Teaching Verbal Behavior to Pigeons

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Pigeons were taught simple analogs of verbal behavior by replicating and extending the procedures presented by Michael, Whitley, and Hesse (1983). A student lab, connected to a course on the experimental analysis of behavior, was used to teach both the students and the pigeons new behavioral repertoires. Most of the 18 birds learned a simple stimulus-selection-based tact, as well as 2-3 topography-based tacts. Several pigeons learned to mand for reinforcers, and a few acquired some simple intraverbal responses. The student's learned the basic features of Skinner's analysis of verbal behavior, as well as several laboratory skills. Further work in this area is encouraged due to its potential contributions to the experimental analysis of verbal behavior, and to teaching language to the developmentally disabled, and other speech and language impaired individuals.

Skinner's (1957) analysis of verbal behavior has generated a great deal of discussion, but very little empirical research (McPherson, Bonem, Green, & Osborne, 1984). Skinner (1978) believes his work has been slow in affecting the culture because those who mainly study language (e.g., linguists and psycholinguists) lack a technical understanding of an operant analysis. Also, Skinner (1978) points out that these language scholars have traditionally emphasized cognitive processes as causal factors and "are primarily concerned with the listener—with what words mean to those who hear them, and with what kinds of sentences are judged grammatical or ungrammatical" (p. 122). Such orientations have prevented researchers from isolating and studying the appropriate independent and dependent variables involved in verbal behavior. Thus, it is no surprise that empirical support for an environmental analysis of language has not come from those already studying language.

Michael (1984) gives several possible explanations why researchers who are not cognitive in their orientation, and have the technical background in operant analyses, have neglected *Verbal Behavior* (Skinner, 1957). Perhaps most relevant to the current paper is the point that:

> Basic researchers whose training prepared them to appreciate Skinner's analysis already had a highly productive research methodology, involving response rate as the dependent variable and automated data collection....Operant researchers in the late fifties and early sixties were strongly committed to behaviorism as a data based science, and less interested—or in some cases even embarrassed by—Skinner's speculative extensions to human affairs...the applied behavior analysis developing in the same period also had an emphasis on data, as the only valid basis for procedure and policy, and from this prospective *Verbal Behavior* did not seem particularly useful (p. 369).

A review of the contents of the *Journal of the Experimental Analysis of Behavior* and the *Journal of Applied Behavior Analysis* will show that reseachers, for the most part, continue to neglect the topic of verbal behavior. The book *Verbal Behavior* plays almost no role in controlling research activity in the behavioral field, yet the topic of language is perhaps the single most important area in human affairs and psychology in general. In 1978 Skinner wrote: "*Verbal Behavior*...will, I believe, prove to be my most important work" (p. 122).

Skinner's book *Verbal Behavior* (1957) contains a radical behavioral analysis of the topic generally referred to as "language." Skinner's main thesis is that language is learned behavior controlled by antecedents, consequences, and establishing operations. The analysis of these environmental variables reveals several different types of control which Skinner identifies as echoic, mand, tact, intraverbal, textual, and transcriptive (he also presents the audience as a source of control). Skinner proposes that these elementary verbal relationships are separate contingencies of reinforcement and can be subjected to an experimental analysis of behavior (Skinner, 1969, p. 25), and in fact, have several advantages as a topic of study (Skinner, 1957, p. 5).

However, verbal behavior is an extremely complex area. Michael (1984) points this out by listing some of the topics found among the first twenty entries in the index of *Verbal Behavior* (abstraction, abulia, acrostics, agglutinated languages, agnosia, agrammatism, alexia, allegory, alliteration, allusion, amanuensis, and ambiguity). The "main difficulty is not with the 'behavioralizing,' but rather with what is being behavioralized" (Michael, 1984, p. 369). The behavioral researcher who works primarily with nonhumans does not usually come in contact with these complexities, or other topics relevant to verbal behavior such as rule-governed behavior, thinking, and complex social behavior. Also, nonhumans have not developed the elaborate collection of conditioned reinforcers and conditioned establishing operations which may control human verbal behavior. Recently, however, basic human operant research is increasing and researchers are starting to address some of these complexities (e.g., Hake, 1982; Buskist, 1982), and several studies on the basic elementary operants have been published (e.g., Boe & Winokur, 1978; Braam & Poling, 1983; Lamarre & Holland, 1985; Lee, 1981; Lee & Pegler, 1982; Savage-Rumbaugh, 1984).

