The Training of a Few Response Forms under Multiple Controlling Variables

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THE TRAINING OF A FEW RESPONSE FORMS UNDER MULTIPLE CONTROLLING VARIABLES

by

Mary-Ann Wiermanski

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The training of a few response forms under multiple controlling variables

Mary-Ann Wiermanski, M.A.
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This study investigated the acquisition of a few response forms under different controlling variables using both a topography based language (TB) (i.e., signing) and a stimulus selection based language (SSB) (i.e., touching symbols) with three language deficient developmentally disabled individuals. The subjects were taught to name, to ask for, and to touch keys that opened boxes that contained some form of reinforcement. Most of the keys' names were trained across more than one set of controlling variables per session. Before training began for a given key under a new condition, a transfer test was conducted, investigating the possibility of stimulus control transfer. Following mastery of a given condition, a probe session with a new key was conducted. The results showed that a new key name introduced after mastery of SSB language conditions was readily acquired. Transfer of stimulus control from one training procedure to another was not complete without training. Each subject demonstrated the use of complex verbal behavior by successfully using "the same word" under different controlling variables. Two subjects also demonstrated the use of verbal behavior multiply controlled as they mastered words in the SSB language.
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Mary-Ann Wiermanski, M.A.
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CHAPTER I

INTRODUCTION

An outstanding developmental problem with most retarded individuals is delayed or inappropriate communication skills (Sundberg, 1980). Until recently effective remediation in this area was not examined. This may be due at least in part to cognitive and biological orientations of language development. The biological position, supported by the writing of Chomsky (1957, 1965), Lenneberg (1966), and McNeil (1966), is based on the notion that an individual is innately endowed with the neurological pathways that allow for the processing of information necessary for language development. This orientation implies that the cause of defective language is a lack of "something inside the organism", which prevents normal language development. Also internalizing the cause of language development, cognitivists (Cole & Cole, 1981) maintain that internal cognitive abilities, which are innate generalized process mechanisms, are responsible for language acquisition. Accordingly, an individual lacking language is lacking "something inside". The belief in the necessity of specific anatomical structures and mental events may have hampered the development of suitable language training programs for the developmentally disabled.
Another hinderance is that the design of the programs that are available is based on a formal analysis of language development. In this framework, the learning of words (i.e., response forms) is the focal point. The linguistic and cognitive psychologists researching and designing programs focus on the structure of remedial language systems. Their programs combine the strengthening of underlying cognitive skills with the normal sequence of language development (Bricker & Bricker, 1974, MacDonald, 1978, and Miller & Yoder, 1974). A formal analysis precludes the examination of the variables under which a given word is learned because a word is said to be learned due to preexistent internal entities, not due to environmental variables. The examination of the formal properties of language (records of spoken words) is not sufficient; a functional analysis considering the circumstances, the behavior of the individual speaker and the consequences is necessary for a true understanding of language (Skinner, 1957).

A functional analysis is strongly urged by Skinner in Verbal Behavior (1957). He does not credit verbal behavior with any mystical qualities that are absent from nonverbal behavior. The only distinction between verbal and nonverbal behavior is that the former is reinforced through the mediation of other people, whereas the latter is reinforced directly. In treating language as an observable behavior, investigation of the relationship between verbal
behavior and its controlling variables, both motivational and discriminative, can be achieved. This type of analysis broadens our understanding or verbal behavior which, as Skinner (1957) stated "is assessed from the extent to which we can predict the occurrence of specific instances and eventually from the extent to which we can produce or control such behavior by altering the conditions under which it occurs" (p. 3).

Even though Skinner's *Verbal Behavior* was published in 1957, development and research based upon his analysis has been minimal. Initially, many behavioral language researchers structured their programs after traditional language programs, differing substantially from the cognitive approach only in the area of methods used to teach language (Mac Donald, 1978; Bricker & Bricker, 1976; Schielfelbusch, 1978). In doing so, many programs emphasized the acquisition of receptive language as a prerequisite to expressive language (Sundberg, Ray, & Reuber, 1979). These programs served as behavioral demonstrations of the development of what cognitivists refer to as "thought structure". They initially taught the language deficient person to think (i.e., to know what a cat is) before teaching him to verbalize his thought (i.e., to sign or say "cat"). This training approach was accepted as a worthy tool for possibly two reasons. First, it gave credibility to behavioral techniques through the replication of cogni-
tive accomplishments. Secondly, due to ignorance of Skinner's analysis, no other approach seemed promising.

A formal program emphasizing the development of receptive language with the belief that expressive language can and will readily follow minimizes the distinction between the language deficient person's behavior as a speaker and as a listener. In doing so, such a program supposes that an individual acquires one type of behavior (expressive language) in the course of acquiring another (receptive language). Programs based on this assumption equate language training with word concept formation. This neglects the importance of antecedent and consequent environmental events as well as the operations which establish consequences as effective forms of reinforcement. Skinner (1957) clearly opposes this type of training as he asserted:

the concept of a word...does not represent a functional unit of behavior of the individual speaker. We must accept the responsibility of giving an independent explanation of how responses of the same form appear in different operants (p. 190).

Recently, there has been some work on language training with the developmentally disabled based on Skinner's functional analysis. Several researchers (Bell, 1980; Bell, Sundberg, Reuber & Yutzy, 1979; Braam, Sundberg & Stafford, 1978; Bradford, 1980; Brigham & Sherman, 1968; Guess, 1969; Guess & Baer, 1973; Hall, 1980; Hall, Sundberg, Stafford, 1979; Reuber, Sundberg & Legg, 1980; and Sundberg, 1978) have investigated one or more of
Skinner's elementary verbal relations (mand, tact, echoic, intraverbal, textual, copying a text and taking dictation). The main focus of this research has been the rate of language acquisition with respect to the discovery and manipulation of variables of which the probability of a response is a function. Many of these studies also investigated the transferring of stimulus control from one verbal relation to another. A synopsis of the studies most directly related to the present research follows.

Hall (1980) asked if manding would occur spontaneously once the tact for the needed object was strong in the individual's repertoire. She found that mands had to be specifically trained. She also found that transfer of stimulus control could be successfully accomplished by either imitative or tact training conditions. Bradford (1980) found that spontaneous transfer did occur in the opposite direction. His results showed that once he trained the mand for an object, the tact appeared spontaneously. While investigating the effect of mand training on early language intervention, Bell (1980) found that echoic control was obtained quicker than tact control and tacts were learned sooner than mands. The data from these studies have extended our knowledge of the controlling variables necessary for a given verbal relation to be trained and of the necessary change of stimuli required to transfer control from one verbal relation to another.
Collective data on the transfering of stimulus control and the acquisition rate for various verbal relations have given guidance concerning the selection of training sequences for behavioral researchers who are beginning to design complete language training and assessment programs (Sundberg, in press).

