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Concept Acquisition as a Function of Two Verbal Training Sequences: Nonvocal-Vocal and Vocal-Nonvocal

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CONCEPT ACQUISITION AS A FUNCTION OF TWO VERBAL TRAINING SEQUENCES: NONVOCAL-VOCAL AND VOCAL-NONVOCAL

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CHAPTER I

The Problem and Its Background

Traditionally, the process of language acquisition necessitates that children learn to respond appropriately to the verbal behavior of other people and to produce verbal behavior which can be appropriately responded to by others. These two components of verbal behavior are often subsumed under the rubrics of "receptive" or "comprehension" skills and "expressive" or "production" skills respectively. "Receptive" skills are generally assessed by whether an individual follows instructions, of which the request to point to an object is among the most common. If he responds appropriately, he is said to have exhibited "understanding". "Expressive" skills are discussed in terms of vocal responding with no reference made to "understanding". This may be an unnecessary and misleading use of terms in so far as both vocal and nonvocal responding by a speaker require that he receive the auditory and/or visual input and then exhibit "understanding" by responding appropriately. From this reasoning it follows that in teaching vocal and nonvocal responding, "understanding" is concurrently taught. For the purpose of this thesis, I wish to dichotomize verbal responding along two response modes: a nonvocal verbal motor response, the gesture of pointing; and a vocal verbal motor response. Both response modes will be considered in terms of appropriate responding rather than "understanding".

Informal observations by parents and more systematic investigations by professionals in the fields of linguistics, psycholinguistics, and psychology have reported a differential rate of acquisition for nonvocal and vocal skills. From her comprehensive review of research in the speech of children, McCarthy (1954, p. 520) stated, "Most writers agree that the child understands the language of others considerably before he actually uses language himself." That is, the acquisition of nonvocal skills precedes the development of vocal skills, suggesting that "comprehension" is a prerequisite for "production" (Fraser, Bellugi, and Brown, 1963).

Theoretical support for this developmental sequence may be found in the writings of the language theorist, Eric Lenneberg (1962). In analyzing the case report of a boy who had a congenital disability for the acquisition of motor speech skills (anarthria), he stated that both "understanding" and speaking depend upon the application and use of a single set of grammatical rules. In the case of "understanding" the rules are used to process and organize the input data, and in the case of speaking, the same rules are utilized in the organization of output data. Lenneberg (1962, p. 424) summarized his position by stating:

> "In the process of language learning, the acquisition of grammatical rules must occur first in connection with analyzing incoming sentences: then with producing outgoing sentences."

Lenneberg (1967) further described the development and acquisition of language as being a function of the physiological or cerebral maturation of the child. He stated that at least one aspect of language acquisition, the age of onset of certain speech and language capabilities, is relatively unaffected by environmental conditions. He concluded:

> "The emergence of speech and language habits is more easily accounted for by assuming maturational changes within the growing child than by postulating special training procedures in the child's surroundings." (Lenneberg, 1967, p. 139)

Unlike Lenneberg, Skinner (1957) emphasized the functional relationships that exist between verbal responses and their controlling variables in the environment. He stated (1957, p. 185-198) that verbal responses of different forms, such as gesturing and vocalizing, are separately acquired and must be accounted for by different controlling variables. Therefore, it is not necessarily the case that one form arises from the establishment of other verbal forms.

Skinner cited three events, a stimulus, a response, and reinforcement, which must be considered when analyzing verbal behavior. In the case of the nonvocal response, gesturing, the form or topography is determined by three controlling variables: (1) a verbal stimulus, (2) a nonverbal stimulus, and (3) past history of reinforcement for similar responses. The gesture of pointing is a function of a speaker's request for nonvocal verbal action e.g., "Point to the . . .". The object or individual to which the gesture is directed is the nonverbal stimulus, and the prior history of reinforcement from the verbal community for such responding is the third controlling variable. When analyzing the vocal response, the form is determined by two variables, a nonverbal stimulus and again, the history of reinforcement for similar responses. A verbal stimulus such as "What is this called?" does not serve as a controlling variable for the form since any vocal response could be emitted.

In designing language training systems some consideration should be given to theoretical positions and empirical findings on language acquisition. The writings of Lenneberg and Skinner may provide some theoretical bases for such development. Certainly both verbal response modes are desirable in one's repertoire, but deciding on the most effective means of training these skills is an empirical question yet to be answered. Would training nonvocal skills prior to vocal skills prove more efficacious than the reverse sequence?

Program designers attracted to Lenneberg's analysis of language development would opt for a nonvocal-vocal training sequence. Lenneberg (1962, p. 422-423) stated that there is no clear evidence that speaking is ever present in the absence of "understanding", hence, it is likely that vocal production of language is dependent upon the "understanding" of language as indicated by some nonvocal behavior.

Advocates of a functional analysis of verbal behavior, who would not generally support the notion that children must "understand" language before they can use it, are placed in a somewhat ambiguous situation when deciding the proper sequencing of training components. Skinner (1957) stated that both are separate repertoires that must be accounted for independently, but he does not suggest any evidence as to the ordering of the components for training purposes. From an operant analysis, it is possible to present support for both a nonvocal-vocal and vocal-nonvocal training sequence.

If a language trainer is presented with a non-language child, a decision must be made whether to teach a gestural response or a vocal response first. The process of developing the gestural response appears to be less difficult than that of a vocal response for both trainer and child. It is relatively easy to physically prompt the gestural response and then fade assistance. However, when training the vocal response, the trainer must rely mainly on imitative techniques since the diaphragm, vocal cords, falsevocal cords, epiglottis and the other components of the vocal musculature are not readily amenable to the same prompting and fading techniques. For children who already possess some minimal skill in gestural and vocal responding, the trainer must decide whether to bring the established gestural response under new stimulus control or shape the vocal productions. With the gesture of pointing established, only the locus of the point would need to be differentiated. In the case of vocalizing, each utterance is subject to confounding as a function of the length of the word, the degree of difficulty in its pronunciation, and the articulatory skills of the speaker. From this logic, it follows that the gestural response would be the more easily taught and readily learned of the two responses.

