The Experimental Use of Operant Procedures with Language Delayed Children

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THE EXPERIMENTAL USE OF OPERANT PROCEDURES WITH LANGUAGE DELAYED CHILDREN

A Thesis
Presented to
the Graduate Faculty
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In Partial Fulfillment
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Master of Science
in
Speech Pathology

by
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CHAPTER I

INTRODUCTION

Operant conditioning techniques have been widely used in many areas of behavioral modification. Overt speech and language, a form of behavior, should be amenable to such procedures. The application of such techniques to children categorized as language delayed should effect a change in their vocal behavior.

Statement of the Problem

It was the purpose of this study: (1) To compare the amount of vocalization produced by each child before the experiment with the amount of vocalization during and after the application of operant conditioning techniques. (2) To compare the variations in the vocalization produced by the children. (3) To explore the possibility of shaping those vocalizations into meaningful words. The study sought to verify the following statement: Utilization of operant conditioning principles will increase the amount and variety of vocalization in language delayed children.

Importance of the Study

The development of language in the human infant is a fascinating and extremely interesting phenomenon. It is one of the most important and complex skills that a human being
ever learns. Language is the means by which man acquires a great deal of his knowledge and passes it on to others. It is through language that he expresses his emotions and establishes self identity. One can easily see the importance of language by observing a deaf person who has never developed adequate language and by considering his problems of learning, adjustment, and communication.

Man lives in a verbal society which attaches a great deal of importance to language skills. He evaluates and categorizes his fellow men on the basis of verbal facility. He makes a distinction between the so-called "normal speakers" and those who have speech or language problems. For these reasons many systems have been derived and adapted for working with children who have not developed adequate language. One method is operant conditioning which is used in this study in an attempt to increase the amount and variety of vocalizations in the subjects.

Definition of Terms

Language delay. The criterion used in this study was that the child should have language development markedly deficient for his chronological age.

Operant conditioning. A system of behavioral control in which the behavior of an organism is a function of its consequences.
**Vocalizations.** Any oral response produced by the subjects other than coughing, crying, screaming, breathing, swallowing, tongue clicks and lip smacks were considered vocalizations.
Language Development

Man has filled many volumes about the development of language and the associated physical and mental capacities. He has questioned the effect of environmental stimulation and the consequences of maturation on its development. Through his efforts Man has gained a great deal of knowledge about language, but there are still many unanswered questions. Nonetheless, Man has been able to establish normative standards for language development in relation to chronological age.

Most of the early vocalizations made by babies are reflexive in nature. These early sounds are both crying and comfort sounds that are related to the child's physical condition. In the early weeks of life infants make new sounds which consist of whimpers, grunts, and cooing. In a matter of only two weeks the infant begins to respond to external vocal stimulation by pausing in his activity, whether vocal or physical. He can be soothed by voice (Green, 1963). This is the important beginning of social-vocal behavior which is vital to the development of language. This is the stage referred to by Mowrer (1952) in which sounds made, that result in attention and care, become
intimately and consistently associated with the parents and their care-taking activities. As a result of association of the sound with basic satisfaction, the child becomes conditioned. In making this association the child is developing his receptive language which is evident through his behavior. The skills involved in language and speech have already begun to be acquired by this time and will continue to develop with each passing day. "These early vocalizations contain more vowels and consonants than whimpering or crying sounds" (Van Riper, 1964, p. 76).

The non-crying sounds are composed of grunts, gurgles, and sighs, and the glottal catch. The contacts and tongue movements involved in these sounds are similar to those used in swallowing, thus, coordination which the baby uses in sucking aids him in learning the basic coordination used in many sounds (Van Riper, 1964).

After being exposed to his new environment for about eight weeks the baby begins to babble and engage in vocal play. This indicates that he has matured enough to establish "feedback" and thus stimulate his own vocal patterns. "It consists of odd little vowels usually the ee, ih, uh, and others made in front of the mouth, and a few m, b, and g, consonant sounds with assorted snorts, gurgles, and grunts all combined with squeals and sighs" (Van Riper, 1964, p. 78).
"By the sixth month, the babbling consists of somewhat regular repetitions of similar sounds with a more noticable rhythm in its patterns" (Simon, 1957, p. 35). During the sixth month to the ninth month the infant begins to imitate sounds made by adults. At first these imitations are very inaccurate. About the ninth month the child may begin to repeat the commonly used syllables mamma, dada, and baba in his babbling and vocal play. Rather than being actual responses to a person or situation these are produced for what seems to be the pleasure of vocalizing. From eight to twelve months the child understands a few simple words and he can respond correctly to them even though he does not say them. By the eleventh to the fourteenth month some of these sounds previously produced may become associated with a specific person, object, or action. Once the child has made this association and is consistent in using the sounds to specify the particular person or thing we can safely say he has said his first meaningful word or words (McCarthy, 1954).

