The Psychological Record, 1986, 36, 315-332

EFFECTS OF THE ACQUISITION OF PREREQUISITE BEHAVIOR ON THE LEARNING OF NONVOCAL VERBAL BEHAVIOR AND VOCAL IMITATION IN CHILDREN WITH SEVERE RETARDATION

M. CARMEN LUCIANO
Universidad de Granada, Spain

AQUILINO POLAINO-LORENTE
Universidad Complutense, Madrid, Spain

The effects of acquisition and maintenance of prerequisite interactions, such as attending behavior, nonverbal imitative behavior, and disruptive behavior, on the learning of nonvocal verbal behavior and vocal imitation were evaluated. Four severely retarded children were selected on the basis of low level or absence of the target behaviors (nonvocal verbal behavior and vocal imitation) and failure to reach the acquisition criterion on prerequisite behavior. The results were evaluated visually and by time series analysis. Findings indicated that the acquisition of prerequisite interactions led to superior performance and fewer trials to reach criteria in this language intervention.

A review of the literature on language training (Bricker & Bricker, 1974; Gray & Ryan, 1973; Guess, Sailor, & Baer, 1974; Guttman & Daniel, 1977; Kent, 1974; Miller & Yoder, 1974) reveals some of the problems that have yet to be resolved in designing more effective programs on acquisition, maintenance, and generalization of language training. One of these problems involves mainly, but not exclusively, content and sequence of target behavior training. Interest here is on content and sequence as it is related to prerequisite behaviors.

This general review points out the absence of experimental studies demonstrating specifically the relation between prerequisite behaviors and the first steps of a verbal acquisition program. Trainers nonetheless advocate its use prior to language training.

Research on prerequisite behavior is usually concerned with attending and motor imitative behaviors on one hand, and frequencies of disruptive behavior, on the other. The necessity of attending training as a prerequisite is mentioned in several studies (e.g., Bijou, 1976; Bricker & Bricker, 1974; Etzel, LeBlanc, Schilmoeller, & Stella, 1981; Foxx, 1977; Gray & Ryan, 1973; Guttman & Daniel, 1977; Harris, 1975, 1976; Kent, 1974; Koegel, Dunlap, Richman, & Dyer, 1981; Sloane, Johnston, & Harris, 1968; Vance-Hall, 1971), but there are few objective definitions on topography, duration, and stimulus control, and many neglect to specify maintenance criteria. In general, only the programs described by Kent and Guttman and Daniel indicate what observable behavior and what criteria the subjects must attain prior to initiating other subsequent

The authors wish to express their appreciation to the psychology students, who recorded data, and to L. Valero, S. Martinez, M. Ruiz, and P. Carrillo, who implemented the procedure. The authors would also like to express their sincere thanks to Dr. Sidney W. Bijou for his valuable suggestions on a final draft of the manuscript. Reprints may be obtained from M. Carmen Luciano,

intervention, however, these criteria are described in purely topographic terms. With respect to interactions included in attending behavior, visual contact with persons has been studied in greatest detail, while visual contact with objects has been studied less often (Booth, 1978; Hogg & Maier, 1974; Kent, 1974; Koegel et al., 1981; Maier & Hogg, 1974; Stanny & Weaver, 1980). We consider that response topography as well as duration and controlling variables must be specified along with acquisition and maintenance criteria.

As regards motor imitative behavior, several studies mention it as a prerequisite interaction. Specific definitions are to be found in, among others, Bijou, 1976; Garcia, Baer, & Firestone, 1971; Guttman and Daniel, 1977; Holdgrafer, 1975-1976; Lovaas, Berberich, Perloff, and Schaeffer, 1966; Peterson, 1968; Sherman, 1965; Sloane et al., 1968.

Finally, a low rate or absence of disruptive behavior is necessary in order to begin any target training (e.g., Guess, Sailor, & Baer, 1976; McCoy & Buckhalt, 1981; Slaine et al., 1968; Whitman, Scibak, & Reid, 1983).

This study tries to examine the effects of prerequisite interactions as a whole, explaining its role functionally with respect to the first steps of nonvocal verbal behavior and vocal imitative behavior, on one hand, and to indicate detailed operational definitions where these are unclear, along with acquisition and maintenance criteria, on the other. This study is concerned with the relationship between three classes of prerequisite interactions: (a) attending behaviors, (b) motor imitative behaviors, and (c) disruptive behaviors on (a) nonvocal verbal behavior and (b) vocal imitative behavior in severely retarded children.

Method

Subjects

Four retarded nonverbal children of 18 who had been evaluated were selected to participate in this study based on the following criteria: a minimal level or absence of the behaviors to be analyzed, that is, on nonvocal verbal behavior and vocal imitation, and failure to reach the acquisition criterion on prerequisite behavior. Disruptive behaviors were individually defined as follows:

Subject 1: hitting people, and making loud, prolonged sounds such as "Ahahahah."

Subject 2: placing objects and/or fingers in mouth, kicking, throwing things, getting up from the chair, throwing herself down on the floor, laying her head on the table, negative behavior (shaking head or saying "no" when a trial is presented), and spitting.

Subject 3: throwing himself on the floor, throwing objects, getting up from the chair, crying and staring at his hand.

Subject 4: screaming, throwing herself down on the floor, getting up from the chair, throwing things, objects and/or fingers in mouth, running and jumping, negative behavior (shaking head or saying "no" when a trial is presented), and hitting people.

Other information such as medical diagnosis, IQ, age, and sex were obtained from the Special Education Center, but were not included in the criteria for selection. Data on the characteristics of subjects are provided in Table 1.