Several investigators (Winitz and Prisler, 1965; Mann and Baer, 1971) have reported that "receptive" discrimination training can be a functional antecedent to sound production. Results showed that training sound discriminations led to substantially improved articulation for normal children. Mann and Baer (1971) suggested several explanations for this including the repeated auditory exposure to the words, the fact that the words were paired with reinforcers, and the extent of the imitative repertoires of the subjects. However, the exact variables responsible for the facilitation effect have not been elucidated. From an analysis of the level of training difficulty for the two responses, and the empirical findings showing a facilitative effect, a strong argument can be made for the nonvocal-vocal sequence for verbal training.

It is conceivable that the reverse order might prove more profitable. The vocal responding of retarded children on relevant dimensions has been shown to enhance gestural discriminations on a match-to-sample task (Hamilton, 1966) and on a geometric form task (Dickerson, Girardeau and Spradlin, 1964). This sequence would require a child to begin training on what is considered a more difficult response, vocalizing, but once established, the need to conduct gestural training to the same stimulus may be nearly obviated. Why vocal training should facilitate gestural responding is not conclusively known. However, it may be that teaching a vocal response, the name of an object, and then teaching the gestural response, pointing to the same object, is essentially only changing the response mode from a more complex motor response to a simpler one. Therefore, vocal training may be somewhat extended, but once achieved, the number of trials needed to conduct gestural training would be negligible resulting in an overall savings in training trials when compared to the nonvocal-vocal sequence.

An investigation of current language acquisition programs provides evidence supporting the effectiveness of both training sequences. Buddenhagen (1971), Lovaas (1968), McLean and Spradlin (1967) and Sapon (1968) have effectively utilized the vocal-nonvocal sequence in their language acquisition programs. On the other hand, Gray and Ryan (1971), Kent (1972), Bricker and Bricker (1970) and Tawney and Hipsher (1972) have established the effectiveness of the nonvocal-vocal sequence. The variance in these programs procedurally makes their comparison in terms of the effectiveness of the two sequences difficult.

Hovell (1973) sought to measure the differential effectiveness of the nonvocal-vocal and vocal-nonvocal training sequences. Using a within-subject design, four retarded children were taught two sets of nonsense words with corresponding nonsense objects. Each set was taught using a different training sequence. His general finding was that vocal training greatly facilitated the acquisition of the gestural response, whereas gestural training facilitated vocal responding to a much lesser degree. The result was that all subjects required fewer training trials (computed by medians) to a particular criterion for the vocal-nonvocal sequence when compared to the reverse order. Subsequent to each training sequence, an overall test was administered to assess both gestural and vocal responding to the nonsense objects. Three of the four subjects exhibited superior results following the vocal-nonvocal sequence of training.

Hovell trained "simple" discriminations in the sense that all nonsense objects were distinctly different from one another. They were purposefully constructed to minimize any similarities relative to shape, size, color, texture, material and general configuration. The nonsense word paired with each object referred to the total object and not to any particular characteristic.

In contrast, the present study trained what may be considered a more "complex" discrimination in the sense that it tested which training sequence would most effectively result in "concept learning". Becker, Engelmann and Thomas (1971) stated that concept learning is complex in that it involves a double discrimination as follows: the relevant characteristics of instances must be discriminated from not-instances; and, within instances or not-instances, the relevant characteristics must be discriminated from the irrelevant. Engelmann defines concepts as "the essential stimulus characteristics shared by a set of instances and not shared by other instances in a given universe of concepts." He suggests that in teaching a concept, responding must be controlled only by the essential characteristics of the concept. Three rules formulated by Engelmann (1971, p. 240-241) concerning how to insure this control are as follows:

> "(1) It is not possible to teach a concept through one instance and one not-instance. A set of instances and not-instances is required."
>
> "(2) The set should be constructed so that all instances have all essential concept characteristics, and not-instances possess none or only some of these characteristics."
>
> "(3) Within the set of instances and not-instances, it is necessary to vary stimulus characteristics that are not essential to instances or not-instances."

Using these rules as a basis, the present study utilized more than one representation for each concept. Each representation of a concept contained the relevant characteristics of that concept and shared some relevant characteristics with other concept representations. Finally, the representations of a concept varied on irrelevant characteristics.

The purpose of this study was to determine the relative effectiveness of the vocal-nonvocal and nonvocal-vocal verbal training sequences on the complex discrimination of concept learning.

CHAPTER II

Method

Subjects

Four children, seven and eight years old, enrolled at the Kennedy Center for the Trainable Retarded served as subjects. IQ scores, based on the Stanford-Binet, ranged from 38-52 with a mean of 43. Based on the limited, non-experimental interactions with the subjects, it was observed that they rarely initiated speech. Their responding to yes/no questions was generally articulate although not always correct, and responses to open ended questions such as "What did you do yesterday/" were usually nonexistent or unintelligible. They were ordinarily able to gesture to common objects within their environment. Three of the children had previously served as subjects in the Hovell (1973) study. Approximately one month separated the two studies.

Setting

The study was conducted in a small conference room approximately 8' by 12'. Located within the room were several children's chairs and a low table. Sessions, generally 20-30 minutes in length, were conducted four days a week.

Stimuli: Nonsense words

Eight nonsense words were constructed in the following manner:

consonant-vowel-consonant trigrams were produced by using the short vowel sounds a, e, and o in combination with the consonants of the alphabet. This produced a total of 1326 consonant-vowel-consonant trigrams. A group of four people then reduced this list by eliminating all words that were identical in sound (e.g., cob, køb) and all words that sounded like or were real words in English (e.g., bac, fat). Those trigrams remaining were randomly selected with replacement to produce 80 two and three syllable nonsense words. The two lists of 80 were reduced to 30 each by excluding those words that were subjectively assessed as being too difficult to pronounce. The eight, one syllable nonsense words were systematically selected from the first syllable of the two and three syllable words so as to reduce any similarities in sounds with the nonsense words used in the previous study. The eight words were randomly assigned to two lists of four each.

Stimuli: Nonsense objects

Two sets of nonsense objects containing four each were produced to provide referents for the eight nonsense words. They were considered to be nonsense objects in that they did not resemble any real objects in the environment. The first set was constructed by taking two materials, cardboard covered with aluminum foil, and leather, and superimposing either painted lines or dots onto each substance. The second set was produced by taking wood and styrofoam and either drilling holes through each of the materials or leaving each complete.

