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THE DIFFERENTIAL EFFECTS OF FOUR TRAINING STRATEGIES FOR USE IN THE SHELTERED WORKSHOP

by

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APPROVAL PAGE

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ABSTRACT

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The present study was designed to investigate the behavior-modification techniques of modeling and chaining as they might apply to retardate training in an industrial setting.

Thirty-two moderately and mildly retarded (IQ 40-60) male and female adults (age 16 and over) employed in a sheltered workshop were given training trials on an assembly task, using four different assembly patterns, and four methods - verbal instructions, concrete modeling, combined verbal instructions and modeling, and chaining. A Latin-square repeated-measures design was used, so that subjects received each method in a different pattern.

No significant differences were found between methods for time to reach criterion. The chaining method required significantly more trials to criterion than the other methods; however, this finding was suggested to be an artifact of the design. Large individual differences were found for subjects on both time and trials for the four different methods.

A first follow-up study, utilizing half of the subjects, investigated whether differences between subjects in time to learn an assembly task were reliable. The same patterns, methods, and instructions were again employed; however, each

subject received a pattern-method combination different from that of the initial study. Again no significant differences between methods were found, except that the chaining method required more trials. The individual differences were again the important finding; they were highly correlated with the preferred methods of responding used by the subjects in the initial study.

A second follow-up study, using the other half of the subjects from the initial study, required subjects to learn a more complex sorting task, using the same four training methods. No significant time differences were found between methods, patterns, or orders of presentation, confirming the initial and first follow-up studies. For the trials data, again no significant differences were found for patterns or orders of presentation, and the chaining method was again found to require more trials, as in the previous studies.

Large individual differences were once again found, and were highly correlated with the preferred methods used by the subjects in the initial study.

It was concluded that the behavior-modification techniques of modeling and chaining have their place in the sheltered workshop as methods of retardate training, for they were found to be as effective with regard to time required to reach criterion on two learning tasks as the more traditional verbal and combined verbal and modeling methods. Further, it was shown that retardates in this workshop setting responded differentially to training methods, and that time and trials to criterion were significantly reduced when each subject's preferred method was used for training. These preferences had reliability over time and task generalization.

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INTRODUCTION

A neglected area of research has been that of the application of psychological learning principles to the training of mentally retarded clients in sheltered workshops (Wolfensberger, 1967). The training usually involves methods that appear to have worked in other industrial settings or in educational settings, or methods that workshop supervisors find adequate, although often frustrating for both clients and themselves.

Hardly any studies have concentrated on or taken into account the variables inherent in the training and placement processes when making predictions concerning vocational success. The application of learning principles to workshop practice would be a fertile field of research for in the United States vocational practices in the field of mental retardation have not been in keeping with the body of empirical knowledge that is available. Where good information is available, it has often been ignored, especially in the area of training. Where no conclusive information exists, it has been frequently assumed to exist. The search for outcome predictors has been based almost completely on the assumption that outcome is nearly exclusively determined by subject variables in the retardate (Wolfensberger, 1967).

The President's Panel on Retardation (1964) concluded that the main distinction between the performance of normals and of retardates on simple tasks is not so much the end-level as the time and conditions needed to achieve it. Carter and Margolin (1964) suggest the management of the retarded is a vital industrial need, and that industrial psychologists should direct more of their talents to this area.

Campbell (1971), in a discussion of non-retardate industrial training, points out that, to date, behavior-modification principles have been applied almost exclusively to neurotic, psychotic, or delinquent behavior, but that these concepts and techniques could be a powerful training model in industrial organizations. A combination of modeling and positive reinforcement would seem useful for many training situations.

Campbell makes four recommendations that might make training and development a more profitable enterprise in terms of successful industrial behavioral change: 1) empirical analyses of the training situation, 2) specifying terminal behaviors, putting learning tasks into components, and seeking optimal sequencing of those components, 3) taking an intelligent plunge into the methods and concepts of behavior modification, and 4) looking at differential effects of competing training strategies. "Knowing these differences is the ultimate payoff," he states.

In the area of workshops for retardates there are in the literature very few analyses of the training situation. Crosson (1970) has suggested looking at terminal behavior and sequencing the components, applying reinforcement for each step. In his study, however, he did not analyze differential ways of presenting each step, and he presented the steps via various media, from verbalizations to pictorial stimuli.

The present paper proposes taking the "plunge" of putting some methods of behavior modification into the workshop situation, by looking at the effects of various training strategies for retardates in a sheltered workshop. The paper will examine the following four strategies: 1) verbal instructions, 2) concrete modeling, 3) verbal instructions combined with concrete modeling, and 4) chaining, as they affect time and trials to criterion in learning situations.

