JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1985, 43, 5-19 NUMBER 1 (JANUARY)

THE FUNCTIONAL INDEPENDENCE OF MANDS AND TACTS

JENNIFER LAMARRE AND JAMES G. HOLLAND

UNIVERSITY OF PITTSBURGH

This study demonstrates functional independence in the acquisition of mands and tacts. Some subjects first learned to mand the experimenter's placement of objects with the prepositional phrases "On the left" and "On the right." They were regularly tested for collateral appearance of tacts with these same phrases. Other subjects learned to tact the location of objects with these prepositional phrases and were regularly tested for collateral appearance of mands. All subjects were next trained in the repertoire that had not been trained in the first condition (either tact or mand). After all subjects had learned both to mand and to tact correctly, another assessment of mand-tact independence was undertaken. Mands (tacts) were reversed and testing assessed collateral reversal of tacts (mands). The results demonstrated that tacts and mands, even when incorporating identical response forms, were functionally independent during acquisition. Subsequent modification of one repertoire (by reversal training) produced collateral reversal in three of nine subjects.

Key words: verbal behavior, functional independence, mands, tacts, prepositional phrases, children

Skinner's (1957) functional analysis of verbal behavior identifies six major types of functional relations, differing in the controlling stimuli and/or the nature of reinforcement contingent upon verbal responses. In his analysis, the functional relation, not the form of the response, is critical for an account of verbal behavior. Skinner's analysis differs from those that use the "word" (morphological form) as a unit of analysis. In such accounts, varied usage of a particular word is said to demonstrate an underlying concept or knowledge of the word's meaning.

Two types of verbal operants that Skinner described are *mands* and *tacts*. A mand, as originally formulated, is controlled by deprivation or aversive stimulation. In an improved formulation by Michael (1982), a mand is controlled either by establishing operations (e.g., food deprivation) or by establishing stimuli that render other stimuli as specific reinforcers (e.g., the carpenter on a ladder, preparing to drive a nail, says to her/his assistant, "Please hand me the hammer"). In either instance the mand is reinforced by a consequence specific to the form of the response rather than by a generalized reinforcer: The mand "Wait" is reinforced by someone's waiting; the mand "Shut the door" is reinforced by someone's closing the door.

A tact, on the other hand, is controlled by a prior nonverbal stimulus (S^D) such as an object or event, a property of an object or event, or a relationship between objects or events. Unlike the mand, the tact is not typically reinforced by a specific consequence but by a generalized or social reinforcer; hence a tact is not under control of a specific establishing operation or of an establishing stimulus relevant to a specific reinforcer. An example of a tact is a child saying "truck" in the presence of a truck and subsequently receiving approval (not the truck) from a parent.

Although the functional relations labeled tacts and mands are different, the verbal responses participating in a tact and a mand may be identical in form. For example, when

This research was based on a thesis submitted by Jennifer Lamarre to the University of Pittsburgh in partial fulfillment of the requirements for the M.S. degree. We thank Evalyn Segal and Mark Sundberg for their helpful comments on an earlier draft and are grateful for the cooperation of the Campus Nursery and Child Study Center at the University of Pittsburgh. Reprint requests should be addressed to James G. Holland, Department of Psychology, University of Pittsburgh, Pittsburgh, Pennsylvania 15260.

a child wants something sweet and says "Candy," the response is reinforced by the receipt of candy, and "Candy" is the mand. The child may also say "Candy" when someone points to a piece of candy and asks, "What is this?," in which case the response is under control of candy as an S^D and is a tact.

According to Skinner's (1957) analysis, different verbal operants are acquired independently even though they may look or sound alike. Establishing one of these verbal operants will not automatically result in the appearance of the other. (Why the same response form so often occurs as both a mand and a tact is addressed later, in the Discussion section.)

The present authors have found no published experimental investigations of functional independence of mands and tacts in human subjects. Skinner's original formulation was based on his own naturalistic, rather than experimental, observations. The psycholinguistic literature on language acquisition might have been expected to contain examples relevant to the independence of mands and tacts, but, regrettably, this seems not to be the case. For example, a recent book (Wanner & Gleitman, 1982), generally recognized to be complete and up to date on language acquisition in children, contains no information specifically relevant to the functional independence of mands and tacts.

However, empirical support for mand and tact independence is found in some of the chimpanzee-language research of Yerkes Laboratory. Savage-Rumbaugh et al. (1980) found that two chimpanzees, Sherman and Austin, learned to ask for tools before they could label them, and a third, Lana, learned to label tools before it could ask for them. They suggested that these two abilities "may not necessarily be related." More recently Savage-Rumbaugh (1984) has recast this work within the framework of Skinner's analysis of verbal behavior. Two chimpanzees, Sherman and Austin, first learned to request (mand) one of 32 foods held before them by selecting the appropriate symbol on a visual display. The particular food was then given as a reinforcer. (Subsequently they manded the food of their choice from an array of foods, and still later manded absent foods.) Following the initial mand training of singly presented foods, an attempt was made to get Sherman and Austin to label (tact) the presented food. When the chimpanzees selected the symbol appropriate to the presented food, the resulting reinforcement was praise and a food different from the named one. This "tact-like" reinforcement procedure produced emotional behavior and a "breakdown in food-symbol correlations." Persistent efforts to teach the tact-like behavior failed until a fading procedure was used by providing small and decreasing portions of the named food. About 200 trials were then required for the chimpanzees to accurately "tact" three different foods, receiving only generalized reinforcement (praise). Thereafter, accurate tacting of the remaining 29 foods was immediate.