The materials, leather, foil, wood, styrofoam, and the forms, dotted, lined, holed, complete, were considered to be the relevant characteristics of the stimuli. For each stimulus, the composite of material and form indicated the nonsense word or the concept of the nonsense object. The result of the above stated construction was that each stimulus within a set shared one relevant characteristic with two other stimuli from the same set e.g., "pel" was defined by complete wood, "rez" by complete styrofoam, and "jov" by wood with holes.

Three representations were constructed for each concept. These representations exhibited the two relevant characteristics associated with each nonsense word but varied systematically on the irrelevant characteristics of color, shape and size. As the stimuli were taught in pairs, representations of the two trained concepts were always matched on one irrelevant characteristic while varying on the other two irrelevant characterisitcs. That is, if the color of the two stimuli were the same, then they varied on shape and size. If the were matched for shape, then color and size differed, and so forth.

Two additional representations of each concept were produced for the second set. They were never trained and therefore, were not matched on any of the irrelevant characteristics. They were used to test for generalization.

Training procedure

The experiment involved two language training sequences: (1) vocal-nonvocal and, (2) nonvocal-vocal. Each subject was trained on both procedures but the order of presentation of these two procedures was reversed for half the subjects. Both components of a given training procedure (i.e., the vocal and nonvocal component) utilized the same word list. A separate word list was used for each of the two training procedures.

At the outset of the study, each subject was told that he or she would be seeing some objects with unusual names. The experimenter told the subjects that he wanted to measure how quickly they could learn the names of the objects. It was mentioned that they would have to either point to an object or give its name when asked. They were told they would receive candy or cereal for correct responding and that the amount accumulated would be eaten at the end of the session. Prior to the training of either component or the administration of a test, directions as to response desired, pointing or naming, were stated.

During vocal training the stimuli were placed directly in front of a subject and the experimenter responded by stating, "[Subjects's name], what is this called?" On the first trial of each word, the experimenter prompted a subject by immediately following the question with the appropriate nonsense word associated with the object. On each subsequent trial, only the question was given. If the subject emitted an incorrect response an additional prompt was presented. All correct responses to prompted trials were consequated immediately with social praise. Correct responding to nonprompted trials was consequated with candy or cereal in addition to praise. Incorrect responses were followed by a five second "time-out" in which the experimenter broke eye contact with the subject. A no-response was recorded if the subject did not respond within a ten second period following the question. This was consequated as an incorrect response.

All aspects of nonvocal training were the same as vocal training with one exception being the response asked of a subject. In the gestural component, the experimenter again presented nonsense objects but instead of asking the child to name the particular stimulus, he requested a subject to point to the appropriate object in the following manner: "[Subject's name], point to the [name of the nonsense object]." Again, the initial trial of each word was prompted by having the experimenter point to the proper stimulus. All response consequation was the same as in the vocal component.

The four concepts for each procedure were trained two at a time. For explanatory purposes, the three representations of each of the four concepts will be denoted as A, A', A"; B, B', B"; C, C', C"; and as D, D', D". Each set of two was presented in the following manner: representations A and B, matched on the irrelevant characteristic color were placed before a subject and a prompted trial conducted for A. If the response was correct, a nonprompted trial was given. If that evoked a correct response, a second nonprompted trial was conducted. Whenever an error occurred, either to a prompted or nonprompted trial, the next trial was a prompt. When two consecutive correct responses were obtained for A, training for B was begun in the same manner.

After two correct responses in succession had been recorded for A and B, they were removed and representations A' and B', matched on either shape or size were placed before a subject. The training for A' and B' was the same as for A and B except for two differences: the initial trials on A' and B' were nonprompted, and after each correct response to a nonprompted trial, the two stimuli were rearranged on the training table.

After two consecutive correct responses had been marked for A' and B', they were removed and representations A" and B" were placed before a subject. These were matched on the third irrelevant characteristic, either shape or size depending upon which had been trained as the second representation. A nonprompted trial was presented for A", and if correct, a nonprompted trial immediately followed for B". As in the training of A' and B', the stimuli were rearranged after each correct response to a nonprompted trial. If the response to A" was incorrect, a prompted trial was run and two successive correct responses were then needed before training could move to B". If the response to the first nonprompted trial for B" was correct, training reverted to A". If incorrect, a prompted trial was conducted and two correct responses in succession were needed before training shifted to A". This general procedure continued until five consecutive correct responses had been obtained for each concept, the last three occurring after a shift. If the subject reached criterion on one stimulus and did not do so on the subsequent trial for the second stimulus, consecutive trials were run to meet criterion. Training for any stimulus was not permitted to go beyond 225 trials.

The representations C, C', C" and D, D', D" were taught in an identical manner to complete the set of four.

Testing

After training was completed for the first component of either procedure, a test was administered to assess the amount of training needed for the second component. If a subject received vocal training first, the test consisted of having a subject point to the appropriate object when requested by the experimenter. Three sets of stimuli were presented separately to the subjects. Each set contained one representation selected randomly from the stimulus groups A, A', A"; B, B', B"; C, C', C"; and D, D', D". One trial was conducted for each representation making a total of twelve trials for the test. Each concept to which a subject made three correct responses was excluded from training in the second component.

If the nonvocal component was taught first, the test assessed vocal skills by having a subject name the objects when requested by the experimenter. Again, three sets of stimuli, each containing a representation from the four stimulus groups, were presented separately. Each concept that was correctly named on three trials was removed from training in the second component. For either test there was no prompting and there was no systematic consequation following test trials.

An overall test was administered at the completion of each training procedure, i.e., after both components had been taught. This assessed both vocal and gestural skills. Three sets of stimuli, each containing a representation from the four stimulus groups, were presented separately. The subjects were asked to either point to or name each specified representation. Twenty-four trials, twelve pointing, and twelve naming, were presented in a random order. As in the aforementioned test, no differential consequation was given for correct or incorrect responding.

A generalization test was conducted for the second set of words.[1] The test was administered directly after the overall test in which both vocal and nonvocal skills were assessed. Two sets of stimuli each containing a newly constructed representation from the four stimulus groups were presented separately. The subjects were asked either to point to or name each representation. Sixteen trials, eight pointing, and eight naming were presented randomly.