There has been a great deal of discussion among those who study language development as to the value of babbling in "normal" language development. It has been observed that all children go through a stage of babbling even though it may vary somewhat in length.
Winitz (1969) discusses the idea developed by Lennenberg (1964) that language in children can be understood best in the context of developmental biology. He stated that babbling plays no role in the development of language and that these early vocalizations appear relatively independent of the amount, nature, or timing of sounds made by the parents. He cited a study which he conducted in which the number of early vocalizations of two groups of children were compared. The control group consisted of normal children with hearing parents. The other group consisted of children of deaf parents. He concluded that the children of the deaf parents produced as many vocalizations as those of hearing parents. Lennenberg failed to note in his study the type of vocalizations, and the length of responses. He paid little attention to the fact that a sound-sensitive light had been placed near the crib of the experimental group to alert their parents to the child's vocalizations. These children could have made the association between the light flashing, the maternal care and their vocalizations and have received as much reinforcement as the children with the hearing parents.

Carroll (1964) says that there are three related steps of development relevant to the learning of language; "(1) The child's ability to recognize, identify, discriminate,
and manipulate the features and process of the world around him. (2) Development of the ability to discriminate and understand speech he hears. (3) Development of the ability to produce speech sounds and sequences of patterns in the language of his environment. The last depends on the second, and both depend at least partly on the first" (Carroll, 1964, p. 31).

Babbling, which emerges after the first two or three months, consists of random vocalizations which are biologically determined and reinforced by the presence of adults. "Although certain trends can be observed in the kinds of sounds emitted by an infant in babbling stages, these sounds have little bearing on the phonemes of the language the child is to learn" (Carroll, 1964, p. 31).

Simon (1957) states that even though the importance of babbling for the development of speech is unknown, the speech producing circuit has become regenerative through kinesthetic and auditory feedback, which is received through the process of babbling.

"When a child babbles he gives us the impression that he is making sounds for 'their own sake', that he derives satisfaction from the utterance itself, that he is playing with sounds; playing with his vocal organs in the same way as he plays with the movements of his fingers and toes" (Lewis, 1963, p. 20). Lewis states that the child
receives satisfaction from babbling at two levels, (a) pleasure of the sound itself - the complex stimulus of motor and auditory sensation, (b) the child begins to find pleasure in the regular pattern constituted by repetition. Lewis feels that the enjoyment from babbling and hearing himself make phonetic and syntactic patterns of language is one of the roots of the child's subsequent enjoyment of literature, written and spoken. And that through these early babbling stages the child, by repeated practice acquires the skill needed in the highly complex procedures of making sounds of speech. The child explores the vocal apparatus in babbling and thus produces a diversity of sounds out of which a comparative few will ultimately form the speech sounds of his language (Lewis, 1963).

Through experimentation with babbled sounds and listening to those within his environment the child is able to learn how to produce those which compose his native language with great accuracy. The production of these sounds, however, is dependent upon the extent of his maturation at the time. Simon (1957), writes that maturation seems to determine not only when a behavior may be learned but also the most efficient time for learning to take place. With a normal environment a child's language development or speech learning depends on a step-by-step maturation: the child learns when he is ready. Strayer (1930) did an
experiment and concluded that intensive instruction will not significantly accelerate speech-learning beyond the level of maturation.

The imitation of speech sounds which begins to emerge at approximately eight months is also an important aspect in the development of language. We find that these early imitations are not very much like words produced by the older members of the speech community. As the child produces sounds that are more like those of his parents they are likely to show approval. By this procedure certain imitative sounds and responses of the child become conditioned. As the child produces a sound he takes careful note of the kinesthetic, auditory, and social feedback he receives from his response. Through a series of such imitations the child stops producing those sounds which were present in his babbling and vocal play but which were not reinforced and develops those sound sets which are characteristic of his native language. Through imitation and reinforcement the child develops more appropriate sounds, words, and sentences as well as other behaviors.

At about the ninth month the child begins to produce paired syllables, which even though they hold no symbolic value, form the basic groundwork for the development of language. Wood (1964) appears to contradict Strayer when he states that environmental differences are of major
importance during these early stages and can effect a child's rate of language development.

Sullivan (1953) says that a child's early sounds, though not communicative to those around him, have meanings and express feelings. He hypothesized that the satisfactions derived from these are built into the child's own pleasures and purposes, his sense of "me-ness".

Beasley (1956) cites Mowrer in stating that the infant's need for comfort and satisfaction is met through his own babbling and repetitive syllabic expression, and later through socializing efforts of the parents to get him to approximate the sounds made by them.

"By the time the child is eighteen months old he will have probably acquired ten to twenty meaningful words" (Simon, 1957, p. 37). He uses these to control his environment and in his vocal play and jargon. Jargon is the richly varied successor of babbling and vocal play and appears to be an important part of language learning. This is the channeling of the child's energy into vocal patterns and a wider variety of differentiated responses. "Jargon reaches its peak at about eighteen months and then diminishes to negligible amounts by the end of the second year. As a channeler of energy for greater differentiation of vocal behavior and as an attainable self-satisfying response to the verbal world of adults, jargon seems a necessary part of the dynamic process of learning to talk" (Simon, 1957, p. 37).
Jargon sounds very much like sentences in a language foreign to the listener. It contains inflections, pause, rhythm, and all the underlying patterns of the child's native language. Listening to the jargon of a child, one may also recognize an occasional word.