Although research on the functional independence of mands and tacts has been limited to these chimpanzee results, related questions concerning the functional independence of speakers' and listeners' repertoires have been investigated (as has the independence of reading and spelling, Lee & Pegler, 1982). In emphasizing functional relations, Skinner clearly distinguished between the behavior of a speaker and the behavior of a listener in noting that "when one 'learns the meaning of a word' as a listener, one cannot then 'use it' as a speaker, or vice versa" (Skinner, 1957, p. 195). Savage-Rumbaugh (1984) also found that the chimpanzee's listener competence "did not appear spontaneously once the chimpanzee had acquired the form of manding and tacting" (p. 238). Listener competence has to be specifically trained.

Research on the independence of human subjects' speaking and listening repertoires shows mixed results. With some subjects it was found that training a speaker's or listener's repertoire did not result in collateral development of the other repertoire (Guess, 1969; Guess & Baer, 1973, Harrelson, 1969). Other subjects did develop a listener's repertoire collateral to developing a speaker's

repertoire (Guess & Baer, 1973; Whitehurst, 1977).

Examining further the relation between speaker's and listener's repertoires, Lee (1981) found, in most cases, that children who learned to place a cup on the left of a book on command (listener's repertoire) did not automatically say "The cup is on the left of the book" when asked the position of the cup (speaker's repertoire). Alternatively, children who were asked the position of a cup and trained to respond with the phrase "The cup is on the left of the book" did not then place the cup on the left of the book when told to do so. However, some of Lee's subjects did demonstrate one repertoire after establishment of the other. Lee found that the subjects in her study, as well as the subjects in other studies (Guess & Baer, 1973; Whitehurst, 1977) who showed collateral appearance of the second repertoire, had already demonstrated that repertoire during baseline assessment. She concluded that collateral changes between speaker and listener repertoires reflected changes only in the stimulus control of preexisting topographies. Her results thus reaffirmed Skinner's (1957) suggestion that an individual acquires speaker's and listener's repertoires independently, even when they are syntactically identical. Only when the word is emphasized in accounting for language is it surprising to see children display "knowledge of the meaning of the word" as speakers but then not "use the word" as listeners, or vice versa.

Additional support for Lee's conclusions regarding the independence of speaking and listening repertoires comes from studies using sign language with hearing, nonvocal children (Sundberg, 1980). Sundberg noted that children with developmental disabilities often have a speaker's repertoire while lacking a listener's repertoire, or vice versa. Sundberg's sign-language training program, based on Skinner's analysis of verbal behavior, successfully generated verbal repertoires in a number of retarded individuals. His success is particularly noteworthy given the problems of transfer often experienced in other training programs. According to Poulton and Algozzine (1980), subjects in the unsuccessful programs rarely signed outside the training situation. These training programs did not discriminate among the different verbal operants that make up a person's language, and instead, primarily taught children to produce signs that corresponded with objects. Sundberg attributed his success to separately establishing each type of verbal operant described by Skinner and thus highlighted the potential value of an experimental analysis of the relation between different verbal operants. (Sundberg [1983] has gone on to develop a language-assessment program involving the separate assessment of functional categories of verbal behavior.)

The present study investigated the relation of mands and tacts that have the same response form. It was designed to examine the claim that one verbal operant does not appear simply as the result of establishing another with the same response form. Some subjects were trained to mand and the effect on the corresponding tacts was assessed. Other subjects were trained to tact and the effect on the corresponding mands was evaluated. The response forms employed were the prepositional phrases "On the left" and "On the right," which Lee (1981) used in demonstrating the independence of speaking and listening repertoires.

The mands that were trained consisted of verbal responses prompted by the experimenter's question, "Where do you want me to put the (object)?" (see Table 1). A pair of small objects, such as a toy dog and a flower, was placed in front of the subject and the experimenter trained the subject to say, "On the left (right)," in response to the question, "Where do you want me to put the dog (flower)?"

Proper placement of the objects by the experimenter was a sufficient reinforcing stimulus, as evidenced by the prepositional phrase being repeated in subsequent mands (but with new objects). This is to say that the only direct consequence of the mand was the experimenter's placement; the placement is a

Table 1
Sample Test Questions and Responses

Objects	*Mand-Evaluating Questions*	*Responses (mands)*	*Subject Reinforces*	
			Standard	*Reversed*
dog & flower	"Where do you want me to put the dog?"	"On the right"	placement on the right	placement on the left
dog & flower	"Where do you want me to put the dog?"	"On the left"	placement on the left	placement on the right
dog & flower	"Where do you want me to put the flower?"	"On the right"	placement on the right	placement on the left
dog & flower	"Where do you want me to put the flower?"	"On the left"	placement on the left	placement on the right

Objects	*Test-Evaluating Questions*	*Standard Responses (tacts)*	*Reversed Responses (reversed tacts)*
dog on right of flower	"Where is the dog?"	"On the right"	"On the left"
dog on left of flower	"Where is the dog?"	"On the left"	"On the right"
flower on right of dog	"Where is the flower?"	"On the right"	"On the left"
flower on left of dog	"Where is the flower?"	"On the left"	"On the right"

reinforcer to the extent that the response is repeated in the future. To be certain that the specific position was discriminated as opposed to just any placement, the experimenter occasionally placed the object in the other position (left when the child said "On the right," for example). After each placement, the child informed the experimenter whether the placement was correct or incorrect.

While the subjects learned to mand, test questions assessed their collateral tacting. Testing consisted of placing the two objects side by side in front of the subject and asking where one of the subjects was. Responses of "On the left" or "On the right," depending on the actual position of the objects, were recognized as tacts having the corresponding response form to the mands being trained.

