

## A Review of Empirical Studies of Verbal Behavior

She-zeen Oah and Alyce M. Dickinson  
Western Michigan University

This paper reviews empirical research which has been directly influenced by Skinner's *Verbal Behavior*. Despite the importance of this subject matter, the book has generated relatively little empirical research. Most studies have focused on Skinner's mand and tact relations while research focused on the other elementary verbal operants has been limited. However, the results of empirical research that exist support Skinner's analysis of the distinction between elementary verbal operants and his distinction between the speaker's and listener's repertoires. Further, research suggests that language training programs may not be successful if they do not provide explicit training of each elementary verbal operant and independent training of speaker's and listener's repertoires.

In his 1958 review of Skinner's *Verbal Behavior* (1957) Osgood called it ". . . one of the two or three most significant contributions to this field in our time. . . (p. 212). Thirty years later similar praise is still being given. In 1988 Michael described Skinner's analysis of language as "...a major behavioral breakthrough, with many theoretical and practical implications" (p. 9). Many others would undoubtedly agree, still very little empirical work has been generated by *Verbal Behavior* when compared with the behavior analytic research on nonverbal behavior during the same thirty-year period. McPherson, Bonem, Green, and Osborne's citation analysis (1984) showed that *Verbal Behavior* has been widely cited but the number of empirical studies using it as a primary source is very small, which can also be seen from Sundberg and Partington's reference lists (1982, 1983). It would seem that most of the literature arising directly from Skinner's analysis of verbal behavior consists of interpretation rather than empirical research (Michael, 1984).

Why has Skinner's book *Verbal Behavior* been neglected by researchers and why has it failed to generate basic research despite the fact that Skinner, himself, believes it to be his most important work (Skinner, 1978)? Skinner (1978) has offered two possible explanations. One is that an operant analysis of

behavior in general is lacking among traditional language researchers. Traditional linguistics, according to Skinner (1957), "has usually remained content with a formal analysis; . . . [linguists] have not developed the techniques necessary for a causal analysis of the behavior" (p. 4). The other has to do with the popularity of cognitive processes as causal variables in our culture. Reference to *meaning*, *idea*, and *image* as explanations of verbal behavior provides fictional causes which cannot be observed independently of the behavior they are said to explain. In other words, traditional approaches to language may have prevented isolating the relevant independent variables which are necessary for an empirical analysis.

Perhaps it should not be surprising that traditional language scholars would make little use of a behavioral analysis, but what about behavioral psychologists? Michael (1984) suggests that the interpretive, or to use a more negative term, speculative nature of *Verbal Behavior* may not be irrelevant.

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 (p. 369).

---

The authors would like to express their appreciation to Jack Michael, William K. Redmon, and Richard Tsegaye-Spates for their comments on earlier drafts of this paper.

Another difficulty may be the absence of effective methodologies. MacCorquodale (1970) pointed out that Skinner does not seem to consider experimental study of verbal behavior as feasible because verbal behavior "is the product of the convergence of many concurrent and interacting variables in the natural environment" (p. 85), and as a result, it is difficult to separate and detect the relevant variables of which it is a function.

Despite the factors mentioned above, there has been some recent empirical research in the field of verbal behavior and the area seems to be expanding. The purpose of the present paper is to review and integrate this basic and applied research, but first it will be necessary to provide a brief review of Skinner's classification of verbal functional relations, and to describe a more recent distinction between topography-based and stimulus-selection-based verbal behavior that is used in characterizing several of the studies reviewed.

The inclusion of studies in this paper was mainly determined by two criteria which were used in McPherson et al.'s citation analysis (1984): (1) citation of the book *Verbal Behavior*; and (2) mention of one or more of Skinner's basic verbal relations (mand, tact, textual behavior, echoic, intraverbal, or autoclitic). The studies classified as descriptive (in which independent variables were not manipulated) in McPherson et al.'s citation analysis will not be included in the present paper<sup>1</sup>.

## CLASSIFICATION OF VERBAL OPERANTS

### *Skinner's Classification*

As can be seen from Figure 1 the elementary verbal relations can first be divided into two broad categories: the mand, where the form of the response (what is said, written, signed, etc.) is controlled by an establishing operation such as deprivation or aversive stimulation; and those where the response form is controlled by a discriminative stimu-

lus (tact, intraverbal, echoic, copying a text, taking dictation, and textual behavior).

Skinner defines *mand* 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. . . and the response has no specified relation to a prior stimulus" (Skinner, 1957, pp. 35-36). Skinner did not use the term *establishing operation* in the definition of mand. Although the term was first introduced by Keller and Schoenfeld in 1950 it was only later brought to general attention and applied to the analysis of verbal behavior by Michael (1982a, 1982b). Skinner's definition of the mand, in which deprivation and aversive stimulation appear instead of establishing operation, is not broad enough to deal with all the variables that control the mand. Thus, the mand can be defined as a type of verbal operant in which a particular response form is reinforced by a characteristic consequence and is therefore under the functional control of the establishing operation relevant to that consequence (Michael, 1988, p. 7). An example of a mand would be someone's asking for water when water deprived.

The verbal operants which are controlled in form by a discriminative stimulus are further subdivided depending on whether it is a verbal or a nonverbal stimulus. A verbal stimulus is the result of verbal behavior and has a specific form or pattern which, as a unit, has controlling effectiveness (Peterson, 1978). For example, when someone says *dog* he/she produces an auditory verbal stimulus which can be heard by someone else or the speaker him/herself. But an actual dog or a picture of a dog is not a verbal stimulus. A verbal operant where response form is controlled by a nonverbal stimulus is called a tact. A tact is "a verbal operant in which a response of a given form is evoked (or at least strengthened) by a particular object or event or property of an object or event" (Skinner, 1957, pp. 81-82). For example, saying *cat* as the result of seeing a cat is a tact.

Central to an understanding of verbal operants controlled by verbal stimuli are the concepts of point-to-point correspondence and formal similarity. The former "is a relationship where subdivisions or parts of the stimulus are related to subdivisions or parts

<sup>1</sup> It is quite possible that studies describing the results of *natural experiments* such as brain injuries, the necessity of learning a foreign language, being born deaf, etc. may yield information that is at least as valuable as that provided by more formalized experiments. However, this review will be restricted to studies in which independent variables were manipulated.

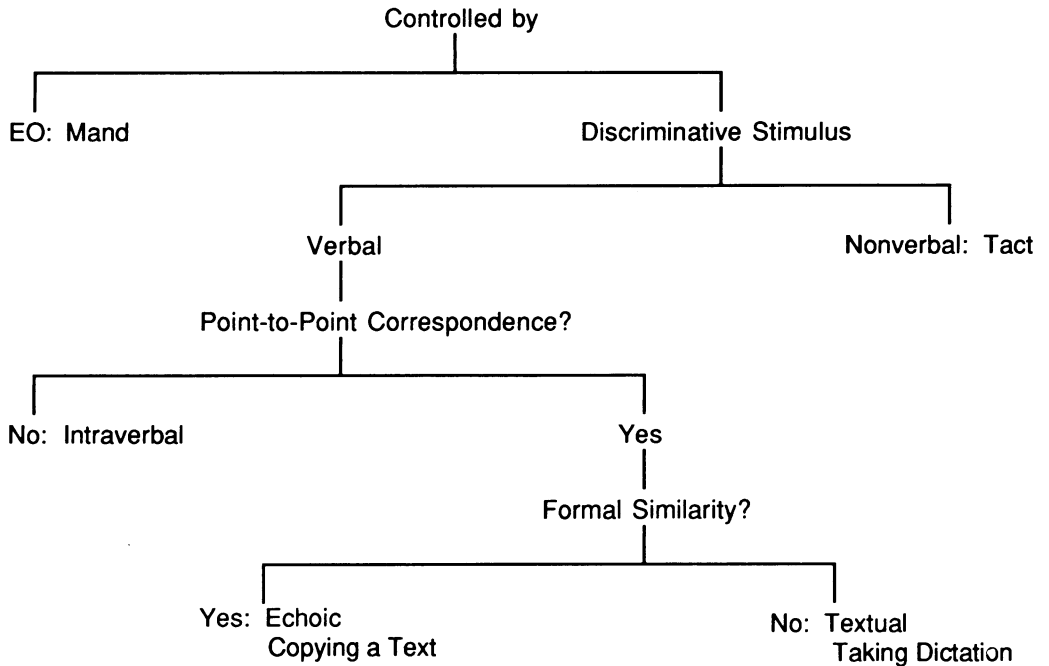


Fig. 1. Skinner's classification of verbal operants.