The present study is an attempt to develop some simple analogs of verbal behavior in pigeons. The study is a replication and extension of a project started by Jack Michael and his students at Western Michigan University (Michael, Whitley, & Hesse, 1983). Their primary research emphasis was to develop repertoires corresponding to Skinner's elementary operants as presented in *Verbal Behavior.* Michael et al. (1983) were successful in teaching several forms of verbal behavior by using motor responses (not unlike those of the American Sign Language) such as circle turning, head bobbing, and toe pecking as response forms. These responses can become linguistic according to Skinner (1957, p. 14) because the form of the response (what is said, signed, written, etc.) is not a defining feature of verbal behavior. The critical feature is that *some* consistent form of behavior be under the functional control of environmental variables.

Skinner (1974, pp. 89-90) points out that a unique feature of most verbal behavior is that the response can occur on almost any occasion and does not require environmental support. The forms of behavior for most of the current study were free from environmental support, that is, the response forms were exclusively part of the organism's musculature and not dependent on physical features of the environment. Michael (1985) and his colleagues (Michael et al., 1983) distinguish between two types of verbal behavior based on the response topography and environmental support necessary for the emission of the response. He has termed these *stimulus-selection-based* verbal behavior (dependent upon environmental support) and *topography-based* verbal behavior (free from support). Michael et al. (1983) taught their pigeons three forms of behavior; stimulus-based tacts, topography-based tacts, and mand compliance (receptive behavior). The current study is a replication of their procedures for developing a stimulus-selection-based tact and a topography-based tact. Then, transfer of stimulus control procedures were used to bring the topography-based tacts under the control of establishing operations (mands), and verbal stimuli (intraverbals).

METHOD

Subjects

Eighteen naive Humboldt pigeons, maintained at 85%-95% of their free-feeding weights, served as subjects. All birds were tamed by hand feeding in order to establish the hand as a form of conditioned reinforcement.

Setting and Sessions

Training was conducted in an open environment (a 5′ x 7′ study carrel) without restraining the pigeons or clipping their wings. Sessions occurred five times a week with a mean length of 30 minutes, and contained approximately 50 reinforced trials.

Trainers

The main body of experimenters consisted of 34 students from Psychology 4720 (The Experimental Analysis of Behavior) at California State University, Stanislaus. This was the first experimental laboratory experience for all students. Lab partners were selected, and each pair of students was assigned complete care and responsibility for one bird (two of the teams had three members). The instructor (the author) and his assistant also conducted the experiment, each with one bird.

Apparatus and materials

There were only a few materials used in the experiment. An experimental chamber was not necessary because the pigeons typically worked in an open area while standing on blocks of wood on a desk top (or on the floor, or on the experimenter's knee). Stimuli were chosen by the experimenters and they typically consisted of geometrical designs, objects (e.g., cup, jar, lid, glasses), or written words. Mixed grain was used as reinforcement and it was delivered by hand. Grain delivery was preceded (within one second) by a whistle or some other stimulus (e.g., click, "tsk-tsk") agreed upon by both partners.

Measurement, design, and reliability

The primary emphasis of the laboratory exercise was to develop the verbal repertoires (of the birds and students) rather than conduct a formal research project. Hence, the measurement system and design were allowed to evolve over the course of the experiment. It was the general consensus that an emphasis on methodology and design would delay the development of the verbal repertoires, especially since most students were naive to measurement techniques, and all the dependent and independent variables could not be identified at the out-set of the experiment. However, it was clear that the research project would teach us about a potential methodology for future research. Data were collected in a number of different ways including the latency, frequency, and topographical characteristics of the responses. Reliability of the repertoires was conducted by observations of the birds' performance by the instructor and the course assistant. This method of reliability is similar to what Skinner (1957) calls "confirmation" (p. 425).