Once the child has made the association of words to objects, to persons, and to actions, and to the power they give him in influencing his environment, his understanding increases greatly. But from about the twelfth and to the twenty-first month, in contrast to the rapid expansion of his understanding, the child's ability to say words usually does not increase very much. Many feel that during this period the child spends his time in investigating his environment, learning how to walk, experimenting with sounds and learning about himself.

After this stage the child's speaking as well as understanding increases rapidly. His articulation is inaccurate and his grammar incorrect but people understand him and accept his speech because he talks of simple familiar things and we expect him to sound this way. His verbal productions are imitations of the things which he hears with most of the nonfunctional words omitted. Things such as "dada car" will be said for "daddy's car". "Me go" will be said for "I want to go". As the parent hears these verbalizations he will respond with an imitation of the child's
speech but will expand it. An example of this would be if the child said "red ball" the parent might say "Yes, that's a red ball". Through these procedures of imitation and reduction, imitation and expansion, the child learns the syntax, morphology, and semantics of his native language. He begins with two word phrases; then four word constructions appear. These are followed by simple active or declarative sentences. The child learns the regular grammatical forms of the language and misuses them for the irregular forms. Gradually he masters the complexities of the regular and irregular forms, at the same time improving his articulation. By the age of seven or eight most children have very large vocabularies and their articulation and grammar are essentially mature. (Brown, Bellugi, 1964)

Operant Procedures

With his knowledge of how a "normal" child develops language Man has expended much effort in seeking out systematic methods of aiding the language delayed child. One of the more successful systems is operant conditioning. Bijou and Baer (1961) define operant conditioning as a way of changing the strength of a response by using reinforcement as a consequence of that response. Operant procedures were first used in experimental psychology by
B. F. Skinner in his studies of behavior control of animals. In these studies he employed a Skinner box or cage and used rats or pigeons. The Skinner box was a small sound proof box which contained a small lever and a food receptacle. The rat was placed in the box and when he pressed the lever, in his investigation of the box, a food pellet was dispensed. After a couple of these accidental pressings and reinforcements the rat made an association between the bar pressing and the reinforcement. At this point the bar pressing increased until the rat reached his saturation point for the food. This is an example of learned behavior.

Experiments similar to this were done with pigeons. In these studies a pigeon was deprived of food for some time before being placed into a cage. In moving about the cage the hungry pigeon eventually faced the direction of a white card with a black spot. As soon as he did so, he was rewarded with a small amount of food. When he again faced the card, he was again reinforced with food. Next the experimenter waited until the pigeon took a step towards the card before providing reinforcement. By reinforcing a series of successive approximations the experimenter would eventually shape the pigeon's behavior so that it would peck at the card, then at the spot. The more selective reinforcement resulted in consistent pecking at the spot.
During World War II missile guidance systems of the U. S. Navy were designed on the basis of such studies and pigeons were used in place of less reliable, heavier and bulkier radio guidance equipment. The improvement of electrical equipment since then has led to the abandonment of this practice (Skinner, 1960).

Many studies of this type have been done. These studies have resulted in an abundance of information about operant procedures and their use in the modification of behavior. Finger (1942) studied the effects of varying the conditions of reinforcement on two groups of rats. One group received reinforcement on each completion of a simple running task. The other group received reinforcement upon completion of only half of the running task. He found that during extinction the rats that had received regular reinforcement required an average of 15.2 trials before the extinction criteria were reached, whereas the animals that had been reinforced only periodically required an average of 21.1 extinction trials.

Similar results were found by Bijou (1957) who used instrumental conditioning with 29 preschool children. He concluded that intermittent reinforcement produced conditioned responses which were more resistant to extinction than those produced by continuous reinforcement in a control group. Grosslight, Hall and Scott (1954) concluded
that when subjects are required to reverse a habit they are able to do so more quickly if the original habit was learned with continuous reinforcement than if it was learned with partial reinforcement.

The above studies involve unconditioned or primary reinforcements which are "those that appear to have reinforcing characteristics as a function of the biological make-up of the organism" (Sloane & McAuley, 1968, p. 9).

In the early studies it was found that in pairing a secondary reinforcer, i.e., a reinforcement that does not directly satisfy some need of the organism, with a primary reinforcer the secondary reinforcer will acquire the reinforcing power of the primary reinforcer. Bersh (1951) did a study in which a light was flashed, but no food was given. The rat learned to press the bar for what appeared to be "the sheer joy of seeing the light". The light, not satisfying any apparent biological need, had become a secondary reinforcer.

Some early studies involved operant procedures and human behavior: Razran (1933) reported experiments in classical conditioning with some feeble-minded subjects. Osipova (1926) found that sub-normal children formed conditioned responses to shock faster than normal children. Segal (1929) working in Lenz's laboratory, attempted to condition salivary responses in an 18-year-old idiot.
Shastin (1930) was able to establish a conditioned response in a 15-year-old cretin. Wolowick (1929) established a conditioned response in a 6-year-old retardate.

