A Standard Methodology for the Analysis, Recording, and Control of Verbal Behavior

Philip W. Drash
University of South Florida

AND

Roger M. Tudor
Westfield State College

Lack of a standard methodology has been one of the major obstacles preventing advancement of behavior analytic research in verbal behavior. This article presents a standard method for the analysis, recording, and control of verbal behavior that overcomes several major methodological problems that have hindered operant research in verbal behavior. The system divides all verbal behavior into four functional response classes, correct, error, no response, and inappropriate behavior, from which all vocal responses of a subject may be classified and consequated. The effects of contingencies of reinforcement on verbal operants within each category are made immediately visible to the researcher as changes in frequency of response. Incorporating frequency of response within each category as the unit of response allows both rate and probability of verbal response to be utilized as basic dependent variables. This method makes it possible to record and consequate verbal behavior in essentially the same way as any other operant response. It may also facilitate an experimental investigation of Skinner's verbal response categories.

Since the publication of *Verbal Behavior* by Skinner (1957), there has been a systematic increase in behavior analytic research in verbal behavior. Within ten years following publication of *Verbal Behavior*, Sloane and MacAulay (1968) published a volume of behavioral research demonstrating the application of behavioral language intervention techniques with a wide variety of populations and problems including mentally retarded children, psychotic children and adults, and individuals with elective mutism, stuttering and aphasia. In the ensuing twenty years, progress in verbal behavior research accelerated rapidly (Michael, 1984). By 1982 a new behavioral

journal, *The Analysis of Verbal Behavior* was published.

Research in verbal behavior has led to the development of procedures and programs for improving verbal skills in language delayed children (e.g., Carr, 1981; Michael, 1984). Behavioral technology has been effective in producing specific elements of a verbal repertoire, such as, imitation of sounds and words, production of labels and sentences (Lovaas, 1966), adjectives and adjective inflections (Hart & Risley, 1968; Baer & Guess, 1971), plurals, (Guess, Sailor, Rutherford, & Baer, 1968), syntax (Garcia, Guess, & Byrnes, 1973; Holdgrafer, 1980), prepositional usage (Sailor & Taman, 1972), acquisition and generalization of verbs (Campbell & Stremel-Campbell, 1982), development of generative sentences (Lutzker & Sherman, 1974), and increasing the probability of a response (Drash, Raver, Murrin, & Tudor, 1989).

Behavior analysts have also succeeded in

The authors wish to express their appreciation to Jack Michael for his valuable comments and recommendations on an earlier version of this manuscript. Appreciation is also expressed to Rebecca High for her valuable assistance with the single subject experiment. Send reprint requests to Philip W. Drash, Florida Mental Health Institute, University of South Florida, 13301 N. Bruce B. Downs Blvd., Tampa, FL 33612

producing programs for the development of functional speech and language in developmentally delayed children. Establishing a functional language repertoire is a major objective of many of these programs (Bricker, 1980, 1983; Bricker & Bricker, 1974; Cushing, Adams, & Rincover, 1983; Drash & Leibowitz, 1973; Drash & Tudor, 1989, 1990; Guess, Sailor, & Baer, 1976; Kent, 1974; Lovaas, 1966, 1977, 1980, 1981, 1987; MacDonald & Horstmeier, 1978; Rogers-Warren & Warren, 1981; Shiefelbusch, 1978; Shiefelbusch & Bricker, 1981; Warren & Rogers-Warren, 1985).

RATIONALE FOR A STANDARD METHODOLOGY

Despite an increase in behavioral approaches to research in verbal behavior, Michael (1984) indicated that progress has not kept pace with other areas of operant research. One explanation for this relative lack of progress may be the failure to develop a standard methodology for the analysis and control of verbal behavior. This may in part be related to not having had a standard dependent variable equivalent to rate of response in the experimental analysis of behavior. Michael (1984) specifically identified the lack of a standard dependent variable, exclusively designed to fit the complexities of verbal behavior, as a factor limiting research progress. He stated, "It may not be possible to force the verbal dependent variable into the typical operant research mold and have anything verbal left over" (p. 366). Likewise, McPherson, Bonem, Green, and Osborne (1984) stated, "unanswered questions regarding appropriate methodology for the study of verbal behavior may . . . hamper research efforts" (p. 164). Salzinger (1984) adds that the necessary verbal dependent variable seems to require a multiple classification of topographies, and the failure to produce such a dependent variable is probably relevant to the relative paucity of operant research on verbal behavior. Finally, Oah and Dickinson (1989) stated, "One of the suggested reasons for the lack of empirical research on verbal behavior

has been the lack of effective methodologies" (p. 67).