Training the tacts consisted of teaching the same two utterances as in mand training but in response to different questions (see Table 1). For example, a toy dog was placed on the right (left) of a flower and the experimenter asked the subject, "Where is the dog?" The subject was trained to respond with the phrase, "On the right (left)." While the subject was trained to tact the correct position of the object, test questions assessed whether the corresponding mands developed. For example, in the test, the experimenter said, "Now you can give me a reward when I put the (object) in the correct position. Where do you want me to put the (object)?" Responses such as "On the left" or On the right" were takes as indicative of collateral development of mands with the tacts being trained.

METHOD

Subjects

From a pool of children enrolled in the Campus Nursery and Child Study Center of the University of Pittsburgh, 9 subjects were selected on the basis of a screening test. The screening test determined that they did not consistently demonstrate the mands and tacts to be trained. The subjects were 3 boys and 6 girls with ages ranging from 3 years 5 months to 5 years.

Setting

Experimental sessions were conducted in a conference room at the Campus Nursery. The subject and the experimenter sat at adjacent sides of a table. The objects used in the study were kept in a bag placed on the floor beside the experimenter. A tape recorder was on the table near the experimenter and the subject.

Procedure

Overview. Children were initially tested (see Screening) to see whether they had al-

Table 2
Training and Testing for Subjects 1 through 4

Condition		
Screening	a. Prerequisite Skills Training:	pointing, naming, listener's repertoire
	b. Testing: Mand-Evaluating Questions:	test for prior acquisition of the specific mands that are going to be trained
	Tact-Evaluating Questions:	test for prior acquisition of the specific tacts that are going to be trained
Mand Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test to indicate whether mand training is necessary with a particular object pair
	Tact-Evaluating Questions:	test to indicate collateral development of tacts with the mands being trained
	c. Mand Training: (as needed)	
Tact Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test for maintenance of previously trained mands
	Tact-Evaluating Questions:	test to indicate whether tact training is necessary with a particular object pair
	c. Tact Training: (as needed)	
Reversed-Mand Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test to indicate whether reversed-mand training is necessary with a particular object pair
	Tact-Evaluating Questions:	test to indicate collateral development of reversed tacts with the reversed mands being trained
	c. Reversed-Mand Training: (as needed)	

ready acquired the mands and tacts that were going to be trained. Nine children who did not demonstrate them were selected. Tables 2 and 3 depict the training and testing received.

Following screening, Subjects 1 through 4 received mand training, during which test questions assessed the emergence of tacts with the same response form. After completion of initial mand training, these subjects received tact training. Test questions during tact training now checked for the maintenance of the previously trained mands.

Following screening, Subjects 5 through 9 received tact training, during which test questions assessed the emergence of mands with the same response form. After completion of initial tact training, Subjects 5 through 9 received mand training, during which test questions for tacts were included to check for the maintenance of the previously trained tacts.

After all subjects were manding and tacting to criterion, reversal training began. Subjects who had initially received mand training were now given reversed-mand training, and test questions determined whether their tacts also reversed as a result. Subjects who had initially received tact training now received reversed-tact training and test questions determined whether their

Table 3
Training and Testing for Subjects 5 through 9

Condition		
Screening	a. Prerequisite Skills Training:	pointing, naming, listener's repertoire
	b. Testing: Mand-Evaluating Questions:	test for prior acquisition of the specific mands that are going to be trained
	Tact-Evaluating Questions:	test for prior acquisition of the specific tacts that are going to be trained
Tact Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test to indicate collateral development of mands with the tacts being trained
	Tact-Evaluating Questions:	test to indicate whether tact training is necessary with a particular object pair
	c. Tact Training: (as needed)	
Mand Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test to indicate whether mand training is necessary with a particular object pair
	Tact-Evaluating Questions:	test for maintenance of previously trained tacts
	c. Mand Training: (as needed)	
Reversed-Mand Training	a. Prerequisite Skills Training:	pointing, naming
	b. Testing: Mand-Evaluating Questions:	test to indicate collateral development of reversed mands with the reversed tacts being trained
	Tact-Evaluating Questions:	test to indicate whether reversed-tact training is necessary with a particular object pair
	c. Reversed-Tact Training: (as needed)	

mands also reversed as a result. Reversal training was followed by training designed to restore conventional usage of "On the right" and "On the left."

The basic procedures employed during all conditions (screening, mand training, tact training, reversed-mand training, and reversed-tact training) were as follows. First, two objects were selected randomly from a set of 60 objects composed of items whose names were easy to pronounce and familiar to the subjects (e.g., crayon, duck, and clock). After checking that the child could both point to and name each object, the experimenter asked the four mand-evaluating and the four tact-evaluating questions of Table 1. If the test results with this pair of objects were negative, either the mand or the tact or the left-right reversal of the mand or tact was trained, depending on the experimental condition. This procedure was repeated with a new pair of objects until the criterion for each condition was met.

Prerequisite skills. For all experimental conditions, it was first necessary that the subject point to and name each object in the current pair of objects. The two objects were placed side by side in front of the subject. The experimenter then said, "Point to the (object)." Correct pointing was followed by praise and the child received a marble. If the child pointed to the incorrect object, the ex-

perimenter modeled by pointing to the correct object. Then the left-right position of the two objects was randomly changed and the procedure was repeated until the child pointed correctly four consecutive times, two for each object.

The subject was then required to name each object in the current pair of objects. The experimenter pointed to one of the objects and asked "What is this?" Correct naming was followed by praise and a marble. After the occasional incorrect naming response, the experimenter informed the child of his or her error and modeled the correct name. Criterion for naming was reached if the child named each object correctly when first asked "What is this?" or, if the response had to be modeled by the experimenter, when the child made four consecutive correct naming responses, two for each object.