The current focus of behavioral language training research is on the development of a large vocabulary (i.e., many response forms) under one or two sets of controlling variables (e.g., tact or receptive language variables). The results are not overwhelming with respect to the language deficient individual's acquisition of normal language (i.e., the same response form used under different conditions). In attempting to establish general language characteristics, similar to the ones acquired through normal language development, the current investigation of language will take a drastically different approach to language training. A small number of response forms (i.e., small vocabulary) under more than one or two sets of controlling variables will be developed. Through this integrated approach to language training, the language-deficient individual may, in cognitive terms, come to "know the meaning of the word" by demonstrating the appropriate "use" of the same "word" under a variety of conditions. Research establishing such a repertoire would hopefully supply empirical data in support of Skinner's
(1957) statement concerning the acceptance of responsibility for independent explanations of how responses with the same form appear in different operants (p. 190). This research may also question the credibility of the cognitivists' belief that a child who can say a word should be able to use the word appropriately in all situations without concern for training the specific relation under the appropriate environmental variables.

Another area which has not been investigated by behavioral psychologists is what cognitivists refer to as symbolic representation. Many cognitive researchers would dispute the claim that through the above mentioned behavioral training programs, the language deficient individual acquires language, since the studies have failed to show "symbolic representational" skills. They believe that what has been demonstrated is only the development of simple associations (S - R relationships). Symbolic representation is defined by the linguists as an internal system that permits referral to objects and events which are not present. Evidence of symbolic representation as stated by Savage-Rumbaugh (1980) "is the demonstration that cognitive operations proceed even when an individual is presented with only symbolic information" (p. 51). Savage-Rumbaugh and her colleagues did the first ape study on symbolic representation (Savage-Rumbaugh, Rumbaugh & Boysen, 1978). They demonstrated representational ability
with chimpanzees through a procedure where a chimpanzee watched while a trainer baited a box with food. The chimpanzee then had access to a computerized symbol board where he depressed the correct symbol for the needed non-present tool to open the box (Savage-Rumbaugh, 1981). Through the ape's ability to also use the same symbol in a variety of ways, it was believed that symbols were shown to function in a referential manner in apes. What was actually required of the apes was to make a conditional discrimination in which their verbal response (i.e., depressing a symbol) was multiply controlled by the baited box and the array of symbols.

The language system used by the Rumbaugh's in their research has been termed by Michael (1982) a stimulus selection based language (SSB). Unlike topography based languages, such as speaking, writing, or signing, this communication system is unfamiliar to most people. In a topography based system, language consists of the relation between controlling environmental and motivational variables on the one hand, and specific response forms or topographies. For example, upon seeing a dog (controlling variable), the speaker says "dog" (specific response form). In the presence of a different controlling variable (hearing "John, where's George?") a different response form is evoked (John says, "He's in the kitchen."). Topographically differing response forms are evoked by different
controlling variables. In a stimulus selection based language, response topography is irrelevant to the controlling relation. The same response form (either pointing to or touching a verbal stimulus) is incorporated in all verbal operants. Language consists of relations between controlling variables and the tendency to select a particular verbal stimulus (lexigram or symbol) from an array of stimuli. For example, in the presence of an appropriate array of stimuli and upon seeing a dog, the speaker points to the "dog" symbol. In the presence of different controlling variables, (different array of symbols) and a different tendency to select a symbol is strengthened (speaker hears, "John, where's George?"), the same response form is evoked (John points) but to the symbol for kitchen. The pointing response itself is not important, except in terms of the stimulus pointed at. The Blissymbolics system used with multihandicapped language deficient individuals is such a stimulus selection based language system.

In extending the previous language research and in keeping within a functional analysis, the present study used a topography based language (signing) and a stimulus selection based language (pointing to arbitrary symbols) to establish a few response forms in at least three verbal operants (mand, tact and mand compliance with respect to a stimulus) in language deficient developmentally disabled individuals. (The last verbal operant, one not mentioned
by Skinner, is analogous to receptive language.) The main dependent variable is rate of acquisition and the main independent variables are the stimulus conditions under which each verbal relation is trained. In this study complex verbal behavior consists of demonstrating each subject's use of the same response forms under different controlling variables and of demonstrating the establishment of verbal behavior that is multiply controlled (training of the stimulus selection based language). The main purpose of this study is to extend language training in a new direction by investigating the development of an integrated, complex verbal repertoire. A secondary purpose is to see if acquisition occurs more quickly as more verbal relations are acquired.
CHAPTER II

METHOD

Subjects

All three subjects were selected from a group of severely or profoundly developmentally disabled students, ranging in age from 14 to 25 years, enrolled in Croyden Avenue School's severely mentally impaired educational program. Selection criteria were: absence of a mand repertoire regarding common objects when the objects were not present, the exhibition of manual dexterity allowing for the manipulation of the keys, and the ability to follow simple instructions in a one-to-one instructional setting. Guardian and official school consent were obtained prior to each subject's participation in the study.

Subject 1 was a 14 year old autistic male labeled as minimal brain dysfunction. He was described by his teacher as an eager worker in one-to-one instructional settings. Generally, when asked to work he readily stood and took the trainer's hand. Over his four years at Croyden communication had been stressed, including a daily speech session with one of the school's speech pathologists. Little vocal progress was made over this time period. Other language training included tacting common objects using
sign language, receptive language training, and imitative training of mand phrases (i.e., I want ball). He had normal hearing and vision and no special health concerns, besides taking Cylbert 110 mg per day (a drug given to minimal brain dysfunction individuals).

Subject 2 was a twenty year old nonvocal male, a student in the main experimenter's classroom. Prior to the study, his language training consisted of signing the name of one object per educational session, imitating mands (such as, "want cup"), and receptive training which involved having the subject touch various objects when asked, or perform simple behaviors when instructed to do so (i.e., "Stand up," when the subject was lying on the floor). He exhibited noncompliance behaviors (i.e., lying on the floor) when asked to come to work. Once in a one-to-one training environment he generally complied with the teacher's instructions. He has normal hearing and vision. He was on an anticonvulsant medication (Depakene, 500 mgm 4 times; Dilantin, 100 mgm a.m. and 175 mgm p.m. and 60 mgm Phenobarbital) which was altered during the course of study to control for infrequent catalonic seizures. Between sessions 15-48, Depakene was increased to 750 mgm 4 times a day, Dilantin in p.m. was increased to 200 mgm and Phenobarbital was discontinued. Due to seizure activity and medication changes, the subject was absent for sessions 49-54 during which time Dilantin was discontinued for 72
hours and reinstituted at 100 mgm in the a.m. and 175 mgm in the p.m. After these changes, the subject's home and classroom behaviors changed dramatically. He had chronic drowsiness, nodding off frequently during educational and research sessions each day. He also exhibited constant tremors in both hands and he staggered when walking. He fell often after the last medication changes. One fall broke his nose causing him to miss 6 additional sessions (sessions 63-68).