Paul R. Fuller reports on an operant conditioning experiment with an 18-year-old inmate of a feeble-minded institution, whose behavior was that of a "vegetative idiot". The only behavior displayed by this subject were eye blinks, openings of the mouth, slight movements of his arms, head and shoulder. He never moved his trunk or legs. It was also reported that he never made any sounds. The subject was deprived of food for 15 hours prior to the experimental settings. A warm sugar milk solution was used as reinforcement. Movement of the right arm towards a vertical position was selected as the response to be reinforced. During the first sessions there was an increase in the movements of the left as well as the right arm, but in the last two sessions the unreinforced movements dropped out almost completely, along with gross movements of the head and shoulder. The subject progressed from a rate of 0.67 right arm movements per minute in the first session to 3 per minute. "The attending physicians of the institution of which the subject was an inmate thought it was impossible for him to learn anything, yet in four experimental sessions, by using operant conditioning techniques an addition was made to his behavior which at his level could be termed appreciable"
(Fuller, 1949, p. 589). The experimenters felt that if time had permitted the subject could have been conditioned to do other activities (Fuller, 1949).

Operant procedures have been realized by many as a powerful tool in the controlling and shaping of the behavior in humans. Experiments have been done with children in relation to bedwetting, thumbsucking, inappropriate behavior, articulation problems, delayed speech, stuttering, etc.

Gerald M. Siegel did an experiment in which a punishment paradigm was used. The point of view of this study was that punishment, shock, would somehow increase dysfluencies in a group of normal subjects. "In the sessions in which shock was used as negative reinforcement it was found that even though the stimulus was clearly unpleasant a significant increase in dysfluencies did not occur. But when the shock was made contingent on the responses they were decreased" (Siegel, 1969, p. 133).

The shock was replaced with a tape recorded word "wrong". The contingent subjects heard the stimulus after each dysfluency during treatment and the random subjects were presented with the stimulus on a predetermined random schedule. The results of this study show that the contingent subjects decreased again during recovery. Both increases and decreases were significant. In comparing the sessions of the experiment using shock to those in which verbal
stimulus was used it appears that the verbal stimulus was more effective than shock in reducing dysfluencies, but that the changes under verbal treatment were less persistent. The random presentation of the stimulus had no effect and the trend was not even in the same direction as the shock experiment (Siegel, 1969).

Richard Martin (1969) did a study to see if the principles of operant conditioning which were originally developed for animals could be used to manipulate overt behaviors of five adult male stutterers. He used shock and verbal negative and positive reinforcement. His conclusions were: (1) Electric shock served as punishment because its presentation upon stuttering behavior lowered greatly the frequencies of stuttering responses, (2) once shock was removed the stuttering response rate rapidly returned to base level, (3) the frequency of a specific stuttering response can be brought under discriminative stimulus control, (4) certain of the overt nonfluent or struggling behaviors emitted during stuttering are susceptible to experimental manipulation in much the same way as our other operant behaviors, (5) contrary to popular belief the use of punishment is an effective technique for decreasing stuttering frequencies. Data obtained in the experiment are consistent with this simultaneous punishment-positive reinforcement motion and suggest that such a
procedure has potential as a desirable therapeutic technique with stutters.

Many studies using operant procedures have been conducted involving the language of child and adult. Leija V. McReynolds (1967) reports on one such experiment at a National Convention of The American Speech and Hearing Association. This study involved a four-year-old child who during the first four days of observation did not emit any vocal behavior, did not imitate any arm, leg or hand movements and did not respond to simple verbal directions such as "sit down". Because the imitative behavior of the child was basically zero, operant procedures could not be employed. So the clinicians started with gross hand movements. The clinician would first make a movement and then manually move the child's arms and hands through the same movements. After completing the movements the child was reinforced. In two weeks the child had learned several motor imitations and could chain them together. With these imitations of the motor movements came some vocalizations. The reinforcement of the motor imitations were then stopped and the vocalizations were reinforced. After five sessions the vocalizations increased from 23 to 144. Two phonemes produced by the child were selected for reinforcement. The clinician produced one of the phonemes and if the child imitated him he was reinforced. When the child
was imitating the two sounds approximately 100% of the time, and other vocalizations had been eliminated, the clinician started working on words. The word "ice cream" was selected because the child liked ice cream and this was what was being used as a reinforcer. The /m/ was taught first, then the /l/. Then the /im/ was taught. By chaining the sounds together in this manner, starting from the last sound and working towards the first, the clinicians were able to establish the desired responses. Social reinforcements were used along with the ice cream. The results of this study show that the effectiveness of social reinforcement cannot always be predicted without exploration. It was found that with this child social reinforcement was inadequate for initiating a response but after the response had been initiated and been reinforced a good number of times it could be continued with a secondary reinforcer. This study also illustrated that operant procedures are of value with language delayed subjects.