A more definitive statement was made by Leigland (1989) who identified two major methodological problems in verbal behavior research. He stated, "One of the most important methodological tasks facing a science of verbal behavior is that of devising ways of making contingencies of reinforcement visible in explicitly verbal contexts..." (p. 32), just as "Skinner found it useful to display behavior changes in a cumulative record because . . . it made controlling contingencies visible and open to direct inspection" (p. 30). The second methodological problem he identified was, "what are the 'units' to be recorded in verbal behavior as they occur in time? . . . Are we to count instances of some sort of 'unit' of verbal behavior in time, and if so, what sort of unit should it be?" (p. 27) . . . "Where or what is the operandum in such an operant preparation?" (p. 31). There is thus general agreement that methodological problems exist, yet few solutions have been offered.

This paper presents a methodology that may provide a partial solution to the need for a standard methodology for the recording, analysis and control of verbal behavior. This methodology is based on strategies and techniques that we have developed and used in our verbal behavior research, training, and treatment programs with language delayed children during the past twenty years (Drash, Caldwell, & Leibowitz, 1970; Drash & Leibowitz, 1973; Drash, Raver, Murrin, & Tudor, 1989; Drash & Shahan, 1988a, 1988b; Drash & Tudor, 1989, 1990; Singer, Pasnak, Baer, & Drash, 1978). In our research, this system of recording and analysis has proven extremely useful in producing functional language in developmentally delayed children. It appears that the system may also be applicable to other areas of research in verbal behavior. The methodology is, therefore, offered as one possible solution to the need for a standard methodology in verbal behavior research.

Our system for analyzing, recording, and controlling verbal behavior incorpo-

rates rate of response and probability of verbal response as basic dependent variables (Drash & Tudor, 1990). The first component of this system involves establishing four functional verbal response classes that can account for all verbal behavior of a subject. When prompted with a stimulus to produce verbal behavior, a subject can do only one of four things: (1) emit a correct response, (2) emit an error response, (3) emit no response, or (4) emit some form of inappropriate verbal behavior, such as screaming. The defined *unit of response* is the occurrence of any vocal response (or nonresponse) that will be counted, recorded and consequated in one of the four response categories. Any vocal response a subject emits, regardless of complexity or topography, can be classified, counted and consequated in one of these four functional response categories. (Approximations are recorded either as correct or error depending on their degree of accuracy).

A second component of the system incorporates *frequency of response* within each category as the *basic unit of response*. This makes the effects of changes in contingencies of reinforcement immediately visible as changes in frequency of response. Using frequency of response within categories makes it possible to derive two dependent variables routinely used in basic operant research. The first measure, *rate of response* within each category is obtained by dividing frequency of response by elapsed time.

Probability of response, the second measure, was recommended as a verbal dependent variable by Skinner (1957). He stated, "The probability that a verbal response of a given form will occur at a given time is the basic datum to be predicted and controlled. *It is the dependent variable in a functional analysis*" (p. 28) (italics added). Using this method of recording, the probability of the occurrence of a correct verbal response is the ratio between the number of correct responses and the number of stimulus presentations:

$$P = CR / S^p \times 100$$

Thus a change in the percent response in one of the four response categories provides a direct measure of the effectiveness of the reinforcement contingencies. Depending upon the research question, an experimenter may use either rate of correct response or percent correct as the dependent variable.

Together these components provide one possible solution to the major methodological problems identified by Leigland (1989) and others, that is: (1) it makes the effects of contingencies of reinforcement immediately visible, (2) it provides a basic unit of response, and (3) it provides basic dependent variables.

This method may also be applicable in free operant settings where specific prompts for responses may not be explicitly presented. In this context, the target verbal responses are counted as correct, and all other responses are evaluated as errors or no responses. The probability of a correct response in a free operant setting is the ratio between the number of correct responses divided by the total number of responses possible, including correct, error, no responses, and inappropriate vocal responses, multiplied by 100:

$$P = CR / CR + ER + NR + IB \times 100$$

The effect of a reinforcement contingency is demonstrated by a change in the percentage of a response within a category.

The purpose of establishing only four operant response classes is to simplify the analysis of complex verbal behavior by reducing to a minimum the number of functional response classes needed to establish and maintain control over a subject's total verbal repertoire. A correct response can be as simple as a single sound or word, or as complex as a five or six sentence statement. By classifying each vocal response into one of these four categories, the researcher or clinician can immediately and contingently apply a predetermined consequence to any vocal response. For example, correct responses might always be reinforced, error responses might be placed on extinction, no responses might cause the therapist to select a different

reinforcer, and inappropriate behavior, such as screaming, might produce a mild aversive consequence such as light dimming or facial screening (Drash, Murrin, Jordan, & Clark, 1985; Drash, Raver, Murrin, & Tudor, 1989; Singer, Pasnak, Baer, & Drash, 1978). In our research with language delayed children, these four operant response classes have been adequate to record and control any vocal response a subject may emit.