Subject 3 was a 25 year old nonvocal male, also a student in the main experimenter's classroom. His previous language training was very minimal, largely consisting of receptive direction following training. In the past year he started to learn the signs for common and preferred objects. He consistently and spontaneously manded one preferred object (a cassette tape) which, when received, would be placed in a tape player so the subject could listen to the tape. Listening to a tape was a very strong behavior so the tape was used as a reinforcer in the study. He frequently made loud yelping noises and banged his ear with an open palm, but once he was quiet and sitting still, he complied with the teacher's instructions during any given one-to-one session. He had normal hearing and vision and was on no medication.
Setting

The study was conducted in a 2.74m by 3.65m enclosed booth. Sessions were conducted once a day for each subject. As each subject proceeded through the study, more procedures were added per session, which extended the number of trials per session from a minimum of 30 trials to 50 trials. This increased the session length from an average of 25 minutes to 45 minutes. Sessions were run for each subject at the same time for each day of the school week. Furnishings in the booth included one student desk, two chairs and one low .91m x 1.2m bookcase.

Apparatus/Materials

Three 22.9cm x 5.7cm identical plastic boxes, each having a plexiglass lid and a lock appendage were used. Each of three various-sized locks was covered with a different abstract-patterned material. All of the material patterns had three colors - either white, black, and red (WBR) or white, green and red (WGR). When a poster board backed piece of material was placed over each lock, each lock was easily modified into one of 3 different shapes (circle, square, and rectangle). Each of the corresponding keys was tagged by an identically shaped material-covered piece of poster board. The tags were placed on the key ring along with the key. The six 5.1cm
x 5.1cm lexigrams (symbols for each key) used in the stimulus selection based language were made out of cardboard and felt. Each lexigram had a white face framed by a piece of black poster board and a different, arbitrary geometric design drawn on it in black.

Sign Selection

To facilitate the acquisition of the signs, the keys' signs (see Appendix A) chosen were arbitrary body movements under imitative control. The experimenter selected them by conducting three group sessions with all subjects. All subjects could individually perform the movement under the control of the trainer's vocal, "Do this," and visual cue of performing the movement. For example, all subjects consistently imitated stretching both arms out in front of the body for all three sessions, so this body movement was selected as a sign and randomly assigned to a square lock.

Reinforcer Selection

A reinforcement sampling procedure (Guess, Sailor & Baer, 1974) was used to establish preferred edible and non-edible reinforcers. A preliminary restriction was placed on the sample array of non-edible reinforcers due to the size of the boxes.
Measurement

Scoring of the subject's responses was based on two criteria: controlling variables and correctness of response. Responses could occur under three types of control, depending upon the stimuli presented by the trainer. The controlling variable targeted under tact conditions was the presence of the key (non-verbal stimulus). Mand conditions were arranged by the presence of a reinforcer-laden locked box without the corresponding key present. The distinguishing controlling variables for mand compliance were the trainer's verbal stimulus (i.e., either the sign of a key or the lexigram of a key dependent upon the language system being trained) and the appropriate key.

Responses were also scored as incorrect or correct. The criterion for correct responses allowed responses to be scored correct if they were close approximations to the desired response. Close approximation was defined as a topography that resembled the sign form closely enough to be discriminated from other signs being trained or already present in the subject's repertoire. The goal of this flexible measure was to allow faster acquisition of the signs.

Response Definitions

Topography based tact

In the presence of a tagged key, the subject made the
correct sign for a given key within five seconds of its presentation.

**Stimulus selection tact**

In the presence of a tagged key, the subject touched the corresponding lexigram from an array of three lexigrams within five seconds of the key's presentation.

**Topography based mand**

In the presence of the two or three locked boxes, one containing a preferred reinforcer, the subject made the sign for a given key which opened the box that contained the reinforcement within five seconds of the box's presentation.

**Stimulus selection based mand**

In the presence of two or three locked boxes, one containing a reinforcer, the subject touched the lexigram corresponding to the key which unlocked the box that contained the reinforcer.

**Topography based mand compliance**

In the presence of three keys, the trainer made the sign for one and the subject picked up the correct key within five seconds of the trainer's sign.

**Stimulus selection based mand compliance**

In the presence of a lexigram, the subject touched the corresponding key from an array of three tagged keys.
within five seconds of the lexigram's presentation.

Data Collection & Reliability Checks

An event recording procedure was used to record the subject's responses per trial presentation. Anecdotal notes were written by the trainers after each session which documented any unusual behaviors observed. Reliability data on subjects' responses were collected by a trained observer, who used an event recording procedure for all trials per session. To reduce sampling error, this procedure was used rather than an incomplete sampling procedure. This was also selected because the observed behaviors had clearly definable beginning and ends. The observer sat behind a one-way mirror partition which allowed full visibility of the training session without either trainer or subject being aware that reliability data were being taken. This prohibited the possibility of any reactivity effects. Also, the observer could not see the trainer's data sheet. Reliability was calculated for each observed session using the formula below:

\[ \text{PERCENT AGREEMENT} = \frac{\text{AGREEMENTS}}{\text{AGREEMENTS} + \text{DISAGREEMENTS}} \times 100 \]

Agreements were defined as the trainer coded trial matching the corresponding observer coded trial. Coded data sheets were used. The observer recorded the responses of the subject as correct or incorrect and additionally classified them as mands, tacts or mand compliance responses depen-
dent upon the stimuli presented. Reliability checks were made at least twice during any given training procedure and always during transfer testing. (See Appendix B for a table of reliability scores.)

The observer was an undergraduate credit student from the W.M.U. Psychology Department. The observer's training consisted of a role playing procedure conducted by the trainer and a staff person at Croyden (who played the role of the subject). Each practice episode was identical to a typical training session. Before each episode the staff person was instructed on how to respond so that all categories of responses applicable to a given training procedure were observed. During randomly selected trials, the trainer deliberately responded inappropriately to the subject's behavior to ensure that the observer's recording behavior was not confounded by the trainer's responses. Verbal feedback was provided to the observer after each practice episode. The role playing sessions were terminated after the observer and trainer achieved 90% inter-observer agreement for three sessions.

Pretraining

**Manipulation of keys with locks**

The subject was taught to unlock the boxes with all the different locks and keys. Training included a backward chaining and fading procedure. Correct responding
was reinforced by obtaining the reinforcer inside the box and social praise. Each manipulation was taught separately during fifteen minute long sessions. There were two phases of this pretraining procedure:

(I) Manipulation of each separate key and lock combination. With one locked box containing a reinforcer, the subject was able to (a) pick up the key next to the box, (b) insert the key into the lock, (c) turn the key to open the lock, (d) remove the lock, (e) open the box to obtain the reinforcer.

(II) Selection of proper key from an array of all the keys. With one locked box containing a reinforcer and all four keys available, the subject was able to (a) select the correct key to fit the given lock; (b)-(e) were the same as in phase I.

