describes the chronology and sequencing of various aspects of the verbal repertoire, and the relations of this chronology and sequencing to other variables (e.g., birth order, IQ scores, socioeconomic status, personal and social characteristics of parents). This information, though not unimportant, does not contribute much to an understanding of the behavioral processes relevant to the chronology or sequencing. Of course, if the verbal speaking and listening repertoire is innate, as some linguists and psychologists believe, then short of genetic and physiological information, description of what appears and when is all that is possible. Although innate determination is not incompatible with a behavioral approach, the empirical evidence for extensive (though not necessarily exclusive) environmental participation is overwhelming, and there is a good deal of research and speculation about the nature of this participation in the traditional literature on language acquisition.

From the perspective of an experimental analysis of behavior, there has not been much *basic* research in this area. When traditional approaches attempt a functional analysis rather than simply describing developmental sequences, they typically rely on mentalistic-cognitive terms and assumptions. This has discouraged behavioral interest in this literature. The experimental analysis of behavior and its applications have emphasized manipulative rather than descriptive research; however, manipulative experimentation is difficult in this area because of the ethical implications of "tampering" with the normal language-acquistion process.

Nevertheless, there has been some important research of this type. Not long after the operant conditioning of adult verbal behavior began, several studies appeared demonstrating that infants' vocal behavior was affected by its consequences. After Brackbill's (1958) demonstration that infants' smiling was affected by continuous and by intermittent presentation of adult smiling, vocalizing, touching, and the like, Rheinhold, Gewirtz, and Ross (1959) showed similar effects with vocalizations in 3-month-old infants. Subsequent studies by Weisberg (1963), Todd and Palmer (1968), Routh (1969), and Haugan and McIntire (1972) showed similar effects and in addition provided information about other variables relevant to the reinforcement effect. For most of this work the dependent variable was simply frequency of vocal responses, but Routh (1969) was also able to alter the relative frequency of vowels versus consonants using differential reinforcement.

As the issue of awareness confounded the operant conditioning of adult verbal behavior, so the effectiveness of adult social responses as eliciting stimuli has confounded the interpretation of the effects of such responses as reinforcement for infant vocal behavior. These issues have been reviewed extensively (Hulsebus, 1973; Millar, 1976), studied more carefully with various control procedures (Bloom, 1975, 1977, 1979; Bloom & Esposito, 1975; Sheppard, 1969), and finally resolved in support of the original findings (Poulson, 1983). These studies are important in demonstrating that the social reactions of adults *can* play a role in increasing the frequency of infant vocalizations and in shaping the specific topographies that ultimately become the child's speech. Of

course they do not prove that speech does in fact develop as a function of reinforcement; however, that a frequently occurring type of adult reaction functions as an effective consequence is sufficient to maintain an interest in the role of reinforcement in the development of verbal behavior.

Imitation is an important way of acquiring new verbal behavior, so the work on the role of reinforcement in the development of generalized imitation is critical to the understanding of normal acquisition (see Peterson, 1968). The first studies in this area were by Baer and Sherman (1964), Metz (1965), and Baer, Peterson, and Sherman (1965), and since then imitation has been the topic of extensive research in applied behavior analysis. Another line of applied behavioral research contributing to this general theme concerns the generation of specific kinds of verbal repertoires—for example, the use of descriptive adjectives (Hart & Risley, 1968), generative use of the plural morpheme (Guess, Sailor, Rutherford, & Baer, 1968), prepositional usage (Sailor & Taman, 1972), acquisition and generalization of verbs (Campbell & Stremel-Campbell, 1982), and the development of generative sentences (Lutzker & Sherman, 1974).

Within the context of remedial instruction, other important research topics have been: receptive language training (e.g., Baer & Guess, 1971); transfer between receptive and productive language (e.g., Keller & Bucher, 1979); developing a nonvocal (sign) repertoire (e.g., Faw, Reid, Schepis, Fitzgerald, & Welty, 1981), and the relation between verbal and nonverbal behavior (see Israel, 1978, for a review of this area).