Table 1

Characteristics of the Subjects. General Information from Special Education Center

Subject	Age	Sex	Medical Diagnosis	IQ	Toileting (1) Feeding (2) Dressing (3) Personal hygiene (4)	Motor Behavior: Gross (G) and Fine (F)	Social Behavior
1	7	M	Cerebellar atrophy and congential neuropathy	35*	(1) No control (2) Total help (3) Total help (4) Total help	(G) Training needed (F) Training needed	No functional social behavior
2	6	F	Down's syndrome	No data available	(1) Control (2) Partial help (3) Partial help (4) Partial help	(G) No training needed (F) Training needed	Functional social behavior with her family at nonvocal level
3	9	M	Profoundly retarded	No data available	(1) No control (2) Total help (3) Total help (4) Total help	(G) Training needed (F) Training needed	No functional social behavior
4	6	F	Profoundly retarded	No data available	(1) Bedwetting (2) Total help (3) Partial help (4) Total help	(G) Training needed (F) Training needed	No functional social behavior

*WPPSI (Wechsler, 1967)

Setting

This study was conducted in a Special Education Center in Granada, Spain. Four rooms of the Center were used as the experimental setting. Each room (6 x 5 m) had two large windows, a mattress on the floor, a cupboard where toys were kept, posters and pictures on the wall, two rectangular work tables, and several chairs. These conditions remained constant for all subjects during the study.

Definitions of Target Behaviors

Prerequisite behavior. The three classes of targeted interactions were defined as follows:

(1) Attending behavior involved body position, visual contact with objects (VCO), and visual contact with persons (VCP). The relationships between the discriminative stimuli and the subjects' response are described, respectively, below.

(a) Body position. Two levels were distinguished:
1st level: Auditory stimulus, "Sit down on the chair."
Response, sitting down on a chair.
2nd level: Auditory stimulus, "Cross arms on the table."
Response, crossing arms on the table, within 3 seconds.

(b) Visual contact with objects.
Auditory stimulus, "Look at this," while the trainer put objects on the table.
Response, establishing visual contact with the objects within 3 seconds.

(c) Visual contact with persons.
Auditory stimulus, "Look at me."

Behavior in response to auditory stimuli was termed "required attending behavior" and behavior produced by situational stimuli (in the same situation but without the specific auditory stimulus) was called "spontaneous attending behavior."

The acquisition criterion was reached when the indicated relationships were maintained without prompts for 5 consecutive sessions at the following levels, (a) body position, 70% of total session time (1st level), and 80-100% correct responses (2nd level); (b) visual contact with objects, 80-100% correct responses; and, (c) visual contact with persons, 80-100% correct resposnes and 5 seconds average duration per session.

The maintenance criterion when other behaviors were being taught was to maintain the acquisition criterion under spontaneous or situational control.

(2) Disruptive behavior was defined as self-injurious (Schroeder, Schroeder, Rojahn, & Mulick, 1981), aggressive (Repp & Brulle, 1981), self-stimulatory (O'Brien, 1981), and incompatible behavior (Luciano, 1983). Each type of behavior has been defined on an individual basis (see description of the subjects).

Criterion was reached when a minimum rate and/or duration was maintained for 5 consecutive sessions as well as during the subsequent training of other target behaviors (maintenance criterion).

(3) Motor imitative behavior was a relation between an auditory stimulus ("Do this"), a visual stimulus (the movements produced by the model), and a subject's response for which the topography was similar to the model's. The maximum latency was 5 seconds. There were 20 different movements, 10 gross and 10 fine. The gross movements were (1) arm raising, (2) clapping, (3) slapping the table, (4) touching his or her hair, (5) walking, (6) jumping, (7) stamping, (8) shaking head, (9) nodding head, and (10) arm swinging. The fine movements were (11) putting finger on his or her nose, (12) touching his or her ear, (13) sticking out tongue, (14) opening mouth, (15) closing and opening fist, (16) closing eyes, (17) chewing, (18) blowing, (19) gritting teeth, and (20) pressing lips together.

Criterion was reached when correct performance was maintained in 80% of the trials for 5 consecutive sessions.

Nonvocal verbal behavior. This was defined as motor behavior under the control of auditory and visual stimuli. The selected target behaviors included an auditory stimulus ("Point to . . .," "Give me . . .,") varying according to each target behavior; visual stimuli (different objects on the table, persons doing different things) varying according to each target behavior, and the subject's response (nonvocal response as a function of the auditory and visual stimuli presented).

The target behaviors were discrimination of basic concepts (pointing, giving, and moving), discrimination of real objects (10 objects), discrimination of photo objects (10), discrimination of body parts (10), discrimination of real actions (10), discrimination of photo actions (8), discrimination of possessive adjectives (my and your), instruction following (20), color discrimination (6), and size discrimination (big and little).

Vocal imitative behavior. This relationship was established between an auditory stimulus ("Say . . . -sound-"), a visual stimulus (movements produced by the model when he or she presented the sound), and the subject's response

(for which topography was similar to that presented by the model within 3 seconds).

The target behaviors were vowels (V), consonant-vowel (CV), (VCV), and functional words (CVCV or CVCVCV).

Design

Two time-series intrasubject designs with concurrent control and replication were used which are described as follows.

Design 1. A1 B... A2 C... A3 BB... A4
Design 2. A5 C... A6 B... A7

where A = evaluation phases of all target behaviors,
C = prerequisite behaviors training phases,
B and BB = nonvocal verbal behavior and vocal imitative training phases.

Design 2 was used, mainly, to control the possible residual effects of the first Phase B in Design 1. The measurement of motor behaviors without intervention throughout the phases (concurrent behaviors) was used to control the effects of time and subject-trainer-observers interaction. These effects could also be evaluated by a careful analysis of pre-intervention data (attending and disruptive behaviors during Phase B in Design 1) which helped detect the presence of trends.

Two subjects were assigned to each design and each subject was trained by a different trainer, who normally worked with mentally retarded children in a private center. Eight students of psychology, who had received observation training before the beginning of the study, participated as observers (two observers per trainer and subject). They were only taught how to record the target behaviors, but were not told the purpose of the research. Neither trainers nor observers had any relation with the Special Education Center.