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[1]Training had begun on the second set of words when this procedural addition was made, therefore, making a generalization test for the first set not possible.

CHAPTER III

Results

Reliability

The experimenter and observer, an experimenter in a related verbal study, simultaneously recorded data during 26 of the 34 sessions needed to conduct training for the four subjects. The observer was not present during four sessions for subject one, three for subject three and one for subject four. The reliability scores for the training trials should not be considered as being independent, although intended to be so, in that the observer heard the experimenter's consequation of correct or incorrect responding. This was not true for test trials which received no systematic consequation. The total number of agreements between the experimenter and observer was divided by the total number of agreements plus disagreements to obtain a reliability coefficient. This was multiplied by 100 to yield percentages. Prompted trials were excluded in the computation of reliability figures. Reliability scores for training trials for each subject ranged from 97% to 100%, (based on 1168 trials). Reliability scores for test trials for each subject ranged from 94% to 100% with a mean of 97% (based on 219 trials).

An additional observer, relatively naive about the study, recorded data during four sessions of vocal training and testing. She also heard the experimenter's consequation for training trials.

Reliability scores based on the experimenter's and her data yielded means of 97% for training trials (based on 217 trials) and 91% for test trials (based on 34 trials).

Training sequences

The number of trials needed to reach criterion for each word served as a dependent variable. The data in Figure 1 show the summed number of trials for each training component and the sum of each sequence for the four subjects. The nonvocal-vocal sequence resulted in fewer trials for three of the four subjects. Savings of 117, 104, and 355 trials were realized for subjects one, two and four respectively. Subject three was the exception as she required 55 fewer trials when exposed to the vocal-nonvocal sequence of training.

By observing the vocal components in both sequences for each subject, it is apparent that fewer trials were required when vocal training followed nonvocal training. Subjects one through four required 79, 51, 32 and 397 fewer trials when vocal followed nonvocal training. By analyzing the nonvocal components in both sequences for each subject, it was found that for subjects one and two the nonvocal component took 38 and 53 fewer trials respectively when it preceded the vocal component. In contrast, subjects three and four required 87 and 42 fewer trials during the nonvocal component when it followed the vocal component.

Testing

The number of correct responses was recorded during testing for each concept. Figure 2 portrays the mean percentages of correct vocal and nonvocal responses to each set of four nonsense objects. Test data for set one support the facilitation effect of vocal training for nonvocal responding. Both subjects one and two exhibited some correct responding, 67% and 8%, following vocal training, but neither subject three nor four made any correct vocal responses following nonvocal training. Data for set two show contrary results. Subjects one and two responded correctly vocally 33% and 42% of the time following nonvocal training. Subjects three and four responded correctly nonvocally 25% and 8% of the time following vocal training.

By comparing the final two tests (the vocal and nonvocal overall test) for the two training sequences for each subjec+, the nonvocal-vocal sequence proved somewhat more effective for all four subjects. In all cases, the vocal test following the nonvocal-vocal training sequence had as high or higher a mean percentage than when it followed the reverse sequence. For subjects one, two and three, the final nonvocal test resulted in as good or better percentages following the nonvocal-vocal sequence.

The number of correct generalized vocal and nonvocal responses was recorded for each concept in the second set of nonsense objects. Figure 3 displays the mean percentages of correct vocal and nonvocal responses to the untrained set. For subjects one and two, the generalization test followed the nonvocal-vocal training sequence. For subjects three and four, it followed the reverse sequence. By comparing the nonvocal generalization tests of the four subjects, a higher mean percentage is displayed for subjects one and two. When analyzing the vocal generalization tests, no differences are seen between the two training sequences.

A useful comparison can also be made between the final vocal and nonvocal tests for set two in Figure 2 with the vocal and nonvocal generalization test of Figure 3. Both subjects one and three displayed little to no generalization to the new stimuli in either test component. In contrast, the generalized responding of subject two during the nonvocal test matched that of the final nonvocal test; and for the vocal test, performance was somewhat lower but still above chance. The data for subject four was surprising in that the mean percentages for both components of the generalization test were higher than the final overall test.

Subject one

Table I displays a word by word summary of the data for subject one. As can be seen, the nonvocal-vocal training sequence resulted in fewer trials and in better test performance. When viewing the number of trials needed to conduct vocal training for the first set, a noticeable disparity is seen between the pairs "fob/lec" and "tas/pev". This may have been a function of the observer's absence during the training of "tas" and "pev". During one of the only times a subject initiated speech, she asked, "Where is?" and pointed toward the observer's normal position in the room. The observer was also absent during nonvocal training of "fob" and "lec". This also shows a relatively high number of trials as compared to the nonvocal component of the second set. It should be noted that the observer was again absent during nonvocal training for all words of the second set. If the observer's absence contributed to any extention in training, it is not evident in this component.

The 100% performance on the nonvocal test for "tas" was the only instance of perfect nonvocal test responding for any of the subjects. As a result, nonvocal training on "tas" was not conducted. This may be the reason for the decrement in performance during the final nonvocal test.

During the vocal training of "cag", the subject often responded with "tag" which was not counted as correct. This may have been a word blend of "cag" and "teg", "teg" being a training word from a previous verbal study with this subject.

Subject two

The results of subject two are summarized in Table II. Again, overall performance, measured by training trials and test percentages, favored the nonvocal-vocal training sequence. Of particular interest for this subject is the comparison of the first nonvocal test for set one and the initial vocal test of set two. The poor performance on the nonvocal test following vocal training is surprising and no tentative explanation can be offered. The 100% performance on the vocal test for "jov" was the only instance of perfect vocal test responding for any of the subjects. Vocal training was therefore not conducted and no decrease in performance is apparent during the final vocal test for "jov". During nonvocal training on the second set, this subject would often supply the vocal response imitatively while pointing to the correct stimulus object. This was probably responsible for the correct responding on "jov" and "cag" during the vocal test.

Subject three

Data for subject three are presented in Table III. This was the only subject who required fewer trials during the vocal-nonvocal training sequence. She also was the only subject who did not participate in the previous verbal study. No correlation is implied between these two events.

