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THE EFFECT OF MODE OF STIMULUS PRESENTATION ON THE ACQUISITION AND GENERALIZATION OF TACTING RESPONSES IN PREVIOUSLY NON-VERBAL CHILDREN

By

Douglas Scott Cutting

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in Partial Fulfillment
of the Requirements for the Degree
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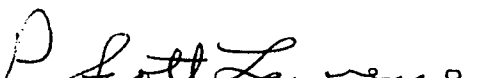

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CUTTING, DOUGLAS SCOTT. The Effect of Mode of Stimulus Presentation on the Acquisition and Generalization of Tacting Responses in Previously Non-Verbal Children. (1973) Directed by: Dr. Scott Lawrence. Pp. 85.

The purpose of the present study was to investigate the effect of mode of presentation on the acquisition of the names of target stimuli and the resultant generalization to other modes. There were three modes utilized so that the subjects were each exposed to objects, slides, and pictures of the target stimuli and were asked to respond to a "What is that?" prompt.

Several measures of acquisition and generalization were employed. During a baseline condition, all subjects were presented each of nine experimental and six control targets by all three modes, i.e., slides, objects, and pictures. The baseline condition was repeated (probe 1) after the subjects had received training on the experimental subset of these targets. The terminal criterion for this phase of training was five successive correct responses to the "What is that?" prompt during two consecutive training sessions. A second repetition of the baseline condition (probe 2) was conducted after training on a somewhat more rigorous criterion had been completed. Correct responses to experimental targets increased 74% by this second probe while correct responses to control targets decreased by 4%. This was attributed to the fact that none of the children had the

opportunity to develop the response class of tacting. The improvement in naming targets presented indicates that this method of training was effective as a language acquisition paradigm.

Since it was not the primary goal of the study to establish a training paradigm, but to evaluate the effects of mode of presentation, a second measure of acquisition, number of trials to criterion, was used to determine if the three slides, the three pictures, or the three objects were acquired more rapidly during training. Results from this phase of the design indicated that objects took significantly fewer trials to criterion than did pictures or slides. This may have been due to the subject's greater familiarity with objects, which may have overpowered the beneficial aspects of "attention focusing," a supposed advantage of the slide procedure.

Generalization was measured by determining which modes presented in training resulted in the greatest increase in correct responding to the other two modes during probe 2. This phase of the analysis revealed that slides generalized more easily than the other two modes; that is, after learning "ball" to the slide ball, subjects increased in their ability to respond to the object ball and the picture ball, although they saw these only during the baseline and probe conditions.

The overall results indicate that the training procedure

employed was effective in that the subjects acquired new tacts. More importantly, slides and pictures were more difficult to acquire, while slides generalized more easily than the other modes of presentation. Thus, if the goal of the acquisition procedures is simply to increase the number of correct responses in a single mode, objects is the most efficient mode. If the goal is generalization to a variety of modes, then slides should be considered as a possible mode of presentation.

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INTRODUCTION

Within the wide range of human activity studied by behaviorists and non-behaviorists, one of the most critical and complicated areas is that of language. Since most children develop speech and language abilities partially as a natural consequence of their environment, the study of language has remained primarily on a theoretical level, with empirical investigation concentrating on "normal" language usage. Recently, however, a new emphasis has appeared to focus on the large number of children who do not develop language or language understanding or who suffer from language disorders, such as stuttering or disfluency (Sloane & MacAulay, 1968). This population has forced experimenter-clinicians in the fields of linguistics, speech pathology, and psychology to carefully examine the development of speech, both in those whose speech is normal, and in individuals who do not develop language under normal environmental consequences.

Unfortunately, there has been a less than unified quest for knowledge about language development and usage. Linguists and psycholinguists, in their study of language, have been greatly influenced by cognitive research and theory which does not emphasize practical application of theory to language deficient populations, relying more on research with populations who have normal linguistic development (Holz & Azrin, 1965).

These psychologists are contrasted to behavioral psychologists who rely more heavily on observable, quantifiable environmental events, rather than hypothesizing the existence of the less observable changes that occur within attitudes, ideas, or feelings. The behavioral psychologists also differ in that they often use subject populations with abnormal or incomplete linguistic development.

The behavioral formulations of language acquisition are primarily the result of the work of B. F. Skinner, especially his book entitled, Verbal Behavior (1957). Though there had been various other studies (for a review of these see Holz & Azrin, 1968, and Krasner, 1958), Skinner has offered the most thorough analysis of vocal verbal behavior as an operant response (Buddenhagen, 1971). MacCorquodale (1970) summarized this analysis:

> Skinner's Verbal Behavior is an analysis of speech in terms of its controlling relations which include the speaker's current motivational state, his current stimulus circumstances, his past reinforcements, and genetic construction. Skinner has accepted the constraints of natural science in his basic analytical apparatus, in that all of its terms are empirically definable. He intends to account only for the objective dimensions of verbal behavior...(p. 83).

Since Skinner's initial analysis, an ever increasing body of empirical literature has been produced to investigate the feasibility of the functional use of the principles within the experimental-clinical model of behavior modification. Within this framework a number of subject populations and variables have been investigated, the majority of these under

experimental-clinical conditions. These subject populations include children with normal verbal behavior (Hart & Risley, 1968), in addition to non-verbal children diagnosed as retarded (Barton, 1970), autistic (Hewett, 1965), psychotic (Lovaas, 1968), and echolalic (Johnson, 1968). An explanation of the emphasis on language within this wide variety of subjects is offered by Risley and Wolf (1968), who state that verbal behavior for these children is the single most important aspect of their behavioral repertoire. This greatly increases the necessity for further study of the processes of language acquisition which may then aid the exploration of later developing behaviors. Furthermore, receptive and expressive verbal behavior or language ability (the terms will hence be used interchangeably) is a prerequisite for a large proportion of the child's social and academic progress, as well as being essential for normal "day to day activity." Without the skill, the child is "doomed to developmental retardation" (Risley & Wolf, 1968), whether the attached diagnostic label happens to be autism, brain dysfunction, or echolalia.

Within each population a number of variables have been specifically investigated in an effort to empirically validate the hypothesized principles of verbal behavior which were developed by Skinner, and based on the laws of behavior formulated by observing non-verbal organisms perform non-verbal tasks (MacCorquodale, 1970). One of the most interesting areas

of concentration involves the sequence of steps by which language is taught to non-verbal subjects. Both Lovaas (1968) and Risley (1966) have developed, through trial and error, a fairly rigid "package" or sequence of components by which various groups of non-verbal children may be taught language. The fundamental components will be outlined briefly here in order to illustrate the basic methodology, but will be discussed in detail later.

The first component is attention, during which the subject is taught to attend to the therapist's face and voice. The second component is motor imitation in which the child learns to imitate various motor responses that are presented by the therapist. Stimulus control is shifted from motor to vocal stimuli in the next component, verbal imitation. Although the subject still relies heavily on the motor cues from the therapist's oral structures, imitation is also of sounds or combinations of sounds called phonemes that are produced by the therapist and imitated by the subject. Further shifting of stimulus control from a modelled stimulus to an object which is presented to the subject within the testing environment occurs during the third component, "tacting." Skinner (1957) has defined tacting as "a verbal operant in which a response of given form is evoked (or at least strengthened) by a particular object or event or property of an object or event (pp. 81-82)." The next phases are less rigid, but include the training of two-word combinations

and longer word chains, using words that the child can now tact; the training of prepositions and pronouns; and various receptive aspects of language. At all levels of the package, the therapist attempts to obtain generalization to stimuli other than those specifically trained. For instance, during the training involving tacts, different sizes of the same object may be introduced to teach a general "response class" (Nelson, 1969). Generalization is critical because the terminal goal is to have the subject using language in a normal, unstructured environment, quite different from the sterile training environment typically devoid of distracting stimuli.

The major concern in regard to the language training components is that although the entire series has been shown to be effective (Lovaas, 1968; Risley, 1966), few of the individual steps in the series have been empirically investigated. This lack of investigation indicates that trial and error may be the primary means by which improved efficiency in the program will occur. Essentially, the studies that have been done have concentrated on the initial and least complex aspect of the program, attention (Nixon, 1965; Walker & Buckley, 1968; Buddenhagen, 1967), or on the more complex aspects such as the generation of plurals and prepositions (Sailor, Guess, Rutherford, & Baer, 1968; Sailor, 1971; Sailor & Taman, 1972). The former has been studied primarily because attentional variables are more easily quantified and

do not necessarily involve vocal verbal behavior, thereby avoiding some of the methodological difficulties of language research. The latter have been investigated primarily in response to the linguists' claim that the behavioral manipulations of language acquisition are grossly simplistic and cannot predict or produce complex linguistic forms such as grammar and syntax (Chomsky, 1957, 1959; Miller, 1965).

Thus there exists a gap in the literature between the most elementary and the most complex aspects of the language training paradigm. The resolution of this discrepancy would seem to rest in a systematic, empirical evaluation of each component utilizing a fairly homogeneous subject population and an experimental methodology designed to clarify the variables critical to the specific component.

One of the most critical areas of such an investigation should involve that component in which the child begins to name or "tact" objects in his environment. It is within this aspect of the program that the child is no longer responding to a modelled verbal stimulus supplied by a parent or therapist, but rather is responding to some two- or three-dimensional environmental stimuli by naming them. Several investigators have attempted to train object names in retarded children (MacAulay, 1968), in psychotic children (Lovaas, 1968) and in echolalic children (Risley & Wolf, 1968) with some success. Others have used various methods of presenting these stimuli, including real objects (Lovaas, 1968), pictures (Risley, 1966)

and slides (Nelson & Evans, 1969). Although little explanation has been offered as to the choice of stimuli, Lovaas (1968) has used words such as "bacon" for the child to tact. After a correct response the child is given the tacted stimulus as a reinforcer. Nelson and Evans (1969) used slides primarily because of ease of presentation and the proposed elimination of interfering stimuli which are darkened while the slide is presented. Little explanation is offered for choosing pictures except for the postulation of ease of generalization to symbols necessary for reading (MacAulay, 1968). None of these studies has compared the various modes to see if there is any one that might be more efficient in terms of acquisition or generalization compared to others after training on one mode is completed.

There is then the necessity of empirical investigation designed to examine the object naming component of the behavior language acquisition program. The present study aims to provide information which is presently lacking as to the most useful means of presenting stimuli to children who are learning language. Secondly, additional data will indicate the extent of generalization of training after a certain mode has emerged as being easier to acquire.

Review of the Literature

Research With Various Subject Populations

Though much recent research designed to investigate verbal behavior has utilized speech deficient or defective

subject populations, many studies have shown that individuals with appropriate language development can also be used in empirical studies of verbal behavior. A review of a large number of early studies using children is found in McCarthy (1954), while Krasner (1958) has reviewed the early adult studies.

Salzinger, Salzinger, Portnoy, Eckman, Bacon, Deutsch, and Zubin (1962) performed a series of five experiments designed to investigate the effect of differential reinforcement schedules on the rate of vocalizations of children in a day nursery whose ages ranged from 5 to 7 years. They found that reinforcement (in this case a red light which turned on during the time the child was speaking) increased the rate of vocalization. Furthermore, the rate of vocalization decreased or stabilized when no reinforcement followed or accompanied the verbal behavior. The number and schedule of reinforcements produced effects in response strengths which were similar to those results obtained in the animal literature; although in these latter studies, the dependent variable was rate of bar pressing or some other non-vocal response rate. Finally, it was found that certain specific classes of vocal behavior such as "pronouns" could be manipulated as a function of reinforcement. It was not possible to increase only this particular class, as rate of vocal output increased somewhat overall, but there was a significant increase in the targeted response class above

the general rate of output.