of the response . . . but the relation need not be physical resemblance" (Michael, 1982b, p. 2). For example, when we say *vehicle* as a result of seeing a car, there is no point-to-point correspondence because no part of the stimulus controls any part of the response. When someone says *vehicle* as a result of seeing a written word *vehicle*, there is point-to-point correspondence in that the *ve* part of the stimulus controls the *ve* part of the response and the *hi* part of the stimulus controls the *hi* part of the response, and so on.

Formal similarity is a relationship in which "the controlling stimulus and the response product are (1) in the same sense mode (both are visual, auditory, tactile, etc.) and (2) resemble each other in the physical sense of resemblance" (Michael, 1982b, p. 2). For example, when a person says *cat* as a result of hearing someone else saying *cat*, there is formal similarity in that both the stimulus *cat* and the response product *cat* are auditory stimuli and resemble each other. It should also be noted that formal similarity is the relationship between stimuli and response products, not the physical characteristics (e.g., muscle movements) required to produce the response products. In the cat example previously provided, there was also point-to-point

correspondence between response and stimulus.

When there is *no* point-to-point correspondence between a verbal stimulus and a response, the verbal operant is classified as intraverbal. Examples of intraverbal behavior are someone's saying *school* as a result of hearing *teacher* (an auditory verbal stimulus), saying *study* as a result of hearing *teacher*, or saying *water* as a result of seeing a written word *lake*. In these cases, there is no point-to-point correspondence between the stimuli and the responses. Saying *water* as a result of hearing *water* is not an intraverbal because there *is* point-to-point correspondence between the stimulus and the response. When there is point-to-point correspondence, the verbal operants are further classified as echoic and copying a text if there is formal similarity, and as textual and taking dictation if there is no formal similarity. Saying *dog* as a result of hearing someone say *dog* is an example of echoic behavior. Writing *dog* as a result of seeing a written word *dog* is an example of copying a text. In these two cases, there are both point-to-point correspondence between the stimulus and the response and formal similarity between the stimulus and the response product. Saying

*dog* as a result of seeing a written word *dog* is an example of textual behavior. Writing *dog* as a result of hearing someone say *dog* is an example of taking dictation. In both cases, there is point-to-point correspondence between the stimulus and the response but no formal similarity between the stimulus and the response product.

Other authors have attempted to supplement Skinner's system by developing new terminologies (Michael, 1982b), additional categories (Michael, 1985), and new classification systems (Vargas, 1982).

#### *Topography-based Versus Selection-based Verbal Behavior*

Independently of whether an instance of verbal behavior is a mand, tact, intraverbal, etc., it can also be classified in terms of the nature of the unit of behavior (Michael, 1985). In *topography-based* verbal behavior, the unit consists of "an increased strength of a distinguishable topography given some specific controlling variable" (Michael, 1985, p. 1). For example, saying *dog* in the presence of a dog or saying *cat* in the presence of a cat is topography-based verbal behavior. When a person says *dog* and *cat*, there are clear differences in topographies in the sense of the movements of the vocal musculature (as well as differences in the auditory response products). In *stimulus-selection-based* (or just *selection-based*) verbal behavior, the unit is the increased control of a pointing response (or some other kind of indicating response) by a particular stimulus as the result of some particular controlling variable; but there are

no important differences in the topographies of the different pointing responses. For example, in a selection-based tact, tacting a dog and tacting a cat by pointing to the corresponding symbols on a communication board do not differ significantly in topographies. Examples of the two types of verbal operants are shown in Table 1. Several studies with both human and nonhuman subjects that took advantage of the distinction between these two different kinds of verbal behavior will be discussed in a later section.

In addition to topography-based and selection-based verbal behavior, Michael has proposed a third *possible* type of verbal behavior called *manded stimulus selection*. In traditional language paradigms, this type of behavior has been called *receptive language*. An example of this kind of behavior is when a child, presented with several pictures of objects, points to the picture of an apple in response to a teacher's request to "Show me the apple." The difference between manded stimulus selection and selection-based verbal behavior is that in the former an array of nonverbal stimuli is presented (e.g., pictures of several objects) along with a verbal controlling stimulus (e.g., someone's saying "Show me the apple"); and in the latter an array of verbal stimuli is presented (e.g., different symbols corresponding to different objects) along with a nonverbal controlling stimulus (e.g., an apple). In other words, the pointing response to a nonverbal stimulus is controlled by a verbal stimulus in the former and the pointing response to a verbal stimu-

Table 1  
Comparison of topography-based and selection-based verbal operants.

Verbal Operant	Controlling Variables	Verbal Response	Comparison of Responses
A. Mand topography-based	food deprivation water deprivation	saying <u>food</u> saying <u>water</u>	different topographies
selection-based	food deprivation water deprivation	pointing to the food symbol pointing to the water symbol	same topographies, but directed at different stimuli
B. Tact topography-based	presence of a dog presence of a cat	saying <u>dog</u> saying <u>cat</u>	different topographies
selection-based	presence of a dog presence of a cat	pointing to the dog symbol pointing to the cat symbol	same topographies, but directed at different stimuli

lus is controlled by a nonverbal stimulus in the latter. The distinction between these two types of behavior will be seen in several studies that attempted to examine Skinner's notion of the independence of the speaking and listening repertoires.

There are also some other classification systems that have been proposed to supplement Skinner's scheme such as Michael's (1982b) usage of two new terms *codic* and *duplic* in classifying some verbal operants that Skinner did not address, and Vargas's (1982) reorganization of verbal operants controlled by verbal stimuli with the terms *interverbal* and *intraverbal*. However, these classifications will not be further discussed here because they are not necessary for the discussion of the empirical studies in the present paper.

## EMPIRICAL STUDIES OF VERBAL BEHAVIOR

The methodologies and findings related to studies of the mand and tact relations will be discussed first, then experiments concerned primarily with the other verbal relations, and finally, studies which have attempted to develop symbolic communication between nonhumans.

### *Mand and Tact Training*

*The key features of mand and tact training.* In the mand relation the response form is controlled by an establishing operation (Michael, 1982b, 1988) and in the tact by a nonverbal discriminative stimulus. Reinforcement for the mand is *specific* to the form of the response whereas for the tact it is *nonspecific* to the form of the response. For example, when a child says candy as a mand, reinforcement consists in the delivery of the *specific* thing manded (candy in this case). When the child says candy as a tact, reinforcement might be praise such as *right* or *good* which is *nonspecific* to the form of the response. Studies that have attempted to develop mands focus on two essential features; the establishing operation (EO) and specific reinforcement. On the other hand, manipulating the nonverbal discriminative stimulus and delivering nonspecific reinforcement are the critical features in tact training.