Procedure

Before beginning the first evaluation phase, the Special Education Center and particularly the subjects' teachers were given information about the study, as provisional and generalized as possible, without any indication of the purpose of the study. Trainers and observers remained constant throughout the study and they stayed in the school during the specific sessions of the study. No subject received any specific language training other than that implemented in this report.

Each subject was brought from his or her habitual class to the experimental room during all sessions of the research. Each session began when the trainer and the subject sat opposite each other, and the two observers were in the room. Then, the trainer implemented the evaluation or training trials corresponding to each phase. Morning and afternoon sessions were carried out with each subject whenever possible. Morning sessions lasted between 45 and 60 minutes each, and afternoon sessions between 20 and 30 minutes each.

The different phases of the study are described below. The procedure indicated in each phase was the same for all four subjects as well as the measurement of dependent variables.

Evaluation Phases

These phases (A) were used to collect data on all target behaviors. Each behavior was recorded using a specific number of trials, and the disruptive behavior throughout each evaluation session. The percentage of correct responses for each target behavior was recorded and the average rate of disruptive behavior was calculated. The number of trials for each target behavior and the presentation sequence for each subject and phase were constant, with neither prompts nor consequences given. Each evaluation session (there were 5 per evaluation phase) was 25 minutes long and consisted of 5-minute work period followed by 5-minute activity period.

All these phases were identical except for the first one, which was preceded by two adaptation sessions which were useful for defining the disruptive behavior, selecting reinforcers, and becoming familiar with the subjects.

Training Phases

The training phases of the different target behavior are described as B, or BB and C.

Phase C, training on *prerequisite behavior.* The following procedures were used to increase attending and motor imitative behaviors and to decrease disruptive behavior. (a) Acquisition of attending and motor imitative behavior: shaping with prompts that were gradually faded out. Different reinforcers were used, changing from a continuous to intermittent reinforcement schedule, and from primary to conditioned reinforcers. (b) Elimination of disruptive behavior: differential reinforcement of other behavior along with extinction, ignoring, and light punishment (time-out, correction, and overcorrection).

Percentages of correct, correct with different prompts, and incorrect responses per session were recorded as well as the average duration per session of visual contact with persons, and the average rate in 5 minutes per session of disruptive behavior. The percentage of total time per session producing disruptive behavior was also recorded for Subject 3. These percentages were also recorded for both gross and fine movements.

Simultaneous training to decrease disruptive behavior and increase attending behavior (under required control), was followed by motor imitative training.

Phase B and BB, training on *nonvocal verbal behavior (NVB)* and *vocal imitative behavior (VI).* Training was carried out under two different conditions: without and with reaching the criteria of prerequisite interactions (without in Phase B of Design 1, and with in Phase BB of Design 1 and Phase B of Design 2).

NVB training was conducted along with VI training. Before presenting each training trial of NVB and VI, attending behavior (body position, visual contact with the trainer, and visual contact with objects) was recorded. Disruptive behavior was recorded during the whole training session.

The number of trials for each target behavior of NVB was fixed and with a predetermined sequence on both phases (B and BB). Each target behavior of NVB was recorded as the percentage of correct responses out of 10 consecutive trials. The number of trials was the following: discrimination of basic concepts, "pointing" (110), "giving" (110), "moving" (110), and a combination of "pointing," "giving," and "moving" (180); discrimination of real objects (350); photo objects (150); body parts (350); real actions (150); photo actions (120); posses-

sive "my" (100), and "you" (100); instruction following (400); color (430); and size (120).

The technique used with respect to NVB was as follows. Errorless discrimination (prompts with early response probing which was gradually faded out); maximum difference between stimuli for each trial; the number of stimuli presented for each trial was a function of a previously determined sequence (this sequence indicated type and number of stimuli per trial); only one positive and one negative example of each stimulus was used; dynamic procedure was used (a specific stimulus was discriminative stimulus, S^d, in a trial, and delta stimulus, S^Δ, in other trials): and stimuli position on the table varied from one trial to the next.

Vocal imitative training was carried out with modeling as follows: shaping with prompts, gradually faded out, and backward chaining to join phonemes from simple to complex units of vocal behaviors. The only combination trained under both conditions, B and BB, was vowels, and the number of trials carried out on both phases was 500 for each vowel. The percentage of correct responses out of 20 consecutive trials was recorded.

A second parameter on each target behavior of NVB and VI was also recorded taking into account the total number of trials for each target behavior. This parameter was the percentage of trials needed to achieve 80% of correct responses in a block of 10 or 20 trials respectively.

Concurrent behavior. The following motor responses were selected for each subject, under modeling (M) or verbal instructions (I):

Subject 1: folding a paper (M and I), and drawing a line (M and I),
Subject 2: folding a paper (I), and drawing a line (M),
Subject 3: drawing a line (M), and folding a paper (I),
Subject 4: turning a chair completely around (I), and folding a paper (M).

Three or five trials, corresponding to one of these behaviors, were carried out at the end of a session, and in the next session three or five trials of the other behavior, and so on. The model or instructional stimulus was presented and the subject's response was recorded as correct, incorrect, or no response within 3 seconds. No prompts were used. Correct responses were reinforced and incorrect or null responses were ignored. Each behavior was recorded as the percentage of correct responses out of 10 consecutive trials.

One of the two (four in Subject 1) concurrent behaviors was trained in Subjects 1, 2 and 4 at the end of the final experimental phase, while the other behavior, in these subjects and both in Subject 3, were carried out along the conditions described. This final training involved introduction of prompts and fading them out.

Interobserved agreement for the total number of trials presented per session, for the number of correct responses per session, and for the total number of disruptive behaviors per session were calculated by the formula, lesser number/higher number x 100. Interobserved agreement was calculated continuous initially, and intermittent afterwards. Agreement during the evaluation and training phases was between 90-100% for all subjects.