Experimental procedures

Preliminary training procedures. The experimenters tamed their birds by using mild deprivation (85%-95% body weight) and hand feeding. After the bird would calmly eat out of one hand while being restrained by the other, the experimenters took their hungry bird to a study carrel and let him loose while holding out their hand containing grain. When the bird approached and ate he was allowed approximately 5 seconds of grain. All experimenters recorded the latency between opening their hand and the first eating response of each trial (magazine training).

Stimulus-selection-based tact training

A simple stimulus-selection-based tact was trained by using a basic shaping procedure. The birds were taught to peck a red dot presented in various locations around the room, and to discriminate it from an array of similar stimuli (e.g., blue dots, squares). Once the birds could respond correctly, on at least 90% of the trials, they began the next phase of training.

Topography-based tact training

The preliminary procedures and stimulus-selection training took approximately four to six weeks. Following the acquisition of pecking the red dot and discrimination training, each pair of experimenters picked a new nonverbal stimulus and trained the bird, using standard shaping techniques, to emit a response that was free from any environmental support (e.g., turning in a clockwise circle, pecking the third right toe). The response was brought under the exclusive control of the specific nonverbal stimulus, by conducting unreinforced trials in the presence of different stimuli.

Typically, experimenters sat in student desk-chairs with the pigeon perched upon a block of wood. The stimuli were placed on small blocks (5 cm in diameter) and the experimenter would raise the block from under the desk and present it approximately 5 inches in front of the pigeon's eyes. (The block also contained the red dot on one side, and stimulus-selection trials were interspersed with the tact training.) Any approximation to the target response was immediately reinforced with a whistle (or whatever form of conditioned reinforcement had been established) and a few seconds of grain delivered by raising the other hand up from under the desk. Both hands were then lowered under the desk and a five second inter-trial interval occurred.

Experimenters repeated the procedure

with a second stimulus and a second response topography. These stimuli were placed on a different side of the same block along with the red dot, and the first topography-based stimulus configuration. Trials on the new verbal relation were interspersed with the previously established repertoires. Some experimenters went on to establish a third topography-based tact.

Transfer of stimulus control

It was necessary to teach the bird to tact some physical object so he could later mand for that object. A baby food jar and the lid to that jar served as the first two stimuli for most experimenters. One stimulus was taped to the jar and the other was taped to the lid. The birds were presented trials in the same manner as above except the stimuli were on the objects instead of the blocks. After a few trials, the symbols were removed from the objects and training was conducted with the objects alone as stimuli.

Transfer to establishing operations

Michael (1982) defines establishing operations (EO's) as "any change in the environment which alters the effectiveness of some object or event as reinforcement and simultaneously alters the momentary frequency of the behavior that has been followed by that reinforcement" (pp. 150-151). Michael identifies two types of EO's; unconditioned establishing operations (UEO) and conditioned establishing operations (CEO). The distinction is in terms of the learning history required for CEO's. The objective in this phase of the training was to bring a specific response under the control of a specific CEO.

The grain was placed in the jar and the lid was placed on the jar. The jar was placed under the desk and a delay procedure (Halle, Baer, & Spradlin, 1981) was used. The birds would typically emit several behaviors, and upon emission of the appropriate response for jar the conditioned reinforcer was given along with raising the jar to the top of the desk. The experimenter then waited again until the appropriate response for "lid-off" occurred and then delivered the conditioned reinforcer (e.g., whistle), removed the lid and allowed the bird to eat.

An additional type of mand training consisted of teaching the bird to ask for a specific jar which contained the grain. The experimenter placed the geometric shapes on different jars, and only one contained food. If the bird emitted the correct "selection" response he was allowed to eat some grain from that jar.

Transfer of stimulus control to verbal stimuli

Once the birds could emit the same response topography under two separate types of control (nonverbal stimuli and establishing operations) a few experimenters progressed on to transfer control to written stimuli. The procedure consisted of either superimposing the symbol on the written word, or using a delay procedure and reinforcing the response under the presence of the written word. This verbal relation would be analogous to the deaf signer who "reads" English by emitting signs controlled by written words. Hence, the relation is an intraverbal because of the lack of point-to-point correspondence between the stimulus and the response.