Although most of the research has been with children whose verbal behavior is deficient (e.g., culturally disadvantaged, mentally retarded, autistic), the behavioral methodology, results, and implications are all relevant to the general topic of verbal repertoire acquisition. In many cases the behavioral methods used to improve the verbal behavior of these subjects also would be appropriate for improving the verbal behavior of normal children and for preventing behavioral deficits. These methods and results direct our attention to important features of the normal environment-child interaction that might well be overlooked were it not for their role in creating or remediating verbal deficits. An example is the procedure called incidental teaching (Hart & Risley, 1975), which consists of systematically prompting, then requiring verbal behavior from the child in the process of interacting with the nonverbal environment. For example, in a playroom setting, a child's observable interest in playing with a toy that is on a shelf too high for the child to reach functions as a basis for teaching the location, shape, color, etc. of the toy, with the receipt of the toy reinforcing the child's appropriate verbal behavior. The effectiveness of this training technique, especially in the continued occurrence of new behavior outside the training situation, suggests the importance of such natural reinforcement in the development of verbal behavior under normal conditions, and invites further descriptive research in behavioral terms.

With the exception of the work on the effects of reinforcement on infant vocal behavior, this thematic line is not only a technology for the remediation of defective verbal behavior but also an important source of facts, concepts, and theories relevant to the acquisition of a verbal repertoire and to the interaction of that repertoire with nonverbal behavior. It is concerned both with behaving as a speaker and as a listener.

This work seems to have resulted most directly from the basic notions of operant conditioning and single-subject research methodology as described by Skinner (1938), from the broad implications of this work for all aspects of human behavior discussed in *Science and Human Behavior* (1953), from the development of basic-research methodology for the study of children's behavior, and a strong societal need to deal more effectively with developmentally disabled, culturally disadvantaged, and other handicapped children.

Interestingly, this extensive body of research makes almost no use of the con-

cepts, terms, and analyses that appear in Skinner's (1957) *Verbal Behavior*. Although the term "verbal behavior" had become widespread, the recent trend is toward increased use of the traditional term, "language," in spite of its implication of a common process underlying kinds of behavior that differ considerably from one another, such as speaking and listening. The terms for elementary verbal relations—"mand," "tact," "echoic," etc.—are used occasionally, but not to any important purpose; the research could easily have been conceived without the benefit of the distinctions Skinner makes.

At present this line of research and theory is very active. There is good contact with and contribution to basic research, involving a productive interaction between this work and the area described later as the study of rule-governed behavior. Most of the studies are with developmentally disabled children, but the merging of this thematic line with behavioral medicine makes it likely that behavioral contributions will increase understanding of the effects of brain injury on verbal behavior. This is a contribution that is sorely needed.

## SKINNER'S BOOK, *VERBAL BEHAVIOR*

A third thematic line consists of interpretation and research arising more or less directly from Skinner's own analysis of verbal behavior. Much of this work is, like *Verbal Behavior* itself, interpretation rather than experimental research, although some research has resulted from Skinner's analysis and this seems to be increasing.

There has been much comment about the seeming paucity of research generated by *Verbal Behavior*. Salzinger (1978) suggested that a major reason is that the book presented no data. E. Vargas (in press) noted that few instructors have taught much about Skinner's analysis, that it is diametrically opposed to the widely prevalent common-sense interpretation of language, and that the book is not easy to understand. Another reason may be that the basic researchers whose training prepared them to appreciate Skinner's analysis already had a highly productive research methodology, involving response rate as the dependent variable and automated data collection; and in 1958 the *Journal of the Experimental Analysis of Behavior* (*JEAB*) began publication. Operant researchers in the late fifties and early sixties were strongly committed to behaviorism as a data-based science, and less interested in—or in some cases even embarrassed by—Skinner's speculative extensions to human affairs. Possibly as a reflection of this same orientation, or as a result of conflict with nonbehavioral orientations, the applied behavior analysis developing in this same period also had an emphasis on data as the only valid basis for procedure and policy, and from this perspective *Verbal Behavior* did not seem particularly useful.