In evaluating responses and delivering consequences across these four categories, the human observer acts both as the response operandum and the dispenser of reinforcement. Leigland (1989) stated, "The closest approximation to an operandum in the case of verbal behavior is the listener . . . there is no reason why the scientist may not serve the function of listener-as-operandum in the direct, functional analysis of on-going verbal behavior" (p. 31). Although a human observer is currently the only "instrument" capable of differentially responding to subtle differences in vocal response topography (and providing consequences based on these differences), standard electromechanical devices may be adequate in less complex verbal behavior experiments. For example, in a previous study that evaluated the effects of reinforcement on rate of any vocalization (independent of topography), a voice activated relay served as the response operandum and responses were recorded and displayed on a cumulative recorder (Singer, Pasnak, Baer, & Drash, 1978). As computer technology for voice recognition improves, it is probable that the computer will serve as operandum in more complex verbal experiments.

By including only one functional response class for evaluating a correct response, a clinician can avoid recording examples of verbal behavior by topography or word combinations. For example, if the objective is to produce a functional three word tact repertoire, any functional three word response, regardless of the word combinations, would be recorded and consequated as a correct response. Therefore, it would not be necessary to

record separately different responses such as, "big brown dog, little grey cat, or big blue ball." For analysis and control, if the phrases are acceptable descriptions of the stimulus, they are all functionally equivalent; that is, three word tact responses.

To record behaviors across these four categories it is essential to have an apparatus that maintains separate frequency counts for each functional category. A data recording instrument that we have found to be highly reliable is the Veeder-Root, five-place manually operated counter (Veeder-Root Co., Hartford, CT). Recording each stimulus prompt and response as it occurs on the five-place counter provides the researcher or therapist with an ongoing, cumulative frequency count of the number of responses in each category, and an immediate, on-line indication of the subject's progress. The effects of a contingency can be rapidly evaluated as a change in response frequency both within and across the four categories. Moreover, by using two five-place counters, a clinician can record two different sets of contingencies simultaneously and track as many as ten different variables. The counter also increases the speed and reliability of data recording and eliminates the need for penciled notations. If a fine-grain analysis of rate is needed, a cumulative recorder may be incorporated to produce an on-line display of rate of response within each category. The reliability of an investigator's classification can be verified by independent observers or by using audio or video recordings (Drash, Raver, Murrin, & Tudor, 1989).

To standardize the analysis and display of data, standard data recording forms are necessary. The first form is an individual session data sheet. One version of this form, with data from the single subject experiment to be discussed below, is shown in Table 1.

As can be seen, this data sheet provides a standard, systematic approach to recording data in each of the following categories: interval duration, number of prompts presented, correct responses, error responses, no responses, and inap-

Table 1

Comparison of two procedures: (1) facial prompting combined with positive reinforcement, and (2) positive reinforcement only in producing any vocal response to prompt and correct echoic response to prompt.

Positive Reinforcement								Facial Prompting					
Session Number	Time	Prompt	Correct	Error	No Response	*Inappropriate Behavior	**Any Vocal Response	Prompt	Correct	Error	No Response	*Inappropriate Behavior	**Any Vocal Response
1	40	59 (-) 2.8	15 25% (-)	21 36% (-)	23 39% (-)	1 2% (-)	36 61% (-)	52 (-) 2.8	13 25% (-)	38 73% (-)	1 2% (-)	7 13% (-)	51 98% (-)
2	40	81 (-) 4.5	18 22% (-)	28 35% (-)	35 43% (-)	11 14% (-)	46 57% (-)	101 (-) 4.5	28 28% (-)	48 48% (-)	25 25% (-)	9 9% (-)	76 75% (-)
3	40	104 (-) 5.4	14 13% (-)	58 56% (-)	32 31% (-)	11 11% (-)	72 69% (-)	111 (-) 5.4	28 25% (-)	52 47% (-)	31 28% (-)	9 8% (-)	80 72% (-)
4	26	62 (-) 4.2	7 11% (-)	19 31% (-)	36 58% (-)	10 16% (-)	26 42% (-)	48 (-) 4.2	11 23% (-)	14 29% (-)	23 48% (-)	3 6% (-)	52% (-)
5	5	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	16 (-) 3.2	1 6% 2	7 44% 1.4	8 50% 1.6	8 50% 1.6	8 50% 1.6
6	40	106 (-) 2.7	60 57% 1.5	31 29% .8	15 14% .4	2 2% .1	91 86% 2.3	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)
7	40	109 (-) 2.7	50 46% 1.3	47 43% 1.2	12 11% .3	2 2% .1	97 89% 2.4	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)
8	40	131 (-) 3.3	64 49% 1.6	49 37% 1.2	18 14% .5	6 5% .2	113 86% 2.8	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)
9	40	155 (-) 3.9	74 48% 1.9	73 47% 1.8	8 5% .2	7 5% .2	147 95% 3.7	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)
10	40	163 (-) 4.1	85 52% 2.1	56 34% 1.4	22 13% .6	20 12% .5	141 87% 3.5	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)	(-) (-) (-)