Responding on the two overall tests showed no difference between the vocal test components. The comparison does yield some differences for the nonvocal test components as the test following the nonvocal-vocal training sequence displayed higher percentages.

Subject four

Training and test data for subject four are summarized in Table IV. Fewer training trials were required during the nonvocal-vocal sequence. There was relatively no difference between the final nonvocal test following the two sequences but performance on the vocal test proved more profitable when it followed the nonvocal-vocal sequence.

The subject's responding during vocal training for "jov" and "cag" was highly unusual. "Cag" never reached criterion as training was concluded after 225 trials. Besides the subject's difficulty in pronouncing the two words, training required four training sessions which were separated by two weekends and five absent days on the part of the subject. These two factors surely extended training for "jov" and "cag", and probably also contributed to the poor overall test performance of subject four.

CHAPTER IV

Discussion

The performance for three of the four subjects indicated that a nonvocal-vocal sequence was superior for the training of concepts. These data are contrary to the Hovell (1973) study, which suggested the effectiveness of a vocal-nonvocal sequence for the training of "simple" discriminations. The difference in findings may be attributable to the fact that concept learning involves a double discrimination as asserted by Engelmann (1971). Children not only need to discriminate the relevant characteristics of instances from not-instances, but also within instances, relevant characteristics need to be discriminated from irrelevant characteristics. This double discrimination task in conjunction with the initial training on the vocal component may have proved more difficult. Therefore, it may have extended training as a function of the more complicated response mode. If training commences with the gestural response, the basic discriminations between the concepts might be more readily acquired, leaving only the name of the concept to be learned during vocal training.

If a more systematic analysis of vocal errors had been employed, additional information concerning this effect would have been obtained. Most subjects made several types of errors: a word blend of two training words, a wrong word from the training set, a completely irrelevant word, a mispronunciation of the correct word, or no response at all. If the errors had been predominately discrimination errors (wrong word from set) as opposed to mispronunciations or no response at all, one might suspect initial vocal training to have interferred with the acquisition of the discriminations. The child may be attending more closely to the complex vocal response, than to the relevant characteristics of the concept. Certainly additional research is needed to delineate the factors interacting between discrimination difficulty and the mode of response before any definitive statements can be made.

Guess (1969) examined the relationship between nonvocal and vocal responding in retarded children, using the plural morpheme as the unit of analysis. Neither of his subjects were able to correctly vocalize plural responses to unreinforced probes interspersed during nonvocal training. Each continued to use the singular form when labelling pairs. Following a vocal training phase where subjects were required to respond vocally with correct singular and plural labels, a "reversal" condition was implemented. Reinforcement was obtained for pointing to a singular object when given its plural label and for pointing to the pair of objects when presented with its singular label. Again, unreinforced probes of vocal plural usage displayed independence from the reversal nonvocal training as each subject continued to use correctly singular and plurals for the unreinforced vocal probes. It was concluded that "receptive language" (the gestural response) and "expressive speech" (vocal response) can be two separate and functionally independent classes of behavior.

Harrelson (1969) used the same research design as Guess, but trained plural vocal usage and probed for correct nonvocal responding. His results indicated again the functional independence possible between the two response modes.

Guess and Baer (1973) combined some of the procedures used in previous studies as both nonvocal and vocal training were scheduled concurrently, using two different classes of plurals as concurrent baselines for training. Probes in the vocal training baseline were presented as pointing trials; probes in the nonvocal training baseline were presented as vocal trials. The findings generally agreed with those of Guess (1969) in which nonvocal (gestural) training failed to "generalize" to the vocal modality, and with the Harrelson study (1969) which formed no "generalization" from vocal plural training to the nonvocal modality.

The Hovell (1973) study and the present investigation do not support this position of functional independence. Hovell reported a facilitative effect from nonvocal training to vocal responding, and also from vocal training to nonvocal responding. The present study also indicated for all subjects that nonvocal training facilitated vocal responding and for two subjects, vocal training enhanced nonvocal responding. These results imply a functional relationship and nonindependence between the two response forms. Why a facilitative effect should occur in either direction is an empirical question yet to be answered. One might speculate that vocal training facilitates nonvocal responding as a function of the temporal pairing that occurs between the nonverbal stimulus (specified object) and the auditory stimulus (the name of the object). When conducting vocal training, the subject is required to vocalize the name of the object in the presence of that object, and if he does so correctly, he receives reinforcement. When training has shifted to nonvocal training, the subject is required to respond gesturally to the auditory stimulus provided by the experimenter. This auditory stimulus includes the name of the object, which has previously been paired with the nonverbal stimulus during vocal training. If the subject has a generalized pointing response and is requested to "point to the fob", he will scan the immediate environment and the nonverbal stimulus which has been previously paired with the auditory stimulus "fob" should exert more control over his pointing response than other objects in his environment. This should result in an increased probability for correct nonvocal responding.

The analysis of nonvocal training facilitating vocal responding is also based on the temporal pairing that occurs between the nonverbal stimulus and auditory stimulus. During nonvocal training, the subject responds gesturally to the nonverbal object when the experimenter supplies the auditory stimulus e.g., "point to the fob". During this training the subject might be imitating the experimenter's auditory stimulus "fob" either covertly or, as was the case in the present study, overtly, as with subject two, and in the Hovell (1973) study, with subject four. Thus, reinforcement for a correct gestural response would also result in reinforcement for the vocal response in the presence of the object, thereby possibly facilitating later vocal responding to the same object. This is probably a unique phenomenon for individual subjects. An additional consideration is that following nonvocal training, the initial trials on vocal training usually involve echoic responding. In the present study, subjects were prompted on the first vocal trial for each concept e.g., "What is this called? Say, 'fob'." Based on the echoic training in the presence of the object, and the previous pairing between the nonvocal object and the experimenter's auditory stimulus during nonvocal training, there is a greater probability that the subject will respond vocally to the nonverbal stimulus. Of course, these rather speculative analyses of the facilitation effects in either direction are not meant to be unequivocal, but rather a suggestion for future research.

Midway through this study, it was decided that a generalization test should be added to assess whether the subjects were actually learning the concepts or simply responding to each representation separately. Unfortunately this same measure was not utilized for the first set of words. The results for subjects one and three indicated little or no generalization. Subject two appeared to be responding to the concepts in that her nonvocal test performances were identical and responding on the vocal generalization test was above chance. The data for subject four are difficult to interpret in that the vocal and nonvocal performances were better on the new stimuli than those previously trained.