The book is really most appropriate for language scholars who are also strongly predisposed to welcome a behavioral approach to their subject matter—at best a small group. I have used it as a text for graduate and undergraduate students ever since it was published, and found that the students' main difficulty is not with the "behavioralizing," but rather with what is being behavioralized. For example, the following are included in the first 20 entries listed in the index: abstraction; acrostics; agglutinated languages; agnosia; agrammatism; alexia; allegory; alliteration; allusion; amanuensis; and ambiguity.

In 1959 *Verbal Behavior* was given a very unfavorable review by N. Chomsky, a well known linguist. This review has been republished in several sources, is widely quoted, and is often credited with having discouraged language scholars from a possibly more favorable approach to Skinner's analysis. This seems reasonable, but the effect is probably overestimated. There had long been a strongly antideterministic and antibehaviorist sentiment at the core of the humanities and the behavioral and social sciences. It is difficult to believe that Chomsky could have done much to intensify this sentiment, although the critique was enthusiastically received by those who were already convinced

that Skinnerian behaviorism was a bad thing. MacCorquodale's (1969) "*Verbal Behavior*: A Retrospective Appreciation" appeared in *JEAB*; it was an "attempt to clarify why *Verbal Behavior* is vulnerable to some misunderstandings" and a reconstruction of "the salient points of the book's argument" (p. 831). One year later MacCorquodale (1970) critically described Chomsky's review. Since 1970, a great deal has been written on the topic of verbal behavior from a behavioral perspective, including an analysis of linguistic theory by Julià (1983) and two introductory-level books (Peterson, 1978; Winokur, 1976).

In describing *Verbal Behavior* as "an exercise in interpretation rather than a quantitative extrapolation of rigorous experimental results" (1957, p. 11), Skinner adds:

> The lack of quanititative rigor is to some extent offset by an insistence that the conditions appealed to in the analysis be, so far as possible, accessible and manipulable. The formulation is inherently practical and suggests immediate technological applications at almost every step. (p. 12)

One of the earliest of such applications was Zoellner's (1969) method for teaching English composition at the college level. J. Vargas (1978) offered a program for teaching composition to elementary school pupils. Sloane, Endo, and Della-Piana (1980) provided an analysis of and some suggestions for facilitating creativity, and Skinner described "How To Discover What You Have To Say" (1981) in an application to professional writing. Johnson and Chase (1981) used some basic concepts from *Verbal Behavior* to develop a typology of verbal tasks for the purposes of instructional design. Glenn (1983) used *Verbal Behavior* to analyze client maladaptive behavior (e.g., lying, denial, demanding) in the clinical situation; and Burns, Heiby, and Tharp (1983) used it in an analysis of auditory hallucinations. Sundberg (1983) used it to assess the language deficits of the mentally retarded, and there are other applications not mentioned here.

The papers just described are for the most part technological applications, based on theory and on empirical observation, but are not research in the formal sense. More formal research also has been conducted. The basic classification system (mands, tacts, etc.) was used by Salzinger (1958) to study the verbal communications of emotionally disturbed adolescents, and by Horner and Gussow (1972) to study mother-child interactions of two 3-year-old black children. Boe and Winokur (1978) investigated the control of echoic behavior in college students; Lee (1981) studied the independence of the speaking and listening repertoires and, later (Lee & Pegler, 1982), the independence of spelling and reading. Likewise, Lamarre and Holland (in press) have investigated the independence of mands and tacts.