* A response may be scored as both an Error Response and an Inappropriate Behavior Response.

**Any Vocal Response = Correct Response + Error Response.

appropriate behavior (or task refusal). At the end of each session, prompt rate and rate and percent of the subject's responses in each category are calculated and recorded on this form. An investigator or therapist may then use these data to make modifications in reinforcement contingencies to increase frequency and rate of correct responses during the next session.

AN ILLUSTRATIVE EXPERIMENT

A single subject experiment will demonstrate the sensitivity of this recording methodology to changes in reinforcement contingencies. The subject was a four-year-old male with a severe language delay. The child had no functional speech, imitated only a few sounds and words, and emitted any vocal response to prompt less than fifty percent of the time. To increase rate of vocal response to prompt, a facial prompting technique was implemented that incorporated an escape-avoidance paradigm that had increased

vocal response rate in other verbally delayed children (Drash, Raver, Murrin, & Tudor, 1989; Singer, Pasnak, Baer, & Drash, 1978). The following procedure was used. The therapist presented a prompt for an echoic response, for example, "Say, 'juice.' " If the child emitted a correct echoic response, his vocalization was reinforced with juice. If an error response occurred, another prompt was given. If the child gave no vocal response within five seconds, a second prompt was presented. If no vocal response occurred within five seconds following the second prompt, the facial prompt was used. In the facial prompting procedure, the therapist held the child's face so the child maintained facial orientation toward the therapist. The therapist then repeated the prompt. If the child emitted any vocal response, the therapist's hands were removed. If the response was correct, the child also received a preferred reinforcer. Each session was approximately 40 minutes in length. Responses for the two con-

Fig. 1. Percentage of any vocal response to prompt and percentage of correct echoic response to prompt across two experimental conditions: (1) facial prompting combined with positive reinforcement, and (2) positive reinforcement only.

ditions were recorded on two separate five-place counters. Results of the study are tabulated in Table 1 and displayed graphically in Figure 1.

As shown in Figure 1, Session 1, the facial prompt immediately produced 98 percent vocal response to prompt, and 25 percent correct echoic responses, compared to only 57 percent response to prompt for positive reinforcement. Facial prompting was thus initially quite effective. In Session 2, the percentage of any vocal response to prompt for facial prompting dropped to 75 percent, but remained higher than the 57 percent response to prompt for positive reinforcement. In Sessions 3 and 4 both the percentage of vocal response to prompt and the percentage of correct echoic responses continued to decline, indicating that facial prompting was becoming progressively less effective.

In Session 5, a five minute probe confirmed the decreasing effectiveness of facial prompting, and it was discontinued.

The remainder of the Sessions, 6 through 10, were conducted using only positive reinforcement. As shown in Session 6, the effect of this change in contingencies was immediate, visible, and substantial. Percentage of vocal response to prompt immediately increased from 42 percent to 86 percent, and percentage of correct echoic response increased from 11 percent to 57 percent. In Sessions 7 through 10, the percentage of vocal response to prompt consistently remained above 85 percent, and percentage of correct echoic responses remained above 45 percent.

This study clearly illustrates the sensitivity of the recording procedures to changes in contingencies of reinforcement. A substantial decline in the effectiveness of the facial prompting technique, which initially appeared to be quite effective, was immediately apparent. After removing the facial prompt contingency, it was obvious that positive reinforcement alone was effective in producing both a high percent-

Fig. 2. Composite daily graph illustrating percentage correct imitation, percentage inappropriate behaviors, prompt rate, correct rate, and error rate.

age of vocal response to prompt and a relatively high percentage of correct echoic responses.

In order to further analyze a subject's progress, a second standard form, the daily progress graph is used. This graph makes it possible to simultaneously display and analyze a number of important verbal dependent variables, including percentage correct response to prompt, percentage no responses, percentage inappropriate behavior, rate of therapist prompts, rate of correct response, rate of error response, and cumulative number of words or sounds produced. The simultaneous display of these variables on one graph

greatly enhances the ability to evaluate the effect of contingencies on a child's progress in acquiring verbal behavior over sessions. In Figure 2, a composite graph using hypothetical data illustrates the display of these variables.