RESULTS

Preliminary training

During the first several sessions in the open environment the first latency to the eating response was over one hour for many birds. For most birds the latency would slowly decrease during the session to under 10 seconds, but then increase again at the beginning of the next session. It took most experimenters approximately ten sessions to completely desensitize their birds (and in some cases, themselves) as measured by a consistent latency of less than three seconds.

Stimulus-selection-based tacting

Most experimenters were successful in teaching their bird to peck the red dot in about two sessions. Discrimination training and selection from an array of stimuli took an additional two to five sessions for most experimenters.

Topography-based tacting

All the birds acquired the first topography-based tact in one to three sessions (see Table

Table 1.
Topography-Based Tacts

	Response 1			Response 2		
Bird #	Stimulus	Response	Sessions	Stimulus	Response	Sessions
31	Spiral Circle	Turn Right Circle	3	Grid	Peck 3rd Right Toe	3
33	Blue Star	Turn Left Circle	2	Green Triangle	Foot Stomp	7
34	Green Triangle	Turn Left Circle	1	Jar	Coo Sound	8
35	Checked Square	Head Bob	3	Blue Star	Peck 2nd Right Toe	14
36	Checked Square	Head Bob	3	Tan Cube	Turn Right Circle	1
37	Spiral Circle	Turn Right Circle	1			
39	Blue Triangle	Turn Right Circle	1	Brown Spiral	Left Wing Peck	7
40	One Inch V	Wing Flap	1	Spiral Circle	Turn Right Circle	1
41	Blue Triangle	Turn Right Circle	1	Cup	Peck 2nd Right Toe	9
42	Purple X	Turn Right Circle	1	Grid	Peck Left Wing	4
43	Blue Star	Turn Left Circle	1			
44	Blue Dot	Turn Left Circle	1	Green Triangle	Turn Left Then Right	1
45	Spiral Circle	Turn Left Circle	2			
46	Spiral Circle	Turn Left Circle	3	Black Cross	Peck Right Wing	1
47	Blue Triangle	Turn Right Circle	3	Grid	Wing Flap	1
48	Blue Star	Turn Right Circle	2	Grid	Peck Right Toe	3
49	Blue Triangle	Turn Right Circle	1	Green Triangle	Peck Right Toe	3
50	Sunglasses	Turn Right Circle	3			

1). The first correct target response (e.g., turning a circle) often occurred within the first ten minutes of the first session. The red dot was interspersed with the new topography-based tact stimulus and all birds would consistently emit the peck to the red dot when it was presented demonstrating two simple, but separate, repertoires. When presented with an irrelevant stimulus the birds typically would not respond.

Eight birds acquired a second topography-based tact in one to three sessions, six birds acquired it between four and fourteen sessions, and four birds failed to acquire a second tact. Several of the experimenters had difficulty with teaching their bird not to emit the first topography under the control of the second stimulus (a common problem in the early phases of teaching sign language to the non-vocal developmentally disabled individual). The more skillful shapers were able to successfully extinguish inappropriate responses and reinforce small approximations to correct responses and teach the new repertoire quickly. Three teams were successful in teaching a third topography-based tact.

Transfer of stimulus control

Transfer from a geometric stimulus to an object occurred in a surprisingly short period of time, often in only a few trials.

Transfer to establishing operations

Transfer to the conditioned establishing operation usually occurred in a few trials and the two-component response became strong in about two sessions. Thirteen birds successfully acquired a two-component mand which usually consisted of the bird "asking" for an absent jar, and then "asking" to remove the lid from the jar (some experimenters had the bird ask for a special light to be turned on, or used a cup instead of a jar). A test for the accuracy of the source of control for the mands "jar," and "lid off," demonstrated that in the presence of the jar, with the lid on, the response "jar" would not occur, rather "lid off" would occur. If the jar was presented with the lid off no response occurred and the bird would begin eating the grain. If there was no grain in the jar the bird would usually pace around and preen. Thus, like Michael's (1982, p. 152-153) electrician example, the presence of the covered jar (the slotted screw) altered the value of removing the lid (the screwdriver), and evoked the behavior of asking for the lid to be removed (asking for the screwdriver). When the lid was removed (when the electrician received the screwdriver) the mand ceased. If the lid was off, but present (if the screwdriver was readily available) the mand did not occur. The ultimate consequence was grain for the pigeon, but the experiment was not unlike teaching a child to ask for spoon in order to eat his ice cream.