*The manipulation of EO and specific reinforce-*

*ment in mand training.* In manipulating an EO, several studies have used what is now called a *blocked-response* CEO<sup>2</sup> (conditioned establishing operation) procedure (Michael, 1988). The blocked-response CEO is related to the fact that the conditioned reinforcing effectiveness of many stimulus changes is itself correlated with the presence-absence of other stimulus conditions (p. 5). Consider, for example, a situation in which a student forgets to bring a pen to class so that he cannot take notes and another situation in which he is playing basketball in the gym. The presence of a pen would be reinforcing in the first setting, but not in the second. In other words, the reinforcing effectiveness of the pen is *conditional* upon the status of other stimulus conditions, and the occurrence of the relevant conditions then functions as an establishing operation. More examples of the blocked-response CEO will be illustrated in the studies discussed below.

In teaching mands to their deaf subjects, Hall and Sundberg (1987) first trained them to complete chains of behavior leading to a reinforcer. For instance, a subject learned to open a can of fruit (using a can opener), to pour the fruit into the bowl, and to eat the fruit with a spoon. After this pretraining, the experimenters provided all the items necessary except one item and asked the subjects to complete the behavior chain. Thus, in order to complete the behavior chain the subject had to mand the missing item. Providing all the items necessary except one, and asking the subject to complete the chain functioned as a CEO, and providing the missing item functioned as specific reinforcement when an appropriate mand occurred. This type of CEO is a blocked-response CEO in that the behavior that would lead to reinforcement is *blocked* until the missing item is provided.

Carroll and Hesse (1987) used a similar procedure. The subjects were first trained to assemble toys, then the experimenter provided all the necessary items except one and asked the subjects to assemble the toy. In order to complete the assembly, the subjects had to ask for the missing part. Thus, the incomplete set of parts functioned as a CEO and the missing part functioned as a specific reinforcement when presented

<sup>2</sup> A detailed treatment of the different kinds of conditioned establishing operations (CEOs) can be found in Michael, 1988.

after an appropriate mand. Yamamoto and Mochizuki (1988) also used a behavior chain procedure in which subjects were instructed to ask for an object from a supplier and bring the object to the director when the director said "Bring me (*the name of an object*)."

Thus, in order to bring the object to the director, the subjects had to mand the object from the supplier. When the object was provided upon emission of an appropriate mand, it functioned as specific reinforcement.

Some studies have not directly manipulated EOs, but instead relied on the preselection of presumed reinforcers such as food and toys, and then presented these objects to the subjects to evoke mand responses. Rogers-Warren and Warren (1980) provided a variety of materials for children to play with and when the children approached, the experimenters asked the children to mand the materials they wanted (*Tell me what you want*). If the children appropriately manded the material they wanted, the material was given to them. In a similar fashion, Simic and Bucher (1980) provided different kinds of food. Subjects were trained to say *I want a...* when the experimenter entered the playroom with a tray of food, and to say *out* when the experimenter stood visibly outside the room. Hung (1980) also presented foods to train his subjects to say *yes* and *no* as mands. When the experimenter held a food item and said, *Do you want \_\_\_\_\_?*, the subjects' response *yes* produced immediate delivery of the food item and *no* led to immediate withdrawal of the item by the experimenter.

Savage-Rumbaugh (1984) and Sundberg (1985) demonstrated mand training with nonhuman subjects. In Sundberg's study, pigeons were trained to tact (topography-based) a food jar and its lid first. The CEO was manipulated when the food jar was placed under the desk with the lid on. Only when the pigeon emitted the response topography for *jar* (e.g., turning a clockwise circle) was the jar raised to the top of the desk, and when another particular response topography for *lid* occurred, (e.g., pecking its third right toe) the lid was taken off and the pigeon was allowed to eat the grain. This type of mand is considered topography-based because the specific response topographies were necessary for the appearance of the jar and removal of the lid. Savage-

Rumbaugh's study is similar to those which did not include the manipulation of EOs. In her study chimpanzees were shown a number of food items and when the experimenter held up each item, the chimpanzees' pointing responses to the corresponding symbols on a panel were reinforced by receiving that item. In this study (as in the Hung study described above requiring *yes* and *no* responses) manding was selection-based in that a pointing response to a particular symbol rather than a particular response topography was required.

In general, the studies described above were quite successful in teaching mand repertoires. However, with regard to those studies in which EOs were not directly manipulated (Hung, 1980; Rogers-Warren & Warren, 1980; Savage-Rumbaugh, 1984; Simic & Bucher, 1980) one point concerning the trained responses needs to be made. The presence of target items (e.g., food or interesting materials) at the time the mand occurred could be functioning as discriminative stimuli which occasion tact responses. This kind of mand could be called *impure* in the sense that the response form may be controlled, in part, by a discriminative stimulus.

*Nonverbal S<sup>D</sup>s and nonspecific reinforcement in tact training.* As in the studies that attempted to develop mand repertoires, both topography-based and selection-based tacts have been studied. Michael, Whitley, and Hesse (1983) attempted to develop both types of tacts with pigeons. In topography-based tact training, reinforcement was delivered contingent upon the emission of a particular response topography in the presence of a particular nonverbal stimulus. For example, a head-thrusting response was reinforced with food when a red ball was presented, and turning in a circle was reinforced when a blue ball was presented. In selection-based tact training, food reinforcement was delivered when the pigeon, presented with several verbal stimuli (i.e., symbols corresponding to nonverbal stimuli), pecked a particular one in the presence of a particular nonverbal stimulus. In this procedure even though reinforcement for the tact responses was unconditioned, it was nonspecific to the response topographies and stimuli selected. Sundberg (1985) replicated the procedures used in this project and the results were quite successful.

Savage-Rumbaugh (1984) provided an example of selection-based tact training with chimpanzees. When the experimenter presented a food item (a nonverbal stimulus), the correct pointing response to one of several symbols which corresponded to the food item was reinforced by social praise plus the delivery of a food item which differed from the one displayed, which thus constituted nonspecific reinforcement. If the same food item had been delivered, the response would have been a mand rather than a tact.

Other studies also contained tact training components even though they were not explicitly interested in developing a tact repertoire. Carroll and Hesse (1987) presented a particular object as a discriminative stimulus and provided praise as reinforcement contingent upon correct responses. Lamarre and Holland (1985) and Lee (1981) placed an object on the right or left of another object as a discriminative stimulus and then reinforced correct tact responses (e.g., saying *on the right* when a dog is placed on right of a flower and the subject asked *Where is the dog?*) with social praise. Similarly, Guess (1969), Guess and Baer (1973), Guess, Sailor, Rutherford, and Baer (1968) presented a single object and a pair of the same objects as discriminative stimuli to their subjects and reinforced correct usage of singular and plural forms (e.g., saying *cup* in the presence of a single cup and *cups* in the presence of two cups) with food. In all of these studies, the key features of tact training consisted of presenting nonverbal discriminative stimuli and reinforcing correct tact responses to those stimuli with nonspecific reinforcement.

*Differences between the mand and the tact.* The difference between mands and tacts is not only based on current controlling variables (an EO in the case of mand and an S<sup>D</sup> in the case of the tact) but also on the consequences that were used for the development of these responses. In general, it can be said that whereas the reinforcement for manding is specific reinforcement, the reinforcement for tacting is generalized conditioned reinforcement and this is especially the case in human speech. However, generalized conditioned reinforcement is not a defining feature of the tact relation (Michael et al., 1983). In some studies described above, correct tacts were consequated with food delivery rather than

generalized conditioned reinforcement and can still be called tacts because the food reinforcement did not control the response topographies emitted or the stimuli selected. Thus, it would be better to characterize the reinforcement for the tact as *nonspecific* to the response form rather than as *generalized* reinforcement.