Rheingold, Gewirtz, and Ross (1959) worked with an even younger population as they utilized reinforcement techniques to manipulate rate of vocalization in infants. Their results indicated that rate of vocalization could be increased when there was an increase in the reinforcing stimuli that followed infant vocalizations. Additionally, the rate of vocalization decreased when reinforcing stimuli were removed, indicating that difference in rate of vocalization varied as a function of reinforcement. Other studies concerning rate of infant vocalization varied as a function of reinforcement. Other studies concerning rate of infant vocalizations have reached similar conclusions (e.g., Weisberg, 1963; Todd & Palmer, 1968; Wahler, 1969).

Older children, aged four, with normal linguistic development have also been used in experimental studies of vocal verbal behavior, (Brigham & Sherman, 1968). Research with such subjects whose vocabulary size and complexity is increasing rapidly under normal environmental circumstances is important to contradict claims such as Miller's (1965). He states that reinforcement procedures may work with language deficient children, who learn language by "rote," but are not applicable to those who exhibit normal language acquisition. The Brigham and Sherman (1968) study concentrated primarily on increasing the child's ability to imitate certain words which were never directly reinforced. The

purpose of such a design was to illustrate the generative nature of verbal imitation following up on the earlier work done by Lovaas, Berberich, Perloff, and Schaeffer (1966) with schizophrenic children. The results indicated that their subjects had the "ability to generate novel responses within the imitative response class by specifically presenting novel stimuli called "probes" which had not been previously trained, and testing to see if the subject performed appropriate imitative responses to these stimuli (Nelson, 1969, pp. 15-16)." One important result of the study is that it was possible to manipulate the content as well as the rate of vocal verbal behavior through reinforcement, modelling, and other behavioral techniques, thus expanding the type of responses that could be varied.

More complex variables have been explored by Bandura and Harris (1966) in response to the argument by Chomsky (1959) that an explanation of verbal behavior based on imitation and reinforcement was too simplistic and neglected to explore the known complexities of language. The results of the Bandura and Harris study seem to refute this claim, although they admit complex grammatical forms such as syntax are very difficult to modify. They found that children with normal linguistic development but with no previous history of using passive voice or prepositions were able to learn to produce sentences containing the passive voice or prepositional phrases when a training program using a combination

of behavior therapy techniques was used.

Due to some deviation from normal development, some children do not develop language at a "normal" rate. As a result, the probability is very high that they will also have subaverage scores on intelligence tests and therefore be classified as "retarded." It is somewhat of a paradox that children may be retarded due to their inability to understand or use language, thereby limiting their contact and learning experiences with a very verbal environment. Accordingly, the child may be non-verbal as a result of a "retardation," here using the term to denote some lack of adaptive behaviors, one of the most important of these being language. The language development of this population has been more extensively studied recently due partially to the convenience and control available in the institutional environment, and partially because it is hypothesized that the studies concerning these individuals fall somewhere between the sub-human literature and the studies done on "normal" human behavior (Bry & Nawas, 1971). Whichever the case, it is easier to isolate and observe language with these subjects because one can maintain adequate degrees of control over variables that often interfere with other human research (e.g., the use of two separate environments is eliminated since "home" and the "laboratory" are identical).

The fact that previously non-verbal, retarded children

can learn to respond to verbal commands and make complex discriminations has been demonstrated by Bricker and Bricker (1970). Using the Wisconsin General Testing Apparatus, and both food and token reinforcers, they were able to increase the receptive vocabulary of previously unresponsive children. Furthermore, individual training after acquisition maintained previous levels of functioning while the group that had no individual followup suffered deterioration in their receptive vocabularies.

Non-verbal retarded children can also be taught expressive language and reading skills (MacAulay, 1968). The subjects for the study were 11 non-verbal retardates whose I.Q. scores ranged from 27 to 92. Through the use of visual, tactile, and auditory cues, various phonemes were taught to the subjects using a teaching paradigm which emphasized small, precise steps by which the terminal goals of speech and letter recognition (reading) were acquired. Candy and tokens were used to reinforce appropriate responses which at first consisted of simply having the child visually fixate on the therapist's face. While the entire training sequence used in this and similar studies will be discussed in detail later, the important point is that "most children acquired a full repertoire of speech sounds within four to six months while being seen only twice a week (MacAulay, 1968, p. 121)." Furthermore, some children were able to acquire reading skills and began reading words; whereas before,

they could recognize only their own names. In summary, on the basis of the case studies presented, it was concluded that "operant procedures applied to speech and language training can be quite successful (MacAulay, 1968, p. 124)."

Buddenhagen (1971) has concentrated on language acquisition in non-verbal, mongoloid children in an intensive effort to explore the variables important to the verbal behavior of this population. His results are based on the extensive analysis of the case studies of four non-talking, mongoloid children who were patients at the Wyoming State Training School. Although somewhat different techniques were used for each subject, the behavioral techniques of modelling, imitation, prompting, shaping, and reinforcement were used in all cases to increase vocal verbal behavior. One of the predominant conclusions drawn from the results of the study was that a child's history of non-talking could be reversed if the environment of that child was one which reinforced verbal responses. The major problem encountered in teaching retarded, mongoloid children was that like most other retarded children, they were confined to institutions where progressive habilitative programs were not always available. When such a program is available, a behavioral language acquisition paradigm (e.g., Lovaas, 1966) "appears to be an extremely economical way of establishing vocal verbal behavior in non-talking children (Buddenhagen, 1971, p. 163)." Other representative studies of language acquisition

in non-verbal retarded children include Wolf, Risley, and Mees (1964), Risley and Wolf (1967), Baer (1966), Barton (1970), Spradlin (1963), Sailor, (1970), Schumaker and Sherman (1970), Baer and Guess (1971).

Some of the most extensive research concerning the acquisition of verbal behavior has used a subject population which has a diagnostic label of "autistic," (Hewett, 1965; Risley, 1966; Risley & Wolf, 1968; Lovaas, et al. 1966; Sailor & Taman, 1972). Lovaas (1968) utilized autistic (he referred to them as schizophrenic) children to develop a language training paradigm which has been the model for many other studies. Due to the importance of his study, the basic aspects will be discussed in detail. He found that the literature on autism has indicated that speech in autistic children does not develop when typical psychotherapeutic techniques are employed (Lovaas, 1968). Accordingly, he devised special techniques for teaching non-verbal children language, and also used them to experimentally investigate the speech of normal children. Lovaas (1968) states that the procedures are certainly not the only ones that would produce speech, but that at least the training methodology gives an empirical basis for language development to supplement the theoretical formulations.

The first phase of the training program is verbal imitation. Two prerequisites for verbal imitation are attention to the therapist and the identification of reinforcers

sufficiently strong to maintain and increase the frequency of responses which precede them. Verbal imitation is produced by reinforcing all vocalizations, then gradually shaping the response so that it follows closely in time and is structurally and acoustically similar to that of the model-therapist. Often the therapist would prompt the response by touching the child's lips or jaws in an effort to physically elicit the appropriate response while producing an auditory stimulus for the child to imitate. Sounds which had easily exaggerated visual cues, such as the labial consonant "m," were chosen for initial training. The sound was presented until the criteria of high quality imitation without physical prompting were attained. The next step was teaching discriminations between sounds by training a new sound, then randomizing the presentation so that old and new sounds would have to be differentiated. These steps were replicated using new sounds and combinations of sounds until the child possessed an extensive repertoire consisting of the basic components of most words.

Lovaas (1968) refers to the second part of the language program as "the establishment of an appropriate context for speech." Basically this consists of three increasingly complex stages. In the first, the child is taught to correctly identify objects within the environment. Next, the child is trained to use and respond to "abstract" terms such as pronouns and prepositions. Finally, in stage three, the

child is taught to utilize the skills in a normal environmental setting such as in a conversation, or to relate a story he has heard. Each of these components will be discussed in detail in the next section of the present paper.

The results of these procedures indicate that children who were previously non-verbal, socially isolated, and without an imitative repertoire can be taught imitative speech, tacting responses, and the expression of simple demands. Several case studies such as the one by Risley and Wolf (1968) have employed a similar design in establishing appropriate verbal behavior in autistic children. Using bites of ice cream as a reinforcer, a six-year-old child who exhibited no appropriate verbal behavior was taught to imitate the words "ice cream" and "very good" within a single session. The authors state this early success was due in large part to the subject's long history of echolalia. To begin transferring control to stimuli other than the therapist's echoic one, pictures of a train, a flower, a car, and an airplane were introduced while the therapist said "train," "car," etc. when the pictures were presented. The subject responded with the appropriate name in each case, but was still responding to the echoic stimulus of the therapist. At this point, the therapist began to delay between the presentation of the picture and the naming of the represented object. After a few trials the pictures assumed good control over tacting responses. More complex responses were also

established after the imitative and tacting responses were at high strength. These included sentence completion and question answering which were attempted in many different situations. Parents were trained as therapists and continued to expand both the tacting and sentence repertoire of the child while also becoming more skilled at extinguishing inappropriate behaviors.

Review of the Training Components

It has recently been demonstrated that a child's ability to attend to visual stimuli is essential for success in classroom or academic settings (Nixon, 1965; Walker & Buckley, 1968). Additionally, Buddenhagen (1967) has argued that although there is less experimental verification, it is equally important for the child to attend to visual stimuli in the process of language acquisition. A number of case studies have included a training procedure designed to evoke visual attending in these subjects as the primary step in language acquisitions (Hewett, 1965; Lovaas, et al., 1966; Baer, 1966; and Sapon, 1966).

Although each of these studies includes a brief description of the methodology used to obtain visual attending, few have devoted much time to the actual investigation or review of the importance of this component in the language training process. Lovaas (1968) is a bit more explicit in how he obtained attention in the autistic children he used as subjects. Often the child would be placed facing the therapist at a

distance of approximately one foot, with the child's legs held between the therapist's knees, thus preventing the child from physically escaping. Furthermore, the therapist would often physically turn and hold the child's face until it was directly in front of his, so that the child could escape visually attending only by shutting his eyes.

Buddenhagen (1967) suggests employing fewer physical prompts or restraints and prefers shaping attention to the therapist's face by administering food reinforcer for increasingly longer eye-face contact. When there is sufficient attention, imitation of motor or vocal responses can be taught much more easily. As Buddenhagen (1967) points out, "imitation and visual attending increases the chances of acceptable imitation by the subject, which upon reinforcement in turn raises the chances of improved vigilance from the subject (p. 3)."

In most studies, there is an attempt to direct the attentional processes toward the face of the therapist. This is accomplished by moving the food reinforcer to a position directly in front of the therapist's mouth or face while giving the vocal command "Look at me" (Lovaas, 1968). When the child makes eye-to-face or eye-to-eye contact, he receives the bit of food. Transferring the visual attention from the face or the eyes to the therapist's mouth is critical (Buddenhagen 1967; Metz, 1966) since the child will be required to imitate the posture of the jaw, lips, mouth, and

tongue in later stages of imitations. Appropriate imitation of the position of these articulators will also help guarantee good speech quality and will make physical prompting of these areas less difficult (Buddenhagen, 1967). In summary Buddenhagen (1971) has stated:

> Evoking and shaping vocal responses into viable speech requires sustained and concentrated attending from the subject. Without such attending, progress will be limited to the degree to which the experimenter or therapist can selectively reinforce the emmission of random vocalizations, bringing to high strength those which contain acoustic properties leading ultimately to intelligibility. . . Visual attending is of prime importance for two reasons. First, it tends to increase the probability of auditory attending. . . Secondly, visual attendance to the experimenter's models permits discriminations which acoustic input alone cannot provide. . . (p. 162).