The training completion criterion for phase I was defined as the subject independently performing four out of the required five behaviors needed to remove the lock from the box for 90% of the trials across three consecutive sessions. The criterion of mastery of phase II was 80% accuracy for three consecutive sessions.

Experimenters

I was the main experimenter. I had developed a social rapport with the subjects through working in the school for over two years. Two of the three subjects used were students in my own classroom, which justified the running of my research during working hours. In the fall, I was the research supervisor for a student, Scott Scheffler, who ran some of the research sessions. He was committed to
work for me up to 10 hours a week in any research related way. A contingency system was established. Scott had a hundred-points bank from which I was allowed to subtract points if he failed to meet any component of his job description. He was trained to run the procedures with the aid of written procedure sheets, role playing, and observance of the main experimenter running practice sessions with the subject. Prior to this study he had no contact with any of the subjects. He ran Subject 1 exclusively for four months (sessions 1-60). Scott knew that the accuracy criterion for a training response was 80% or better across three consecutive sessions but he did not do any calculations nor see a record of the calculated data.

Experimental Design

In following a dynamic approach to research (Johnson & Pennypacker, 1980), each step in this design was determined by immediately previous results. Thus, the results of training any given verbal relation or sequence determined what experimental conditions were to follow for a given subject. Explanation of changes and justification for changes are described under the experimental conditions for each subject. One standardized element of the design was that prior to each new training procedure for a given key being trained under other conditions within the same language system, at least one transfer session was conducted,
allowing for the possibility of stimulus transfer under different conditions to be observed. This design allowed for maximum flexibility in examining variables which contributed to the establishment of an effective language training program.

Another standardized component was the criterion for introducing a probe key. Prior to its introduction, the subject needed to master all training keys in a given condition with 80% or greater accuracy across three consecutive sessions.

Controls for extraneous artificial variability were established. In avoiding sequence and carry-over effects when more than one procedure was being trained per session, the sequence of training procedures was randomly selected. To help differentiate one procedure from another each one was trained in a different location in the booth or in a different trainer-subject positioning.

The rationale for beginning subjects 1 and 2 with different tact conditions was the hope that three signs or lexigrams would be trained readily. The study would then proceed by alternating the tacting conditions of the two subjects in hope of comparing the within-subject results of the two procedures. Due to training proceeding slowly and the time constraints for completing the research, manding and mand compliance with each subject were introduced in hope that they would facilitate the other training.
(as in the Bradford study). A third subject was brought into the study to see if starting a subject with mand conditions would make a difference in acquisition of key names.

General Procedures for All Subjects

**Baiting Box Procedure**

The trainer baited one of two or three boxes with a preferred reinforcer while the subject watched. The trainer then asked the subject where the reinforcer was placed. The subject generally touched the box that contained the reinforcer. For all trials, the locked box that contained the reinforcer was randomly selected prior to the beginning of each session.

**Transfer Test Procedure**

Prior to starting a new training procedure for a given key already being trained under other conditions within the same language system, the transfer test procedure was implemented. For any given condition, the stimuli, their presentation, and trainer's behaviors were identical to the training procedure with the exception that no model or immediate prompt was given nor was there any correction loop for an incorrect response or no response. Ten trials were run per session. The transfer test procedure was conducted for a varying number of sessions dependent upon accuracy of responding.
Probe Test Procedures

This procedure was used after a stimulus selection based language (SSB) training condition was completed for a given subject. This procedure was identical to the training procedure for a given condition with the exception that an untrained lexigram was one of the three lexigrams presented to the subject per trial presentation. For each session, 10 trials were run. Five sessions were conducted for each untrained lexigram-key combination.

Key Selective Procedure

For a given language system's first training condition, the training keys used were arbitrarily selected. For additional conditions within the same language system, the same training keys were used (see Figure 1 for the description of the training keys used for each subject across conditions).

Time-out Procedure

For most training procedures, if the subject made no response or an incorrect one, the trainer swiftly removed the stimuli presented and turned his/her head away from the subject for five seconds. The trainer also stated, "No," if an incorrect response was made.

Dependent Variables

Percentage of Correct Responding for an Individual Key

In the presence of the appropriate stimuli, the subject correctly responded. Criterion for mastery was at
Figure 1. Keys trained across conditions showing also chronological mastering plus trials to criterion.
least 80% accuracy across three consecutive sessions to the key's controlling variables for a given experimental condition.

**Sessions to Completion of Training Procedures**

The number of training sessions completed before the subject correctly responded with at least 80% accuracy across three consecutive sessions for all keys being trained for a given experimental condition.

**Independent Variables**

**Experimental Conditions for Subject 1 (see Figure 2)**

**Stimulus Selection-Based Tact Training (SS-TACT)**

**Phases A & B (Sessions 1-18).** The basic training procedure used during phases A & B is diagrammed in Figure 3. Phase A lasted five sessions during which the accuracy of responding was 100%. Additional phases were added when procedural changes needed to be made to facilitate training. This subject had a total of five phase changes for this training procedure. Only the changes made in each phase are described below---the rest of the procedure remained consistent.

Phase B was discontinued after 13 sessions. Each training key had a wide range of correct responding from 0% - 80%. During the last five sessions, for two of the keys, correct responding dropped to a range of 9% - 40%.
Figure 2. Experimental conditions for each subject across sessions (A - F letters = phases in training procedure; TT = transfer test; PRO = probe test).
Figure 3. Stimulus selection based tact training (Phases A and B).
It was thought that repetition of the correction loop (flipping the lexigrams face down – see Figure 3) was an ineffective, time-consuming procedural component. For any given trial, the loop was repeated anywhere from zero to eight times. Running through the correction loop several times each trial considerably lengthened each trial. This extended each trial presentation's time from approximately thirty seconds up to five minutes. This loop also reduced both the opportunity for the subject to be reinforced per procedure and the quality of reinforcement (given only social praise).

**Phase C (Sessions 19-22).** In this phase, if an incorrect response or no response was made after the two lexigrams were placed down, for the next key's presentation, the immediate prompt procedure was implemented. Responding in this phase remained highly variable ranging from 10% - 60% correct for any given key. It was next decided that ten consecutive trial presentations for a given key was redundant and hampered the subject's differential responding dependent upon stimuli presented. Also, because of the subject's history of poor discrimination training with three objects, the number of training stimuli was reduced to two.

**Phase D (Sessions 23-33).** Each key was randomly presented for each training session in Phase D. The trainer only placed two lexigrams in front of the subject.
The key dropped from training was the one with the middle average of correct responding per session. To increase the subject's attending to the key presented, the trainer placed the two training keys in a can that he held up to the subject and selected a key out of it. If the subject made an incorrect response or no response following the five second timed-out period, the trainer held up the key and matched the key to the lexigram and stated, "Look, Steve. These go together." The next trial then began. This phase continued until both keys were mastered with at least 80% accuracy across three sessions.

**Phase E (Sessions 34-69).** The only change made in this phase was the reintroduction of the previously dropped key to the training procedure.