An additional prerequisite was a correct (nonverbal) listener's response to "On the right" and "On the left" mands by the experimenter. This prerequisite was assessed and, if necessary, trained only during screening. Two objects were placed on the table, one in front of the other. The experimenter randomly gave one of four possible instructions to put a named object of the pair either on the right or on the left of the other object. For example, the experimenter might have said, "Put the dog on the right of the flower," and a correct response would be defined as the child's placement of the dog to the right of the flower. Correct placements were followed by praise and a marble. Incorrect placements were so labeled by the experimenter and the correct placement was modeled. The criterion for a listener's reperoire was four correct placements, one for each instruction.

Testing. Testing took place immediately after prerequisite-skills training with each pair of randomly chosen objects, and consisted of asking in random order the four mand-evaluating and the four tact-evaluating questions listed in Table 1. There was no verbal confirmation after the subject's responses to these questions. Standard or reversed responses were as defined in Table 1. During each condition—screening, mand training, tact training, reversed-mand training, and reversed-tact training—the important data consisted of the subjects' responses to these test questions.

During the mand-training condition, the purpose of the eight test questions was two-fold: Four questions tested mand development and the other four tested collateral tact development. First, the subject's mands with the current pair of objects were evaluated by presenting a pair of objects and asking the four "Where do you want me to put the (object)?" questions. If a subject manded successfully with this pair of objects (success indicated by a standard response to each of the four questions—see Table 1), no mand training on this pair followed. Thus, the test questions assessed if mand training on the current pair of objects was necessary. If mand training was necessary with a pair of objects, training began immediately following the test questions without any indication to the subject that an answer during the test phase was incorrect.

Second, the other four questions evaluated the development of the subject's tacts. Tacts were assessed by presenting the pair of objects in left-right positions and asking the four "Where is the (object)?" questions. Standard responses (defined in Table 1) to all four questions indicated collateral development of tacts.

As in mand training, the purpose of the eight questions asked with each pair of objects during tact training was two-fold: Four questions tested for tact development and four questions tested for collateral mand development. First, the subject's tacts were evaluated by presenting the two objects in left-right positions and asking the four "Where is the (object)?" questions. If the subject did not answer each question with the appropriate "On the left" or "On the right," tact training was given following testing of collateral manding. Second, the collateral development of mands with the tacts being trained was evaluated by the subject's responses to the four "Where do you want me to put the (objects)?" questions.

During reversed-mand and reversed-tact training, the eight questions served the same purpose as during mand and tact training, respectively. During reversed-mand training, the subjects' responses to the four mand-evaluating questions assessed whether reversed-mand training was necessary with a particular pair of objects. The four tact-evaluating questions assessed whether subjects continued to demonstrate standard tacts or whether their tacts were reversed. During reversed-tact training, the subjects' responses to the four tact-evaluating questions assessed whether reversed-tact training was necessary with a particular pair of objects. The four mand-evaluating questions assessed whether the subjects continued to demonstrate standard mands or whether they reversed their mands.

Experimental Conditions

Screening. This condition determined whether or not the child had already acquired the mands and tacts to be trained. During screening, each subject was given a prerequisite-skills evaluation with a particular object pair and then was tested with this object pair. Children who responded to all four mand-evaluating questions with standard or reversed mands or to all four tact-evaluating questions with standard or reversed tacts were disqualified. Children were chosen for participation in the present study only if they did not demonstrate the specific mands and tacts with five stimulus pairs (except Subject 3, who was tested with only three stimulus pairs).

Mand training. During this condition, a subject was trained to indicate where an object was to be placed. The experimenter set the occasion for the response by asking, "Where do you want me to place the (object)?" Mand training was required with a particular pair of objects if the subject did not give a standard response during testing to each of the mand-evaluating questions. Mand training with a particular pair of objects, if needed, started immediately following testing with that pair of objects. During training, the subject was instructed to give the experimenter a reward (a marble) each time the experimenter put the object in the correct place. Then the experimenter asked, "Where do you want me to put the (object)?" The experimenter trained the response by modeling, "Say, 'On the right (left)'." The experimenter put the object in the wrong place on the average of once every four times. The subject was instructed to say "No" or its equivalent and not to give the experimenter a marble when the experimenter put the object in the wrong place. Training continued with a particular pair of objects until the subject gave eight standard responses to the question, "Where do you want me to put the (object)?," and had told the experimenter "No" each time she put the object in the wrong place. The criterion for completion of this condition was standard mand responses to all mand-evaluating questions during testing with five consecutive pairs of objects not previously used.

Tact training. During this condition, each subject was trained to label the position of an object. For example, if the experimenter placed a dog on the left of a flower and asked, "Where is the dog?," the subject was trained to respond, "On the left." Tact training with a particular object pair took place if the subject did not give a standard response during testing to each of the tact-evaluating questions. This tact training, if needed, started immediately following testing with that pair of objects. During training, the experimenter placed the two objects in left-right positions and asked the subject where one of the objects was. The experimenter then taught the subject "On the left" and "On the right" responses through modeling. This training was completed for a particular pair of objects when the subject twice correctly labeled both possible positions of each object. Thus, training was terminated when the subject responded with eight standard responses to the "Where is the (object)?" question. Criterion for completion of this condition was answering the four tact-evaluating questions with four standard tacts during testing with five consecutive pairs of objects not previously used.

Reversed-mand training. Subjects who were initially taught to mand went through mand training again in this condition but they were trained to reward the experimenter's putting an object on the left when they requested that the experimenter put it on the right, or vice versa. Criterion for completion of reversed-mand training was answering the four mand-evaluating questions with four reversed mands (defined by the subject's response to the experimenter's object placement) during testing with five consecutive new pairs of objects.