The next goal typically is the acquisition of a generalized response class of imitation (Nelson, 1969). This is defined by the child's having learned to make an imitative response to an imitative stimulus when the particular stimulus-response combination has never been specifically taught. New members of the response class can be added with only a single modelling presentation. This basic behavioral mechanism is very important to language development and "may account for much of the remarkable similarity and conformity of human conduct (Peterson, 1968, p. 61)."

One of the outstanding studies in motor imitation, Baer, Peterson and Sherman (1965) used three severely retarded non-verbal children, who had no imitative behaviors, in a "prompt-fade paradigm." The experimenter's goal was to

establish the response class of imitation through the use of food and praise contingent upon correct imitation of a modelled stimuli. The procedure used to establish the response included physically moving the subjects hands through the response while giving the verbal command. The physical prompts were gradually faded while food and praise were delivered for increasing competence on the part of the subject. The subjects began to demonstrate the imitative response class as they imitated motor responses the first time the modelling stimulus was presented. Furthermore, a wide variety of imitative responses could be maintained within a child's repertoire as long as reinforcement was contingent upon some subset of the responses.

One of the most difficult problems in the area of imitation deals with the number and type of motor imitations necessary to define the "response class" so that new motor items may be added. This is preliminary to the introduction of verbally modelled stimuli to which the subject will be asked to respond. Peterson (1968) has prepared a list of possible responses to be attempted including "clap your hands," "stand up," "touch your head" ("eyes," "nose," etc.), and other simple motor behaviors which are presented verbally as a request as they are modelled. Metz (1965) found it necessary to program a number of motor responses involving the model's oral structures before commencing verbal imitation.

The shifting of control from an imitative stimulus to control by an object or event in the environment is crucial in the language acquisition process (Buddenhagen, 1971). The objects that are typically used are those that appear commonly in the home or school environment (cup, chair, dog, etc.), body parts (eye, nose, ear, etc.) and common behaviors (drink, eat, etc.). The child is presented the stimulus object directly in front of him while the therapist says the word. Often the therapist must wait until the child focuses on the object before giving the verbal prompt. The child imitates the prompt and is given food or other reinforcers. The stimulus is then removed and a second trial initiated. The verbal prompt is then faded so that the stimulus object is sufficient to elicit the correct response. As soon as the first object is correctly "tacted," training on a second begins. After the identification of the second object is completed, the two objects may be displayed randomly to insure appropriate naming.

Lovaas (1968) notes several interesting things about this phase of training. First, he notes the rate of acquisition varies tremendously across subjects, although all those in the study were able to acquire a number of responses. Secondly, there was a positively accelerated acquisition rate for all the children. Finally, in this particular study only objects or parts of the body were used to teach the tacting responses. Lovaas (1968) admits that variables such as these

are presently of unknown importance to the language training process. In fact, he openly invites empirical suggestions to aid a program that "leaves much room for improvement (p. 148)," hopefully decreasing the tremendous amount of time such a program takes.

MacAulay (1968) used printed word cards to teach object names to retarded children who had been taught the symbols for various sounds. Control was transferred from the word card to the picture or object which corresponded to the card after the fading procedures had progressed sufficiently. Words were chosen that were common within the child's environment as well as those which were easy to say (usually consonant-vowel-consonant words or words that had two identical syllables). Using this procedure, all six of the initially mute subjects learned to speak understandable words presumably under the control of the stimulus object rather than an echoic stimulus. Furthermore, five of the six children could read after only five to six months in the program.

Drash and Leibowitz (1969) have also used the "What is that?" prompt to teach object identification. After the subject is imitating the names of objects 100% of the time, he is shown "a small toy object, such as a ball," is asked "What is that?" and reinforced if there is a correct tacting response. The therapist prompts after incorrect responses by naming the object and asking the child to imitate. After 50 objects can be identified 70% of the time, pictures of other

objects are introduced, and the same procedures used to teach the naming response.

The authors offer no explanation or empirical support as to the purpose of presenting the 50 objects before using pictures as stimuli, although for all seven subjects "spontaneous speech" (tacting) was increased from zero to more than 200 words for one subject and from zero to over a hundred for several others. Most subjects accomplished this in approximately 40 to 50 one-hour sessions.

More complex forms of verbal behavior have also been taught to previously non-verbal subjects using behavioral techniques. For example, Lovaas (1968) has taught autistic children pronouns and prepositions, Guess, Sailor, Rutherford, and Baer (1968) and Sailor (1971) have trained retarded children in the use of plurals, Schumaker and Sherman (1970) have shown that a similar population can acquire generative verb usage, Lahey (1971) has increased the frequency of descriptive adjectives in the speech of children in a Head Start Program, and Drash and Leibowitz (1969) have increased sentence production in autistic and non-verbal children. In many of these studies, the authors used three dimensional objects for training complex grammatical forms. As has been noted some researchers have also utilized two dimensional picture presentations in the early stages of language training. Seldom is there a rationale given for the choice of mode of presentation. The next section of the present paper is designed

to look more specifically at the various methods of stimulus presentation.

Type of Stimulus Presentation

It is the primary goal of the present study to improve upon the tacting component of the language training paradigm. At present there are a number of procedures that have become fairly rigid in this component and which have been adopted in most studies. Stimuli are usually ones which are common in the child's environment; they are typically consonant-vowel-consonant (cup) or repeated syllables (mama); and are generally taught as the next component after the words are under the control of the echoic stimulus presentation by the therapist. One variable which seems to be less consistent across studies is the mode of stimulus presentation. Lovaas (1968) employed objects and pictures to teach the tacting response. MacAulay (1968) used color-coded phonetic symbols paired with pictures to train her subjects on object identification, while Nelson and Evans (1968) utilized slides to teach children the same type of response. Each of these studies offers some rationale for choosing a particular mode, but none has substantial evidence to support a claim that one mode is superior to another. It is hoped that the present study will present such evidence in an effort to improve the efficiency of the language training methodology.

Nelson and Evans (1968) used color slides of common objects, parts of the body, and people familiar to the child. The slides

purposefully contained only the object which was being used as the training stimulus. The therapist would typically ask "What is that?" and immediately reply "cup" to provide an echoic stimulus as well as the tacting prompt. The echoic stimulus was gradually faded until the child was responding only to the slide and the question "What is that?" Expansion of the verbal repertoire was possible by introducing new slides and asking a variety of questions such as "What color is that?" Nelson and Evans report that the slides were chosen because of the "ease of stimulus presentations, the relative ease of eliciting observation responses, and the ability to make the objects represented the dominant stimuli in the environment (p. 119)." The results they obtained with the four non-verbal subjects (two autistic, one educationally subnormal, and one aphasic) indicated that there was measurable improvement in tacting responses by three of the four subjects. The mean number of 40-minute sessions per subject was 30, indicating that these changes were accomplished over a relatively short period of time.

The use of a slide presentation has been shown to be effective in reinstating verbal behavior in certain mute schizophrenics by Wilson and Walters (1966). In one condition a series of 35 mm color slides were shown to mute or near mute subjects while a model described the slide. Other subjects were exposed to the slides without the model but within an experimental situation in which they were reinforced for any

verbalization. The last two groups consisted of model plus reinforcement and control subjects. The results indicate the modelling and modelling-plus-reinforcement groups showed significant improvement in the amount of verbal behavior. No specific mention was made of the choice of slide presentation, but the slides themselves were quite different from those used in a typical language acquisition procedure. Nelson and Evans (1968) state that their slides were devoid of distractions which might interfere with object identification. In the Wilson and Walters study the purpose was the reinstatement of verbal responses that had once existed so the slides were of everyday scenes and activities and contained more than a single object.

Studies by Liebert and Fernandez (1970) and Fernandez and Liebert (1970) have used a slide presentation format to investigate various aspects of complex language modelling. The slides were of objects in the first two studies and of states in the last study, and were used to elicit verbal responses after a modelled stimulus had been presented. Although not mentioned specifically, it is implied that slides were chosen because of the ease of presentation and the versatility of what could be used as stimuli. (This versatility is limited in the case of objects.) Furthermore, variables such as length of presentation are easily controlled by using a slide projector which contains an attached timer.

Lovaas (1968) recommends the use of objects such as

edibles (toast, bacon, etc.) to be used in the initial stages of object identification with autistic children. Although difficult phonemically, these items may be quickly used as reinforcers when appropriately identified. Risley and Wolf (1968) used a similar procedure to train an echolalic subject, using the words "ice cream." Because of their convenience, Lovaas (1968) recommends using body parts and articles of clothing to be used in object naming since generalization to the normal environment may be greatly aided.

Risley and Wolf (1968) suggest using objects held in front of a bite of food. This is similar to the suggestion by Lovaas (1968), for it is then possible to quickly follow a correct response with a reinforcer. There seems to be the possibility, however, of creating confusion for the child as he may not discriminate as to whether he is naming the stimulus object or the food reinforcer which is held up simultaneously. Within the same study the authors used pictures with at least two of the subjects, although the results of these subjects were not differentiated from those trained with objects. The only rationale offered was in the case of a blind child who was trained using objects in order to utilize the tactile cues of the three dimensional stimuli. Subjects who participated in the study each acquired tacting responses although rate of acquisition varied somewhat. Since direct comparisons were not attempted, and since different types and sizes of targets were used for each subject, an

accurate comparison and analysis of the acquisition rates of those subjects learning tacts with objects and those learning with pictures is impossible.

Sherman (1968) has used pictures of common objects to expand the vocabulary of a previously mute psychotic from a single word to a ten word naming vocabulary including "ship," "dog," and others. The technique used was similar to the one used with non-verbal children in which the subject is taught verbal imitation prior to object naming (Hewett, 1965; Lovaas, 1968). After learning names of targets on pictures, the subject was also taught the names of various reinforcers which were presented after he supplied the correct tact.

A different technique has been employed by Stark, Giddan, and Meisel (1968) as they used 3" x 5" cards on which letters representing sounds were placed. These were shown the child while he was imitating the particular sound produced by the therapist. The therapist then faded the imitative stimulus, so that the subject would emit the appropriate sound when the card was presented. After learning single sounds and consonant-vowel-consonant combinations the cards for these sounds were paired with both pictures and objects. The sound cards were gradually faded until the pictures or objects alone elicited the appropriate tact. Within an eight month training period of one 75 minute training session five days a week, the subject attained a vocabulary of 30 nouns including some that had four phonemes. Again, since this

was simply an intensive case study, the primary conclusion is that a viable tacting repertoire can be acquired using this method of training, but the comparative efficiency of this as compared to other methods using other slightly different techniques is not possible.

A study by McLean (1970) used a similar technique, but transferred stimulus control from an echoic stimulus to a picture then to a printed word, reversing the pattern set in the Stark, et al. (1968) study. The authors remarked that the transition from one type stimulus presentation was "remarkably easy," but that rates varied across subjects. They recommended further extensive research into the variables associated with this transition.

Complex responses can be attained in subjects following a language training program which employs pictures to teach tacting responses. Risley and Wolf (1966) have used such stimuli with echolalic children reported that the children were eventually able to learn sentences and other complex forms.