The validity of the findings in this study is dependent upon the equality of the two word lists. Both lists were produced in a random manner, but the possibility does exist that one might be easier than the other. If this were the case, either training sequence associated with the easier list would prove to be more effective as measured by total trials. As the order of training sequences was reversed for half the subjects and the order of list presentation was constant, one would expect that for two subjects a nonvocal-vocal sequence would prove more efficacious, and for the other two subjects the reverse order should prove more profitable. This did not occur in the present study.

A second potential confounding variable is a "learning-how-to-learn" phenomenon. It is possible that exposure to the initial training sequence would enhance the performance during the second sequence. If this were the case, the second training sequence would always show improved responding irrespective of the component ordering. Since three of the four subjects exhibited a better performance during the second sequence, one might suspect that this phenomenon was occurring for subject three whose data were contrary to the other subjects'.

The results of this study should not be considered supportive of Lenneberg's analysis of language development. This research investigated the training of concepts in language deficient children, and is not pertinent to his reference of internalized grammatical rules being the basis for the language processes occurring in young children. Verbal behavior in general is more aptly discussed in operant terminology than from a linguistic vernacular. Terms such as "receptive" and "expressive" language skills, originally used to denote the behavior of the listener and speaker, are more evaluative than descriptive. "Receptive" skills supposedly reflect auditory "comprehension" or "understanding" and "expressive" skills can only be considered as one's vocal production. A more accurate and consistent appraisal of verbal behavior should employ descriptive terms to indicate the response modes, such as vocal and nonvocal. This categorization may need even further delineation when discussing the American Sign Language system which is clearly different from simple pointing. The utility of such a descriptive system is realized through the clarification of its terms and by eliminating the need for reference to internal processes such as "reception" and "understanding" to indicate appropriate responding. By analyzing these more descriptive response modes as opposed to the labels of the linguists, one can then more readily attend to the controlling variables responsible for the topography of the response. This affords an operant framework that is consistent and observable for the experimental analysis of verbal behavior.

In conclusion then, these data do suggest that a nonvocal-vocal training sequence will result in a more efficient acquisition of concepts. For the findings of this project to be influential in the future design of language acquisition programs, replication with other populations and extensions to more complex aspects of language are needed.

TABLE I

A COMPARISON OF TWO LANGUAGE TRAINING SEQUENCES FOR SUBJECT 1

Number of trials to criterion   Percent correct

SEQUENCE I

Nonsense Words	Vocal Training	Nonvocal Test	Nonvocal Training	Overall Test	
				Vocal	Nonvocal
Fob	9	67%	33	0%	33%
Lec	17	67%	38	0%	67%
Tas	97	100%	--	0%	33%
Pev	100	33%	8	0%	67%
Totals	223		79		
Total	Trials	302			

SEQUENCE II

Nonsense Words	Nonvocal Training	Vocal Test	Vocal Training	Overall Test	
				Vocal	Nonvocal
Pel	8	0%	18	67%	67%
Rez	17	0%	27	0%	67%
Jov	8	67%	45	0%	67%
Cag	8	67%	54	67%	67%
Totals	41		144		
Total	Trials	185			

TABLE II

A COMPARISON OF TWO LANGUAGE TRAINING
SEQUENCES FOR SUBJECT 2

Number of trials to criterion Percent correct

Nonsense Words	Vocal Training	Nonvocal Test	Nonvocal Training	Overall Test	
				Vocal	Nonvocal
Fob	59	0%	17	67%	67%
Lec	29	0%	10	67%	67%
Tas	20	33%	33	0%	0%
Pev	14	0%	39	33%	67%
Totals	122		99		
Total	Trials	221			

Nonsense Words	Nonvocal Training	Vocal Test	Vocal Training	Overall Test	
				Vocal	Nonvocal
Pel	21	0%	23	33%	33%
Rez	9	0%	35	33%	0%
Jov	8	100%	--	100%	67%
Cag	8	67%	13	100%	100%
Totals	46		71		
Total	Trials	117			

TABLE III

A COMPARISON OF TWO LANGUAGE TRAINING
SEQUENCES FOR SUBJECT 3

Number of trials to criterion Percent correct

SEQUENCE I

Nonsense Words	Nonvocal Training	Vocal Test	Vocal Training	Overall Test Vocal	Overall Test Nonvocal
Fob	40	0%	14	0%	67%
Lec	21	0%	10	67%	67%
Tas	47	0%	13	33%	33%
Pev	29	0%	10	33%	67%
Totals	137		47		
Total	Trials	184			

SEQUENCE II

Nonsense Words	Vocal Training	Nonvocal Test	Nonvocal Training	Overall Test Vocal	Overall Test Nonvocal
Pel	14	0%	8	67%	33%
Rez	22	0%	20	67%	33%
Jov	23	67%	8	0%	67%
Cag	20	33%	14	0%	0%
Totals	79		50		
Total	Trials	129			