Finally, Table 2 shows the *total duration* of experimental phases, with respect to total number of sessions and real time spent through subjects and phases.

Table 2

Duration of Experimental Phases

Subjects	1	2	1	2	3	4	1	2	3	4
Sessions	1-38	1-30	39-84	31-71	1-90	1-87	85-149	72-126	91-170	88-165
Total number of sessions	38	30	46	40	90	87	64	54	70	77
Total hours	38	30	28	23	45	46	41	33	46	45
Phases	B		C				BB		B	

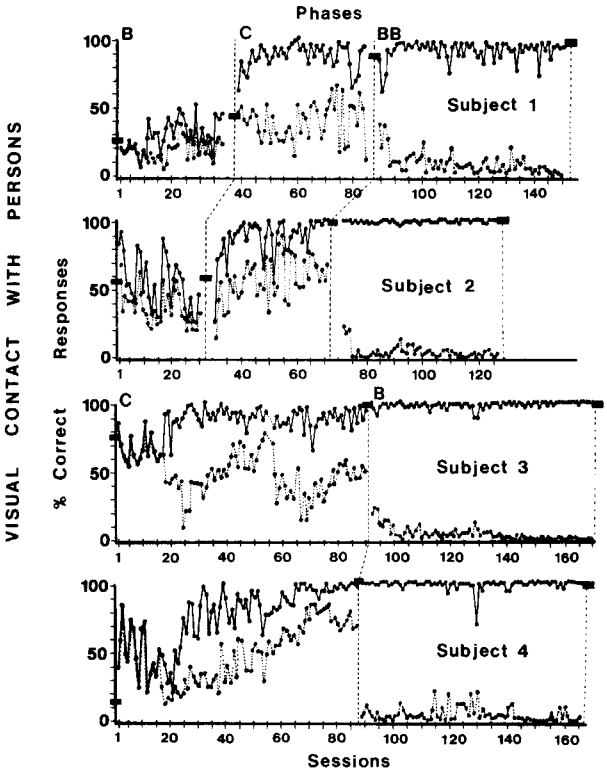


Figure 1. Visual Contact with Persons. Continuous line indicates the percentage of both, required and spontaneous correct response. The dotted line indicates only the percentage of required correct responses. Evaluation data, corresponding to required and spontaneous correct responses are indicated by ■ symbol.

Results

The figures in this report do not include all trained target behavior, due to space limitations. Figures for these behaviors are available upon request from the first author. However, those behaviors not included in these figures are

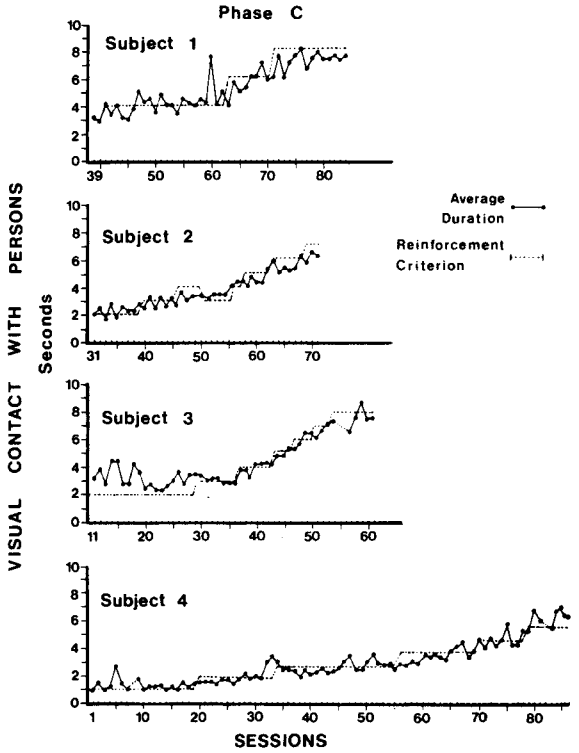
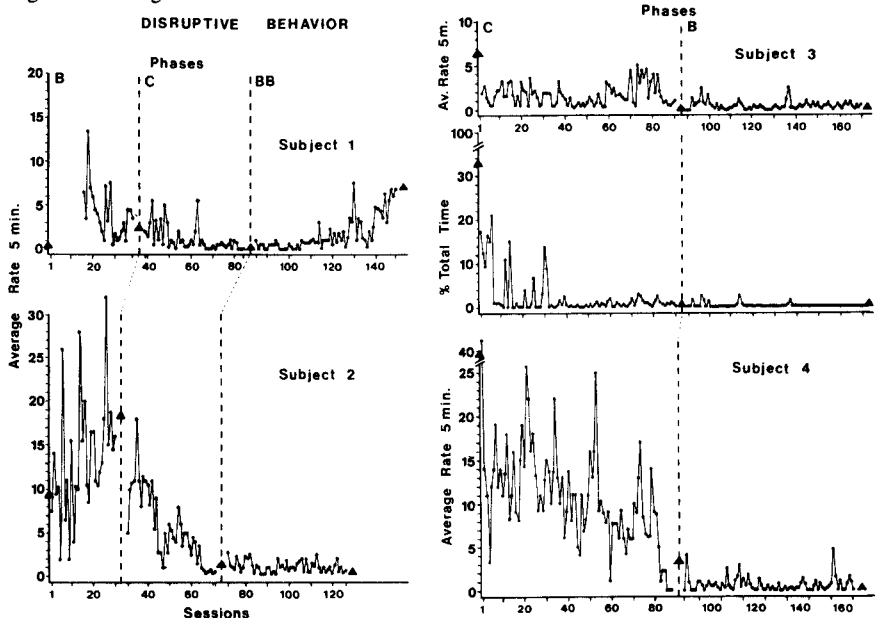


Figure 2. Average duration of Visual Contact with Persons.