Another difference between mands and tacts is that the mand is beneficial to the speaker and the tact more useful to the listener (Skinner, 1957, pp. 36 & 84). The mand is beneficial for the speaker in the sense that when the specific manded thing is supplied by the listener the EO is altered (e.g., the deprivation and/or aversive stimulation is reduced). The tact is beneficial for the listener because it permits the listener to react to an object or event that did not function directly as a stimulus for the listener, but rather as a stimulus for the speaker (Skinner, 1957, p. 367).

Related to this latter difference, some studies have empirically examined the relative effectiveness of the specific reinforcement in the mand contingency and the nonspecific reinforcement in the tact contingency on the acquisition of verbal behavior. Stafford, Sundberg, and Braam (1988) demonstrated that a specific reinforcement condition (a mand condition) produced stronger verbal behavior than did nonspecific reinforcement. In this study, although percent correct responses was about the same in the two conditions, response latency was shorter in the specific reinforcement condition and the subjects preferred that condition over the nonspecific condition. Similarly, Carroll and Hesse (1987) found that it took fewer trials to teach a tact repertoire to preschool children in a mand-tact alternating condition than in the tact only condition. Thus, it seems that using specific reinforcement or having a specific EO in effect produces a stronger verbal repertoire and makes the acquisition of the verbal repertoire easier.

*Practical implications.* The findings from the studies discussed above have significant practical implications for the fields of developmental disabilities and speech pathology. Mainly, the differences between the mand, tact, and intraverbal should be more clearly recognized in language training programs. Since these three operants are functionally different, effective language training requires

that attention be given to the controlling variables and consequences for each.

Michael (1988) and Stafford et al. (1988) assert that mand training has been generally neglected in favor of tact and receptive language training in developmental disabilities and speech pathology. Mand training needs to be emphasized more, especially given the findings that such training facilitates the acquisition of other verbal operants (Carroll & Hesse, 1987; Stafford et al., 1988). One possible reason for the neglect is the difficulty associated with manipulating EOs (Michael, 1988), but recent studies (Carroll & Hesse, 1987; Hall & Sundberg, 1987; Yamamoto & Mochizuki, 1988) have overcome this difficulty by using the blocked-response CEO procedure.

#### *Empirical Studies of Other Verbal Operants*

*Echoic behavior.* Boe and Winokur (1978a) examined echoic control with college students in an interview situation. Students were asked to answer standard questions across three sessions, and in each session certain target words were embedded in the questions. The same sets of target words were used in Sessions 1 and 3 but a different set in Session 2. It was found that the words spoken by the students in answering the interview questions were highly dependent on the words contained in the questions. In another study, Boe and Winokur (1978b) examined similar echoic control in conversational speech. Each subject was paired with another subject and asked to speak on a topic in two different conditions, dialogue and monologue. In the monologue condition, both subjects were present, but each subject conversed in turn on the topic. In the dialogue condition, the subjects conversed with each other on the topic. The mean percentage of words in common in the dialogue condition was higher than in the monologue condition. The main purpose of these two studies was, as the authors maintained, to test whether echoic control exists outside of specific tutorial situations. The authors tested Skinner's statement that "The two halves of a dialogue will generally have more words in common than two monologues on the same subject" (Skinner, 1957, p. 56). The results obtained clearly supported Skinner's analysis.

Lane and Schneider (1963) examined the

relative effectiveness of six methods for self-shaping of a minimal echoic operant in foreign language training. The six were (1) matching in which subjects were asked to imitate a sound provided by experimenters; (2) discrimination training in which they pulled a lever when they heard the first sound in a series and every time thereafter when they heard the same sound, and they accumulated points on a counter when they correctly pulled the lever; (3) delayed auditory feedback in which subjects heard their own response played back; (4) visual analog display in which they were presented with two parameters of their responses (pitch and duration) on an oscilloscope; (5) digital visual display in which they were presented with the duration of their responses on a frequency counter; (6) free responding in which subjects were not provided with the sound which they had been imitating and were asked to reproduce the sound. It was found that discrimination training alone and delayed auditory feedback alone did not lead to a marked improvement, although when the two methods were combined a small improvement was noted. A marked improvement resulted when the analog visual display and digital visual display methods were introduced. The digital visual display was the most effective method for self-shaping of response duration. An implication of this study might be that a behavioral analysis of language can be applied to the design of effective foreign language training.

*Intraverbal behavior.* Braam and Poling (1983) taught mentally retarded children an intraverbal repertoire by providing a nonverbal stimulus such as a picture of an object as a prompt when subjects could not emit appropriate intraverbal behaviors upon presentation of a verbal stimulus. For example, when the experimenter signed *food*, the correct intraverbal responses consisted of giving the sign for food items such as apple, hot dog, or orange. If these responses did not occur, pictures of the food items were shown until unprompted intraverbal behaviors were emitted. The procedures used by Braam and Poling (1983) have been successfully replicated and extended by Luciano (1986). She found, for example, that variations of the transfer procedure, such as a shorter



delay to the prompt, improved the development of intraverbals.

Chase, Johnson, and Sulzer-Azaroff (1985) were concerned with whether intraverbal behavior relevant to an educational situation could be further classified into more specific operants such as definition, example identification, and exemplification. College students as subjects received concept training on these three kinds of intraverbal relations and were then tested. Because the speed of acquisition and error rate differed for these three kinds of relations the authors concluded that intraverbal behavior can be further classified into more specific operants.

*Textual behavior.* McDowell (1968) attempted to develop textual repertoires for kindergarten children through programmed reading instruction. Subjects were randomly assigned to one of three procedures. In the first, textual stimuli were supplemented with auditory verbal stimuli (tape recording of target words) and nonverbal stimuli (pictures related to the target words). The supplementary stimuli were then faded out so that only textual stimuli could control reading responses. In the second procedure the nonverbal supplementary stimuli were presented but not the auditory stimuli, and in the third the auditory stimuli were presented but not the nonverbal stimuli. No differences were found in the acquisition of textual repertoires across the three procedures. Thus, it was concluded that neither the auditory nor the nonverbal stimuli facilitated the acquisition of the textual repertoire.

*Autoclitic behavior.* Only one study (Howard & Rice, 1988) has examined the autoclitic. Howard and Rice attempted to develop a qualifying autoclitic with preschool children. According to Skinner (1957), qualifying autoclitics "qualify the tact in such a way that the intensity or direction of the listener's behavior is modified" (p. 322). An example is the term controlled by the metaphoric nature of an extended tact, as in "It is *like* a chair" or "It is *like* red." In the study, there were two types of stimulus cards for nine concepts for the tact and autoclitic behaviors. One type consisted of unambiguous or generic examples of the concepts and was used for the tact training (e.g., three stimulus cards for red were all clearly red although they differed slightly in shades). The other type consisted of distorted exam-

ples of the concepts and was used for training and testing for autoclitic response (e.g., the distorted stimulus cards for red were reddish-purple, reddish-pink, and reddish-orange). The experiment began with tact training in which correct tact responses (e.g., saying *red* when unambiguous stimulus cards were presented) were reinforced with verbal praise and a happy-face stamp. After subjects could tact all the concepts correctly, autoclitic training started. This consisted of presenting distorted stimulus cards (e.g., a color similar to red but not exactly red) and delivery of reinforcement when appropriate autoclitic responses occurred (e.g., saying *like red*). It was found that all subjects acquired autoclitic behaviors.