TABLE IV

A COMPARISON OF TWO LANGUAGE TRAINING
SEQUENCES FOR SUBJECT 4

Number of trials to criterion   Percent correct

SEQUENCE I

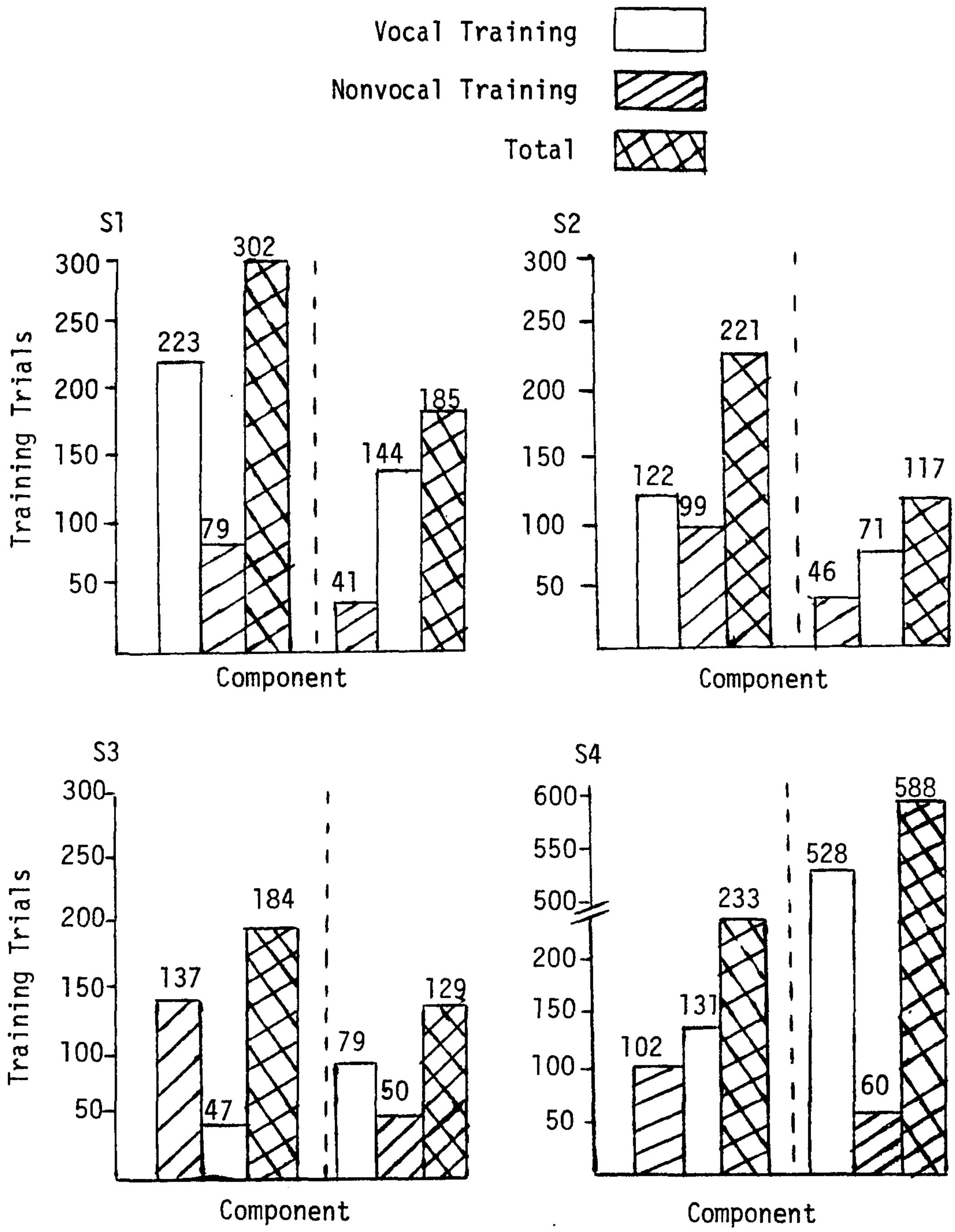
Nonsense Words	Nonvocal Training	Vocal Test	Vocal Training	Overall Test Vocal	Overall Test Nonvocal
Fob	19	0%	35	33%	33%
Lec	34	0%	48	0%	0%
Tas	17	0%	28	33%	0%
Pev	32	0%	20	100%	50%
Totals	102		131		
Total	Trials	233			

SEQUENCE II

Nonsense Words	Vocal Training	Nonvocal Test	Nonvocal Training	Overall Test Vocal	Overall Test Nonvocal
Pel	38	0%	23	0%	0%
Rez	82	33%	8	33%	33%
Jov	183	0%	21	0%	67%
Cag	225*	0%	8	0%	0%
Totals	528		60		
Total	Trials	588			

* Never reached criterion.

FIGURE LEGEND



Vocal Training
Nonvocal Training
Total
S1
300
250
200
150
100
50
Training Trials
223
79
302
41
144
185
Component
S2
300
250
200
150
100
50
122
99
221
46
71
117
Component
S3
300
250
200
150
100
50
Training Trials
137
47
184
79
50
129
Component
S4
600
550
500
200
150
100
50
102
131
233
528
60
588
Component