A few birds were taught the "mand selection" repertoire and acquired it in one session. The birds would readily "ask" the experimenter for a jar which contained food by emitting the "name" of the jar. This procedure was like asking a child to select from a number of different items one which functioned as reinforcement at that moment.

Transfer to verbal stimuli

Seven students continued the experiment the following semester as an independent study. They replicated many of the above procedures and worked on the improvement of the data collection system. Three birds acquired a simple intraverbal repertoire consisting of emitting the same response (which had been previously acquired as a mand and tact) under the control of written stimuli (e.g., "LID," "JAR"). These birds all acquired at least six separate verbal relations (McDoungh & Sundberg, 1984; Winfrey, 1984). The birds could consistently emit two appropriate responses under the control of nonverbal stimuli (tact), conditioned establishing operations (mand), and written words (intraverbal). The transfer of stimulus control was more difficult than with the other repertoires, but still occurred between three and eight sessions. The delay procedure was much more successful than the fading procedure. And all the verbal repertoires became weak if training was disrupted for more than a week.

DISCUSSION

The experimenters and pigeons acquired a number of new behaviors during the course of the experiment. Perhaps most surprising was the speed in which the pigeons acquired the verbal responses. Many of the experimenters were able to teach their birds a specific topography in a matter of minutes. Simultaneously, that response came under the control of a specific nonverbal stimulus. Once stimulus control was established, the transfer of stimulus control to a different variable occurred very quickly by using prompting and fading, and delay procedures.

It appears that the essential features of teaching pigeons topography-based verbal behavior involve bringing a motor response (which is free from environmental support) under some type of stimulus control, and then transferring that control to the variables involved in verbal behavior. Imitative control is typically used for teaching sign language to the developmentally disabled, and once control is established, training is given to transfer control to other nonverbal and verbal antecedents and establishing operations (Sundberg, 1980). Transfer to those sources of control occurred so rapidly with the developmentally disabled that the author identified the procedure as the "the quick transfer procedure." However, the number of trials required to transfer stimulus control with pigeons was less than those required for many nonvocal developmentally disabled persons.

The students became quite skillful in observing behavior, shaping, prompting, fading, and delivering consequences. Their verbal repertoires also showed some major changes. The terms mand, tact, and intraverbal became part of their analytical repertoire and classroom analyses of human situations showed great improvement. The students were very proud of their birds and took every opportunity to show them off. Perhaps the main result of the lab was that the students had become very confident in the principles of behavior and the techniques of behavioral engineering.

Some of the experimenters had difficulty teaching the birds the second tact and more complicated behavior. The training required careful shaping procedures with immediate differential reinforcement for very small improvements and mistakes often took a long time to correct. Also, some of the birds emitted an increased amount of aggressive behavior as the repertoires become more complicated (not unlike many developmentally disabled individuals). This was probably due to their poor conditioning history and schedule strain.

The current study could be improved in a number of ways. Perhaps most important would be the use of a more refined data collection system and experimental design. Due to the exploratory and instructional nature of the lab a number of standard procedures for ensuring experimental rigor were not employed. However, a useful data collection system was developed during the two semesters. A modified version of the system used for the developmentally disabled was used (Sundberg, 1980). The essential features consist of a coding system for scoring all the antecedents and consequences of each verbal episode, along with the response latency and topography. A second experimenter was necessary to collect the data, but a running account of the verbal episodes between the experimenter and the pigeon was useful. Attempts at collecting latency data were also promising. Ultimately, a computer could be used to record all these data. Such a system could help refine the training procedures and further promote the development of the experimental analysis of verbal behavior.

The experiments conducted in this lab produced only small verbal repertoires in the pigeons, but the potential for more complex verbal repertoires seems clear. Further research could be conducted in virtually all aspects of verbal behavior given the refinement and extensions of these basic procedures and repertoires. This research should improve our understanding of verbal behavior, as well as increase our efficiency in teaching language to the developmentally disabled, and other speech and impaired individuals.

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