Summary and Purpose of the Study

The language acquisition literature has shown that non-verbal children with a variety of physiological and behavioral disorders can acquire a repertoire of vocal-verbal behavior. Through the use of a fairly rigid training paradigm which includes five basic components, children acquire language skills which should enable them to communicate to some extent in a

normal environment. One of the most critical of these components involves "tacting" which includes the transfer of stimulus control from verbally modelled stimuli to control by an object in the environment which is named. Unfortunately, most of the variables involved in this acquisition process have not been empirically investigated. One of these variables includes mode of presentation in terms of efficiency of training and generalization to other stimuli. In connection with this variable, several questions may be raised. One of the most important questions asks if one mode of presentation requires fewer trials than another for the child to reach the same learning criterion? A second question would be does learning a single mode increase generalization to the other modes? The empirical investigation of these two issues will raise a third question. Can such research have clinical relevance in terms of improving this particular component of the language training paradigm, thereby making language acquisition more rapid? It is the purpose of the present paper to answer these questions, thereby improving the tacting component of the language training paradigm.

METHOD

Subjects

The subjects for this study were six day-training students at the Henry Wiseman Kendall Center in Greensboro, North Carolina. Each subject was observed informally for a period of at least two weeks by two psychologists and a speech therapist to detect the child's ability to name (tact) stimulus objects. Such ability would eliminate the child from the subject pool, though several did exhibit the ability to emit random vocalizations. Tacting also occurred randomly, but was not under the stimulus control of parents or therapists with whom the child comes in contact. In other words, the children did not respond verbally to the question "What is that?" nor did they spontaneously identify objects in the environment. The mean chronological age for the subjects was 4.5 and all were functioning in the moderately retarded range. A comprehensive description of each subject may be found in Appendix A.

Materials

The stimuli for the study consisted of fifteen target words which had a single syllable and were the names of objects found in the day care environment at Kendall Center. A list of fifty common objects was compiled by the special education teacher from which the fifteen targets were selected

on the basis of their phonemic similarity by the speech therapist. The words which comprised the final list included: ball, bird, doll, soap, broom, cup, can, pen, dog, mop, rope, bell, ring, block, and watch. These fifteen stimuli were shown to the subject by three separate modes of presentation during baseline and probe conditions. One mode was "object" which consisted of presenting a three dimensional object to the subject by holding it 24 to 36 inches in front of his face. For each object, a 35 mm Kodacolor slide was prepared. The "slide" mode consisted of projecting the slide on a wall 36 inches in front of the subject, the projected size being two feet four inches on each side. The third mode of presentation was "picture." Each of the slides was made into a 3 by 5 inch glossy print which were mounted on pieces of 8 by 11 inch white paper by means of transparent adhesive tape. These stimuli were presented to the subject by holding them 24 to 36 inches in front of his face. Modes of presentation were randomized in all conditions so that the same mode never appeared successively. A description of the objects used in the study is included in Appendix B.

Setting

The center from which the subjects were chosen is designed to habilitate developmentally disabled children ages two through 15 utilizing a behavior modification treatment program. Each subject had a behavioral prescription which outlines a very structured treatment program designed to

increase the repertoire of adaptive behaviors for each child. All children used as subjects in this study had the development of a verbal repertoire as a primary treatment objective.

The room in which the experiment was conducted was "L" shaped and contained only those items necessary for the experimental procedures. The lower "leg" of the "L" was partitioned off by a wooden screen so that the actual dimensions were 6 by 8 feet. There were two chairs and a trapazoidal table in the room which faced the wall to the left upon entering. Directly behind the subject and the therapist (as they faced the wall) was a 24 by 30 inch one-way mirror through which the data-collection team watched and from which the slides were projected. This arrangement prevented unnecessary distraction since neither the noise produced by the slide projector nor the visual or auditory stimuli of the observers was discernible. The data-collection team could hear the responses transmitted via a Sears, Model 3-3462, wireless, two-way intercom system. There was some distortion in sound reproduction, but little reported difficulty in understanding subjects verbal responses. This was verified by the high degree of reliability recorded by the two observers in the observation booth, and between the therapist and the two observers.

The therapist could control presentation of the stimuli in the therapy room by means of a remote control device connected with the projector, and by hiding pictures and objects

under the table out of the subject's field of vision. Slide presentation was additionally controlled by switching the room lights on which effectively "washed out" the slide image projected on the wall. All slides, pictures, and objects were presented approximately 24 to 36 inches in front of the subject.

Instructions to Observers

Observers were four undergraduate psychology students who volunteered to record data for the length of the study. The same therapist was used for all subjects and also was responsible for data collection during the baseline and probe conditions while presenting the stimuli. Observers were instructed in a baseline and training session during pilot conditions. Each was then asked to demonstrate their competence by coding a data sheet in accordance to a series of child responses. When reliability was 85% or better, the trainee was included as an observer for the present study. Responses were recorded continuously during each baseline and probe session with each observer recording both number and kind of response (correct, incorrect, or no response). During training, observers recorded the number of verbal prompts necessary to teach a specific response.

Reliability

Reliability was calculated on all baseline and probe conditions. Reliability was also recorded on random training sessions by two observers behind the one-way mirror. The

therapist was not aware of those sessions on which reliability was calculated, and as a further control each session was audiotaped. This audiotape was played for two "blind" observers who also scored data sheets in the same way as the other reliability checker. A comparison of these two revealed only an 8% disagreement. All reliability coefficients were expressed as percentage of agreement, defined as number of agreements divided by the number of disagreements plus the number of agreements.

Experimental Conditions

The design of the study called for a baseline condition, a training condition, a probe, a retraining condition, and a final probe.

Baseline

During the baseline condition, each of the nine experimental target stimuli and six control stimuli were presented to the subject by three modes of presentation: slides, pictures, and objects. These 45 different target-by-mode combinations were randomized so that neither the same mode nor the same target word (in different mode) were presented successively. A baseline presentation consisted of the therapist showing a subject an object, picture, or slide within a 30° visual arc directly in front of the subject while saying "What is that?" Each target was presented for five seconds, removed for a three second inter-response interval, then represented. This procedure was followed five

successive times for each target for all 45 target-by-mode combinations. The baseline condition was conducted during a single session which averaged about 60 minutes across subjects. A five minute break was scheduled after the first thirty minutes. If the subject answered correctly within the five-second interval, both the therapist and reliability checker behind the one-way mirror (listening via the intercom system) scored a check mark (✓). If there was an incorrect response an "X" was scored. If there was no response within the interval, a "O" was scored. Reliability, calculated on all baseline conditions, was 99.1%.

Training

During the training phase of the study, the nine experimental target stimuli were presented, three targets by each of the three modes. Thus, all nine target stimuli were presented, e.g., picture can, object pen, slide cup, object bell, slide ball, picture doll, object bird, slide mop, picture dog. These stimuli were randomized with the condition that the same mode was never presented successively. To prevent an order or mode effect across subjects, the mode-by-target presentation was changed for each subject. Additionally, for each subject, the order of presentation was changed daily. Since generalization was a dependent variable the target-by-mode presentation was constant within a subject. The training procedure used was one in which the therapist would present the target using the prompt "What is

that?" If there was then a correct response to the prompt, the subject would receive both praise and bits of food (Froot Loops, M & M's, etc.). If there was an incorrect response, the therapist said "No," paused two seconds and then presented the target word. If there was no response the therapist simply paused, then prompted or partially prompted the target word (e.g., "b..."). Approximations or correct imitations were followed by praise and bits of food. Data collectors recorded two classes of training presentations, the number of imitation prompts (e.g., "ball" or "b...") and the number of tacting prompts (i.e., "What is that?"). These were summed to produce the total number of trials-to-criteria. (The two classes were used clinically to evaluate the needs of the child in terms of a post-experimental treatment program to continue language acquisition.) The criteria for each target was five successive correct responses when prompted by the tacting prompt, "What is that?" The five-in-a-row criteria had to be met on two successive days before the next word was trained. If the five-in-a-row criteria was met during the session for a target, then a second target criterion was met or the 40-minute time limit for the session expired. Only targets for which the subject had not met criteria were used. Only during retraining were words that had been trained to criteria reviewed. After all nine stimuli had been trained to criteria, this retraining session was begun to compensate for the time between the training of the first and

last words on the list. The criterion for completion of a retraining session was that all nine target words reached a five-in-a-row criterion within the 40-minute session. For subjects who learned quickly, it would be possible to do both training and retraining on successive sessions. Reliability on the number of trials coded was taken on an average of every other session and was 95.4%.

Probes

The session following the initial session in which retraining criteria was reached was designed to probe for retention and generalization from the training sessions. The baseline data sheet which consisted of all nine experimental targets and six control stimuli presented by each of the three modes of presentations (45 different target-by-mode combinations) was used to ascertain the generalization from training stimuli. The control stimuli were used to see if increased exposure to the discriminative cues of the experimental procedure produced a nonspecific increase in tacting. Any increase in tacting these stimuli could not be attributed to training since these stimuli were never trained. Again, each stimulus was presented five times along with the question "What is that?" A correct response within three seconds was followed by "That's right"; an incorrect response was consequated by the experimenter turning away for 3 seconds; and a failure to respond was followed by a pause prior to another presentation of the object and the "What is

that?" prompt. Scoring was identical to that conducted in the baseline condition. Reliability was calculated for initial probe sessions and was 98.0%.

After the probe 1 was completed, subjects were returned to a training procedure which was maintained until a second criterion was met. This criterion was a correct response to the "What is that?" prompt five times in succession on two separate presentations during the 40-minute session. At the session after this criterion had been met a second probe was made to determine if "over-learning" affected either retention or generalization. (Clinically, the series of such criteria could be indefinite and depend largely on the rate and level of acquisition.) Most subjects improved steadily as a function of more demanding criteria, and probe data provided an efficient means of determining which mode was most effective for longer range language acquisition and generalization.

Experimental Design

Several types of data were available for analysis. The total number of correct responses on baseline and probe conditions provided feedback as to the general progress of the subject in terms of the improvement in the total number of appropriate tacting responses regardless of mode of presentation. Closer analysis revealed the percentage of improvement for each of the three modes. The training data (number of trials and amount of time to criteria) also revealed information about the efficiency of the modes of training, i.e., did

it take more trials (and/or time) to train slides, objects, or pictures? Finally, analysis of the probe data provided the most efficient mode of presentation in terms of generalization, i.e., did "objects" that were learned during training "generalize" in the sense that those targets that were trained as objects were responded to more accurately in the other two modes during probes?

In order to determine if there was an effect due to the mode of presentation, the number of trials needed for acquisition for each item was entered under the appropriate mode and analyzed via a completely randomized factorial design (Kirk, 1969). Even though each pair of subjects received a different combination of target-by-mode presentations, this factor was made negligible by the target's equation on the basis of familiarity and degree of phonemic difficulty. Furthermore, the target-by-mode combinations were varied and order effects were controlled experimentally as the order of presentation was changed for each day's training. Multiple comparisons for carrying out pairwise distributions among means were accomplished via Tukey's HSD test (Kirk, 1969, p. 88). This is a powerful test designed for making pairwise comparisons between a relatively low number of means.

A comparison was made between the improvement score from baseline to probe 2 for congruence of training and test mode versus the average for the two modes not congruent. For

example, if a target (such as ball) was trained as an object, the score compared was the difference between correct responses on baseline and correct responses on probe 2 for the object ball versus the average of the same difference for ball presented as a slide and as a picture. An analysis of the least difference between gains on these two scores was accomplished through an analysis of variance and a comparison of the means using Tukey's HSD test. The raw data utilized consisted of the improvement in the number of correct responses on slides and pictures after being trained on objects; the improvement in objects and slides after being trained on pictures; and the improvement in pictures and objects after being trained on slides.

RESULTS

In order to determine the general effects of the treatment procedures, the percentage of correct responses on experimental targets during baseline for all six subjects was compared to the percentage of correct responses on each probe condition. The control targets, which were presented at baseline, probe 1, and probe 2 are also represented in Figure 1.