#### *Functional Independence of Verbal Operants and Separate Speaker/Listener Repertoires*

In traditional language theories, it has been assumed that once the meaning of a word has been acquired the same word can be spoken when the child asks for something as well as when the child describes or refers to it (Skinner, 1957). For example, once the child learns to describe an orange, he/she can also ask for the orange, and vice versa. According to Skinner's analysis, however, different verbal operants are acquired independently even though the response forms might be the same. Thus, when a child learns to *describe* or *to refer* to an object, the child is not automatically able to *ask for* the object as well, and vice versa (Skinner, 1957, pp. 187-190). Further support for functional independence is evident in some types of aphasia, where there is a loss of one class of behavior but not the other. "The aphasic may not be able to name an object, though he will emit the name immediately in manding it" (p. 190). As a result of their work with aphasic patients, Sidman (1971) and Sidman, Stoddard, Mohr, and Leicester (1971) emphasize the general point that a brain injury does not necessarily break down all verbal stimulus-response relations. A single verbal stimulus such as a written word can produce several different responses such as reading aloud, copying the word, or pointing to a picture. Aphasics may be unable to produce some of these responses even though others are still possible.

In language training with chimpanzees, Savage-Rumbaugh (1984) provided some

empirical evidence for mand and tact independence. Two chimpanzees were first trained to mand food items. When the experimenter held a food item before the subjects, their pointing responses to a symbol corresponding to the food item was reinforced by the delivery of that item. After the chimpanzees could successfully mand the items, they were tested as to whether they could tact the food items without direct tact training. To test this possibility, the experimenters changed the contingencies so that the pointing response to the symbol corresponding to a food item was reinforced by the delivery of a *different* food item plus praise. For example, pointing to the symbol for orange when they were shown an orange was reinforced with an apple. Reinforcement for the tact was thus nonspecific to the form of the response. This procedural change resulted in failure, however, until the experimenters adopted a fading procedure in which the mandated item was also provided initially but gradually reduced in amount. The failure of the first attempt and the necessity of the fading procedure indicated that direct tact training was necessary for development of the tact repertoire.

Lamarre and Holland (1985) conducted another relevant study with severely retarded language impaired subjects. Some of their subjects were first trained to mand using the prepositional phrases *on the left* and *on the right* when the experimenter asked the question, *Where do you want me to put the object?* Also, the effects of this training on corresponding tacts were assessed. Other subjects were first trained to tact *on the left* or *on the right* when the experimenter put a dog on the right (or left) of a flower and asked, *Where is the dog?*, and the effect on corresponding mands was assessed. Subjects who acquired a mand repertoire first did not demonstrate the corresponding tact repertoire and, similarly, subjects who acquired a tact repertoire first did not demonstrate the corresponding mand repertoire.

Hall and Sundberg (1987) obtained similar results in a study with deaf mentally retarded children. These authors first trained their subjects to correctly tact all the items necessary to complete a behavioral chain. The mand repertoire was then probed by providing subjects with all the necessary items to complete the chain except the one needed,

and then asking them to complete the behavior chain. The subjects who received only tact training could not mand the missing items.

Lee and Pegler (1982) examined the possible functional independence of textual and transcription behavior. In their first experiment, it was found that training in reading (textual behavior) did not substantially improve spelling (transcription). In the second experiment, spelling improved when overtraining in reading was conducted. However, subsequent experiments revealed that increased opportunities to look at the words during overtraining in reading rather than the overtraining itself was responsible for the improvement in spelling. Thus, the authors concluded that the results supported Skinner's notion of functional independence.

Skinner suggests not only that different verbal operants are acquired independently but also that repertoires as speaker and listener are independent.

Although semantic theories frequently assume that meaning is the same for speaker and listener, the processes through which a man becomes a listener differ... from those through which he becomes a speaker. In acquiring a verbal repertoire the speaker does not necessarily become a listener, and in acquiring the behavior characteristic of a listener he does not spontaneously become a speaker. After "learning the meaning of a word" as listener, one cannot then "use it" as a speaker, or vice versa. (Skinner, 1957, p. 190).

Several studies have attempted to test this hypothesis but the results of those studies are inconsistent. Guess (1969), using two retarded children as subjects, examined whether receptive language training (the listener's repertoire) automatically resulted in the acquisition of an expressive language repertoire (the speaker's repertoire). The training consisted in teaching the difference between singular and plural words. During receptive training a single object and a pair of the same objects were simultaneously presented to the subjects. A pointing response to a single object was reinforced when the subjects were asked to point to the object labeled in singular form (e.g., *Point to the dog*) and a pointing response to the pair of objects was reinforced when the subjects were asked to point to the object labeled in plural form (e.g., *Point to the dogs*). During expressive training, the experimenter asked

the subjects, *What do you see?* When the subjects labeled the single object in singular form and used the plural form in the presence of the pair of objects, reinforcement was delivered. The results showed that without direct expressive language training, the subjects could not correctly label the object in singular or plural form. That is, the expressive language repertoire was independent of the receptive language repertoire.

Guess and Baer (1973), using four retarded children as subjects and a similar procedure obtained inconsistent results across subjects; three of four subjects did not show the generalization from receptive to expressive language, but one did. Whitehurst (1977) using normal children found that training a receptive repertoire did ultimately generate an expressive repertoire. In his experiment subjects, presented with a pair of pictures, were trained to point to a particular picture when an experimenter spoke a sentence containing direct and indirect objects. For instance, subjects were provided with a picture in which a tiger is pointing to a bear while looking at a dog and another picture in which a tiger is pointing to a dog while looking at a bear. And when an experimenter spoke *The tiger shows the bear the dog*, or *The tiger shows the dog the bear*, pointing responses to the correct picture were reinforced. Then subjects were tested to determine whether they could produce verbal responses when provided with pictures. Five of the six subjects demonstrated the generalization from receptive to productive language.

As a result of the inconsistent findings in these studies, Lee (1981), with retarded children as subjects, conducted another study using a procedure similar to those of Guess (1969) and Guess and Baer (1973) but including more elaborated and prolonged use of different sets of stimuli and responses. She found that some subjects showed some improvement in nonverbal responses (the receptive repertoire) without direct nonverbal training but only when the nonverbal topographies later used in the verbal training had been emitted by subjects during baseline, even though the topographies were not always reliably or correctly emitted. Based on these observations, Lee concluded that for these subjects the topographies used in the verbal training were not new, and thus the collateral effects could be considered

"changes in the stimulus control of preexisting topographies" (p. 242), rather than the spontaneous acquisition of a new nonverbal repertoire. Lee analyzed the results of the Guess and Baer (1973) study similarly. In that study subjects were asked to point to either a single object or a pair of objects when asked to do so. According to Lee, "prior to verbal training their subjects responded at about chance level to the *singular* and *plural* instructions" (p. 240). Thus, the pointing response topographies had already been emitted by the subjects. Acquisition of the appropriate pointing repertoire could, therefore, again be considered a change in stimulus control rather than spontaneous acquisition of a new repertoire. Lee was able to make a similar interpretation of the results of the Whitehurst (1977) study with normal children where receptive training did generate an expressive repertoire. Based on these analyses, Lee concluded that when spontaneous transfers occurred, they were due to changes in the stimulus control of already existing repertoires rather than the nonindependence of the speaker and listener repertoires.

*Practical implications.* Many current language training programs attempt to teach the meanings of words assuming that if the individual is taught to name (tact) an object he/she will also be able to ask for (mand) it. In addition, traditional language training programs focus on receptive training at the expense of expressive training. This practice is also based on the notion of the acquisition of the meaning of the words since it is assumed that if individuals can be trained to be effective listeners they will also be effective speakers. Taken together, the results from the preceding studies indicate that language training may be ineffective if it focuses on the acquisition of the meaning of words and, as a consequence, includes only tact and receptive training. However, considering that only a limited number of studies have so far been conducted, and that there are some inconsistencies across studies, more research is clearly needed on the functional independence of verbal operants and the independence of speaker and listener repertoires.