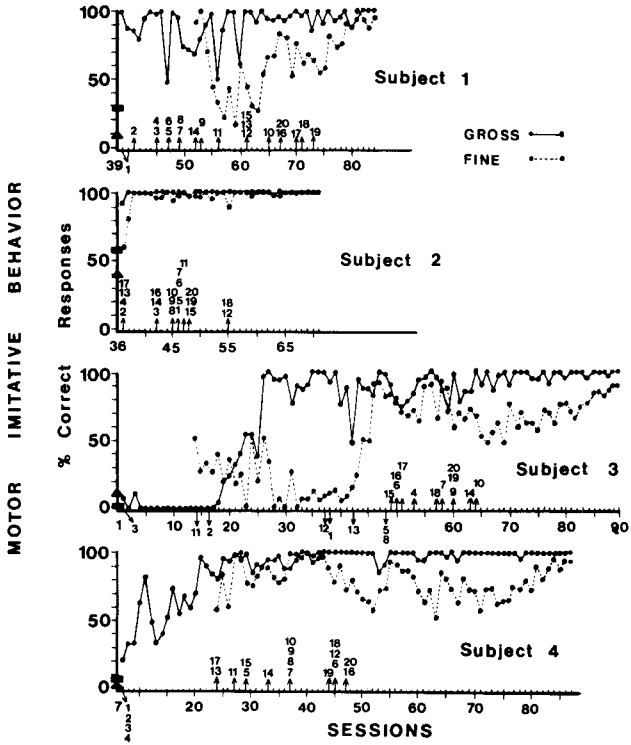


Figure 4. A Motor Imitative behavior. Evaluation data in gross motor behavior are indicated by ■, and in fine motor by ▲. Vertical arrows show the session when the different motor behavior (indicated in numbers) began to be trained. The motor behavior that corresponds to each number can be found in the text.

Most of the performance curves were analyzed visually and by a simplified time-series analysis (Tryon, 1982). The evaluation data were analyzed by non-parametric statistical techniques: Wilcoxon and Binomial. However, we should mention that the data from the evaluation phases provide less quantitative and qualitative information than those from the time-series curves. Hence, we generally present data from the training curves. The analysis based on individual training curves can be summarized, visually and statistically, as follows.

Prerequisite behaviors

(1) Attending behavior: the results of visual contact with persons are presented in Figures 1 and 2. The data from the different phases show the following:

B: The two subjects who received this training phase (NVB and VI without training prerequisite behavior) showed no significant change in prerequisite behavior. The percentage of correct responses did not change during this phase. Although the performance level of S2 was higher than that of S1, it did not reach criterion and was quite variable.

C: Each subject's performance showed significant changes on reaching acquisition criteria, on one hand, with respect to the percentage of correct responses, and, on the other hand, on duration (an average of 5 seconds or more

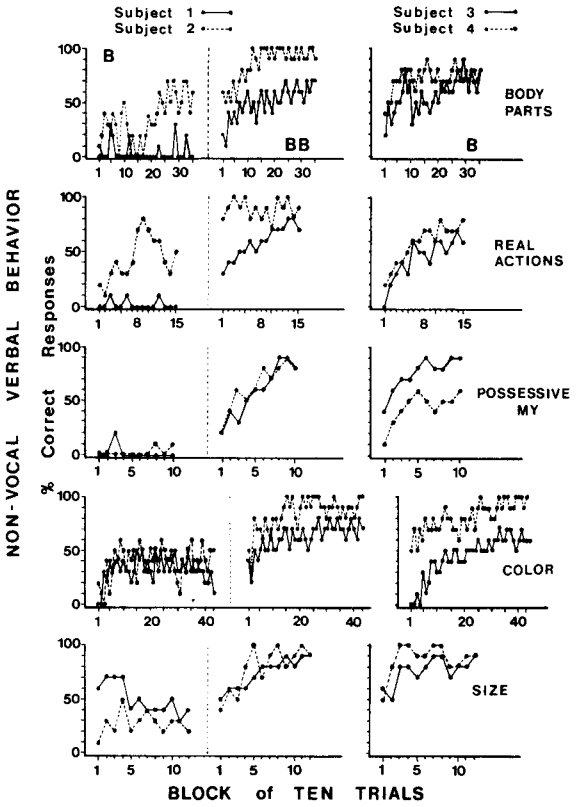


Figure 5. Non-Vocal Verbal Behavior.

BB (S1 and S2), and B (S3 and S4): The performance curves of each subject during this phase (NVB and VI training, after training on prerequisite behavior) indicate that all subjects maintained the acquisition criteron reached in the preceding phase. Most responses were, then, spontaneous rather than required responses. The sudden change in the level of spontaneous responses was due to the fact that in the preceding phase, (C), there were more trials for required than for spontaneous responses. In Phase BB or B, an auditory stimulus for required responses was presented to the subject, only when he or she did not produce spontaneous attentive response before a NVB or VI trial.

Similar performances were obtained in the other attending behaviors: body position and visual contact with objects.

(2) Disruptive behavior: Figure 3 presents the curves for each subject.

B: In this phase without direct intervention in this behavior, neither S1 nor S2 showed any changes in performance. Despite the apparent downward and upward trends there was no statistically significant trend.