An important practical advantage of this system of recording and analysis is that it can be used to operationalize and standardize the entire process of shaping functional speech and language in verbally delayed children. We have developed a complete language training program around this system. For more details on the program see Drash and Tudor (1989, 1990) and Drash and Shahan (1988a, 1988b).

APPLICATION TO RESEARCH ISSUES IN VERBAL BEHAVIOR

Our methodology has been applied primarily to research with verbally delayed children. However, since the methodology solves several problems that have hindered research progress in verbal behavior, it may also prove useful in other areas of verbal research. The methodology provides elements essential to conducting operant research in verbal behavior, including a standard functional unit of response, standard dependent variables, and a visible, on-line record of the effects of contingencies on verbal behavior. The sensitivity and generality of these procedures allows them to be adapted to investigate many independent variables in verbal behavior research. This section demonstrates their applicability in evaluating a number of commonly investigated independent variables.

Rate of vocal response as a reliable dependent variable. An important question is whether rate of vocal response is a reliable dependent variable for use in verbal behavior research. Our research has demonstrated that rate of vocal response is highly sensitive to different reinforcement contingencies (Singer, Pasnak, Baer, & Drash, 1978). In this experiment we compared the effects of positive reinforcement alone to a procedure that combined positive reinforcement with a *mild aversive contingency* (light dimming) with retarded children as subjects. Changes in measured vocal response rate clearly demonstrated the benefits of combining positive reinforcement with *negative reinforcement* in an escape—avoidance paradigm to quickly increase vocal responses in developmentally delayed children.

Contingencies of reinforcement. The sensitivity of the functional response categories to changes in reinforcement contingencies was demonstrated in an experiment that compared the effects of three different procedures in producing verbal responses to therapist prompt in preschool children with Down syndrome. The results indicated that a combined procedure which included both positive reinforcement and a mild aversive contingency was more

effective than positive reinforcement alone (Drash, Raver, Murrin & Tudor, 1989).

Schedules of reinforcement. We have also evaluated the effects of different schedules of reinforcement on rate of vocalization of retarded children. The effects of CRF and FR 10 schedules of reinforcement were compared by evaluating the rate of correct and incorrect echoic vocal responses produced. The FR 10 schedule produced a substantially higher rate of correct echoic responses (Drash, Caldwell, & Leibowitz, 1970).

Stimulus topography variables. In this same experiment we investigated the effects of stimulus topography on rate of vocal response. A set of eight different sounds was used by each of four therapists as prompts for echoic behavior. Certain sounds consistently produced higher rates of echoic behavior regardless of the therapist, thus demonstrating the sensitivity of rate of vocal response to topography of speech sounds (Drash, Caldwell, & Leibowitz, 1970).

Rate of stimulus presentation. Rate of presentation of prompts for vocal behavior can be evaluated separately as an independent variable, or can be held constant to investigate the effects of other variables. By holding stimulus presentation rate constant across experimental conditions, we were able to demonstrate a functional relationship between reinforcement contingencies and vocal response rate of preschool children with Down syndrome. (Drash, Raver, Murrin, & Tudor, 1989).

Stimulus control. The degree of stimulus control produced by different training procedures can also be evaluated with these functional response categories. A high rate or percentage correct in response to therapist prompt is indicative of stimulus control. Our research demonstrated that procedures which combine positive reinforcement for correct responses with escape from a *mild aversive contingency for responding* generally produce a higher percentage of response to prompt than does positive reinforcement

used in isolation (Drash, Raver, Murrin, & Tudor, 1989).

Evaluating therapist variables. Therapist differences and skill levels in producing tact, mand, and echoic repertoires in verbally delayed children can be compared and evaluated by using rate or percent of correct vocal response. We have previously evaluated therapist differences by alternating four different therapists with identical sets of stimulus sounds within a session for the same subject. One therapist consistently produced higher correct response rates. Effectiveness of staff performance can thus be measured directly by using rate of response. (Drash, Caldwell, & Leibowitz, 1970).

Evaluating training methods. Determining the efficacy of different language training techniques and procedures is an important issue in developing new language programs. This recording method allows an investigator to perform a fine-grain analysis of differences in rate and percentage correct that may result from different training approaches. Some of the procedures that might be further investigated include manding (Rogers-Warren & Warren, 1980; Yamamoto & Mochizuki, 1988), natural language training (Koegel, O'Dell, & Koegel, 1987; Laski, Charlop, & Schreibman, 1988), or escape-avoidance procedures (Drash, Raver, Murrin, & Tudor, 1989).