**Phase F (Sessions 70-76).** Due to the accuracy of responding for one of the training keys being consistently above 80% for five out of six sessions (Sessions 64-69), the procedure was changed reducing the number of trials per session from an average of ten trials to an average of three for that key. This trial reduction allowed the other two training keys to be presented for more training trials which increased the probability of their acquisition in fewer sessions. An additional change in procedure was made in this phase. To ensure that the subject's responding was controlled by the relevant stimuli and not extraneous
visual cues exhibited by the trainer, a blind control was added. After placing the lexigrams on the table, the trainer held a .91m x .2m posterboard behind the lexigrams for each trial presentation. The key was held above the board, and the subject handed the trainer a lexigram. The trainer was unable to see the lexigram until the board was removed. Before the board's removal, the trainer asked the subject if the lexigram was correct. If the subject responded negatively either by stating, "No," or by removing the lexigrams from the trainer's hand, he was allowed to place a different lexigram in the trainer's hand.

Stimulus Selection Based Mand Compliance Training (SS-MAND COMP)

Phase A (Sessions 39-51). The basic procedure used during Phase A is outlined in a flowchart (see Figure 4). Procedural changes made were classified as new phases in the procedure. The rationale for the changes and the changes implemented are discussed below.

Phase B (Sessions 52-54). The subject responded poorly in Phase A due to consistently choosing the center key independent of the lexigram presented. A procedural change was made in hope of increasing the lexigram control over responding. Prior to beginning each trial, all three lexigrams were placed on the table to the right of the keys. The trainer randomly selected a lexigram as the subject
Figure 4. Stimulus selection based mand compliance training (Phase A).
watched. This phase continued until responding dropped back to the previous low levels (50%) for two consecutive days.

**Phase C (Sessions 55-60).** Because the selection preference was still evident, another change was implemented. The number of training keys was reduced to two in hope of strengthening the other two response classes (i.e., choosing the left key and choosing the right key). The training key dropped had the lowest accuracy of responding across all training sessions for this procedure.

**Phase D (Sessions 61-62).** A blind control procedure was instituted to control for the possibility of the subject's responding depending upon the trainer's facial expression. As of the 61st session, the main experimenter became the trainer for the subject. It was observed that the subject stared attentively at the trainer's face and selected keys dependent upon slight facial changes of the trainer. To ensure against the possibility of extraneous variables controlling the subject's response, the trainer shuffled the lexigrams face down and then arbitrarily selected one. The subject was then told to look as the trainer pointed to it without looking at its front. With closed eyes, the trainer asked the subject to place the correct key in her hand.

**Phase E (Sessions 63-75).** It was decided to go back to three keys to drop the probability of chance responding
from 50% to 33% since the accuracy of responding remained relatively low.

Phase F (Sessions 75-81). In an attempt to have the subject master one or two keys in this training procedure before the end of the study, the number of training keys was again reduced to two. The training key dropped was one that had been individually mastered.

Stimulus Selection Based Mand Training (SS-MAND)

Phases A & B (Sessions 40-71). To facilitate tact training, this procedure was implemented. The basic procedure used is outlined in a flowchart (see Figure 5). Both Phases A and B are diagrammed. Phase A was implemented for eleven sessions (Sessions 40-50). In Phase B (Sessions 51-71), the correction loop was changed. Keeping in mind that the mand relation is characterized by the speaker receiving what is asked for, this phase was implemented to strengthen the mand. In this phase, when the subject incorrectly manded (i.e., touched the wrong lexigram), the manded key was received.

Topography Based Manding Training (T-MAND)

Phase A (Sessions 68-70). Due to mastery of SS-MAND, T-MAND training was begun to see how its acquisition compared to SS-MAND. A detailed flowchart of this procedure is shown in Figure 6. For this subject, only Phase A on the flowchart
Figure 5. Stimulus selection based mand training (Phases A and B).
Figure 6. Topography based mand training (Phases A and B).
was implemented. Once again, changes implemented in the procedure were classified as phase changes and are described below.

**Phase B (Sessions 71-81).** This phase had a correction loop for incorrect responding. If the subject signed for the wrong key, he was given the key and allowed to manipulate the key in the lock for 2 to 3 minutes. The trainer then presented the correct key and opened the reinforcer-laden box without allowing the subject to obtain the reinforcer.

**Topography Based Tact Training (T-TACT)**

**Phase A (Sessions 75-81).** To help the acquisition of T-MAND training, it was decided to train the same two keys under tact conditions. The procedure (Phase A, Sessions 75-81) used is outlined in Figure 7 with the exception that only ten trials were run per session.

**Experimental Conditions for Subject 2 (see Figure 2)**

**Topography Based Tact Training (T-TACT)**

**Phases A & B (Sessions 1-24).** The basic training procedure used during Phases A and B is outlined in Figure 7. Phase A lasted for five sessions, having 100% accuracy of responding across all the sessions. In Phase B (Sessions 6-24), accuracy of responding fluctuated across a wide range of correct responding (0% - 80%) for two training keys. The
Figure 7. Topography based tact training (Phases A and B).
Phase C (Sessions 25-53). This phase was introduced in the training paradigm to facilitate the transfer of stimulus control from imitative to tact conditions for the two noncriterion keys. Prior to implementation, a pre-training session was conducted to identify successful partial prompts. The selection criterion for partial prompts was three successive correct trials using a sign prompt. For each trial, the trainer presented a key. If the key required a partial prompt, the trainer placed the key on the table and gave the subject a minimal prompt. One key required that the trainer place her hand over the desk to inhibit the subject from forming the wrong sign. The other partial sign prompt required that the trainer modeled the sign using minimal effort. In explanation, instead of extending arms out in front of body at shoulder level (the correct sign), the trainer lifted her hands off the table. For the criterion-reached key, the trainer followed the procedure stated in Phase B. The partial prompts were given during the key's first presentation per trial. In this phase, also, the keys were randomly presented in an effort to get responding under strict stimulus control of the key presented. This phase continued until each key reached 90% correct responding (correct sign following partial prompt for the two keys and correct signing with no prompt for the criterion-reached key) for three consecutive sessions.
third key (rectangle) had reached the accuracy of 90% correct responding. When necessary, additional phases were added to facilitate training. Any procedural change constituted a phase change.

**Phase D (Sessions 54-78).** Due to the subject's lethargic behavior, only between 10 and 20 trials were run. Also, the prompts were given only if the subject did not sign correctly within five seconds of the trainer's request. For the criterion-reached key, if prompts were necessary, the prompts were complete modeled prompts as in Phase B. This phase continued throughout the duration of the training.

**Topography Based Mand Compliance (T-MAND COMP)**

**Phase A (Sessions 28-78).** Because of the subject's observed strong imitative signing repertoire and his attentiveness to the trained signs, this training procedure was implemented to facilitate tact training. The training procedure used is outlined in Figure 8.