A study by Blake (1969) concerns two eight-year-old boys. One was diagnosed as brain-damaged in addition to having Down's Syndrome, and the other as having heart disease in addition to Down's Syndrome. These subjects were able to produce only a few sounds so they were first taught a repertoire of sounds by imitation and reinforcement of successive approximations. Once sounds had been taught and babbling
in syllables had been done to some extent, words were carefully reinforced. Single descriptive words were first produced by the subject in response to a picture book. Then the therapeutic process was expanded to require two-word, three-word responses and finally complete sentences. This was achieved through an imitation process of the clinician by the children and reinforcements of all improvements. After one year of speech therapy both subjects produced sentences of seven or eight words. They used functional speech appropriately and spoke in sentences with an average length of four words.

Another study very similar to the one just cited was done by Sloane, Johnston, and Harris (1969). They attempted to develop verbal behavior by using operant procedures. The subjects in this study were seen daily at the clinic, also the mothers who were trained in the procedures worked with the children in their homes daily.

Training started with behavior already in the child's repertoire, and proceeded by progression of small steps towards the desired goal. The training steps began with simple non-verbal motor imitations. If the child would not imitate the clinician as in the McReynolds study he was physically manipulated through the procedures and reinforced upon completion of them. Next imitation of placement of the vocal musculature and associated structures were
taught. Once these imitations were learned they were done with sound and were shaped to the specific speech sound. The sounds were then chained together. Each sound of the chain was individually taught and strengthened and then a direct attempt to obtain the entire chain was made. After learning to produce sounds corresponding to simple words the child was taught to "name" simple objects and pictures by imitating the teacher. Then the auditory stimulus was faded and the child would respond to the picture. Next simple word mands were taught in two ways: (a) the clinician said words appropriate to the child's activities or desires, and (b) the child was taught the name of the objects first, then the use of this name was required in approximate situations and nonverbal responses were not reinforced.

Word chains were developed next; individual words were taught starting with the terminal word. When the child had acquired a moderate verbal repertoire attempts were made to develop flexible control. This was done by presenting the child with a wide range of stimuli, such as questions and leading remarks, books, pictures and objects. Social reinforcement and intermittent concrete reinforcements were given.

With all the children in this study, social reinforcement seemed effective. "The pairing of social and
material reinforcers probably strengthened the control that verbal reinforcers had over the child's behavior" (Sloane, et. al., 1969, p. 85). Every satisfactory response received social reinforcement even though material reinforcers were delivered on an intermittent schedule. "'Rewarding' desirable behavior is not a new concept, but maintaining a precise, consistent and immediate relation between a specific verbal response and its consequence leads to entirely different results from the general idea of 'using rewards'" (Sloane, et. al., 1969, p. 18).

Schell (1967), Stark, et. al., (1968) each used operant procedures in the development and increasing of verbal behaviors in an autistic child. These studies assumed that a child learns by imitation and therapy was approached with this in mind. The results of Schell's therapy taught the child Kipper to attend, increased his responsiveness to people, effected his discriminative responses to a variety of controlled auditory and visual stimuli, increased his rate of vocal and non vocal behavior, and increased the control of his behavior by verbal commands (Schell, 1967).

Stark, Giddan and Meisel report that Kipper was taught to discriminate between /m/, /o/, /ma/, /pa/ and about 30 nouns by placing a poker chip on the correct picture. His vocal imitations became easier, he could
reproduce new words which contained four phonemes. He could copy letters and figures. His verbal labelling and discriminative activities were extended and lexicon items were presented in longer sequences with a greater number of choices. The use of language acquired secondary reinforcing properties. Kipper also no longer needed to see a candy reward during training sessions (Stark, Giddan & Meisel, 1968).

A study done by Johnston is of interest to those who are dealing with language delayed children because of the echolalic behavior often displayed by them. In this study operant procedures were used. The subject was a seven-year-old boy who had been diagnosed as retarded and emotionally disturbed. His verbal behavior consisted of only a few words, a high rate of crying, screaming and tantrums. He did not attend or respond to adults.

Social reinforcement and M & M's were used for reinforcement. Reduction of echolalic speech, increase in flexibility and spontaneous speech, and training of parents to evoke the correct responses at home were the goals set for therapy.

The child's total verbal output went from 42 verbalizations which contained 22 minics and 20 non-minics to 180 verbalizations with 53 minics per day. Appropriate verbal phrases were emitted approximately 112 times per
session. There was a significant increase in verbalizations. This increase was reflected in all the classes of verbal behavior that were part of the training program and indicates that controlling the environmental consequences of verbal behavior can successfully bring echoic speech under more appropriate discriminative control (Johnston, 1968).

A study done by Mowrer, Bake, and Schutz was done to construct a standard written instructional program which would bring a high degree of success in articulation therapy and to decide upon an adequate criterion measure of articulation to be administered prior to and at the completion of the experimental sequence.