Individual subject variation. Individual differences in relation to experimental contingencies can be readily evaluated using this methodology. Two children with similar language deficiencies may respond quite differently to similar treatment procedures or identical reinforcers. The on-line nature of the recording process allows a therapist to rapidly identify effective reinforcers or contingencies that will produce a rapid acceleration in rate of correct response.

Evaluating generalization effects. Generalization and maintenance of language remain major unresolved problems in applied verbal behavior research (Carr, 1981). Generalization from one setting to another or from one therapist to another can be evaluated by comparing the relative

frequency or percentage of correct responses produced by different training techniques. A method for assessing the effectiveness of different generalization techniques might facilitate research leading to more effective programs.

A METHODOLOGY FOR ADVANCING SKINNER'S PROGRAM FOR A SCIENCE OF VERBAL BEHAVIOR

The foundation of B. F. Skinner's functional analysis of verbal behavior is based on the principles and techniques derived from the experimental analysis and control of nonverbal behavior. Skinner's objective was to create a science of verbal behavior that could predict, and ultimately control the production of verbal behavior (Skinner, 1957, p. 3). The methodology we have described appears well suited to assist in the investigation of many theoretical and applied issues raised by Skinner (1957) in *Verbal Behavior*. It may help to provide a transition from Skinner's "interpretive analysis" (Skinner, 1979, p. 282) to an experimental analysis.

Despite the fact that *Verbal Behavior* "has had a profound influence" (particularly). "in the philosophical and theoretical area" (Michael, 1984, p. 370), several behavior analysts have commented on the relative lack of empirical research resulting directly from *Verbal Behavior* (Eshleman & Vargas, 1988; Knapp, 1980; MacCorquodale, 1969, 1970; McPherson, Bonem, Green, & Osborne, 1984). This observation, while partially valid, overlooks the fact that one of Skinner's major objectives, the establishment of a science of verbal behavior, is, nevertheless, being realized. As reviewed by Michael (1984), much operant verbal research has been and continues to be conducted. While perhaps not directly dependent on *Verbal Behavior*, all operant verbal research has by definition been influenced either directly or indirectly by Skinner's experimental analysis of behavior.

Given the recognized scientific contribution and status of *Verbal Behavior*, it may be difficult to comprehend why research based directly on this work has been limited. The lack of a standard methodology

and absence of empirical data have been cited as partial explanations (Michael, 1984). The methodology presented here may encourage this research. This methodology provides away to visibly demonstrate *control* of verbal behavior through contingencies of reinforcement. Skinner (1957) emphasized control as the basis for a science of verbal behavior in stating, "The extent to which we understand verbal behavior in a 'causal' analysis is to be assessed from the extent to which we can predict the occurrence of specific instances and, eventually, *from the extent to which we can produce or control such behavior by altering the conditions under which it occurs*" (p. 3), (*italics added*).

The provision of a standard methodology will not, in and of itself, produce an increase in operant research based on *Verbal Behavior*. Rather, it eliminates a major obstacle to research and may help provide a strategy for investigating the establishment and production of different functional response classes including mands, tacts, and intraverbals. Practical problems identified by Skinner (1957) can also be investigated. Some of these include, "How can the teacher establish the specific verbal repertoires which are the principal end-products of education? ...How can the writer evoke his own verbal behavior in the act of composition? How can the scientist...manipulate his verbal behavior in productive thinking?" (p. 3).

Investigation of other technical issues in *Verbal Behavior* is also possible. For example, in his discussion of language acquisition by children, Skinner (1957, p. 29) presented a functional analysis describing how parents might shape speech and language in young children by using behavioral techniques. Although his analysis describes some of the possible controlling contingencies, it does not provide detailed answers to practical problems such as, "What specific procedures should parents use? What should they do if the procedures do not work? Are there procedures they should avoid? Why do some children acquire language very rapidly, while some acquire it very slowly, and some not at all? Are there

procedures and techniques that will insure the acquisition of language by all physically healthy children?" These and other similar questions can be answered only through experimental research that is itself dependent upon a reliable methodology.

SUMMARY AND CONCLUSION

Lack of a standard methodology has been identified as one of the major reasons for the relative lack of progress of behavior analytic research in verbal behavior. This paper presents a methodology for the analysis, recording, and control of verbal behavior that we have found to be highly effective in our research with language delayed children. It appears that this methodology may help to overcome a number of practical problems that have been identified. It utilizes frequency of response as the basic unit of response, provides two standard operant dependent variables, rate of response and probability of response, and makes the effect of contingencies of reinforcement on verbal operants immediately visible. The methodology is highly adaptable and can be used to investigate a wide variety of research issues in verbal behavior, including many of those discussed by Skinner (1957) in *Verbal Behavior*.