**Topography Based Mand Training (T-MAND)**

**Phases A & B (Sessions 39-56).** Due to the low accuracy of responding under tact conditions, mand training was implemented. It is conceivable that an individual will more readily sign for something they want because of the presence of an obvious establishing operation (locked boxes with
Figure 8. Topography based mand compliance (Phase A).
preferred reinforcer). When manding, the speaker is directly benefitted unlike with other verbal behavior where the speaker receives only generalized conditioned reinforcement. The first two Phases, A and B, of this procedure are outlined in Figure 6. Phase A (Sessions 39-41) continued until the subject responded with at least 80% accuracy over three consecutive sessions. The correction loop in Phase B (Sessions 42-56) was changed. This procedural change implemented a phase change.

Phase C (Sessions 57-78). In this phase, if the subject manded for the wrong key, he received it and was allowed to manipulate the wrong key in the lock for approximately two to three minutes. The trainer then shrugged her shoulders and stated, "Why did you sign for the wrong key? This is the key you want," while she held up the correct key. She then repeated the request and modeled the correct response. This request-modeled sequence was repeated until the subject made the correct sign before the model. After a correct response, the subject received the key and was allowed to open the box. The trainer swiftly removed the opened box which prevented the subject from getting the reinforcer and stated, "No (token or treat) because Mary had to help."
Experimental Condition for Subject 3 (See Figure 2)

Stimulus Selection Based Mand Training (SS-MAND)

Phases A & B (Sessions 1-22). The basic procedure is in a flowchart (see Figure 5). Both Phases A and B are diagrammed. Phase A was eight sessions long. Criterion for phase change was 50 trials completed, with the last 15 trials having 100% accuracy. In Phase B (Sessions 9-22), the correction loop was changed based on the same rationale described under Subject 1's SS-MAND.

Topography Based Manding Training (T-MAND)

Phase A (Sessions 1-8). For a detailed flowchart of this procedure see Figure 6. For this subject, only Phase A (Sessions 1-8) on the flowchart was implemented. This phase continued for 50 trials, with the last 15 trials having 100% accuracy. The only procedural changes made are described in the phases below; the remaining components of the procedure were not changed.

Phase B (Sessions 9-40). Due to having already strengthened in his repertoire the name of the reinforcer (cassette tape), the subject frequently signed "tape" immediately following the trainer's request. If this occurred in this phase, the trainer repeated the request and visual prompt (running finger across lock), and additionally stated, "Sign the name of the key." This loop
was repeated three times. If, after the third time, the subject failed to sign correctly, the trainer modeled the correct sign. The trainer repeated the loop until the subject signed correctly before the modeled prompt. The subject was given the requested key; but after unlocking the box, the subject was not allowed to remove the reinforcer. The trainer removed the boxes and stated, "No tape, because Mary had to help." A correct response received the reinforcement (15 seconds of music from a cassette recorder) as the subject retrieved the tape from the box and exchanged it for a pair of headphones. If the subject signed for the wrong key, the trainer followed the same procedure outlined in Subject 2, T-MAND, Phase C.

**Stimulus Selection Based Mand Compliance (SS-MAND COMP)**

**Phase A (Sessions 29-40).** The basic procedure used is outlined in a flowchart (see Figure 5). In addition, as with Subject 1's SS-MAND COMP, Phase D, a blind control procedure was used. Although there was no evidence of this subject's use of visual cues from the trainer's facial expression, the control procedure was implemented to ensure that extraneous confounding variables were not controlling the subject's responses.

**Stimulus Selection Based Tact Training (SS-TACT).**

**Phases A & B (Sessions 26-40).** Because this subject mastered SS-MAND training with two lexigrams and a third
lexigram key combination was readily acquired, it was decided to see how quickly the same keys could be acquired under tact conditions. The procedure used during Phases A and B is outlined in Figure 3. Phase A (Sessions 26-28) was run until the subject responded with at least 80% correct responding across three consecutive sessions. Phase B (Sessions 29-40) was the only other phase in this training procedure. No procedural changes were necessary for this training procedure.

**Topography Based Tact Training (T-TACT)**

**Phases A & B (Sessions 30-40).** This procedure was implemented to see if increased exposure to the training stimuli used in T-MAND would facilitate sign acquisition. This procedure used during Phases A and B is outlined in Figure 7. Criterion for ending Phase A (Sessions 30-32) was at least 80% accuracy over three consecutive sessions. In Phase B (Sessions 33-40), the only procedural change was a reduction in the number of trials per session. Ten trial presentations were made per session for this procedure.
CHAPTER III

RESULTS

As the study progressed each subject was exposed to one or more experimental conditions (i.e., training procedure) per session. In Figure 9, the percentages of correct responding per session across experimental conditions as chronologically introduced are plotted for Subject 1. Figures 10 and 11 show the same data for Subjects 2 and 3 respectively. As Figure 9 shows, Subject 1 reached mastery criterion for SS-TACT in 73 training sessions; whereas SS-MAND was run for 22 sessions before training was completed. Figure 9 also shows that T-TACT was mastered in fewer sessions (7 sessions) than T-Mand (14 sessions). Subject 3, who had the fewest training sessions overall, mastered only one training procedure, SS-MAND. As Figure 11 illustrates, Subject 3 entered the study when Subjects 1 and 2 were on their 42nd training session. Subject 2 did not master any training condition. As Figure 10 shows, Subject 2 was absent for 15 training sessions. His absence was due to drug dosage health related problems.

Subjects 1 and 3 were exposed to both language systems. Subject 2 only had training under topography based language conditions. All keys that were used in training for each subject across conditions are depicted in Figure 1.
Figure 9. Subject 1's percentage of correct responses per session across conditions.
Figure 10. Subject 2's percentage of correct responses per session across conditions.
Figure 11. Subject 3's percentage of correct responses per session across conditions.
For Subject 2, the same three keys were trained across conditions. As Figure 1 shows, for Subjects 1 and 3 the same three keys were trained across 2 conditions: SS-TACT and SS-MAND COMP. Besides showing the keys used in training, Figure 1 also displays trials to criterion for keys trained. Subject 1 met the training criterion for all keys under the above mentioned conditions. Under the same conditions, Subject 3 mastered only one training key name. Both Subjects 1 and 3 mastered two of the same keys under a third training procedure, SS-MAND. Under SS-TACT, SS-MAND and SS-MAND COMP, Subject 1's trials to criterion decreased as a given key was mastered across training procedures. This finding was not consistent. In examining Subject 1 and Subject 2's acquisition of the same key under both T-MAND and T-TACT training procedures, trials to criterion increased as the key was mastered across conditions. Subject 3 did not master the same key in more than one condition. The WBR square key was individually mastered by Subject 1 in three training procedures (SS-TACT, SS-MAND and SS-MAND COMP) within a 7 session time block (Sessions 61-67).