The frontal lisp was the articulation problem selected for this study because of its prevalence in the school populations and because of the ease of operationally defining it. Successive approximations and differential reinforcement were used. The /s/ sound was first worked on in isolated sounds, then words and sentences, as responses to objects in the child's environment, and hopefully in conversation. Redeemable tokens and visual feedback from a mirror were used as reinforcement of correct responses.

The subjects in this study were 75 children with frontal lisps between the age of 5 and 7. The hearing of all subjects was normal. The subjects were divided into
seven groups, a control group, a group which was reinforced with the tokens for correct responses and a buzzer was sounded for incorrect responses, and a group which received only verbal reinforcement to their responses. The control group of 15 subjects did not receive any program. They were administered the criterion test at the beginning and at the end. Within the other six groups there were subjects who actively participated and subjects who only sat and observed. The subjects who only observed were reinforced just as were those who actually participated. The results of this study showed that the groups which received token reinforcers achieved the higher level of performance. Visual and auditory cues such as facial cues, teeth closure, smiles, frowns and verbal cues played an irrelevant role in affecting the performance of the child. The results also indicated that the activity-participants were dramatically superior in performance to the observer-listener subjects. Both the token-reinforced and socially-reinforced groups were statistically superior to the control group. According to the delayed retention tests neither the subjects who were observers and encouraged to silently participate nor those who were socially reinforced performed any better than the control group.

The results of this study indicate that carefully planned operant procedures can be effective in the correction
of speech, and that these procedures can be carried out after brief training by a non-speech therapist thus freeing the speech therapist to work with more difficult speech problems (Mowrer, Baker and Schulz, 1969).

Another study was done investigating the use of self-teaching methods for teaching speech sound discriminations for children with defective articulation. These methods employing the use of teaching machines are established upon the principles of reinforcement learning therapy. They provide immediate reinforcement and cause the behavior to be emitted. They work through a series of successive approximations in the development of complex responses while they gradually withdraw the stimulus support.

In this study a teaching machine was developed which presented an auditory problem (single word, pairs of words, or isolated sounds) by tape recorder. The subject responded to each item by pressing one of three buttons. An incorrect response resulted in the tape recorders immediately rewinding and replaying the problem. A correct response caused the tape recorder to continue to play.

The experimenter found that the rewinding of the recorder was a good negative reinforcer. The study indicated that the use of self instruction for improvement of sound discrimination for children with articulation problems are amenable to teaching machine programming. This study
also suggests that a clinical method is adaptable to automated teaching (Holland, Matthews, 1969).
CHAPTER III

PROCEDURES

Subjects

The subjects used in the present study were five children defined as language delayed according to the criteria stated earlier in the text. The subjects were all males.

Subject A was a small towheaded boy diagnosed as having delayed speech and language with possible mental retardation. He is hyperactive, distractable, stimulus-bound, emotionally labile, and tends to be easily excited. At the time of the study subject A was 4 years, 11 months old. He was an only child. His expressive language skills were severely retarded and he said only these words; "I see", "Oh Oh", and "bye bye". His receptive abilities had been estimated to be at a 2 to 2-1/2 year level.

Subject B, the oldest child in the study, was 9 years, 2 months old at the beginning of the study. He was the oldest of three children in his family and was attending special education classes.

An EEG examination at 21 months of age revealed an abnormal pattern which the neurologist diagnosed as epilepsy of the petit mal type. A further diagnosis was mental retardation and delayed language development with
a neurological basis. Subject B produced no spontaneous speech but did vocalize on request. Those vocalizations produced were often very unintelligible and never more than a single word.

Subject C was 3 years, 6 months old when the study began. He was the youngest of three brothers. He had been reported as developing normally until he was hospitalized for chicken pox at six months, for dehydration at one and one-half years, and a virus infection accompanied by a high fever ($104^\circ$) at three.

He was diagnosed as having delayed language and possible mental retardation. His receptive ability is three to six months more advanced than his expressive language. His receptive language at 2 years, 7 months was at a 1 year, 10 month level. His expressive language consists of only three words: da, up, and gosh. His speech and language retardation appear to be related to a general intellectual deficit. However, his deficit in communication skills appears to be more severe than deficits in other areas of functioning.

Subject D was diagnosed as very hard of hearing. He had no meaningful language but communicated through gestures, inflectional babbling of ma-ma, da-da and facial expressions. He is the oldest of three children and was 5 years, 5 months of age at the beginning of the
study. He was reported as being of at least average intelligence and able to perform fairly complicated motor tasks.

Subject E was 4 years, 11 months of age at the beginning of the study. He had one sister who was three years older. He was attending a Head Start program. He was diagnosed as having apparent developmental retardation secondary to anoxia at birth with accompanying seizure disorder. He has been free from the seizures since June when he was started on medication. It was reported that the subject's present problems were primarily behavioral rather than neurological ones.

Diagnostic results show a vocabulary of 2 years, 8 months, articulation skills well within normal limits, and a tendency to speak slowly and to perseverate on some phrases. The subject produces very little spontaneous speech and what is produced is at a slow dysrhythmic rate.