Figure 1

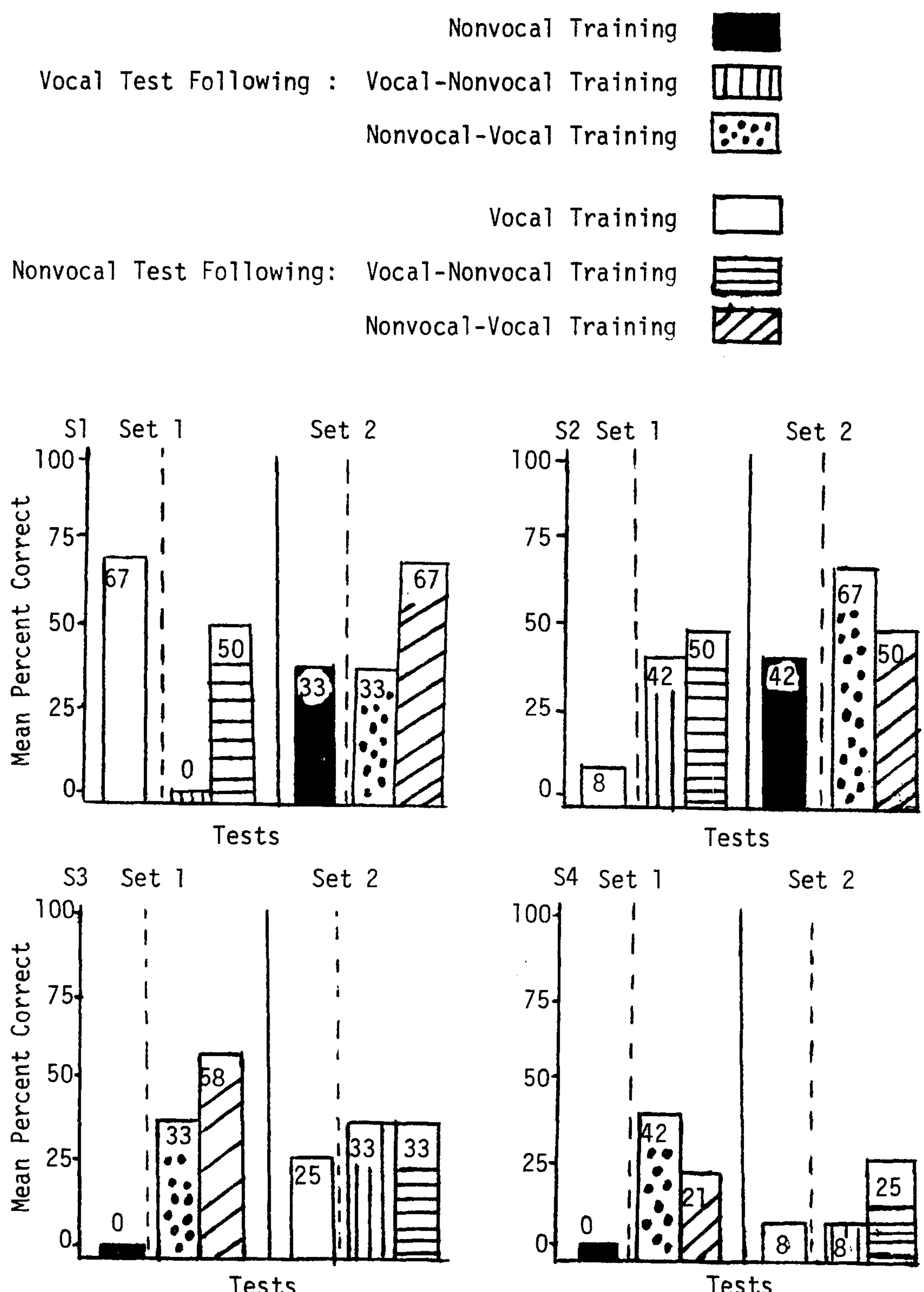
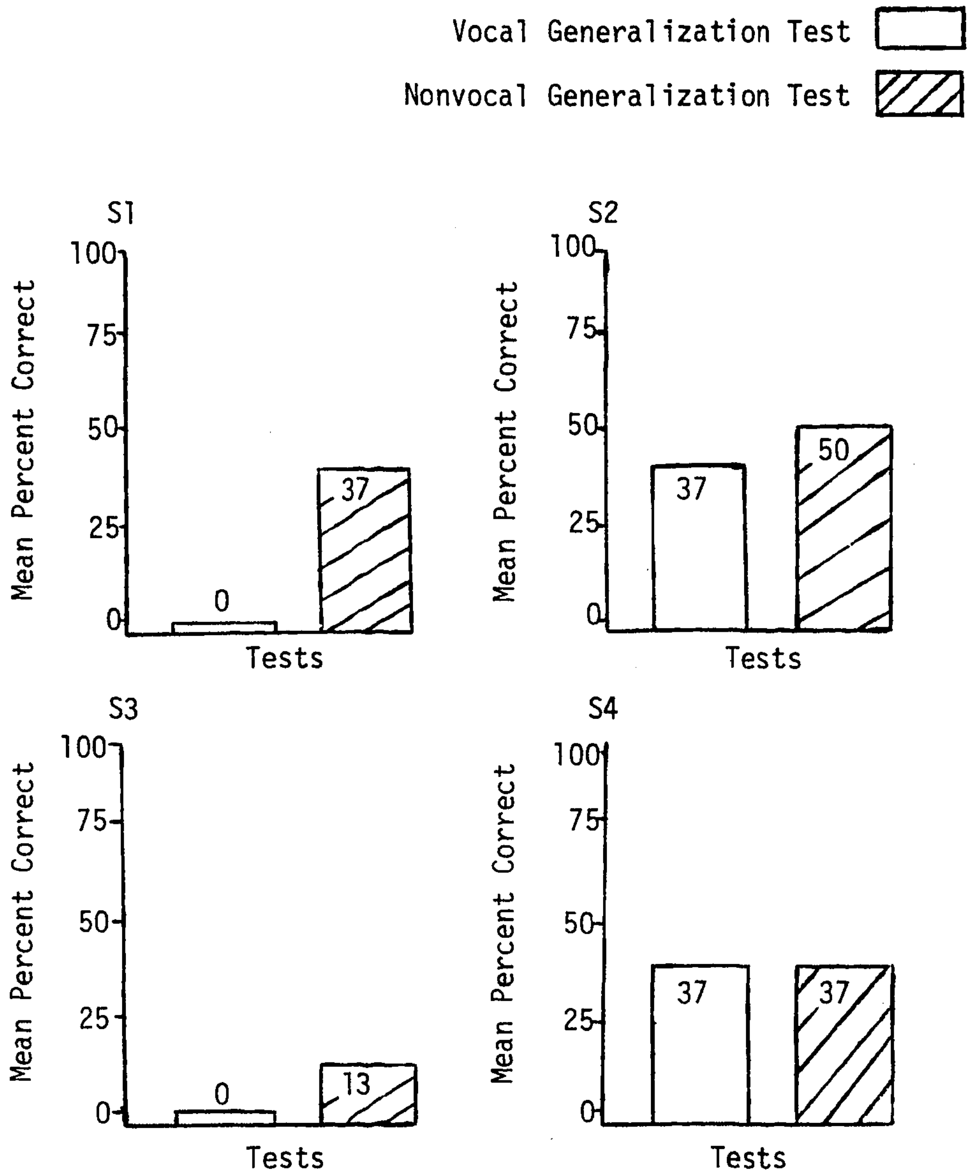

Nonvocal Training
Vocal Test Following :
Vocal-Nonvocal Training
Nonvocal-Vocal Training
Vocal Training
Nonvocal Test Following:
Vocal-Nonvocal Training
Nonvocal-Vocal Training
S1
Set 1
Set 2
Mean Percent Correct
100
75
50
25
0
67
0
50
33
33
67
Tests
S2
Set 1
Set 2
8
42
50
42
67
50
Tests
S3
Set 1
Set 2
0
33
58
25
33
33
Tests
S4
Set 1
Set 2
0
42
21
8
8
25
Tests

Figure 2



Vocal Generalization Test
Nonvocal Generalization Test
S1
S2
S3
S4
Mean Percent Correct
100
75
50
25
0
37
50
13
Tests

Figure 3

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