After several words were trained under a given stimulus selection based experimental condition, new words introduced were readily acquired. After Subject 1 completed training of three keys under SS-TACT experimental conditions, a new key (probe key) was introduced and
acquired without training. The data plotted in Figure 12 show that extensive training was required before the initial keys were mastered. The completion of SSBT training took 73 training sessions. Two training keys (WBR rectangle and WBR circle) reached criterion in 32 sessions, but the third key required an additional 32 training sessions before it was successfully trained. Finally, nine more training sessions were required before the overall training criterion was reached with the three keys. Even after keys were successfully trained (i.e., reached training criterion), wide variability in correct responding (ranging from 0% to 100%) was present across the duration of the training procedure. Figure 13 displays similar data for Subject 1 in that after successfully acquiring two of the same keys under SS-MAND, two probe keys were acquired readily. Training sessions were fewer in number under the mand condition, taking only 24 to meet the stated criterion. Accuracy of responding to one key (WBR rectangle) dramatically increased and stabilized at 100% immediately after the trainer was changed. The second key and overall training criterion were met within three days of the trainer's switch. As Figures 12 and 13 show, WGR circle key was acquired readily during the same sessions in both conditions. Subject 3 also acquired a new word readily after completing SS-MAND training for two keys (WGR rectangle and WGR circle). The SS-MAND training extended
Figure 12. Subject 1's percentage of correct responses under SS-tact for 3 training keys and 1 probe key.
Figure 13. Subject 1's percentage of correct responses under SS-mand for 2 training keys and 2 probe keys.
across 22 sessions which was followed by five probe sessions. Figure 14 presents the percentage of correct responding to the 2 training keys and to the probe key.

Training under T-MAND conditions which was introduced during Session 65 was successfully completed for Subject 1. This training took the second fewest number of sessions to complete. The two training keys (WGR rectangle and WGR square) jointly maintained mastery criterion within 14 sessions.

Subject 1 individually mastered six keys across three training procedures, SS-MAND COMP, T-MAND and T-TACT as shown in Figure 1. The same key was mastered under both T-TACT and T-MAND conditions. In both conditions, the subject required comparable training sessions to reach criterion, seven and six respectively. SS-MAND COMP training began six sessions after the same two keys (WBR rectangle and WBR circle) had been individually mastered in SS-TACT. The WBR rectangle key met criterion in six SS-MAND COMP training sessions. In both conditions, SS-TACT and SS-MAND COMP, the WBR circle took 32 sessions to be trained, even though it was not mastered within a close time span for both conditions. For SS-TACT, this key was mastered in Session 32; whereas, for SS-MAND COMP it was mastered in the 81st session. In between the mastery of this key in the above stated procedures, it was acquired as a new word in SS-MAND PROBE. For a third key

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Figure 14. Subject 3's percentage of correct responses under SS-mand for 2 training keys and 1 probe key.
trained under both SS-TACT and SS-MAND COMP conditions sessions to criterion across conditions was not similar. For SS-TACT, training consisted of 54 sessions; whereas, for SS-MAND COMP training consisted of 33 sessions. Although across the time span of the study, it was mastered within 4 sessions under both conditions.

Subject 3 individually mastered three keys across three conditions, SS-TACT, T-TACT, and T-MAND, as shown in Figure 1. The probe key used after SS-MAND training was concurrently being mastered under SS-TACT conditions. Responding across conditions for the mastered keys remained consistent. This subject also mastered an individual key (WBR square) under T-TACT conditions in the same number of sessions and within comparable trials to criterion as Subject 1. Subject 3 mastered the key in 7 sessions across 39 trials and Subject 1 mastered a key (WGR rectangle) in 7 sessions across 33 trials. Similarly, this subject also mastered a key (WBR rectangle) in T-MAND training in comparable sessions and trials to criterion as Subject 1. Subject 1 reached criterion in 56 trials across 14 sessions for the WGR square; whereas, Subject 3 reached criterion in 53 trials across 16 sessions.

Subject 2 individually mastered four keys across three different experimental conditions shown in Figure 15. No probe sessions with untrained new keys were run due to the subject's lack of mastering training words under any
Figure 15. Subject 2's acquisition of individual training keys.
experimental conditions. Responding for this subject to any given key fluctuated greatly. After his absence, between sessions 49-52, due to health problems involving medication changes, the subject could only correctly respond consistently to one stimuli per procedure during a given session. The first two graphs in Figure 15 illustrate his selective correct responding. When he mastered one key (WBR rectangle), he responded with 45% accuracy to the other key concurrently being trained. Later in the study, after another long absence (sessions 63-66) due to medication changes, he mastered the other key in T-MAND while his accuracy of responding to the previously mastered key fluctuated greatly. Before his absences, the key (WBR rectangle) mastered in T-TACT maintained an accuracy criterion of 80% or greater across 11 consecutive sessions; after his absences, correct responding dropped considerably. By the end of this study, he was making no correct responses in the presence of the previously mastered key. The other two keys being trained in T-TACT never reached the criterion for accuracy.
CHAPTER IV

DISCUSSION

Although the actual results of this study are minimal in terms of the number of keys trained across several verbal operants, all of the subjects mastered one or more keys in more than one verbal operant. Subject 1 mastered three of the five training procedures he was exposed to throughout the study. Subject 3 mastered one out of the five conditions. All subjects did fairly well in mastering individual verbal relations. Subject 1 mastered all but one of his 11 training verbal relations. Although Subject 2 did not complete any training procedure, he did master four out of eight training relations. Finally, Subject 3 mastered five out of the 12 possible verbal relations.

Results from Subjects 1 and 3 show that a new word introduced under SS-MAND and TACT conditions after several keys (words) were already trained could be acquired without training. This result implies that after a few response forms in a given operant are trained, the acquisition of more words in the verbal operant occurred more readily than the initial words. This interpretation conflicts directly with Sundberg's (1980) mand training results which indicated that the speed of acquisition is dependent upon amount of training time, not a function of
previous words learned. The present study only witnessed this phenomenon in a stimulus selection language system; however, Sundberg's (1980) assertion was based on results obtained through the use of sign language, a topography based language system. Research which investigates acquisition of new words under varying conditions is needed to resolve this issue. For example, a study which introduced new words under two different conditions, after X number of training sessions and after mastery criterion was reached for the training stimuli would help resolve the above interpretative difference.