Subject F, the youngest child in the study was 2 years, 6 months old at the beginning of the study. The child appeared to be in very good health and quite independent for his age. He was the younger of two children. Subject F is diagnosed as having a severe bilateral hearing loss and retarded language development. He babbles quite frequently and uses good inflection but has no words.

The children were enrolled in the Speech Clinic at Central Washington State College.
Procedures

An experimental booth was used in the experiment. The booth was a three-sided, four foot by four foot room with a light box screen inserted in the back wall. The light box was frequency and intensity responsive and was activated by the vocal productions of the subjects. A cut off switch was installed in the circuit of the light box which enabled the experimenter to prevent the reinforcement of any undesirable vocalizations or response of the light box to environmental noises. The light box contained four colors of lights that would flash on and off, through a light distorting plexiglass front giving splashing rays of color, in response to the child's vocalizations.

A base-line of vocal productions was established for each subject by placing him in the experimental booth for two 10 minute sessions without conditioning. The base-line sessions were followed by ten 10 minute sessions in which conditioning was used. A comparison was made of the base-line sessions to those which followed in regard to the amount and type of vocalization. During the early conditioning sessions all vocalizations were reinforced by the lights. Once the child was making enough vocalizations to show a definite increase, a particular phoneme or series of phonemes was selected for shaping. An attempt
to shape the selected phoneme into a desired vocalization was made by reinforcing a series of successive approximations. All sessions were recorded on a Wollensak model Tl500 tape recorder and were evaluated by the experimenter. Because the experimenter found it impossible to count the number of vocalizations, the amount of vocalization was tabulated on a time basis by timing it with a stop watch when evaluating the tapes. The kind of vocalization was tabulated by listing those vocalizations which occurred. One can see the effect of the shaping by noting those words or phonemes which were not present at the start of the study and were established as the study proceeded.

During the early sessions the subjects were given a task to perform. Painting on a blank piece of paper was not too distracting, all the subjects enjoyed it, and it made it easier to retain the child for the full ten minutes; It was found that once the subject made the association between the lights and his vocalizations the activity could be dispensed with. Vocal stimulation was used with subject A and subject E, and Subject B was given written letters to initiate vocalizations.

The experimenter was in the booth during all the sessions. He sat behind the subject and operated the cut-off switch. He did not interact with the subject in any way vocally. His physical interactions were in no way
communicative, but only to control the situation.

Reinforcement to initiate and increase the vocalizations was used for each response. Once the increase was evident a random reinforcement schedule was used.

A pilot study was conducted with subject A prior to the rest of the study. Both the pilot and the main study were done in the same manner except: (1) in the pilot study one session would follow another after a short rest; whereas in the main study one session per day was held; (2) the sessions in the pilot study were at varying times during the day; whereas in the main study the sessions were at the same time of the day for each subject. The number of sessions for each child varied between seven and sixteen. The total duration of the study for each child was approximately six weeks.
CHAPTER IV

RESULTS

The purpose of the study was to increase and shape the vocalizations of the subjects by using a form of operant conditioning. The subjects in the study were five children described as language delayed who were enrolled at the speech and hearing clinic at Central Washington State College. The conditioning of the subjects took six weeks.

Baselines of vocalizations were determined for each child by observation of the child in the experimental environment before conditioning took place. Each child acted as his own control and graphs of his total vocalizations are used to compare the amount of increase to the baseline vocalizations. The results of the study show a marked increase in vocalizations by all subjects. Figure 1 shows the amount of vocalizations made by subject A. The first two sessions are the baseline sessions with an average of 30 seconds of vocalization. The average of the conditioned sessions is 168 seconds of vocalization. "Boo" was the selected vocalization which was reinforced after a definite increase in the amount of vocalization was shown. At the beginning of the study "boo" was nonexistent in the subject's vocalizations, by the sixteenth session the subject produced 127 "boos".
FIGURE 1

A SUMMARY OF SESSIONS FOR SUBJECT A OVER A THREE WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
Subject B's data is shown in Figure 2. The first two sessions are the baseline sessions. No vocalizations were emitted by the subject during the first four sessions. In the fifth session subject B responded to stimulation only. The stimulation consisted of writing letters on the desk. Subject B responded vocally to each letter and was reinforced. In session number six the subject was stimulated by written numbers and letters thirty-three times while he produced 175 vocalizations. In session number seven and all those to follow the subject vocalized spontaneously. In session nine the subject was using two-word responses and by the twelfth session he was stringing as many as five words together. In session eight and nine only louder vocalizations were reinforced to increase the intensity of the subject's responses. Through this selective reinforcement the intensity increased markedly. The average of subject's baseline sessions was 0. The average of the conditioned sessions was 151 seconds of vocalization.

Subject C's results are shown in Figure 3. The average of the baselines is 53 seconds of vocalizations, while the average of the conditioned sessions is 115 seconds of vocalization. Many new vocalizations were noted during the course of the experiment which were not present in the earlier sessions. These were: /ʃ/, /ʌk/,
FIGURE 2

A SUMMARY OF SESSIONS FOR SUBJECT B OVER A SIX WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
FIGURE 3

A SUMMARY OF SESSIONS FOR SUBJECT C OVER A SIX WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
Subject C's repertoire at the beginning of the study. It was noted by the experimenter that the subject had a slight tendency to produce a back platal sound after /æk/. The experimenter reinforced this and was able to shape it into a consistent production.