Although the amount of formal research directly related to *Verbal Behavior* is still small, Skinner's "exercise in interpretation" has had a profound influence. One continuation of this theme is in the philosophical and theoretical area. The behavioral epistemology that developed out of *Verbal Behavior* is an active and growing alternative to traditional approaches. Perhaps the most encouraging development is the increasing revision and refinement by others of Skinner's analysis of verbal behavior.

A different approach that does not fit readily into the main themes identified in this paper, but which should be noted, is that by Salzinger and his associates (Salzinger, 1959, 1968, 1969, 1973, 1978; Salzinger, Portnoy, & Feldman, 1964, 1966). Their work is unique in having employed a much broader methodology to study language than is seen in any of the preceding themes (which are mostly concerned with the speaker rather than the listener). Skinner (1957), for example, was mainly concerned with the speaker and has been criticized for failing to deal more extensively with the effects of verbal stimuli on the listener (e.g., Parrott, 1984). He justifies his emphasis on the grounds that in many respects verbal stimuli serve the same function that nonverbal stimuli do (e.g., as conditioned elicitors,

discriminative stimuli, conditioned reinforcers) and have no uniquely verbal features (Skinner, 1957, pp. 33-34). There are cases in which functioning as a listener seems uniquely verbal, but this seems to be because of the listener's repertoire as a speaker.

Much of Salzinger's research has dealt behaviorally with conventional psycholinguistic issues, usually related to the effects of verbal stimuli on a listener or reader. He uses the cloze procedure (Taylor, 1953), Osgood's semantic differential (Osgood, Suci, & Tannenbaum, 1957), and other related techniques, both as dependent and independent variables (Salzinger, 1978; see also Salzinger & Feldman, 1973; Salzinger & Salzinger, 1967). Recently (1984) he argued that behavioral psychologists should broaden their methodological scope. That the verbal dependent variable seems to require a multiple classification of topographies is probably revelant to the paucity of operant research on verbal behavior. Salzinger has been able to produce and to inspire a steady output of basic behavioristic language research, making use of a much broader methodological perspective than has been seen in much of the other experimental literature.

## VERBAL BEHAVIOR IN NONHUMAN ANIMALS

Efforts to teach language to nonhuman animals is a thematic line of research that has derived very little from the experimental analysis of behavior. However, in early operant research, behavior was developed in nonhuman animals that was deliberately similar to parts of the human verbal repertoire—for example, some components of arithmetic behavior (Ferster & Hammer, 1966). The most ambitious project was Premack's work (1970, 1976), which was concerned with the extent to which chimpanzees could behave appropriately with respect to certain logical and/or semantic relations.

In contrast to the other ape-language researchers described below, Premack did not attempt to develop a general-purpose functional language, but instead studied the effects of training and generalization of a small number of "concepts." His book (Premack, 1976) reports the results of that research and includes insightful general interpretations of verbal behavior and its controlling relations. The first report of this work was published in *JEAB* (1970) and Premack's earlier contributions are not far from the mainstream of behavioral thought, but the work described in the book seems to owe more to a cognitive orientation than to a behavioral one. The training methods were clearly behavioral in the explicit use of reinforcement and in the manipulation of stimuli, but the interpretation of the results is in common-sense, semitechnical, or logical terms that usually imply internal processes. Many human verbal responses are, in fact, under the control of complex abstract relations such as the ones Premack studied, and, in spite of various methodological criticisms (Terrace, 1979a), he would seem to have shown that chimps' behavior can be brought under the control of similar abstract relations.

Early efforts to develop human language in chimpanzees were directed at vocal behavior, but probably because the ape's vocal apparatus does not make human noises easily, if at all, such efforts were unsuccessful. Gardner and Gardner (1969) avoided the vocal difficulty by teaching a chimpanzee (Washoe) hand movements and positions (using the conventional signs of the American Sign Language of the deaf) as verbal responses, a strategy that was soon followed by other researchers (Fouts, 1974; Patterson & Linden, 1981; Terrace, 1979b).