#### *Symbolic Communication Between Nonhumans*

The first study on symbolic communication with pigeons was conducted by Epstein, Lanza, and Skinner (1980). One pigeon was

designated as observer throughout the study and another as informer. The communication was initiated when the observer pecked a rectangular *What color?* key (mand) in her chamber. As soon as she pecked this key, one of three colors, red, green, or yellow, was illuminated on a key in the informer's chamber. The color key in the informer's chamber was hidden so that it could not be seen by the observer pigeon. Figure 2 shows the arrangement of the keys in the chambers.

The informer pigeon was to match the color to the corresponding symbol by pecking one of three keys, R, G, or Y (tact). Upon observing the symbol pecked by the informer, the observer first had to peck a *Thank You* key which operated the informer's feeder (reinforcement for the informer's tact response), and then matching the symbol pecked by the informer to the appropriate color, by pecking an appropriate color key, produced reinforcement. After 5 days of this training, both pigeons responded accurately on more than 90 percent of the trials.

Using a similar procedure, Lanza, Starr, and Skinner (1982) conducted a study that showed how a change in the contingencies led to *lying* behavior. The pigeon interaction was exactly the same as in the study conducted by Epstein et al. (1980). In one condition, when the hidden color was red the informer's correct report was reinforced with grain for 3.8 seconds but when the hidden color was either green or yellow the inform-

er's correct response was followed by a much shorter duration of reinforcement. In the other condition, the durations of reinforcement following appropriate responses were the same regardless of the colors. When the reinforcement durations were different (when reporting red was reinforced for a longer period of time), informers *lied* by sometimes reporting that the color presented (either green or yellow) was actually red. When the condition was changed so that the durations were the same, informers eventually *reported* the colors appropriately.

Using the Epstein et al. procedure, Lubinski and MacCorquodale (1984) and Lubinski and Thompson (1987) investigated whether the symbolic interaction between nonhumans could be maintained in the absence of unconditioned reinforcement. Lubinski and MacCorquodale were primarily interested in whether the tacter (the informer) would continue to tact when satiated and/or when she received generalized conditioned reinforcers without unconditioned reinforcers. In developing a generalized reinforcer, the tacter was deprived of food on some days, of water on others, and of both occasionally. Then she was trained to peck a food and a water key. The pecking responses were reinforced with food or water only when a light was flashing. The flashing light, having been paired with both food and water, was thus established as a generalized conditioned reinforcer. The components of the interaction between the

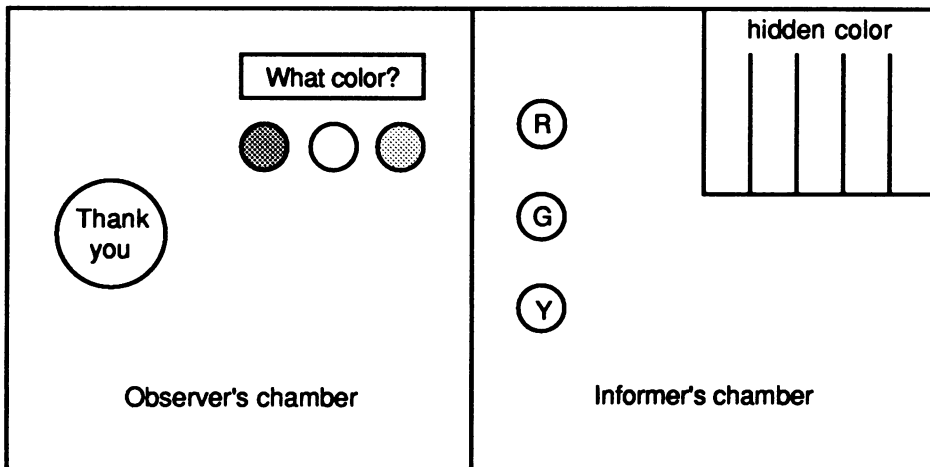


Fig. 2. Key arrangements in the observer's and informer's chambers. When the observer pecked the *What color?* key one of three colors was illuminated behind the curtain in the upper right-hand corner of the informer's chamber.

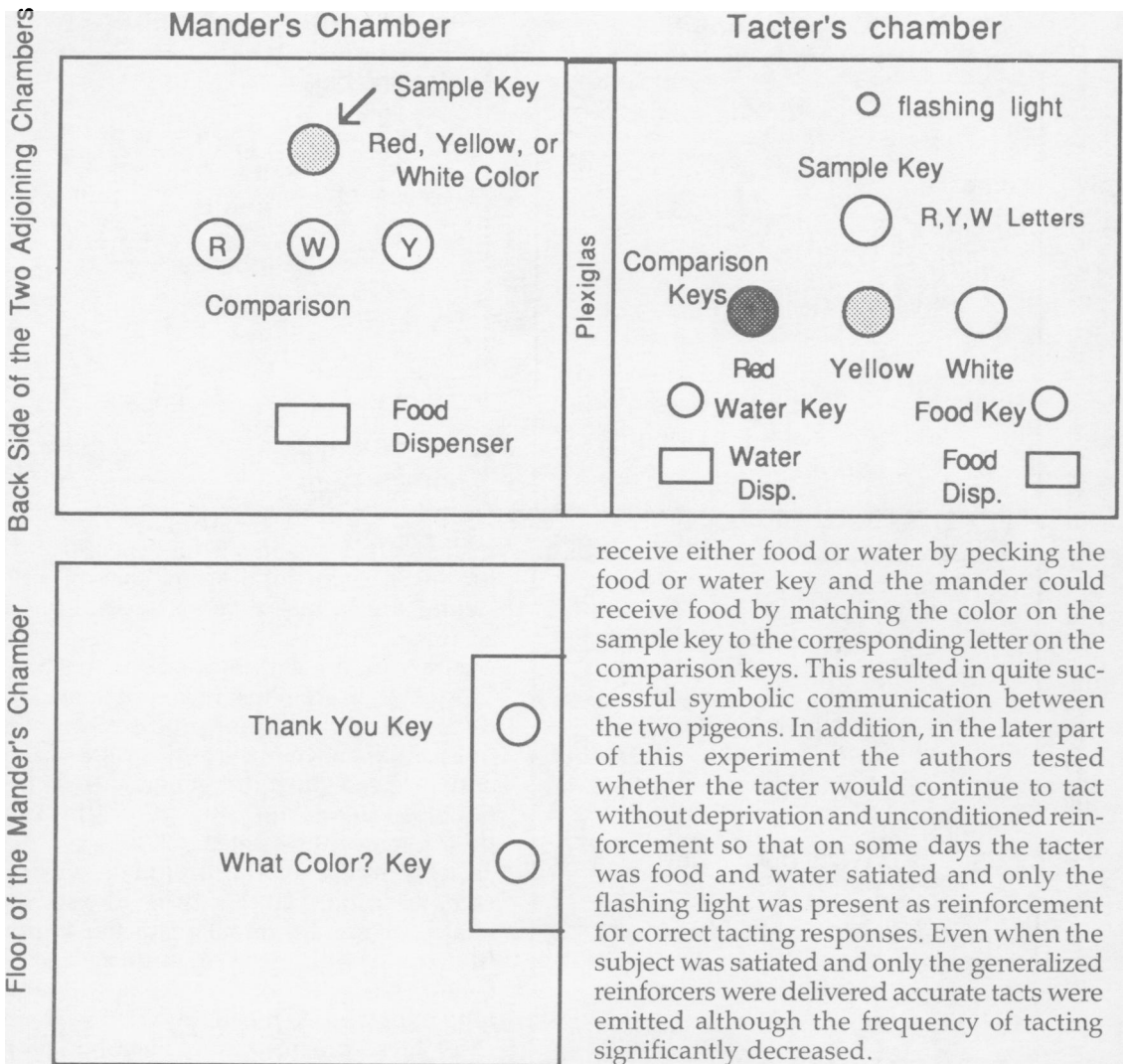


Fig. 3. The experimental apparatus in Lubinski and MacCorquodale's (1984) study.