C: Disruptive behavior decreased to a minimum during direct training in all subjects. While downward trends are more obvious in S2 and S4, who began this phase with a higher rate than S1 and S3, the disruptive behavior of S1 also

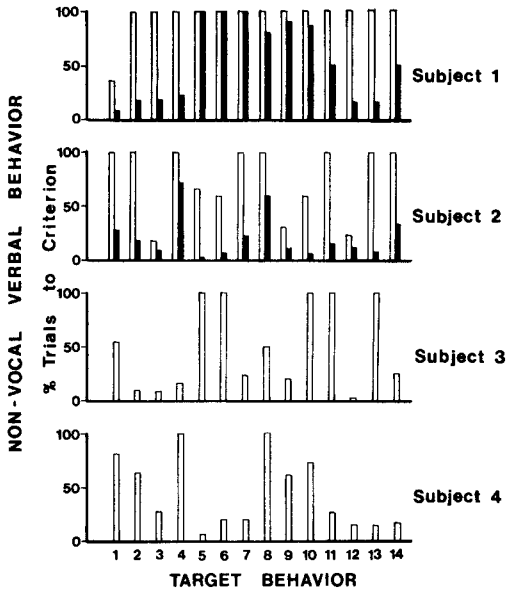


Figure 6. Non-Vocal Verbal Behavior. Percentage of trials needed to reach criterion during phases, B (□), and BB (■). The different numbers indicate each target behavior: (1) basic concept, "pointing," (2) "giving," (3) "moving," (4) combination of the three previous basic concepts, (5) real objects, (6) photo objects, (7) body parts, (8) possessive "my," (9) possessive "your," (10) real actions, (11) photo actions, (12) instructions following, (13) color, and (14) size.

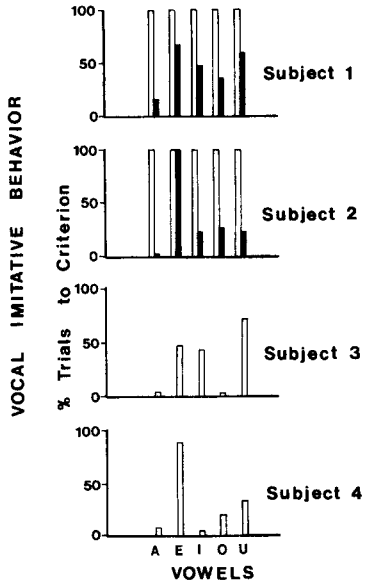


Figure 7. Vocal Imitative Behavior. Percentage of trials needed to reach criterion during phases, B (□), and BB (■).

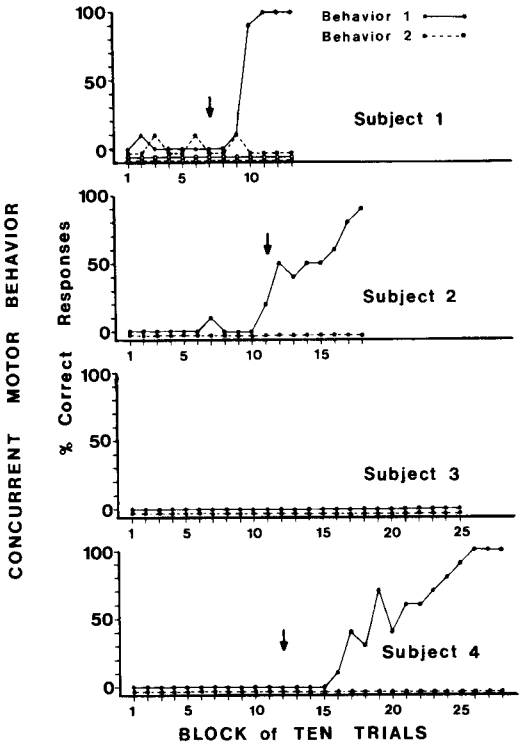


Figure 8. Concurrent Motor Behavior. Percentage of correct responses per block of ten trials. The arrow indicates when behavior 1 began to be trained in subjects 1, 2, and 4.

average rate did not change in S3, the criteron of duration was reached and was clinically acceptable, since the most disruptive behavior was crying.

BB (S1 and S2), and B (S3 and S4): Disruptive behavior showed maintenance of Phase C criterion on all subjects. However, there was an upward trend at the end of this phase by S1, which coincided with a week's absence due to illness. Upon the subject's return, on Session 140, the mother remained in the training room.

(3) Motor imitative behavior: Figure 4 shows the performance curves during training of the total number of movements. The acquisition criterion was reached by all subjects, in gross and fine motor behavior.

Nonvocal Verbal Behavior (NVB)

Only 5 of the total NVBs trained are presented in Figure 5. The performance curves before (Phase B) and after (Phase BB) training prerequisite behavior are shown for S1 and S2. Also show are the performance curves for S3 and S4 after training (Phase B). The maintenance of the acquisition criterion on prerequisite behavior during NVB training, pertaining to visual contact with persons and disruptive behavior is shown in Figures 1 and 3. These 5 curves will be analyzed and results for all targe NVBs trained summarized.

B: During this phase, S1's performance did not change, either visually or statistically, whereas S2 did tend to improve, with an upward trend apparent.

BB: The performance of S1 and S2 improved. When comparing both phases, we noted a change in trend, from zero to upward in S1, while in S2 there was a change from the final trend in B to the initial trend in BB.

Both S3 and S4 improved after training in prerequisite behaviors, with an observable upward trend for both.

Discrimination of *real actions.*

B: No improvement was displayed by S1, while the performance of S2 showed an initial upward trend and a downward trend at the end, which was statistically significant.

BB: For S1 there was an upward trend; for S2 the level of performance was consistently high, between 80-100% correct responses.

Comparing both phases, S1 showed a change of trend, from zero to upward, and in level as well. S2 showed only a change in level.

For both S3 and S4, there was upward trend.

Discrimination of the *possessive adjective my.*

B: No change was observed in either S1 and S2.

BB: Both S1 and S2 showed an upward trend. Comparing both phases, a change of trend, from zero to upward, appeared for both subjects.

The performance curves for S3 and S4 revealed an upward trend.

Color discrimination.

B: S1's performance showed an initial upward trend and a final downward trend, which appeared statistically significant. S2's performance showed a brief initial upward trend, which proved not to be statistically significant.

BB: Improvement was again apparent in both S1 and S2. Comparing both phases, a change of trend appeared in both subjects.

Performance curves for S3 and S4 showed upward trends.

Size discrimination.

B: S1 showed a downward trend although it was not statistically significant, but S2's performance revealed no trend.