Reversed-tact training. Subjects who were initially taught to tact went through tact training again in this condition but now their saying that the object was "On the right" was reinforced when the object was really on the left and similarly for an object on the right. Criterion for completion of reversed-tact training was responding to the four tact-evaluating questions with four reversed tacts during testing with five consecutive new pairs of objects.

Reliability. An observer was present during one experimental session and transcribed onto data sheets both the subject's and experimenter's verbal and nonverbal responses. Comparing the experimenter's records with those of the observer yielded an interobserver reliability score of 100%.

RESULTS

The results from testing are presented in Figures 1 through 3. For each subject there is a graph displaying cumulative standard tacts, reversed tacts, standard mands, and reversed mands that were demonstrated during testing in each condition—screening, mand training, tact training, reversed-mand training, or reversed-tact training.

Initial Mand Training

Results from the four subjects who initially received mand training are presented in Figure 1. Testing yielded similar results for Subjects 1, 2, and 3, but different results for Subject 4. None of Subjects 1 through 3 tacted or manded during screening. Following screening, these subjects were trained to mand. Subjects 1, 2, and 3 required 7, 12, and 7 pairs of objects, respectively, to meet the criterion of consistently manding during testing with five consecutive untrained pairs of objects. It is important to note that subjects were not trained to mand with test pairs of objects. When a subject manded with an object pair during testing, it was the result of mand training with previous pairs of objects.

During mand training, none of these three subjects tacted. They did not answer any of the four "Where is the (object)?" questions with either a standard or reversed tact with any pair of objects. Thus, for these subjects, tacts did not develop collaterally with the mands being trained.

During the next condition, these subjects learned to tact. They also continued to demonstrate their previously trained mands. Thus, by the end of the tact-training condition, Subjects 1 through 3 were demonstrating standard mands and tacts.

Subjects 1, 2, and 3 then received reversed-mand training and test questions assessed the collateral reversal of tacts. Subjects 1 through 3, for the most part, did not show collateral reversal of tacts that corresponded to trained mand reversals. Subject 1 showed no reversed tacts. Subject 2 answered two of the 24 "Where is the (object)?" questions with reversed tacts; 22 questions were answered with standard tacts. Subject 3 answered 11 of the 112 "Where is the (object)?" questions with reversed tacts and 101 of them with standard tacts.

Subject 4 differed from Subjects 1 through 3 in several respects. First, during screening he gave some indication of manding with the fourth pair of objects. However, he was not disqualified from the study because he did not respond to all four of the mand-evaluating questions with standard or reversed mands. During testing with the fifth pair of objects in the mand-training condition, Subject 4 answered all four tact-evaluating questions with standard tacts. This single test set was the only example in the study of collateral development (acquisition) of the alter-