two pigeons were similar to that in Epstein et al.'s study, but the chambers and key arrangements were different, as shown in Figure 3. The observer (mander) initiated the interaction by pecking the *What color?* key. This pecking response produced a letter on the informer's (tacter's) sample key. The tacter then matched the letter on the sample key to the corresponding color on the comparison keys. Upon this matching response, if the mander pecked the *Thank you* key, the tacter's light flash came on and the color the tacter previously matched came on the observer's sample key. Then the tacter could

receive either food or water by pecking the food or water key and the mander could receive food by matching the color on the sample key to the corresponding letter on the comparison keys. This resulted in quite successful symbolic communication between the two pigeons. In addition, in the later part of this experiment the authors tested whether the tacter would continue to tact without deprivation and unconditioned reinforcement so that on some days the tacter was food and water satiated and only the flashing light was present as reinforcement for correct tacting responses. Even when the subject was satiated and only the generalized reinforcers were delivered accurate tacts were emitted although the frequency of tacting significantly decreased.

In the Lubinski and Thompson (1987) experiment the tacter tacted private stimuli rather than public stimuli. The key arrangements and chambers are similar to those in Lubinski and MacCorquodale's (1984) study (see Figure 4). They first developed a generalized conditioned reinforcer for the tacter as in Lubinski and MacCorquodale (1984). That is, pecking a food key or water key was reinforced only when a blue light was flashing so that the blue light would function as a generalized conditioned reinforcer. Prior to the communicational interaction, a depressant, a stimulant or a saline solution was administered to the tacter. Thus, the private stimuli consisted of the interoceptive effects produced by the three kinds of injections. The interaction was initiated when the mander pecked a *How do you feel?* key. This

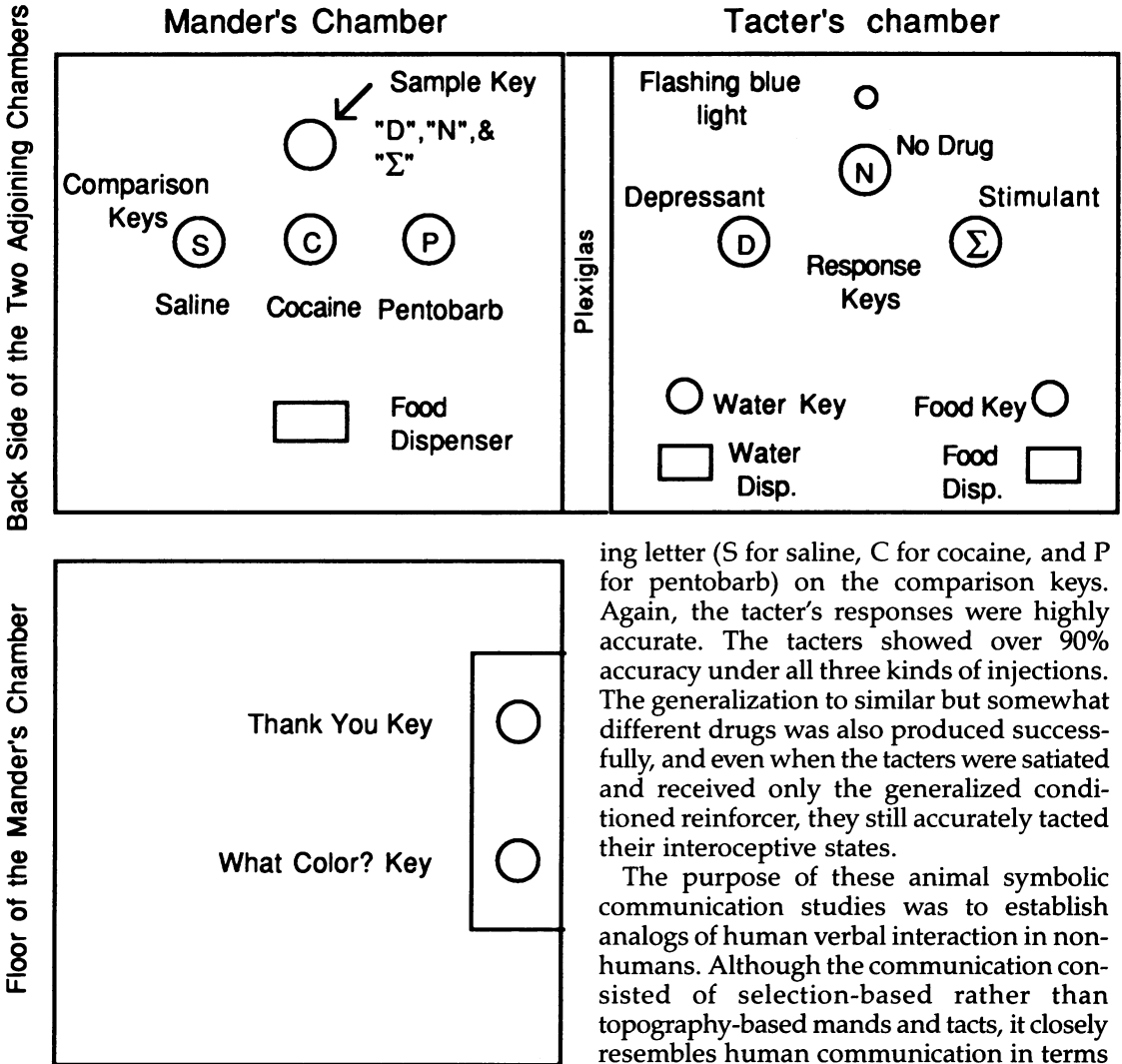


Fig. 4. The experimental apparatus in Lubinski and Thompson's (1987) study.

response illuminated three keys in the tacter's chamber (D for depressant, Σ for stimulant, and N for no drug). When the tacter pecked the key corresponding to the drug it had received, the *Thank you* key in the mander's chamber was illuminated. When the mander pecked the *Thank you* key, the flashing light in the tacter's chamber came on and the letter pecked by the tacter appeared on the sample key in the mander's chamber. Then, the tacter could receive food or water by pecking the food or water key and the mander could receive food by matching the letter on the sample key to the correspond-

ing letter (S for saline, C for cocaine, and P for pentobarb) on the comparison keys. Again, the tacter's responses were highly accurate. The tacters showed over 90% accuracy under all three kinds of injections. The generalization to similar but somewhat different drugs was also produced successfully, and even when the tacters were satiated and received only the generalized conditioned reinforcer, they still accurately tacted their interoceptive states.

The purpose of these animal symbolic communication studies was to establish analogs of human verbal interaction in non-humans. Although the communication consisted of selection-based rather than topography-based mands and tacts, it closely resembles human communication in terms of the functional relations between the causal variables and resulting verbal behavior.

**CONCLUSIONS**

The present paper reviewed basic empirical research directly stemming from Skinner's analysis of verbal behavior. Only a limited number of studies have been conducted up to the present, and of these, most focused on the mand and tact relations. But even though the number of studies is limited, empirical research in this field is valuable for several reasons. First, the studies discussed provide some empirical support for Skinner's theoretical analysis of verbal behavior. As Michael (1984) has pointed out, Skinner's analysis of verbal behavior has been neglected, possibly in part because

data-oriented behavioral researchers were not interested in Skinner's extensive speculative analysis. Empirical research which provides data might stimulate such researchers to give more attention to that analysis.