Subject D's experimental results are shown in Figure 4. The average of the baseline sessions was 17 seconds of vocalization. The average for the conditioned sessions was 127 seconds. It was noted that subject D started each vocalization with an aspirated /m/ which sounded as though it could possibly be shaped into an /h/. The reinforcement resulted in an increase of shorter productions, thus an increase in aspirated /m/ 's. It was also noted that the aspirated /m/ became somewhat similar to the /h/. The experimenter was not able in the time allowed to shape the aspirated /m/ into the /h/.

Subject E's experimental results are shown in Figure 5. The average of the baselines was 70 seconds of vocalizations. The average of the conditioned sessions was 136 seconds of vocalization. Vocalizations which were exhibited in the latter sessions but not in the baselines were: /k/-k/, /bu- bu/, /bæi/, /bæ/, /ju/, /gj/, /gæ/, /hæt-kæk/, /wən/, /jæ/, /pik/. The speed of subject
FIGURE 4

A SUMMARY OF SESSIONS FOR SUBJECT D OVER A SIX WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
A SUMMARY OF SESSIONS FOR SUBJEC T E OVER A SIX WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
E's vocalizations was increased in the experimental sessions. "Boo-boo" was selected as the vocalization to increase in the subjects behavior. This vocalization became very prominent.

Subject F's experimental results are in Figure 6. Because of the subject's illness only seven sessions were held. During one of the seven sessions the subject was ill and spent the entire session crying. The average of the baseline sessions was 20 seconds of vocalizations while the conditioned sessions had an average of 125. No real variation or shaping of vocalizations took place.
FIGURE 6

A SUMMARY OF SESSIONS FOR SUBJECT F OVER A SIX WEEK PERIOD. SESSIONS ONE AND TWO ARE BASELINE SESSIONS.
CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

It was the purpose of this study (1) to compare the amount of vocalization displayed by the subjects before the experiment with the amount of vocalization after the application of operant conditioning techniques; (2) to compare the variation of vocalizations; and (3) to attempt to shape the vocalizations of the subjects into words. The question the study sought to answer was: Will operant conditioning procedures increase the amount and variety of vocalization in language delayed children? Baselines of the vocalizations were obtained before the conditioning started. The type of vocalizations was also noted in the baseline sessions and during the early sessions. The vocalizations produced during the conditioned sessions were noted and compared with those produced during the baseline sessions. Those which occurred during the experiment were listed in the results.

Conclusions

There is a marked increase in the amount of vocalization demonstrated by each subject when the pretraining baselines are compared to the conditioned sessions and the concluding baseline. The variation of vocalizations is
increased in subjects C, B, and A. The effect of shaping the vocalizations by the method used is evident in subjects A, B, C, D, and E. Upon results of the study the experimenter concludes that the method used, (1) will increase vocalizations; (2) is useful in shaping vocalizations; and (3) will bring about a spontaneous increase in vocalization in some subjects.

Discussion

There are some children with normal speech mechanisms who seldom or never vocalize and instituting vocalizations in these children is sometimes very difficult. Because of the importance of preverbal vocalization in language development any procedure which brings these into existence in language delayed children's behavior may be of much value. The experimenter feels that the procedures used did this. He also feels that because vocalizations were freely emitted by the subjects within a couple of sessions once reinforcement was present that this procedure was of value.

If the experimenter was to conduct further study he would vary some conditions. Those conditions would be: (1) each subject would be restrained in his chair throughout the study; (2) random reinforcement would be introduced as soon as the initial increase in vocalization took place; and (3) the vocalizations of each subject would be carefully evaluated in selecting the responses to shape and the successive steps would be carefully reinforced.
The fluctuations in vocal responses between sessions may well have been caused by some of the following: (1) continuous instead of intermittent reinforcement; (2) general physical and mental state of the child; (3) weekends and vacations between sessions; and (4) illness.

In considering the study one must realize that the language problems of the subjects were of different etiologies. One can only speculate about the effectiveness of this type of visual reinforcement in establishing behavior in mentally retarded or neurologically impaired children as opposed to deaf children. The experimenter was aware of possible difference of visual stimulation with deaf children, but no difference was noted in the reinforcement strength of the procedures used in the study. It was noted that those subjects who were less attentive in general, were less attentive to the lights and showed less increase in vocalizations.

An interesting study to further extend this one would be to reinforce a group of language delayed children with frequency and intensity sensitive lights, a control group with only colored lights and another control group with white lights. One could then possibly establish the effect of these three features. Another study of interest would be to investigate if deaf children would be more sensitive than hearing children to lights as reinforcement. A third study
could be conducted to investigate the usefulness of the tape recordings of the babbling as an auditory reinforcement for increasing vocalizations in language delayed children.
BIBLIOGRAPHY