The percentages in Figure 1, reflect the fact that the subjects increased from an average of 134 correct responses on the experimental targets to 445 on probe 1 and 627 on probe 2. This represents a percentage increase of 16.5% to 54.8% to 77.4% or a total increase of 60.9%. The control targets, which were never shown during training, varied from a total of 16.4% during baseline to 21.1% at probe 1 and 12.3% at probe 2, for a net decrease of 4.1%. A t test for correlated observations showed that the difference between the increase in the experimental targets was significantly greater than the increase in control targets (t (5)=11.54, $p<.001$). Figure 2 demonstrates that all three modes showed a gain in the total number of experimental targets correct.

The total number of trials that were necessary for all six subjects to acquire targets from each of the three modes is illustrated in Figure 3. These totals include all training

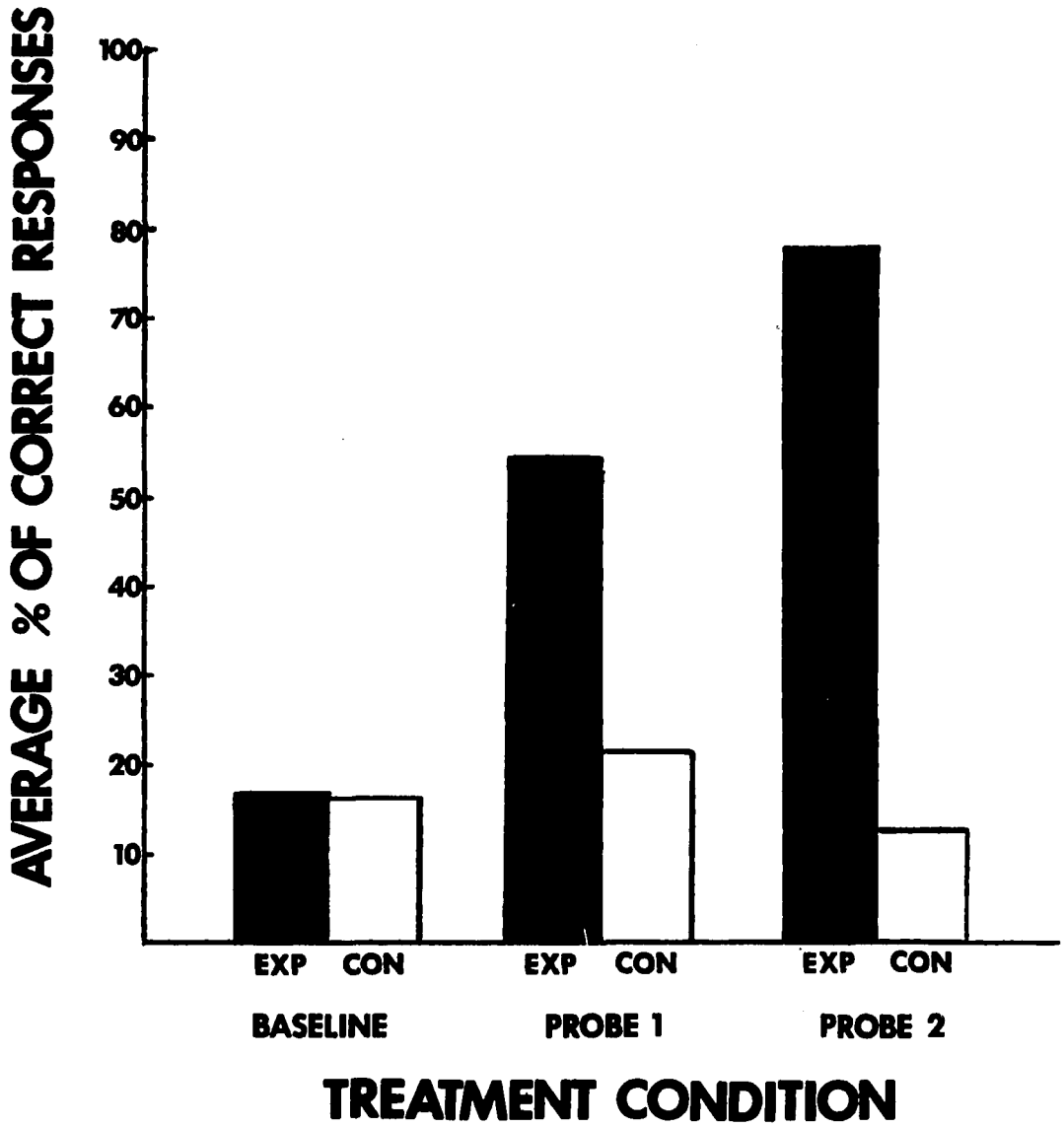

Fig. 1. Average % of correct responses on experimental and control stimuli for baseline, probe 1, and probe 2.

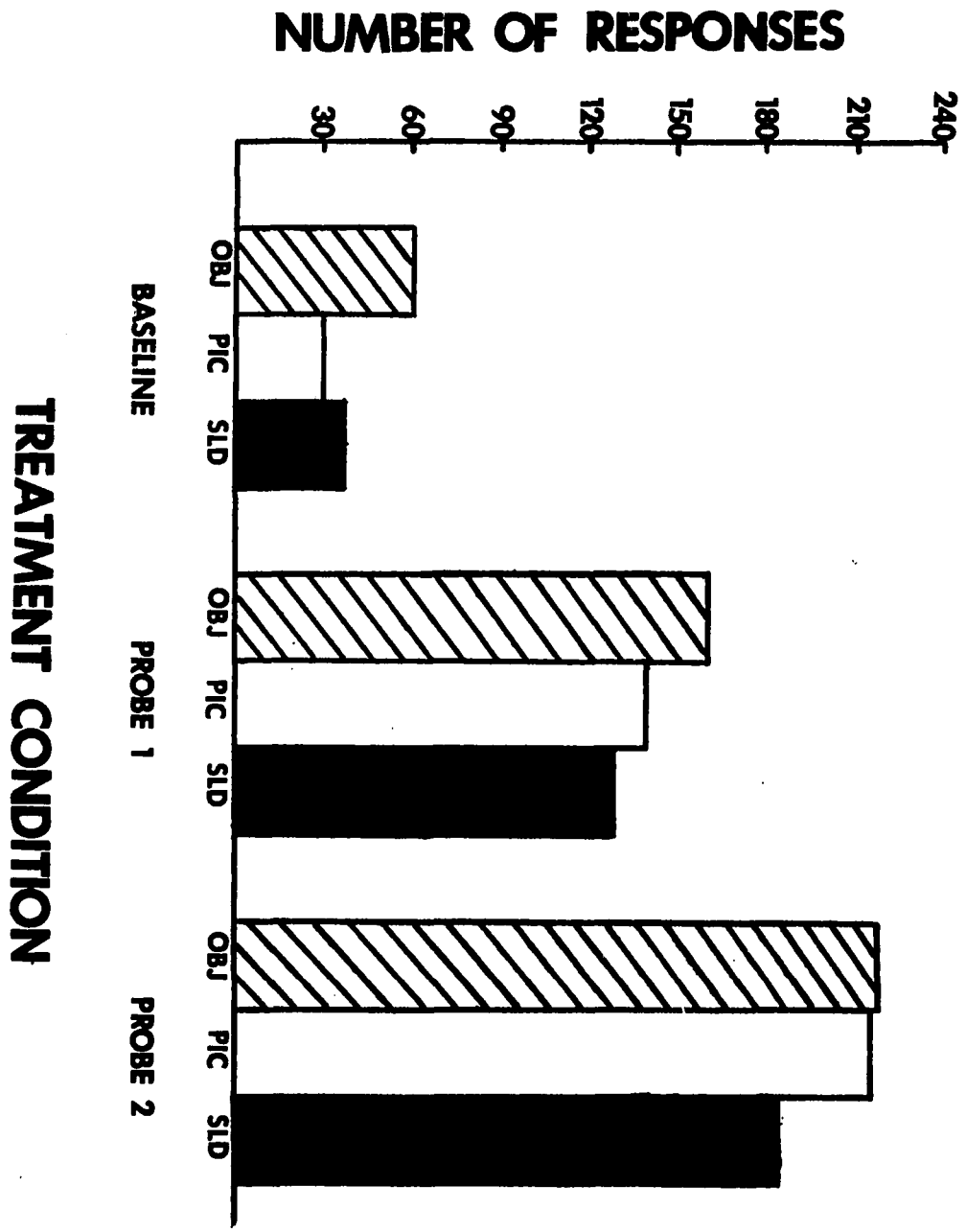

Fig. 2. The number of correct responses for all subjects for all three modes on baseline, probe 1, and probe 2.

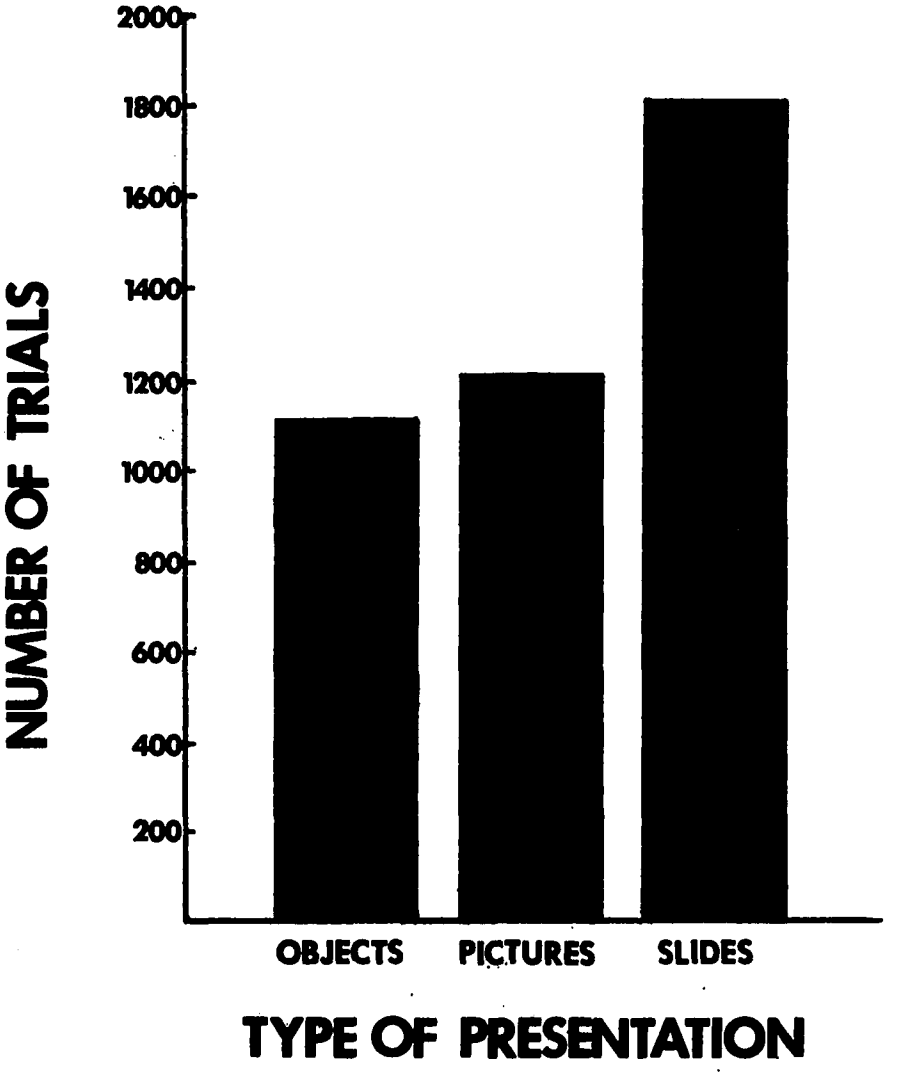

Fig. 3. The total number of trials that were necessary for all six subjects to learn three objects, three pictures and three slides.

presentations prior to both probe 1 and probe 2 and represent training on three objects, three slides, and three pictures for each subject. A randomized factorial design was utilized to determine if these graphic differences represented a significant difference between modes of presentation. The summary table with results of this design is presented in Table 1, and shows that there was a difference at the .05 significance level in regards to mode of presentation. Item differences were not significant as predicted due to their phonemic similarity, equation in terms of previous availability in the environment, and the randomization procedures which insured that the mode-by-target representation was alternated for every subject. Further analysis by means of the Tukey's Highest Significant Difference (HSD) test comparing the means, shows slides were the least efficient in terms of requiring a higher number of trials to criterion during acquisition. By comparing this analysis of the means, and referring the graphs in Figure 3, it can be seen that objects and pictures needed significantly fewer trials for acquisition than did slides. Another representation of this is found in Figure 4, in terms of individual differences. In this figure each subject's acquisition data is plotted for each of the three modes to illustrate the similarity in terms of acquisition trials. The amount of variance accounted for by the mode variable was 10%.