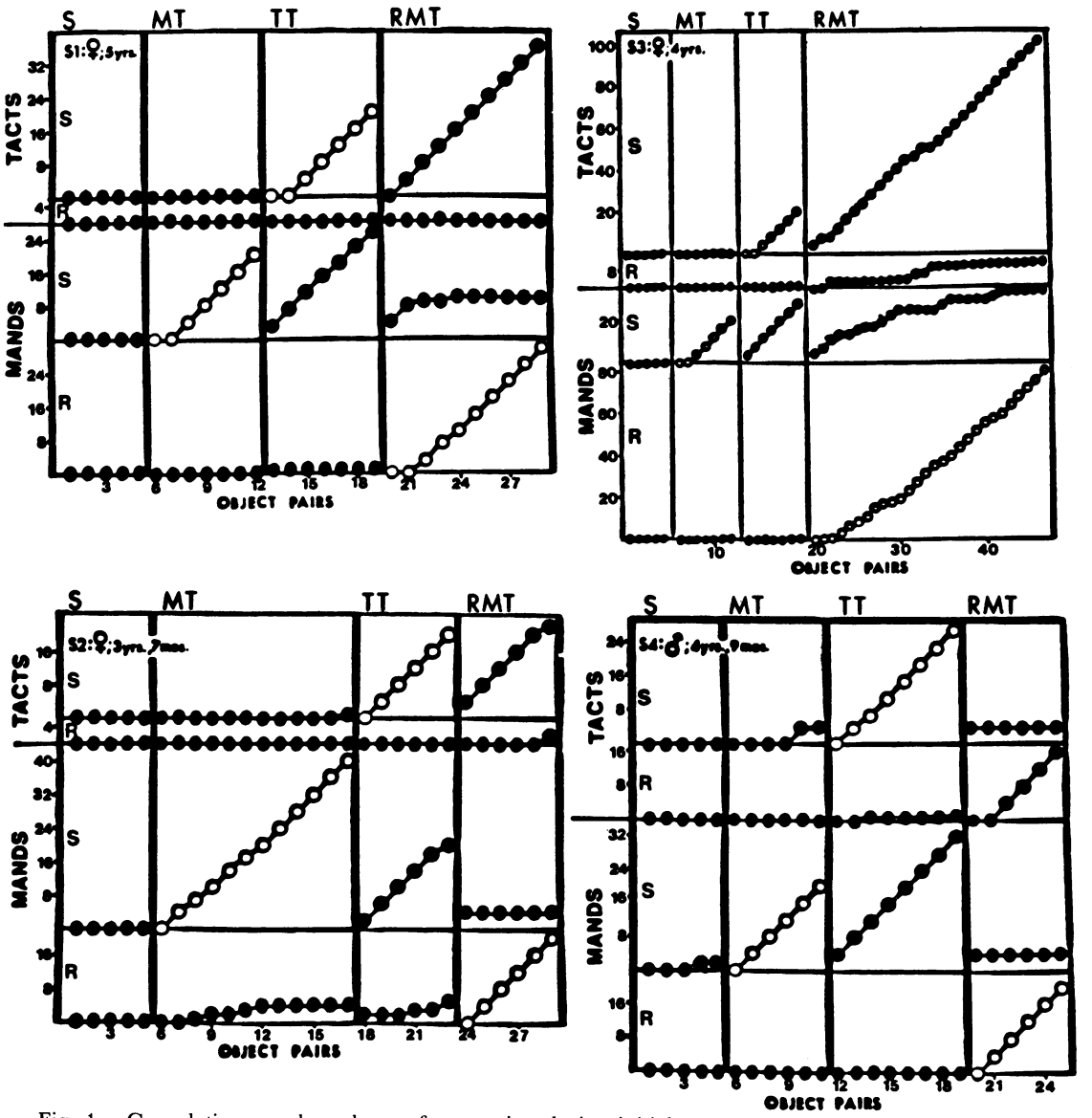

Fig. 1. Cumulative mands and tacts from testing during initial screening (S), mand training (MT), tact training (TT), and reversed-mand training (RMT) for Subjects 1 through 4. Tacts and mands are classified as standard (S) or reversed (R). Open circles indicate that, during training, responses from this repertoire were reinforced.

nate repertoire. Finally, during reversed-mand training, Subject 4 did show collateral modification of his tacts. He reversed his tacts while he was being trained to reverse his mands.

Initial Tact Training

Results from the five subjects who initially received tact training are presented in Figures 2 and 3. Results from all five subjects were similar during screening, tact training, and mand training. During screening, none of these subjects demonstrated the mands and tacts that were going to be trained. All subjects learned to tact during the tact-training condition but did not show collateral development of mands. By the end of the mand-training condition, Subjects 5

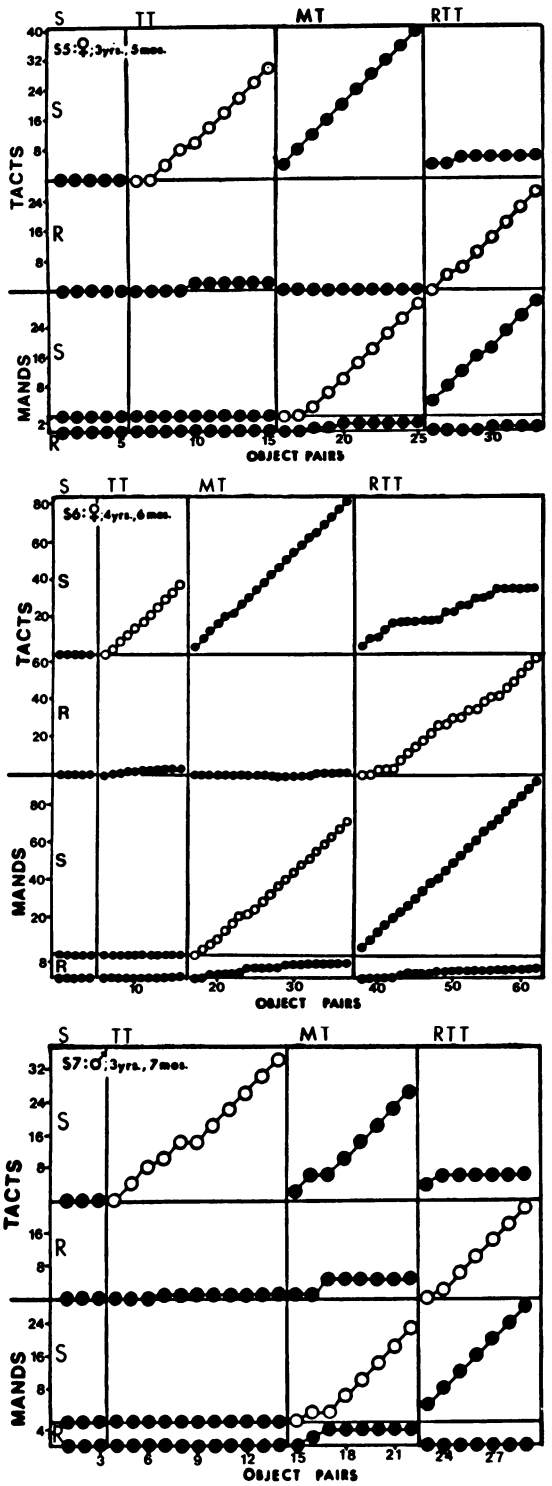

Fig. 2. Cumulative mands and tacts from testing during initial screening (S), tact training (TT), mand training (MT), and reversed-tact training (RTT) for Subjects 5 through 7. Tacts and mands are classified as standard (S) or reversed (R). Open circles indicate that, during training, responses from this repertoire were reinforced.

through 9 were all demonstrating standard mands and tacts.

The results of Subjects 5, 6, and 7 differed from those of Subjects 8 and 9 in the reversed-tact training condition. The standard mands of Subjects 5, 6, and 7 were unaffected by the establishment of reversed tacts. Subjects 8 and 9, however, did show reversed mands as a result of the reversed-tact training.

Summary of Results

In summary, for all nine subjects, mands and tacts were shown to be functionally independent during acquisition. Four subjects learned to mand with the phrases "On the left" and "On the right" but did not demonstrate collateral acquisition of the tacts "On the left" and "On the right." Five subjects learned to tact with these phrases but did not collaterally acquire the corresponding mands. Establishing one repertoire clearly did not result in collateral development of another repertoire with the same response form.