Prior to Skinner's basic work in the experimental analysis of behavior, nonverbal behavior was thought to be far too complex to be effectively analyzed or controlled. But "a new world (was) opened to inspection" through Skinner's cumulative records (Skinner, 1956, p. 229). In essence, the methodology presented in this paper makes it possible to count, record, consequence, and control verbal behavior in essentially the same way as nonverbal behavior, thus opening up the entire "world" of human verbal behavior to operant analysis, prediction and control.

REFERENCES

- Baer, D. M., & Guess, D. (1971). Receptive training of adjectival inflections in mental retardates. *Journal of Applied Behavior Analysis*, 4, 129-139.
- Bricker, D. D. (Ed.). (1980). *New directions for exceptional children: Language intervention*. San Francisco: Jossey Bass.
- Bricker, D. D. (1983). Early communication: Devel-

- opment and training. In M. Snell (Ed.), *Systematic instruction of the moderately and severely handicapped*. Columbus: Merrill.
- Bricker, W. W., & Bricker, D. D. (1974). An early language training strategy. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives: Acquisition, retardation and intervention* (pp. 431-468). Baltimore: University Park Press.
- Campbell, C. R., & Stremel-Campbell, K. (1982). Programming "loose training" as a strategy to facilitate language generalization. *Journal of Applied Behavior Analysis*, 15, 295-301.
- Carr, E. G. (1981). Language acquisition in developmentally disabled children: Preface to the symposium. *Analysis and Intervention in Developmental Disabilities*, 1, 241-243.
- Cushing, P., Adams, A., & Rincover, A. (1983). Research on the education of autistic children. In M. Hersen, R. M. Eisler, & P. M. Miller (Eds.), *Progress in behavior modification*: Vol. 14. (pp.1-48). New York: Academic Press.
- Drash, P. W., Caldwell, L. R., & Leibowitz, J. M. (1970). Correct and incorrect response rates as basic dependent variables in the operant conditioning of speech in non-verbal subjects. *Psychological Aspects of Disability*, 17, 16-23.
- Drash, P.W., Murrin, M.R., Jordan, S.E., & Clark, H.B. (1985). Rapid reduction of off-task behavior in retarded children by use of light-out. *Psychological Reports*, 56, 499-509.
- Drash, P. W., & Leibowitz, J. M. (1973). Operant conditioning of speech and language in the non-verbal retarded child: Recent advances. *Pediatric Clinics of North America*, 20, 233-243.
- Drash, P. W., Raver, S. A., Murrin, M. R., & Tudor, R. M. (1989). Three procedures for increasing vocal response to therapist prompt in infants and children with Down syndrome. *American Journal on Mental Retardation*, 94, 64-73.
- Drash, P. W., & Shahan, S. H. (1988a). *The TALK Program: Techniques for language development. A video training tape*. Tampa, FL: University of South Florida, Florida Mental Health Institute.
- Drash, P. W., & Shahan, S. H. (1988b). *The TALK Program: Levels of language development. A video training tape*. Tampa, FL: University of South Florida, Florida Mental Health Institute.
- Drash, P. W., & Tudor, R. M. (1989). Cognitive development therapy: A new model for treatment of an overlooked population, developmentally delayed preschool children. *Psychotherapy in Private Practice*, 7, 19-41.
- Drash, P. W., & Tudor, R. M. (1990). Language and cognitive development: A systematic behavioral program and technology for increasing the language and cognitive skills of developmentally disabled and at-risk preschool children. *Progress in Behavior Modification*, 26, 173-220.
- Eshleman, J. W., & Vargas, E. A. (1988). Promoting the behaviorological analysis of verbal behavior. *The Analysis of Verbal Behavior*, 6, 23-32.
- Garcia, E. E., Guess, D., & Byrnes, J. (1973). Development of syntax in a retarded girl using imitation, reinforcement, and modeling. *Journal of Applied Behavior Analysis*, 6, 229-310.
- Guess, D., Sailor, W., & Baer, D. M. (1976). *Functional Speech and language training for the severely handicapped*. Austin: Pro-Ed.
- Guess, D., Sailor, W., Rutherford, G., & Baer, D. M. (1968). An experimental analysis of linguistic development: The productive use of the plural morpheme. *Journal of Applied Behavior Analysis*, 1, 297-306.
- Hart, B., & Risley, T. R. (1968). Establishing use of descriptive adjectives in the spontaneous speech of disadvantaged pre-school children. *Journal of Applied Behavior Analysis*, 1, 109-120.
- Holdgrafer, F. (1980). Facilitating syntax acquisition. *Psychological Reports*, 46, 498.
- Kent, L. (1974). *Language acquisition program for the severely retarded*. Champaign, IL: Research Press.
- Knapp, T. J. (1980). Beyond *Verbal Behavior*. *Behaviorism*, 8, 187-194.
- Koegel, R. L., O'Dell, M. C., & Koegel, L. K. (1987). A natural language teaching paradigm for nonverbal autistic children. *Journal of Autism and Developmental Disorders*, 17, 187-200.
- Laski, K. E., Charlop, M. H., & Schreibman, L. (1988). Training parents to use the natural language paradigm to increase their autistic children's speech. *Journal of Applied Behavior Analysis*, 21, 391-400.
- Leigland, S. (1989). On the relation between radical behaviorism and the science of verbal behavior. *The Analysis of Verbal Behavior*, 7, 25-41.
- Lovaas, O. I. (1966). A program for the establishment of speech in psychotic children. In J. K. Wing (Ed.), *Early childhood autism* (pp 115-144). Oxford: Pergamon.
- Lovaas, O. I. (1977). *The autistic child: Language development through behavior modification*. New York: Irvington.
- Lovaas, O. I. (1980). Behavioral teaching with young autistic children. In B. Wilcox, & A. Thompson (Eds.), *Critical Issues in Educating Autistic Children and Youth* (pp. 220-233). U.S. Department of Education, Office of Special Education.
- Lovaas, O. I. (1981). *Teaching developmentally disabled children: The me book*. Baltimore: University Park Press.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, 55, 3-9.
- Lutzker, J. R., & Sherman, J. R. (1974). Producing generative sentence usage by imitation and reinforcement procedures. *Journal of Applied Behavior Analysis*, 7, 447-460.
- MacCorquodale, K. (1969). B.F. Skinner's *Verbal Behavior*: A retrospective appreciation. *Journal of the Experimental Analysis of Behavior*, 12, 831-841.
- MacCorquodale, K. (1970). On Chomsky's review of Skinner's *Verbal Behavior*. *Journal of the Experimental Analysis of Behavior*, 13, 83-99.
- MacDonald, J. D., & Horstmeier, D. (1978). *Environmental language intervention program*. Columbus, Ohio: Merrill.
- McPherson, A., Bonem, M., Green, G., & Osborne, J. G. (1984). A citation analysis of the influence on research of Skinner's *Verbal Behavior*. *The Behavior Analyst*, 7, 157-167.
- Michael, J. (1984). Verbal behavior. *Journal of the Experimental Analysis of Behavior*, 42, 363-376.
- Oah, S., & Dickinson, A. M. (1989). A review of empirical studies of verbal behavior. *The Analysis of Verbal Behavior*, 7, 53-68.
- Rogers-Warren, A., & Warren, S.F. (1980). Mands for verbalization: Facilitating the display of newly trained language in children. *Behavior Modification*, 4, 361-382.
- Rogers-Warren, A., & Warren, S. F. (1981). Form and function in language learning and generalization.