An analysis of variance for the generalization data also

TABLE 1

Analysis of Variance on the Total Number of Trials to Criteria for Objects, Pictures, and Slides

Source	SS	df	MS	F
A (mode)	15,024	2	7,512.0	3.67*
B (order of presentation)[a]	240	2	120.0	N.S.
AB	1,390	4	347.5	N.S.
w/cell	90,006	45	2,000.13	
Total	106,660	53		

[a]Irrelevant factor necessitated by the random order of presentation and the changing of target-by-mode order for each subject.

*$p < .05$

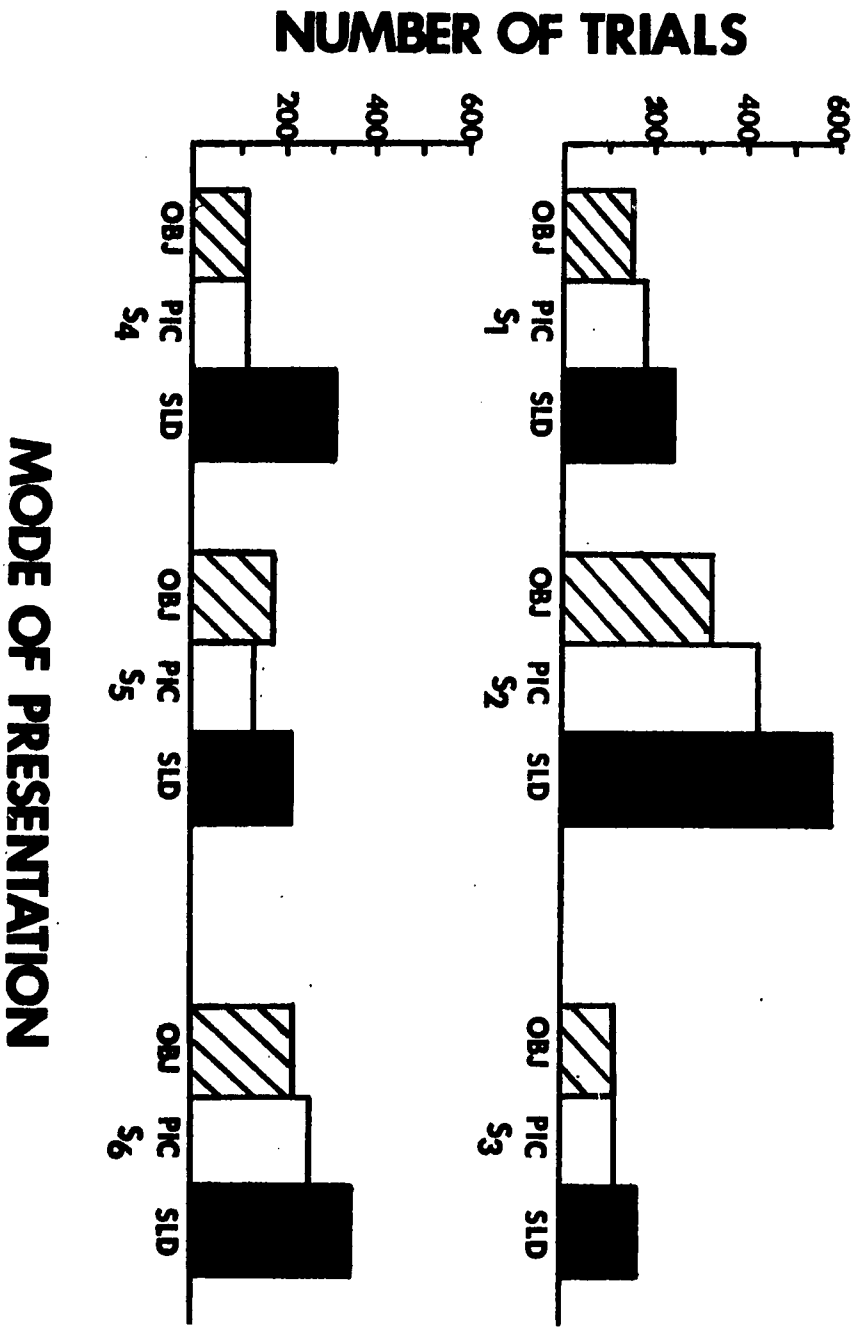

Fig. 4. Individual acquisition data for all three modes for individual subjects.

revealed a significant difference. The data used were the amount of target increases from baseline to probe 2 for the two non-trained modalities. Probe 2 was chosen to insure that all subjects were performing at the same learning criteria. The increasingly demanding criteria, the most rigorous being immediately prior to probe 2, helped to insure this equality as well as providing additional acquisition trials. An example of the sequence from which the data were collected would be as follows. The subject was trained on slide ball, then the amount of improvement (from baseline to probe 2) in terms of the number of correct responses to the presentation of the object ball was added to the number of correct responses on the picture ball. This improvement score was added to improvement scores from the two other modes. A comparison was then made between the improvement after learning slides, after learning objects, and after learning pictures. Alternating subjects were trained on different target-by-mode combinations, so that if subject 1 received presentations including slide ball, slide cup, and slide dog, this prevented a target-by-mode confounding. Results from the analysis of variance are presented in Table 2. These indicate that there was generalization effect in that training in a particular mode enabled the subject to respond correctly to presentations in a different mode. A Tukey's pairwise comparison of means indicated that means from the slide condition significantly exceeded both objects and

TABLE 2

Analysis of Variance of Improvement Scores of Trained Versus Untrained Stimuli

Source	SS	df	MS	F
Total	988.00	17		
SS Between	466.34	2	233.17	6.70*
SS Within	521.66	15	34.77	

*$p < .05$

pictures. Figure 5 is a graphic representation of these results. This illustrates a superior generalization from training on slides, while generalization from training on pictures and objects were very nearly equal. Better overall improvement in the picture and object mode is also illustrated in Figure 2, where all three conditions are visible.

Individual t tests were also performed to determine the differences in performance of individual modes. The results indicated that performance on objects was greater after training on slides than after training on pictures (t (17)=10.49, $p < .01$); performance on pictures was also greater after learning slides than after learning objects (t (17)=51.0, $p < .01$); and performance on slides was greater after learning on pictures than after learning on objects (t (17)=50.0, $p < .01$).

In order to determine if generalization was affected by the amount of training subjects had received during the acquisition phase, an analysis of covariance was performed. The covariates were the number of trials to criterion during acquisition for individual subjects and the concomitant increase in the number of correct responses from baseline to probe 2. The summary data in Table 3 show a significant difference in the improvement scores by modes after the differences due to acquisition exposure has been partialed out. The raw data for all conditions are found in Appendix C.

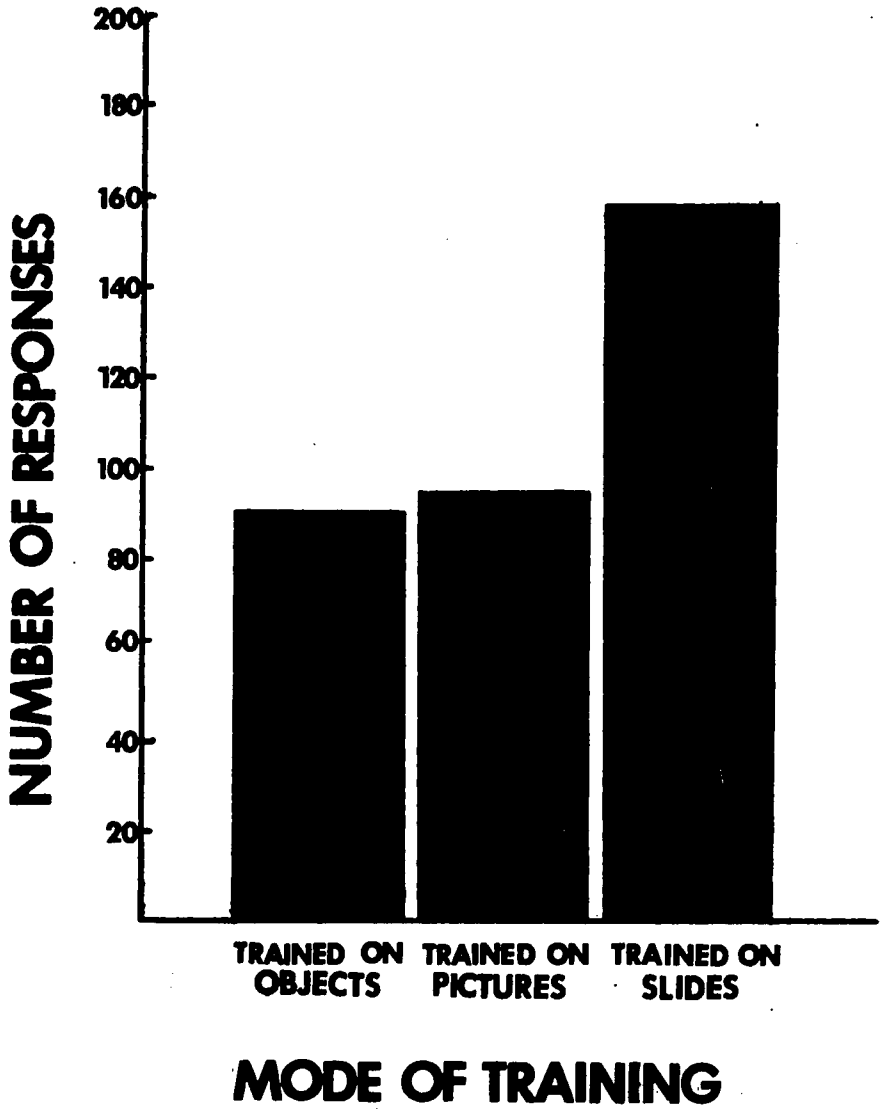

Fig. 5. The difference between the number of correct responses on untrained stimuli at baseline and the number of correct responses at probe 2.

TABLE 3

Analysis of Covariance of Acquisition and Generalization Totals

Source	SS	df	MS	F
Between Groups	201,305	2	105,152.5	6.30*
Within Groups	233,423	14	16,673.0	
Total	434,728	16		

*$p < .01$

DISCUSSION

The effects of the language training procedures for retarded children as outlined by Lovaas (1968) and Risley (1966) and utilized by many others (Sloane & MacAulay, 1968; Buddenhagen, 1971), are seldom disputed as being a viable vehicle by which non-verbal, retarded children can acquire a vocal verbal repertoire. Accordingly, there is evidence that the children in the present study acquired the capability to name the target stimuli as a function of the training procedures.