For 6 of the 9 subjects, reversing one repertoire did not result in reversal of the other. Three of these subjects received reversed-mand training but continued to demonstrate standard tacts. The other 3 subjects received reversed-tact training but continued to demonstrate standard mands. There were, however, 3 subjects for whom reversing one repertoire resulted in reversal of the other. One of these subjects collaterally reversed his tacts while receiving reversed-mand training. The other two subjects collaterally reversed their mands while receiving reversed-tact training.

DISCUSSION

Evidence from the present study indicates that mands and tacts are separately acquired, thus experimentally verifying Skinner's classification of mands and tacts as functionally distinct. These findings corrob-

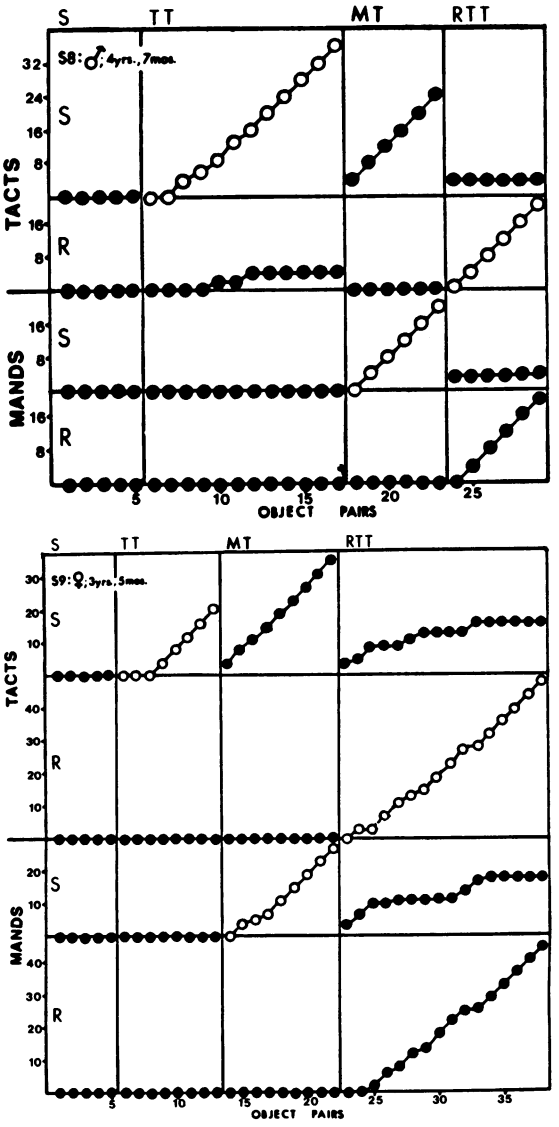

Fig. 3. Cumulative mands and tacts from testing during initial screening (S), tact training (TT), mand training (MT), and reversed-tact training (RTT) for Subjects 8 and 9. Tacts and mands are classified as standard (S) or reversed (R). Open circles indicate that, during training, responses in this repertoire were reinforced.

orate the findings of functional independence for mands and tacts in the language-instruction research at Yerkes Laboratory (Savage-Rumbaugh, 1984). As such, the results of the present study are relevant to the current debate as to whether each of the various chimpanzee-language projects has provided evidence for genuine language capacity in the chimpanzee. Opponents charge Clever Hans-type overcueing and overinterpretation of chimpanzee responses by the trainer on the one hand, and failure to conform to particular formal characterizations of human language on the other (see Sebeok & Umiker-Sebeok, 1980). The fact that Sherman and Austin were not able to label a food, or to act on instructions regarding a food after having learned to request a food, might be interpreted by some as evidence that the chimps' behavior was not language-like. On the contrary, the functional independence of mands and tacts and of speaking and listening is characteristic of human verbal behavior according to Skinner's analysis, the present results, and those of Lee (1981). Furthermore, the research of Savage-Rumbaugh (1984) was apparently not guided by a behavioristic interpretation although the results were subsequently recast in that framework because of the potential interest of these results to behaviorists. Indeed, earlier the work had been solely in pursuit of "symbolic communication." Given the general lack of awareness of functional independence of mands and tacts in psycholinguistic literature, the advance expectation and the potential outcome that most would have viewed as supporting a correspondence to human language would have been for the "meaning" of the "symbolic representation" of a food to be generally available in all three task types. Because the common wisdom regarding human verbal behavior was incorrect, any Clever Hans or other biased cueing would not have produced the functional independence actually found.

Although in the present study acquisition of mands and tacts was functionally independent, in natural settings it often seems that when a speaker acquires a tact the corresponding mand appears collaterally. Skinner (1957) has suggested several ways this may happen. The child may learn to tact the name of an object by asking, "What is that?" and then echo the name in a learned mand frame "Give me a ____." Similarly, transcription or translation is used when foreign

travelers consult a dictionary for a textual response that is emitted and reinforced as a mand. Three other possibilities involve the mixing of the two functional types at the time of acquisition. First, an object may be manded when it is present as a discriminative stimulus. Second, the object manded and received may be the same as the S^D controlling the tact. Third, the listener may reinforce a tact as if it were a mand or reinforce a mand as if it were a tact.

Although the present evidence is compelling for functional independence during acquisition, 3 of the 9 subjects showed collateral reversal of one repertoire while being trained to reverse the other. Two of the 3 subjects who showed these collateral effects did not differ in any discernible way, in terms of responses during previous conditions, from the subjects who did not show collateral reversal. However, 1 of these 3 subjects (S4) did differ from all the other subjects. During initial mand training, he did tact with one of six stimulus pairs, thus providing some evidence for the collateral development of a tact repertoire being trained. He also showed some mand behavior during screening, although not enough to be disqualified by the adopted criterion.