In addressing the issue of whether or not transfer of stimulus control from one verbal operant to another for a given word could successfully occur, it was found that this could not occur without training. Contrary to this, Bell (1980) found that if mand training occurred the same words could transfer to tact conditions without training. The present investigation found such a transfer to be only temporary. In Subject 1's 77th session, T-TACT was the first training procedure. The subject consistently signed the other training topography in the presence of WGR rectangle for five training trials, which included numerous modeling correction loops during which he still persisted in signing incorrectly. This training procedure was immediately followed by T-MAND for the same two keys. The subject under T-MAND controlling variables correctly signed
for the WGR rectangle for each of its five presentations during the procedure. In this session, for curiosity's sake, T-TACT was repeated. This sequence was followed to investigate whether or not the subject would now sign correctly when presented with the WGR rectangle key. He was randomly presented with both training stimuli (keys). For the first seven presentations of the WGR rectangle the subject signed correctly, but for the remaining ten presentations the subject responded incorrectly by once again signing the name of the other training stimulus. In the next session, T-MAND was the first procedure; the subject signed correctly for the WGR rectangle key 100% of the time. He also signed correctly in the presence of the WGR in all five of the presentations of it under T-TACT controlling variables. This finding supports that what might be viewed as transfer of stimulus control from mand to tact variables could actually be a temporary carry-over effect produced by either the preceding mand variables or from the transition variables involved with going from mand to tact conditions. As stated under the experimental design for this study, a control procedure was implemented to guard against the possibility of carry-over effects.

The present research also does not replicate Bradford's results (1980) where he specifically found that the mastery of manding missing items was sufficient to produce tacting. His data supporting this claim are minimal. Only one of
the two subjects successfully tacked 80% of the mand items without training. He does not give any indication of the number of opportunities to tact the items nor the maintenance of a tact across time. In the present study if the subject responded correctly (i.e., above the chance level) during a transfer test session, the test was continued during the next session. This permitted the observance of response maintenance under the new variables. Maintenance of responding in any transfer test was not found.

Another finding supports Hall's (1980) conclusion that transfer from tact to mand variables does not occur without specific mand training. During session 36 for subject 3's T-TACT training, he correctly signed in the presence of the WBR square key for each of its five presentations. This training procedure was immediately followed by T-MAND for the same two keys. In this procedure, he failed to sign correctly for the WBR square key five times in a row. Also, during the previous days, training when the presentation order of the training procedure was reversed, correct responding to the WBR square for both conditions was poor.

The collective results of the six transfer tests: two tact to mand, two mand or tact to mand compliance, and two mand to tact support, Skinner's statement concerning the need to take responsibility of independent explanation for the establishment of the same response form
in more than one verbal operant (Skinner, 1957).

This study can make no statement concerning the acquisition of new words after mastery of a few words in a topography based language. The study's time limitation inhibited this investigation, even though Subject 1 mastered training under both T-MAND and T-TACT variables. This area is definitely one that should be pursued in future research endeavors.

Slow acquisition of individual keys could be partly due to the subject's past history of responding during instructional settings. Generally, for mastery of an educational objective, the student is required only to make one correct response repetitively across trials to master an objective. This method of instruction could possibly condition the subject to make one response over and over. The response made repetitively becomes strengthened in the student's behavioral repertoire due to the reinforcement the student receives. This response is more likely to be performed again in a given session than another behavior. This training method reduces the probability that the student will make differential responses based on the stimuli presented. In research sessions, the subjects were randomly presented with one of two or three stimuli per procedure. To obtain maximal reinforcement, the subjects needed to differentially respond to stimuli presented; this type of responding was very
weak in their repertoire. Differential responding did improve across time as shown by the subjects' ability to master individual keys and training procedures.

This present research had slow acquisition of a given response form under more than one set of controlling variables. Each procedure was presented for at least ten trials before switching to another training procedure. In attempting to gain faster acquisition across conditions for a given response form, future research could investigate the usage of what Sundberg (1980) called the "quick transfer" technique. This technique entails only having one or two trials under one condition before switching to another. He found that this technique facilitated faster acquisition of a response form across different verbal operants.

Due to the minimal training results under both language systems, no convincing statement concerning preferential usage of one system over another can be made. This study did find that individual words mastered in the topography based language system were generally acquired in fewer trials. Topography based language conditions T-TACT and MAND for Subject 1 were also mastered in fewer sessions than SS-TACT or MAND. The results stated above could be partially attributed to procedural differences between stimulus selection based and topography based conditions. In T-TACT conditions, only two keys were trained whereas in SS-TACT three keys were trained. The

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results could also possibly be explained by the differing complexity of controlling variables in each system. In a topography based language, the form of the response is controlled by one set of controlling stimuli. In explanation, under T-TACT conditions, the subject was presented with one key (controlling stimulus) which evoked a sign. The subject only needed to attend to one stimulus in making a correct response. In a stimulus selection based language, the form of the response is multiply controlled by stimuli. In explanation, under SS-TACT conditions, the subject was presented with one key (controlling stimulus) but also three lexigrams (additional controlling stimuli) and then he touched one lexigram. The subject had to attend to more stimuli in order to make a correct response. The subjects in the study had difficulty performing appropriate scanning behaviors. Each of the subjects had to develop good scanning behaviors before their selecting response (i.e., touching a lexigram) could be effectively controlled by the relevant stimuli. The time needed to shape up these behaviors could explain why SS-TACT and SS-MAND took longer to train than T-TACT and T-MAND. An interesting follow-up study to this research could control for this confounding variable by training good scanning behaviors in pretraining sessions. One could then make a more comparable comparison between the two language systems.
FIGURE CAPTIONS

For Figure 1 under Subject 1, the same first numeral (e.g. 1-281 & 1-315) indicates that the keys were mastered during the same session.

For Figure 9 - Figure 15 identical symbols were consistently used across these seven figures. Key to the graphs symbols: (*) training criterion reached; (A-F) training phases; (TT) transfer test; (PROBE) probe test; (WBR) white/black/red; and (WGR) white/green/red.
APPENDICES
## APPENDIX A

### DESCRIPTIONS OF SIGNS USED IN TOPOGRAPHY BASED LANGUAGE TRAINING

<table>
<thead>
<tr>
<th>Sign</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>square</td>
<td>both arms extended out in front of the body with either opened or closed fists at shoulder level</td>
</tr>
<tr>
<td>circle</td>
<td>sliding motions up and down with hands together palms touching</td>
</tr>
<tr>
<td>rectangle</td>
<td>one or both opened hands touching head.</td>
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</table>
### Table of Observational Reliability Scores across Subject and Responses

<table>
<thead>
<tr>
<th></th>
<th>Subject 1</th>
<th>Subject 2</th>
<th>Subject 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stimulus Selection Based</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tacting</td>
<td>100%</td>
<td>--</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
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<td>100%</td>
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<tr>
<td></td>
<td>92%</td>
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<td></td>
</tr>
<tr>
<td><strong>Stimulus Selection Based</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Manding</td>
<td>90%</td>
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<tr>
<td><strong>Stimulus Selection Based</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mand Compliance</td>
<td>100%</td>
<td>--</td>
<td>94%</td>
</tr>
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<td></td>
<td>92%</td>
<td></td>
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<tr>
<td><strong>Topography Based</strong></td>
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BIBLIOGRAPHY


Sundberg, M. L. A program for teaching a verbal repertoire to persons in whom it is absent or defective. Paper presented at the California Behavior Analysis Conference, Stockton, California, March, 1978.