In order to determine if the exposure to the discriminative cues of the experimental training procedure might elicit a generalized tacting repertoire producing an increase in tacting, both training stimuli and control stimuli were presented to all subjects during baseline and probe conditions. Increased tacting on untrained control stimuli would also occur if parents or others reinforced their tacts and thereby expanded the child's tacting repertoire, thus creating a response class of tacting (Nelson, 1969). There was no gain in the six control stimuli, thereby indicating the child's increased ability to tact was specific to the stimuli for which he had received training. This result is illustrated by the data concerning the control stimuli which showed a net decrease of 4.1% while the experimental targets increased 61%.

An additional explanation for this difference is that the training procedure occurred over a relatively short period of time, averaging about three weeks per subjects. The data clearly indicate experimental targets increased from baseline to probe 1 and from probe 1 to probe 2, while the controls did not increase over this same period.

Acquisition

One of the main functions of the present study was to determine the most efficient mode of presentation which could be used to teach non-verbal children tacting. Prior to this study, the selection of the mode has been primarily a function of ease of presentation (Nelson & Evans, 1969) or availability of the stimuli as reinforcers (Lovaas, 1968). The appropriate rationale for choice of mode should be on the basis of experimental evidence which indicates that one mode is attended to more easily, or that one mode can be used to elicit responses more accurately or more consistently than another. The results indicate that the particular population of non-verbal children in the present study was able to learn objects more easily than slides or pictures. Lovaas (1968) had used objects in the form of bits of food that the subject was to name (e.g., "bacon"). These were chosen due to the quickness by which the child could then be reinforced. The difficulty in enunciating the multiphoneme word was hypothetically overcome because the bacon could be quickly given the child after it was named. Since no foods were included in the list of objects to be named

here, this explanation is not pertinent to the present study. Furthermore, the subjects did not receive the same target-by-object presentations, so that an effect cannot be completely target specific, but rather can be assumed to be mode specific. An interpretation is that some feature of the object mode made this mode easier to acquire than the slide or picture mode.

A reasonable post hoc hypothesis for the superiority of objects might be the subjects' familiarity and contact with stimuli of this type in their environment. The subjects live in environments where the predominant modality with which they come in contact is three dimensional, including both the day care environment from which the particular stimuli were selected, as well as the home environment. As stated before, the subjects in the present study had not been observed to tact the target stimuli prior to training. It is not possible to rule out their exposure to the targets however, nor does it guarantee that the child's learning history is one in which an equal number of slides, objects, and pictures had been presented. It was not the purpose of this aspect of the study to control for these variables. Rather, it was intended to take a sample of non-verbal children who may be assumed to have had learning histories comparable to those of non-verbal children used in studies in which modes of presentation have been chosen randomly, and to determine whether this sample responds to a particular mode of stimulus presentation more efficiently.

Other factors besides the three dimensionality of objects

which may have contributed to the superiority of objects. The size of the objects was typical of the size of stimuli of this type in the environment. The size of the objects depicted in the pictures on the other hand was necessarily reduced by photographic processes. This factor may have been somewhat offset by the potential familiarity many non-verbal children have with pictures (Sherman, 1968) which will be discussed later. Since the slides were projected on the wall in front of the subject, the size of these stimuli was much larger than the objects or pictures. Another possible reason objects might have been superior is that the tactile cues from objects would have made them more discriminable, while pictures and slides do not have tactile cues to which the child can respond. This potential cue was controlled for within the confines of the experimental procedures by not allowing subjects to touch the targets, but they certainly had had experience in handling objects prior to this study.

The data reveal that pictures, though not significantly different from objects, had significantly lower mean than did slides. As mentioned previously, there is a greater likelihood that the subjects had not become familiar with slides in their environments. Furthermore, most parents use objects and pictures, rather then slides, to teach their children to tact. The Peabody Picture Vocabulary Test, which was employed to measure the receptive language abilities of the subjects, uses pictures to which the child points to determine what stimuli

the child knows. Most of the subjects in the present study were very poor in terms of pointing to the correct target, indicating pictures were generally not a strong mode (prior to the experimental procedures) for this sample population. The pictures used in this design were unlike those typically used by parents or test administrators in that they were glossy color photographs whereas most typical training pictures are not photographs, nor are they always in color (e.g., the pictures used in the Peabody).

The least efficient mode of presentation was slides which took significantly more trials to acquire than the objects modes. Several explanations of this finding are possible. Perhaps the most obvious is the lack of exposure most of the subjects had to slides prior to the experiment. Few had seen isolated objects in slides and few of the parents of the subjects reported that the children had ever seen slides. Reiterating, this factor (amount of pre-experimental exposure) was not controlled, but was felt to be a factor typical of this mode of presentation and one not taken into consideration when this mode is chosen for use in other language acquisition procedures. The strongest argument in the literature concerning slides has focused on the reduction of potentially interfering stimuli because of the darkened room. This argument is somewhat misleading, however, because of the amount of light produced by the beam of projector light. There is sufficient light to provide illumination of any reflecting

surfaces such as walls, tables, and therapists. There is, however, some question as to the sufficiency of this light to maximize the visual cues used by the therapist in a fully lighted environment. Most language acquisition procedures emphasize or exaggerate the model's oral structures which are thought to be critical to the subject as he learns an imitative repertoire (Metz, 1965). Buddenhagen (1971) also points out the fact that although auditory cues are of extreme importance in language acquisition, visual cues are more important. In his research, after a subject learned to imitate, the acoustic cues were dropped and the subject's imitations were prompted by pantomimic (mouthed) models. His directions to maximize these cues were followed in the present experiment and are outlined as follows:

> First of all, models were not presented until the subject was looking at the experimenter. Secondly, the models were accompanied by a change in the experimenter's posture: the experimenter leaned closer to the subject and tilted his chin slightly upward, so that there would be no chance that the experimenter's lip and jaw movements would be obscured. Finally, the models were frequently accompanied by exaggerations or distortions of the relevant visual cues (p. 140).

These cues were gradually faded to the point that only minimal visual prompts were necessary. Due to the limited illumination of the therapist's mouth, the subjects in the present study may not have been able to pick up these critical visual cues. Although there was no formal measurement, the children did seem to attend to the slides quite well since they were

both bright and vivid. The problem was that the therapist was unable to position herself between the child and the presentation to demonstrate oral positions because she would have blocked part of the presentation. The vivid nature of the slides might also have been a problem. The brightness seemed to cause a delay in responding as the children often stared at the brightly colored targets for long periods of time before answering the "What is that?" prompt. Again, these are anecdotal and no data were collected to indicate the extent of the response latency of slides as compared to the other modes.

Generalization

Lovaas (1968) and Risley and Wolf (1968) both state that one of their primary goals in language training with a non-verbal population is to insure that their subjects can respond verbally to a variety of verbal and non-verbal prompts in a variety of situations. This variety of responding is called generalization and is important for several reasons. First, the ability to respond to a variety of prompts hopefully broadens the base of the language capabilities of the child. Questions about objects could be either less complete or more complex than simply "What is that?" The subject may have to respond to a partial prompt such as someone pointing to an object. The object itself may be of a different shape or size, or there may be a multiple prompt asking for the name and the number or location. Neither will the subjects

be responding to a single familiar therapist, in a small barren room, containing only one stimulus object at a time. It is more likely to be a stimulus included among an array of stimuli and presented in a noisy, crowded environment.

The first step in training generalization is to introduce a stimulus similar to one already within the child's repertoire, but differing in one dimension such as shape. The present study sought to explore this aspect of generalization and to determine the overall efficiency of the different modes of training by means of a second measure incorporated into the experimental design. Since the subjects were presented stimuli in both untrained modes at probe 1 and probe 2 it was possible to determine if the training in the trained mode was effective enough to enable the subject to respond to the same target in a different mode. The results indicate that there was a significant difference between the modes. The individual t tests indicate that slides were superior in terms of generalization. Targets that were learned by means of slides were more often correctly labeled when later presented as objects or pictures. This is confirmed by the test for the differences between the means of a combination of individual groups which was also significant. This result may be interpreted as indicating that although slides are more difficult to acquire, this increased difficulty is compensated for somewhat after their acquisition. This finding is especially important since slides would typically be used more for intensive training,

while parents and teachers would rely more heavily on objects and pictures due to their availability in the environment. Another possible variable in the generalization effect is the dimensionality of the targets. The available data concerning generalization indicate that unless several specific procedures are followed, including systematic training on multiple stimuli, or gradual fading from one stimulus situation to another, generalization will be severely limited (Walker & Buckley, 1972). Additionally, an important variable for generalization is the similarity of discriminable stimuli available in the two situations. This similarity may either be stimuli connected with setting in general or to specific aspects of the stimulus environment that are outstanding and demand attention (Baer, Wolf, & Risley, 1968). In the present study there were several intermodal similarities to account for generalization, e.g., the color and shape of the target stimuli, the position of the physical properties of the room, and the therapist who was the same for all subjects.

There are several possible explanations for the fact that presentations shown as slides were significantly superior to the objects in terms of generalization. One is that after learning a two-dimensional stimulus such as slides, being asked to respond to another two-dimensional stimulus, such as pictures though in a different mode, is considerably easier. Objects however must generalize to two different-dimensional

modes, while slides and pictures had to generalize only to a single different-dimensional mode. There is some problem with accepting this explanation however, since pictures should have shown a concomitant increase in the number of trials necessary to reach criterion.

Another factor that may have influenced generalization concerns the testing environment. During picture and object trials, the lights were on to insure maximum visibility. These were subsequently turned off to allow for slide presentations, offering a very distinct and unique visual cue as to what mode of presentation was forthcoming. Subjects were observed to laugh and become more active after this sudden change, and as noted previously, took somewhat longer to respond. This latency could possibly be attributable to the physiological adjustment to the light differential, and may have caused a reduction in correct responses to slide targets during baseline and probes.

The lighting may have effected generalization in another manner as well. Heinemann and Rudolph (1963) have noted the importance of the number and visibility of cues in a generalization experiment using pigeons as subjects. Their results indicated that generalization was greatly effected by the number of cues present prior to tests for generalization. The relevance to the present study is that trials necessary for acquisition of slide presentations were possibly increased due to the absence of the visual cues from the model's

oral structures. However, as in the Heinemann and Rudolph study, generalization would be impaired to this mode after having learned via objects and pictures, since a greater number of cues were available during training but were absent when testing included the slide mode. On the other hand, after learning via slides, generalization to objects and pictures would be easier since additional visual cues not present during acquisition would now be present.

A possible explanation of the increased generalization of slides due to more trials for these during acquisition was statistically analyzed by the analysis of covariance. From the results reported there, it was determined that the amount of trials necessary to acquire tacting responses did not bias the generalization data significantly. Thus, the most feasible hypothesis concerning the results is that variables, such as increased visual cues or the discriminative cues of the stimulus situation, or a combination of these cues, contributed to the treatment effects. More intense investigation, in which these particular variables were independently manipulated, would be necessary to draw more parsimonious and explicit conclusions.