When human adults teach children to talk, they do not have to give any consideration to the complexities of language, viewed either from a cognitive-linguistic perspective or from a behavioral one. They simply talk to the children, tell them the words for things, actions, relations, etc., prompt them to use these words in appropriate situations, and seemingly without much instructional effort, the children become verbally fluent. By the time a child is 3 or 4 years old, there

is usually no question about the linguistic status of the vocal repertoire.

Ape-language research could have had similarly unambiguous results. The researchers essentially tried to teach the apes to sign the same way children are taught to talk. There was considerable initial success in that the apes learned to make the individual signs seemingly under the same kinds of controlling variables relevant to a child's early words. The vocabulary of signs grew rapidly—in some cases at a rate similar to a child's early vocabulary growth—and there was no clear reason to believe that the apes would not soon be discussing the details of the project with the researchers. Had this happened, the research would have been an enormous scientific success, easily fundable, and undoubtedly of great popular interest. The researchers themselves were properly conservative, but early press coverage strongly implied that dramatic results were imminent. When Terrace (1979b) entered the field, it was easy to believe that progress would be even more rapid.

Unfortunately, this did not happen. The apes continued to learn more signs, but their language did not "take off" as a child's does. The work came under considerable criticism from ethologists, linguists, and psycholinguists who questioned whether the apes' behavior was "really" language, and the ape-language researchers began to criticize each other's work. The research was very expensive, and when grant funds dwindled, some of the projects had to be discontinued.

Rumbaugh (1977) overcame the vocal inadequacy of his chimpanzee subject, Lana, by teaching her to select particular keys on a console. Each key had a distinctive embossed figure (lexigram) on it, and the different lexigrams were systematically related to environmental objects, properties, actions, or relations. This approach has the advantage of replacing topography shaping with simpler training procedures, and of automatic recording of responses rather than dependence on human observation and judgment.

Except for the type of language and the automated management of the system with a computer, the early work with Lana was much like the work with the signing apes. Instead of being "taught signs," she was "taught lexigrams." On the other hand, sequencing and grammatical relations were a part of the training contingencies: The computer that processed the input from the animal's console would not accept (and thus would not reinforce) inputs that were not proper according to the rules of the artificial language that was being used. And as with the signing apes, Lana might have developed a repertoire of such complexity and effectiveness that no one would have doubted its linguistic status. She did acquire some verbal behavior according to behavioral criteria, but again it did not reach the level that even quite young children reach, or a level any more impressive than that achieved by the signing apes.

More recent work by Savage-Rumbaugh, Rumbaugh, and Boysen (1978a, 1978b, 1980) with Lana and two additional chimps, Sherman and Austin, resembles to some extent the work by Premack. The goal has not been to develop a general-purpose verbal repertoire, but rather to test for specific cognitive capacities that are presumed to be essential to language. In a series of ingenious experiments involving tool usage, tool "naming," categorical sorting, and cooperative behavior between chimps, these reseachers seem to have demonstrated more complex and human-like forms of verbal behavior than appear systematically in any of the other projects.

It is difficult to judge the ape-language research from a behavioral point of view, because the rationale, procedural descriptions, and interpretations of results are heavily cognitive in form. The animal is said to be "associating" objects and their "names" and thus learning the "meanings" of the signs or lexigrams. When they sign or touch lexigrams, they are said to be "using" the signs or lexigrams to "express these meanings, or to express their emotions or needs." If their behavior is true communication, their "use" of signs or lexigrams is done with "intentionality"; otherwise it is merely "responding

to stimuli in a rote manner." They "symbolically encode" various environmental events and relations, which permits them later to "recall these representations." When they react to the signs or lexigrams produced by others, they are responding "receptively," that is, receiving "information," which they may or may not "process" adequately. Thus, ape-language research provides many examples of what Skinner has called "internal surrogates of the contingencies" (1977, p. 1), or "internalization of the environment" (p. 5). These hypothesized internal events could be defined behaviorally, but it would be much easier if the language were more behavioral to begin with. A hopeful sign is the recent paper by Savage-Rumbaugh (1984) in *JEAB* in which she interpreted the projects mentioned above (Savage-Rumbaugh et al. 1978a, 1978b, 1980) in terms of the concepts and general approach of Skinner's *Verbal Behavior.*