BB: Both S1's and S2's performance showed an upward trend. Comparing both phases, a change of trend appeared in both subjects.

The performance curves for S3 and S4 showed initial upward trend, but S3's change did not appear significant.

The *results for all the target behaviors of NVB,* in which the subjects were trained (not only for those presented here), can be summarized as follows. With respect to S1 and S2:

B: No significant changes were observed. There were no upward trends, except in two of S2's target behaviors, discrimination of real actions and body parts.

BB: Significant changes were seen in all the target behaviors of both subjects, either in the form of an ascendant trend or optimum performance level from the beginning of training.

When both phases are compared, the differences in the subjects' performances can be classified as (a) changes of trend, from zero or downward trend to upward trend, (b) changes of level and trend, or (c) changes of level only. An obvious improvement in performance appeared during Phase BB.

In Figure 6, the second parameter of dependent variables—percentage of trials needed to reach 80% correct responses—was analyzed. In this case there was also a significant difference between the phases. Fewer trials were necessary to reach this criterion during Phase BB.

S3 and S4 showed an upward trend during Phase B in all target behaviors. With regard to the second parameter, the criterion level was reached in 8 behaviors by S3 and in 12 by S4.

Vocal imitative behavior (VI)

The only target behavior trained under the two conditions, that is, without and with training in the prerequisite behavior, was vowel pronunciation. However, after training of prerequisite behavior, other combinations (CV, VCV and CVCV or CVCVCV) were trained when vowel topography began to improve.

This anlaysis will focus on vowels. Only the second parameter recorded has been included: percentage of trials needed to reach 80% correct responses. These data appear in Figure 7. S3 and S4 reached the criterion on all vowels, with the same number of trials presented to S1 and S2 during Phase B (500 trials), whereas S1 and S2 did not reach this criterion during B. A significant change between phases was observed in S1 and S2, where the number of trials necessary to reach criterion was lower during BB.

The CV, VCV and CVCV or CVCVCV combinations in which all subjects were trained after reaching the acquisition criteria of the prerequisite behaviors, are summarized as follows. There was improvement in all subjects and target behaviors, even though the number of intracombination behaviors and the level reached varied from one subject to another.

Concurrent behavior

Figure 8 shows that there was no change in motor behaviors. Such a change appeared only when training was implemented for behavior 1, on S1, S2 and S4. This training was not implemented in S3.

Discussion and Conclusion

Training prerequisite behaviors involved the following criteria: (a) 80-100% correct responses of attending behavior—body position, visual contact with objects and persons—and an average duration of 5 seconds in visual contact with a person, (b) a minimum rate or absence of disruptive beahvior, and (c) acquisition of motor imitative behavior—gross and fine—80-100% correct responses. These criteria resulted in superior performance level and a decrease in the number of trials necessary to reach the criterion of 80% correct responses in all target behaviors in nonvocal verbal behavior and vocal imitative behavior.

The results in Phase BB could be due in some degree to the first Phase B, however the comparative visual analysis of performance curves of the first intervention of each design, without and with prerequisite behavior training (Phase B in both designs) would eliminate this possibility: Subjects 3 and 4, who received only one training on nonvocal verbal behavior and vocal imitative behavior (with acquisition criteria of prerequisite behavior), reached criteria for

correct performance more rapidly than Subjects 1 and 2 during the first intervention (without training of prerequisite behavior).

The possibility that Subjects 1 and 2 would have been able to improve their performance after the first training (Phase B), if training had been prolonged, could be explained by trend anlaysis during this phase. The trends were null or downward except in the two target behaviors in Subject 2, mentioned previously. However, in these two behaviors which exhibited an upward trend, it could have been possible for them to continue improving, albeit more slowly, whereas with only one intervention after reaching criteria on prerequisite behavior, improvement was more rapid. The same can be said for vocal imitative behavior.

Similar conclusions can also be drawn from a comparison between different evaluation phase data. However, these data are not sufficient to explain the previous observation. This was only possible with an analysis of trends and performance levels during training. "It is necessary to record the dependent variables in time series during acquisition, and not after it had taken place" (Sidman, 1960).

Returning to the initial goal of this study, we conclude that the wide-ranging definitions on topography, duration, and stimulus control of attending behavior, along with imitative motor behavior and a minimum level of disruptive behavior, are not only useful but are necessary as the first goal to be attained in training mentally retarded children. The results indicated a relationship between the acquisition criteria on prerequisite interactions and the level reached on nonvocal verbal behavior and vocal imitative behavior. However, it would be useful, in future studies, to analyze the specific effects of each acquisition criterion in prerequisite behavior.

With reference to generalization, the clinical replication of certain behavioral problems in different subjects, and the systematic replication (with respect to different trainers in the same training setting, dependent variables and procedures) would permit the generalization of results across trainers and subjects, with the same behavioral problems. It is possible that the acquisition of these prerequisite behaviors may produce the same improvement in level and rate of acquisition in other behaviors. This has been clinically observed, but systematic replication studies are required.

Finally, it is necessary to emphasize that training prerequisite behaviors would enhance the effects of subsequent interventions. Teachers and parents must be told about the most useful sequence of behaviors to be taught in order for a retarded child to acquire the adaptive behavior required by his or her verbal community. This would optimize the use of time and budget, as well as minimize the disappointment of unsuccessful interventions. This research provides information about the initial steps of this sequence.

References

BIJOU, S. W. (1976). *Child development: The basic stage of early childhood.* Englewood Cliffs,

BOOTH, T. (1978). Early receptive language training for the severely and profoundly retarded. *Language Speech and Hearing Services in Schools,* 9, 151-154.

BRICKER, W. A., & BRICKER, D. D. (1974). An early language training strategy. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives, acquisition, retardation and intervention* (pp. 431-468). Baltimore, MD: MacMillan.