Second, the existing empirical studies provide a good groundwork for future empirical research. One of the suggested reasons for the lack of empirical research on verbal behavior has been the lack of effective methodologies (MacCorquodale, 1970). The methodologies developed in the studies reviewed can be used and elaborated on in future research. For example, the blocked-response CEO procedure adopted in several studies can be extremely useful in cases where one cannot rely on naturally occurring EOs.

Third, findings from empirical research propose some changes in the direction of language training for developmentally disabled and other language defective individuals, especially the importance of training each type of verbal operant, and of training speaker's and listener's repertoires independently.

The efforts to understand language from a behavioral perspective seems to be just beginning. However, researchers in this area have already collected invaluable data and information. Undoubtedly, future research will result in the further accumulation of even more valuable information.

## REFERENCES

- Boe, R., & Winokur, S. (1978a). A procedure for studying echoic control in verbal behavior. *Journal of the Experimental Analysis of Behavior*, 30, 213-217.
- Boe, R., & Winokur, S. (1978b). Echoic control in conversational speech. *Journal of General Psychology*, 99, 299-304.
- Braam, S. J., & Poling, A. (1983). Development of intraverbal behavior in mentally retarded individuals through transfer of stimulus control procedures: Classification of verbal responses. *Applied Research in Mental Retardation*, 4, 279-302.
- Carroll, R. J., & Hesse, B. E. (1987). The effects of alternating mand and tact training on the acquisition of tacts. *The Analysis of Verbal Behavior*, 5, 55-65.
- Chase, P., Johnson, K., & Sulzer-Azaroff, B. (1985). Verbal relations within instruction: Are there subclasses of the intraverbal? *Journal of the Experimental Analysis of Behavior*, 43, 301-314.
- Chomsky, N. (1959). Review of B. F. Skinner's *Verbal behavior*. *Language*, 35, 26-58.
- Epstein, R., Lanza, R., & Skinner, B. F. (1980). Symbolic communication between two pigeons (*Columba livia domestica*). *Science*, 207, 543-545.
- Guess, D. (1969). A functional analysis of receptive language and productive speech: Acquisition of the plural morpheme. *Journal of Applied Behavior Analysis*, 2, 55-64.
- Guess, D., & Baer, D. M. (1973). An analysis of individual differences in generalization between receptive and productive language in retarded children. *Journal of Applied Behavior Analysis*, 6, 311-329.
- 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.
- Hall, G., & Sundberg, M. L. (1987). Teaching mands by manipulating conditioned establishing operations. *The Analysis of Verbal Behavior*, 5, 41-53.
- Howard, J. S., & Rice, D. E. (1988). Establishing a generalized autoclitic repertoire in preschool children. *The Analysis of Verbal Behavior*, 6, 45-59.
- Hung, D. (1980). Training and generalization of "yes" and "no" as mands in two autistic children. *Journal of Autism and Developmental Disorders*, 10, 139-152.
- Keller, F. S., & Schoenfeld, W. N. (1950). *Principles of psychology*. New York: Appleton-Century-Crofts.
- Lamarre, J., & Holland, J. G. (1985). The functional independence of mands and tacts. *Journal of the Experimental Analysis of Behavior*, 43, 5-19.
- Lane, H., & Schneider, B. (1963). Methods for self-shaping echoic behavior. *Modern Language Journal*, 47, 154-160.
- Lanza, R., Starr, J., & Skinner, B. F. (1982). "Lying" in the pigeon. *Journal of the Experimental Analysis of Behavior*, 38, 201-203.
- Lee, V. L. (1981). Prepositional phrases spoken and heard. *Journal of the Experimental Analysis of Behavior*, 35, 227-242.
- Lee, V. L., & Pegler, A. M. (1982). Effects on spelling of training children to read. *Journal of the Experimental Analysis of Behavior*, 37, 311-322.
- Lubinski, D., & MacCorquodale, K. (1984). "Symbolic communication" between two pigeons (*Columba livia*) without unconditioned reinforcement. *Journal of Comparative Psychology*, 98, 372-380.
- Lubinski, D., & Thompson, T. (1987). An animal model of the interpersonal communication of interoceptive (private) states. *Journal of the Experimental Analysis of Behavior*, 48, 1-15.
- Luciano, M. C. (1986). Acquisition, maintenance and generalization of productive intraverbal behavior through transfer of stimulus control procedures. *Applied Research in Mental Retardation*, 7, 1-20.
- 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.
- McDowell, E. E. (1968). A programmed method of reading instruction for use with kindergarten children. *The Psychological Record*, 18, 233-239.
- 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. L. (1982a). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior*, 37, 149-155.
- Michael, J. L. (1982b). Skinner's elementary verbal relations: Some new categories. *The Analysis of Verbal Behavior*, 1, 1-3.
- Michael, J. L. (1984). Verbal behavior. *Journal of the Experimental Analysis of Behavior*, 42, 363-376.

- Michael, J. L. (1985). Two kinds of verbal behavior plus a possible third. *The Analysis of Verbal Behavior*, 3, 2-5.
- Michael, J. L. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior*, 6, 3-9.
- Michael, J. L., Whitley, P., & Hesse, B. E. (1983). The pigeon parlance project. *The Analysis of Verbal Behavior*, 1, 6-9.
- Osgood, C. E. (1958). Verbal behavior, by B. F. Skinner, *Contemporary Psychology*, 3, 212-214.
- Peterson, N. (1978). *An introduction to verbal behavior*. Grand Rapids: Behavior Associates, Inc.
- Rogers-Warren, A., & Warren, S. (1980). Mands for verbalization: Facilitating the display of newly trained language in children. *Behavior Modification*, 4, 361-382.
- Savage-Rumbaugh, S. E. (1984). Verbal behavior at a procedural level in the chimpanzee. *Journal of the Experimental Analysis of Behavior*, 41, 223-250.
- Sidman, M. (1971). The behavioral analysis of aphasia. *Journal of Psychiatric Research*, 8, 413-422.
- Sidman, M., Stoddard, L. T., Mohr, J. P., & Leicester, J. (1971). Behavioral studies of aphasia: Methods of investigation and analysis. *Neuropsychologia*, 9, 119-140.
- Simic, J., & Bucher, B. (1980). Development of spontaneous manding in nonverbal children. *Journal of Applied Behavior Analysis*, 13, 523-528.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1978). *Reflections on behaviorism and society*. Englewood Cliffs, NJ: Prentice-Hall.
- Stafford, M. W., Sundberg, M. L., & Braam, S. J. (1988). A preliminary investigation of the consequences that define the mand and the tact. *The Analysis of Verbal Behavior*, 6, 61-71.
- Sundberg, M. L. (1985). Teaching verbal behavior to pigeons. *The Analysis of Verbal Behavior*, 3, 11-17.
- Sundberg, M. L., & Partington, J. W. (1982). Skinner's *Verbal behavior*: A reference list. *The Analysis of Verbal Behavior*, 1, 9-13.
- Sundberg, M. L., & Partington, J. W. (1983). Skinner's *Verbal behavior*: An update on the 1982 reference list. *The Analysis of Verbal Behavior*, 2, 9-10.
- Vargas, E. A. (1982). Interverbal behavior: The codic, duplic and sequelic subtypes. *The Analysis of Verbal Behavior*, 1, 5-7.
- Whitehurst, G. J. (1977). Comprehension, selective imitation, and the CIP hypothesis. *Journal of Experimental Child Psychology*, 23, 23-38.
- Yamamoto, J., & Mochizuki, A. (1988). Acquisition and functional analysis of manding with autistic students. *Journal of Applied Behavior Analysis*, 21, 57-64.