Skinner (1957) focused on the functional independence of mands and tacts at the time of acquisition and did not discuss possible interactions during the modification of one of the operant types after a particular phrase had been learned both as a mand and as a tact. In one respect, it is surprising that the majority of the subjects did not reverse one operant as a result of reversal training with the other, because the situation in which the mand was taught had so much in common with the situation in which the tact was taught. The position of the stimuli that controlled the tact was identical to the position of stimuli that reinforced the mand. Also, the prepositional phrases (relatively unfamiliar to all subjects prior to this study) had been taught both as tacts and as mands before one of their functions was reversed.

Six of the 9 subjects did not reverse one repertoire as a result of reversal training with the other repertoire, but instead, continued to show functional independence of mands and tacts. For example, during reversed-mand training, with a toy dog and a flower as objects, the experimenter said, "Where do you want me to put the dog?" and a typical subject said, "On the right." The experimenter put the dog on the left of the flower and the subject said "Good" and gave the experimenter a marble. On some trials, with the same objects in the same position, the experimenter asked, "Where is the dog?" and the subject said, "On the left." Throughout reversal training, the subject manded "On the right" and tacted "On the left" even though the position of the objects remained the same. Such contradictory verbal exchanges between the experimenter and the child indicate continued functional independence of mands and tacts during reversal training for these 6 subjects.

Research with human subjects (and especially with verbal behavior) frequently raises the question of whether the subjects' responses are rule-governed or contingency-managed. For example, a reader might attempt to appeal to such an explanation for what seems a paradox in the opposite "use" of "right" or "left" for mands and tacts by those subjects who did not show collateral reversal. It could be suggested that these subjects had learned only "the rules of the situation." It is interesting that these are the very subjects whose behavior conforms to the simplest expression of the contingencies—namely, the responses that received reversal training reversed and the responses that did not receive reversal training did not reverse. Other readers with a strong expectation of continued functional independence might suggest, with more reason, that the 3 subjects showing collateral reversal had developed rules such as "now left is right and right is left." Such is the facileness of positing rules. Although rule-governed behavior occurs in many situations, the experimenters observed no sign of it for any subjects in the behavior under study. There were no tell-tale autoclitics and no public fragments of private instructional behavior.

The task does not seem particularly conducive to establishing some "rule of the situation" relevant to the mands and tacts in question. The critical data were from test performances of the untrained repertoire. Responses were simply recorded as mand, reverse mand, or neither (or as tact, reverse tact, or neither). No reinforcement or confirmation was provided to the subject. Thus there were no "rules" regarding responses on test questions. Although one may argue that the children could generate their own rules, the situation offered none and there seems little reason to propose rules in the absence of evidence.

Incidental to the main purpose of determining whether or not mand and tact acquisition is functionally independent, the procedures employed during screening yielded results that confirm Lee's (1981) demonstration that speaking and listening repertoires are acquired independently. During screening, a listener's repertoire was trained when subjects learned to put an object on the right (left) of another object in response to the command, "Put the object on the right (left) of the other object." Though this listener's repertoire was established (to a criterion of four correct responses per object pair), none of the subjects demonstrated the corresponding speaker's repertoire (i.e., none of the subjects spoke the phrases "On the left" or "On the right" in response to the experimenter's questions concerning the position of the object).

When verbal behavior is analyzed in terms of words and their meanings, the distinction between different verbal operants is lost. A child who tells someone to put something on the right and rewards the responses appropriately is said to know the meaning of the phrase. One would expect that if the child were now asked the position of an object that had been placed on the right of another object, the child would respond with the phrase "On the right." If one analyzed verbal behavior in terms of words as general semantic units, as most of the verbal community does, one would not predict the results of the present study, but rather would expect that the word would be "called up" and used when needed, whether to describe something, to ask for something, to repeat another's utterance, or to comply with an instruction. Awareness of the operation of functional variables in the control of verbal behavior counters this common formulation. Lee (1981) found that an instruction responded to as a listener will not automatically enter the person's speaking repertoire, and vice versa. Similarly, the present study demonstrates that a phrase learned as a tact is not automatically available as a mand, and vice versa.

REFERENCES

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.

Harrelson, A. W. (1969). *Effects of expressive plural training on receptive language.* Unpublished master's thesis, University of Kansas.

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.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior,* **37,** 149-155.

Poulton, K. T., & Algozzine, B. (1980). Manual communication and mental retardation: A review of research and implications. *American Journal of Mental Deficiency,* **85,** 145-152.

Savage-Rumbaugh, E. S. (1984). Verbal behavior at a procedural level in the chimpanzee. *Journal of the Experimental Analysis of Behavior,* **41,** 223-250.

Savage-Rumbaugh, E. S., Rumbaugh, D. M., Smith, S. T., & Lawson, J. (1980). Reference: The linguistic essential. *Science,* **210,** 922-925.

Sebeok, T. A., & Umiker-Sebeok, J. (Eds.). (1980). *Speaking of apes: A critical anthology of two-way communication with man.* New York: Plenum Press.

Skinner, B. F. (1957). *Verbal behavior.* New York: Appleton-Century-Crofts.

Sundberg, M. L. (1980). *Developing a verbal repertoire using sign language and Skinner's analysis of verbal behavior.* Unpublished doctoral dissertation, Western Michigan University.

Sundberg, M. L. (1983). Language. In J. L. Matson & S. E. Breuning (Eds.), *Assessing the mentally retarded* (pp. 285-310). New York: Grune & Stratton.

Wanner, E., & Gleitman, L. R. (1982). *Language acquisition: The state of the art.* Cambridge: Cambridge University Press.

Whitehurst, G. J. (1977). Comprehension, selective initation, and the *CIP* hypothesis. *Journal of Experimental Child Psychology,* **23,** 23-38.

Received November 5, 1982
Final acceptance November 8, 1984