ETZEL, B. C., LEBLANC, J. M., SCHILMOELLER, K. J., & STELLA, M. E. (1981). Stimulus control procedures in the education of young children. In S. W. Bijou & R. Ruiz, *Behavior modification: Contributions to education* (pp. 12-47). Hillsdale, NY: Lawrence Erlbaum Associates.

FOXX, R. M. (1977). Attention training: The use of overcorrection avoidance to increase the eye contact of autistic and retarded children. *Journal of Applied Behavior Analysis,* 10, 489-499.

GARCIA, E., BAER, D. M., & FIRESTONE, I. (1971). The development of generalized imitation within topographically determined boundaries. *Journal of Applied Behavior Analysis,* 4, 101-112.

GRAY, B., & RYAN, B. (1973). *A language program for the nonlanguage child.* Champaign, IL: Research Press.

GUESS, D., SAILOR, W., & BAER, D. M. (1974). To teach language to retarded children. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives: Acquisition, retardation and intervention* (pp. 529-564). Baltimore, MD: MacMillan.

GUESS, D., SAILOR, W., & BAER, D. M. (1976). *Functional speech and language training for the severely handicapped.* Part I-II-III. Lawrence, KS: H. H. Enterprises.

GUTTMAN, A. J., & DANIEL, S. A. (1977). A behavioral approach to language training in the retarded. In T. Thompson & J. Grabowski (Eds.), *Behavior modification of the mentally retarded.* (pp. 301-354). New York: Oxford University Press.

HARRIS, S. L. (1975). Teaching language to non-verbal children, with emphasis on problems of generalization. *Journal of Consulting and Clinical Psychology,* 82, 565-580.

HARRIS, S. L. (1976). *Managing behavior 8. Behavior modification: Teaching speech to a nonverbal child.* Lawrence, KS: H. H. Enterprises.

HOGG, J., & MAIER, I. (1974). Transfer of operantly conditioned visual fixation in hyperactive severely retarded children. *American Journal of Mental Deficiency,* 79, 305-310.

HOLDGRAFER, G. (1975-1976). Imitation in language training. *Mental Retardation Bulletin,* 3, 202-215.

KENT, L. R. (1974). *Language acquisition program for the retarded or multiply impaired.* Champaign, IL: Research Press.

KOEGEL, R. L., DUNLAP, G., RICHMAN, G. S., & DYER, K. (1981). The use of specific orienting cues for teaching discriminative task. *Analysis and Intervention in Developmental Disabilities,* 1, 187-198.

LOVAAS, O. I., BERBERICH, J. P., PERLOFF, B. F., & SCHAEFER, B. (1966). Acquisition of imitative speech by schizophrenic children. *Science,* 151, 705-707.

LUCIANO, M. C. (1983). *Implantación de conducta verbal en niños no verbales, en función de la diversificación y secuencia de las fases de tratamiento.* Unpublished doctoral dissertation, Universidad Complutense, Madrid.

MAIER, I., & HOGG, J. (1974). Operant conditioning of sustained visual fixation in hyperactive severely retarded children. *American Journal of Mental Deficiency,* 79, 297-304.

MCCOY, J. F., & BUCKHALT, J. A. (1981). Language acquisition. In J. L. Matson & J. R. McCartney (Eds.), *Handbook of behavior modification with the mentally retarded* (pp. 281-330). New York: Plenum Press.

MILLER, J. F., & YODER, D. E. (1974). An ontogenetic language teaching strategy for retarded children. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives: Acquisition, retardation and intervention* (pp. 505-528). Baltimore, MD: MacMillan.

O'BRIEN, F. (1981). Treating self-stimulatory behavior. In J. L. Matson & J. R. McCartney (Eds.), *Handbook of behavior modification with the mentally retarded* (pp. 117-150). New York: Plenum Press.

PETERSON, R. F. (1968). Imitation: A basic behavioral mechanism. In H. N. Sloane & B. F. MacAulay (Eds.), *Operant procedures in remedial speech and language training* (pp. 61-73). Boston, MA: Houghton Mifflin.

REPP, A. C., & BRULLE, A. R. (1981). Reducing aggressive behavior of mentally retarded persons. In J. L. Matson & J. R. McCartney (Eds.), *Handbook of behavior modification*

SCHROEDER, S. R., SCHROEDER, C. S., ROJAHN, J., & MULICK, J. A. (1981). Self-injurious behavior: An analysis of behavior management techniques. In J. L. Matson & J. R. McCartney (Eds.), *Handbook of behavior modification with the mentally retarded* (pp. 61-116). New York: Plenum Press.

SHERMAN, J. A. (1965). Use of reinforcement and imitation to reinstate verbal behavior in mute psychotics. *Journal of Abnormal and Social Psychology*, 70, 155-164.

SIDMAN, M. (1960). *Tactics of scientific research*. New York: Basic Books.

SLOANE, H. N., JOHNSTON, M. K., & HARRIS, F. R. (1968). Remedial procedures for teaching verbal behavior to speech deficient or defective young children. In H. N. Sloane & B. D. MacAulay (Eds.), *Operant procedures in remedial speech and language training* (pp. 77-101). Boston, MA: Houghton Mifflin.

STANNY, C. J., & WEAVER, G. E. (1980). Directed attention and the recognition of pictures. *Bulletin of the Psychonomic Society*, 15, 410-412.

TRYON, W. W. (1982). A simplified time-series analysis for evaluating treatment interventions. *Journal of Applied Behavior Analysis*, 15, 423-429.

VANCE-HALL, R. (1971). *Managing behavior. Part 2. Behavior modification. Basic principles*. Lawrence, KS: H. H. Enterprises.

WECHSLER, D. (1967). *Manual for the Wechsler Preschool and Primary Scale of Intelligence* (Spanish edition). New York: Psychological Corporation.

WHITMAN, T. L., SCIBAK, J. W., & REID, D. H. (1983). *Behavior modification with the severely and profoundly retarded*. New York: Academic Press.