- Analysis and Intervention in Developmental Disabilities*, 1, 389-404.
- Sailor, W., & Taman, T. (1972). Stimulus factors in the training of prepositional usage in three autistic children. *Journal of Applied Behavior Analysis*, 5, 183-190.
- Salzinger, K. (1984, May). *The maintenance of verbal behavior*. Address presented at the annual meeting of the Association for Behavior Analysis, Nashville, TN.
- Schiefelbusch, R. L. (Ed.) (1978). *Language intervention strategies*. Baltimore: University Park Press.
- Schiefelbusch, R. L., & Bricker, D. (Eds.). (1981). *Early language: Acquisition and intervention*. Baltimore: University Park Press.
- Singer, F. L., Pasnak, R., Baer, R., & Drash, P. W. (1978). Rapid reduction of lengthy pausing during vocal responding by nonverbal retarded children. *Behavior Therapy*, 9, 669-670.
- Skinner, B. F. (1956). A case history in scientific method. *American Psychologist*, 11, 221-233.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1979). *The shaping of a behaviorist*. New York: Knopf.
- Sloane, H. N., & MacAulay, B. D. (Eds.). (1968). *Operant procedures in remedial speech and language training*. Boston: Houghton Mifflin.
- Veeder-Root Company, 70 Sargent St., Hartford, CT 06102, (203) 527-7201.
- Warren, S. F., & Rogers-Warren, A. K. (Eds.). (1985). *Teaching functional language: Generalization and maintenance of language skills*. Austin, Texas, Pro-Ed.
- Yamamoto, J., & Mochizuki, A. (1988). Acquisition and functional analysis of manding with autistic students. *Journal of Applied Behavior Analysis*, 21, 57-64.