There seem to be two future directions that this type of research might take with respect to the experimental analysis of behavior. First, the current ape-language researchers might become more familiar with behavioral theory and research—possibly as a result of supportive interest and offers of cooperative participation on the part of behavioral psychologists who are interested in this area. This would seem to be occurring to some degree already. Another future development might be behavioral psychologists doing their own research in the development of human language in nonhuman animals. Most of the accomplishments of the apes studied so far do not seem very different from nonverbal behavior that has already been demonstrated in laboratory settings with smaller brained and much less expensive animals. From the perspective of Skinner's *Verbal Behavior,* many of the elementary aspects of behaving as speaker and listener should be demonstrable with monkeys. Some work, although not very behavioral, is under way with the parrott (Pepperberg, 1981) and with sea lions (Schusterman & Krieger, 1984). Some of the basic verbal functional relations may even be studied with pigeons (Sundberg, 1984). To what extent such less expensive animals can be usefully studied with respect to interesting aspects of verbal behavior is simply not known at this time, but their use would certainly be a reasonable approach. And of course, it would be ideal if behavioral psychologists with extensive familiarity with *Verbal Behavior* and related research could do their own research with apes.

## RULE-GOVERNED BEHAVIOR AND HUMAN OPERANT RESEARCH

Another recent research development is one that in many respects resembles the operant conditioning of adult verbal behavior described above. It started with attempts to understand why human schedule performance (e.g., on a fixed-interval schedule) did not resemble that of other organisms that had been studied. Instead of the typical fixed-interval scallop, humans on fixed-interval schedules in a laboratory setting (e.g., pushing buttons for monetary reinforcement) either showed a low rate pattern with only a few responses occurring during the interreinforcement interval, or responded at a high rate throughout the entire interval. A good deal of recent research has been aimed at understanding these human deviations from lower animal schedule performance. It has become clear that they are related to instructions given by the experimenter, implied from the experimenter's behavior, or somehow occur as a part of the subject's own verbal repertoire as a form of "self-instruction" (Harzem, Lowe, & Bagshaw, 1978; for a review, see Lowe, 1979). The topic is sometimes considered in terms of sensitivity to schedule parameters, with instructional variables affecting subjects' sensitivity (Shimoff, Catania, & Matthews, 1981).

Although this research examines human operant performance (repeated responding under the control of a reinforcement schedule) and a type of factor that affects it (instructions that are given, implied, or self-generated), it can also be conceptualized as a

convenient way to study the effects of verbal stimuli, including those that are self-generated, on nonverbal behavior. There is considerable current interest in rule-governed behavior, but not much research. Here is a way to study rule-governed behavior with a convenient and well understood dependent variable. A similar approach is involved in the study of the effects of verbal behavior on delayed matching-to-sample performance (Parsons, Taylor, & Joyce, 1981), and repeated acquisition (Vaughan, in press). This approach could also be taken with respect to feature-value effects, generalized matching, and stimulus equivalence.

This would seem to be the beginning of an experimental analysis of the effects of verbal stimuli on nonverbal behavior, as well as a way of studying the effects of one's own verbal behavior on other behavior occurring at the same time. This same topic is also under investigation in the applied field as the study and the generation of correspondence between verbal and nonverbal behavior, and it is to be hoped that the two lines of investigation will merge.

The area of verbal behavior is the link between principles of nonverbal behavior that we share with other species and our uniquely human social and intellectual accomplishments. Our efforts to understand this area from a behavioral perspective are just beginning, but it seems to me that we have an excellent start and our progress is accelerating.

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