CONCLUSIONS

The primary goal of the present study was to analyze in some detail and hopefully improve one component of the language training paradigm presently in use (Buddenhagen, 1971; Sloane and MacAulay, 1968). To accomplish this goal, a sample of non-verbal children was chosen who had completed the necessary preliminary steps of attention (Look at me," etc.), gross motor imitation ("Clap your hands," etc.), fine motor imitation ("Touch your mouth,", etc.) and verbal imitation ("say b," "ball," etc.). These steps were equally as complex as the tacting phase, but were not specifically altered or investigated in order that all the subjects might have similar training. The basic implication in the present investigation of the tacting phase was not simply that objects were superior to pictures and slides in terms of the number of trials to reach criteria, nor that slides were somewhat better in terms of generalization. The important issue is that one of the components has been closely analyzed to determine what variables were critical to this aspect of the language training "package". In addition, several new variables emerged as being potentially important. One was the amount of lighting necessary to allow the subject to see the therapist's face if the visual cues from the therapist's oral structures were indeed critical to the

acquisition process. Secondly, what was the importance of the increased amount of attention subjects seemed to pay to slide presentations and what were the variables (brightness, size, color) that possibly are responsible for this increase.

Accordingly, the difficulties encountered in matching and randomizing target stimuli on the basis of phonemic difficulty and familiarity indicate the need for replication using a similar subject population with a different experimental design. It would be equally difficult to match subjects in a yoked design in which one group was trained on slides, one on pictures, and one on objects, but confirming results would support the conclusions drawn on the basis of the present data. Such a yoked design would prevent target-by-mode confounding and make randomization much less complex. It would still be possible to measure generalization and acquisition, but matching subjects would be extremely precarious. The factors of chronological age, sex, mental age, language abilities, and clinical diagnoses should be controlled to eliminate these as confounding variables.

Conclusions based on the specific results should be viewed with some caution. The size of the population and the acknowledged importance of individual learning histories necessitates a careful analysis of the results. The fact that labels were more difficult to acquire but more easily generalized from training on slides, indicates that the proposed (Nelson & Evans, 1969) justification for using them is

somewhat verified. The superiority in terms of acquisition for three dimensional objects, and the availability of these objects as well as pictures in the environment is certainly encouraging in terms of parent and teacher instruction in language acquisition for populations of non-verbal children.

Further relevance can be found in the overall acquisition rates which, while impossible to compare statistically to preceding studies, seem to demonstrate by their rapid linear progression that alternating presentation could improve many methodologies. It also explains the success of many language acquisition programs (e.g., MacAulay, 1968) which used different modes of presentation for different subjects depending upon the terminal goals. For instance, if the program is one designed to develop reading, the pictures of an object along with the symbols which represent the phonemic qualities of the object's name could possibly be alternated with the object itself accompanied by the symbols. If the goal is to have the child respond to a wide range of modalities, and rapidity of acquisition is not critical, then slide presentations should also be considered.

Again it should be stated that such conclusions must be viewed with consideration to the particular population that is being utilized. The present population was one which consisted of moderately retarded, non-verbal boys, chronologically between four and six, with a variety of etiological histories, and a learning history that included at least preparatory

training in those components many behaviorists feel necessary for rapid language acquisition.

A final experimental note is necessary in terms of the entire paradigm and the accusations by linguists referred to in the introduction of the present paper. It is certainly true that a single study will neither prove nor disprove the accusations of oversimplication and irresponsibility (Chomsky, 1957, 1959) that have been leveled at behaviorists and their programs. It is hoped however that the data here add to the growing number of studies that illustrate the effects of training on rate and direction of language growth. Together they place language in a position where description and prediction are possible, hopefully removing it from the realm of speculation and theoretical surmising.

In sum, perhaps the most important clinical aspect of the program was in terms of feedback that could be given to parents and teachers of the children. General information and instruction concerning how to teach object naming using the "What is that?" prompt was augmented by more specific information as to the tacting abilities and mode preferences of individual subjects. For instance, by looking carefully at individual data concerning the control targets, it was determined that subject three, "Paul" evidenced an increase on the untrained stimuli. It was felt that intensifying his training program in object names while deemphasizing receptive language training might result in the response class

of tacting in the very near future. Another example which was more common is illustrated by subject six, "Todd," who took almost 60% more trials to learn slides than the other two modes. His language prescription would then be changed so that his acquisition program reflected this preference. These specific clinical programs reflect the use of the immediate feedback from the individual data. This feedback, used in conjunction with the general conclusions concerning the modes, hopefully will increase the efficiency of this component of the language acquisition paradigm, providing a more thorough and complete program for non-verbal children.

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APPENDIX A

Description of Subjects

Steven was a five year old caucasian male who had a serious convulsive disorder which had begun after he had encephalitis and severe brain damage at age 2 1/2 years. He was extremely hyperactive and had lost the use of his left hand. The use of the left shoulder and left leg were severely impaired and upon entry to the Center, his speech was characterized by stuttering and lack of fluency. Upon entry, Steven could name a variety of objects in the environment spontaneously, but would not attend or respond consistently to objects when presented to him. Furthermore at the time he was included in the present study, frequent seizures and/or medication had severely limited all verbal behavior. Steven was functioning in the moderately retarded range and scored 22 on the PPVT while obtaining a score of 12 on the expressive subtest of the ITPA.

Tommy was a four year old caucasian male who exhibited "autistic-like" behaviors such as mannerisms of spinning, running in circles, poor social responses, and delayed speech. Speech when it did occur was repetitive and nonsensical. Tommy was reported to be functioning within

the moderately retarded range, and was unable to name more than a few objects consistently when the present study began, but had developed an extensive imitative repertoire during several months of intensive treatment. His raw score on the Peabody Picture Vocabulary test was 8 and was 3 on the expressive subtest of the Illinois test of Psycholinguistic Ability.

Paul was a caucasian male, three years and seven months old when the present study began. A brief summary of his evaluation included his having a seizure disorder currently uncontrolled by medication; organic hyperactivity; and mild retardation. Paul had a fairly extensive expressive vocabulary at the time of the study, although much was random and could not be elicited under controlled conditions. One exception to this was naming colors, but fortunately no colors were included in the targets. Paul had good self-help skills, improving motor development, and many appropriate social responses when he began the language acquisition study. His new raw score on the PPVT was 12, and his score on the expressive subtest of the ITPA was 2.

Junior was a caucasian male whose chronological age was exactly six years when he entered the study. He was born anemic with a cleft palate and suffered about a 40% hearing loss. He had adequate self-help and motor skills, but had severely delayed speech which reportedly caused

impaired intellectual functioning which had been tested to be in the moderately retarded range. Junior had not been observed to spontaneously tact objects in the environment though he was able to imitate many words. Because of the cleft palate, enunciation was poor, although most sounds could be produced in isolation. Junior was not overly active during the pre-training sessions, and scored 12 on the PPVT and 2 on the ITPA.

Billy was a four year old black male who was diagnosed as being hyperactive and non-verbal with the exception of jargon and other random vocalizations. Prior to using him in this study, he was given intensive training in verbal imitation and performed very well. Just prior to the present study, he was able to imitate two and three syllable words and could point to all body parts. Billy had no history of auditory or psychological pathology other than delayed speech. It was thought this delay was caused because both parents were deaf and were not able to provide adequate auditory stimulation. Billy scored 0 on the Peabody and 0 on the expressive subtest of the ITPA. He also had been assessed as functioning in the moderately retarded range.

Todd was a four year old caucasian male diagnosed as Downs' Syndrome. At the time of the present study he had an extensive imitative repertoire, good socialization and self-help skills, and adequate motor development. He

was functioning in the moderately retarded range of intellectual development and had acquired some tacts for body parts and articles of clothing. Todd did not spontaneously tact objects in his environment, nor had he been observed to tact any of the target stimuli. Todd, like many children with Downs' Syndrome, had great difficulty with articulation making it hard to interpret many of his verbalizations. Standardized tests such as the Peabody Picture Vocabulary test revealed a raw score of 7, while the score on the expressive subtests of the Illinois Test of Psycholinguistic Ability was 2.

APPENDIX B

Description of Targets

Ball	The ball was a white tennis ball without lettering or brand name.
Cup	The cup was a red, plastic cup which was three inches high.
Can	The can was a number 6 tin can which had no labels or markings.
Dog	The dog was a brown and white plastic bulldog which was 3 1/2 inches high.
Bell	The bell was 3 1/4 inches tall and had the clapper taped so it did not ring.
Bird	The bird was a green and yellow plastic canary which was 4 3/4 inches in length.
Pen	The pen was a black ball point which was 5 inches in length.
Doll	The doll was a 6 inch plastic doll which was in a sitting position.
Mop	The mop was a toy 39 inches long, with a wooden handle.
Block	The block was made of cloth, multi-colored, and 5 inches square.
Broom	The broom was also a toy broom and was 42 inches long.
Watch	The watch was a brown plastic toy, 4 1/4 inches long.
Ring	The ring was plastic, yellow and 3 inches in diameter.

Rope	The rope was a jump rope 36 inches long with blue handles.
Soap	The soap was yellow and 2 inches by 3 inches.

APPENDIX C

RAW DATA FOR ALL CONDITIONS

C-1

RAW DATA FROM EXPERIMENTAL AND CONTROL TARGETS ON BASELINE, PROBE 1, AND PROBE 2

	BASELINE		PROBE 1		PROBE 2	
	EXP	CON	EXP	CON	EXP	CON
S_1	32	9	98	6	115	8
S_2	7	10	37	18	81	14
S_3	64	53	134	65	126	63
S_4	17	17	96	19	115	15
S_5	12	0	51	6	97	0
S_6	2	0	29	0	93	0
Σ	134	89	445	114	627	100
$\bar{X}$	22.3	14.8	74.2	19.0	105.5	16.7

C-2

RAW DATA FOR ACQUISITION TRIALS FOR ALL SUBJECTS

ABS SUMMARY TABLE									
	OBJECTS			PICTURES			SLIDES		
S_1	35	30	47	22	53	37	52	54	49
S_2	59	78	42	64	45	26	91	62	55
S_3	40	53	54	43	56	76	61	87	80
S_4	46	39	36	51	41	30	130	85	85
S_5	87	84	47	122	66	53	133	90	94
S_6	61	84	179	118	135	171	191	171	215
	328	368	405	420	396	393	658	549	578
$\bar{X}$	54.67	61.33	67.50	70.00	66.00	65.50	109.67	91.50	96.33

AB SUMMARY TABLE			
	b_1	b_2	b_3
a_1	328	368	405
a_2	420	396	393
a_3	658	549	578
$\mathcal{E}$	1406	1313	1376
$\frac{\mathcal{E}^2}{N}$	109824.0	95766.0	105187.5

C-3

RAW DATA FOR GENERALIZATION AFTER LEARNING A SPECIFIC MODE

BS SUMMARY TABLE			
	OBJECTS	SLIDES	PICTURES
S_1	10	23	13
S_2	13	23	16
S_3	12	28	6
S_4	27	26	12
S_5	11	29	20
S_6	17	28	28
Σ	90	157	95
$\bar{X}$	15.00	26.17	15.83
$\frac{\Sigma^2}{N}$	1350.00	4108.17	1504.17

C-4

RAW DATA ON NUMBER OF CORRECT RESPONSES ON ALL THREE MODES AT BASELINE, PROBE 1, AND PROBE 2

	BASELINE			PROBE 1			PROBE 2		
	OBJ	PIC	SLD	OBJ	PIC	SLD	OBJ	PIC	SLD
S_1	21	19	24	44	45	45	41	45	45
S_2	9	9	14	31	34	33	38	39	38
S_3	1	0	1	16	5	8	37	30	26
S_4	12	4	1	37	35	24	34	41	38
S_5	5	0	0	19	2	11	34	30	17
S_6	12	0	0	21	13	17	40	34	23
Σ	60	32	40	168	144	128	224	219	187