Modeling

With regard to concrete modeling as a learning procedure, Bandura and Walters (1963) state that rate and level of learning may vary as a function of mode of model presentation, and that an actual performance is apt to provide substantially more relevant cues with greater clarity than are conveyed by verbal description. Pertinent research is said to have demonstrated that when a model is provided, patterns of behavior are acquired in large segments rather than through a slow, gradual process based on differential reinforcement. Thus, following a demonstration by a model, or (to a lesser extent) following verbal descriptions, the learner reproduces more or less the entire response pattern, even though he may perform no overt response or receive no reinforcement through the demonstration (Bandura & Walters, 1963).

Also, evidence that discriminations acquired on the basis of non-verbal responses may be sometimes more precise than those based on verbal labels has been suggested by Eriksen (1958). He concludes that language may be an inadequate vehicle for reflecting discriminations that people can actually make.

Bandura (1969) sketches what he regards as optimal conditions for observational learning, and discusses the characteristics of both the model and the observer in addition to stimulus variables. Enhancing and focusing attention is the major requisite in modeling conditions, he suggests. Persons who are informed in advance that they will later be asked to reproduce a response and rewarded in terms of correct performance pay much closer attention to relevant modeling stimuli. The best situation is one in which the model is reinforcing and the observer is somewhat dependent, has a lowered level of competence, and is highly motivated or otherwise emotionally aroused. Stimuli should not exceed the observer's receptive capabilities and should be discriminable.

Bandura also maintains that graduated modeling procedures in which complex patterns of behavior have been reduced to small units of behavior, and each unit established through modeling, have proved highly effective. This technique eliminates the stressful failure experiences which reduce attentional control and motivation.

Hovland, Lumsdaine, and Sheffield (1949) and Maccoby, Michael, and Levine (1961) have also found that periodic reproduction of modeled segments is likely to elicit and sustain greater attentiveness to modeling stimuli than passive observation of lengthy sequences.

Chaining

Spitz (1966) suggests that in studying the learning process in retardates, cognizance should be taken of the tendency of retardates to follow certain types of response sequences, especially those of perservation and alternation. This tendency makes the concept of chaining in learning sequences of particular importance.

Skinner (1953) describes chaining simply as responses that may produce or alter some of the variables which control another response. Some chains have a functional unity, he states; the links have occurred in more or less the same order, and the whole chain has been affected by a single consequence. We often deal with a chain as a single response. Skinner suggests that we often emphasize the initiating member, overlooking the fact that it precedes by several stages the response which is actually reinforced.

Hilgard (1956) discusses the practical meaning of "functional unity" in a given set of stimuli in relation to chaining. The advantages of the concept lie in the description of observable and regularly occurring sequences or chains of responses. In a chain, each response produces the discriminative stimulus for the next response. The transition is made smoothly, so that it seems to be one response, not several.

Breland (1965) emphasizes the importance of chaining in teaching the mentally retarded. Teaching the task backward is very effective, she states. It is best to teach long segments by starting at the end, teaching the last step first, and then expecting more each time before the last step, which is reinforced. This gives the retardate assurance that he can complete the task.

<u>Retardate Learning</u>

There has been much written on the subject of retardate learning and how this might differ from learning in normal subjects. The questions remain largely unanswered, however. Baumeister (1967) remarks that the research often suggests that learning deficiency in mildly and moderately retarded subjects is task-specific, or related only to certain aspects of the learning situation. We should not expect one set of behavioral laws to apply to retardates and another to normals, but rather that the same set of terms will apply to both populations with the values of certain constants differing. He also posits that multidimensional stimulus displays produce better performance than unidimensional ones for discrimination learning.

Zeaman and House (1967) think that the attentional concept is important and should apply to other areas besides concept learning. They regard the fundamental difficulty of the retardate to be his inability to attend to relevant stimuli.

Ellis (1963) thinks that visual displays might be better than auditory, and that multimodalities are good. He thinks a retardate can have a durable association once formed; however, it is necessary to insure a strong stimulus trace via intensity, duration, and meaningfulness of the stimuli at time of initial presentation. In other words, the best approach to training retarded individuals would be to take effective measures to improve their short-term memory, according to Ellis. Thus, in his opinion, in arranging the retardate's environment to compensate for his inferior trace, visual displays might be more effective than auditory.

Luria's (1960, 1963) verbal-dysfunction theory of retardate learning posits a defect in the second signaling system. Luria's theory involves two signal systems. The first is governed by direct signals from the environment, and the second system involves language. Verbal behavior is preeminent over motor behavior in the normally functioning individual, because human beings subordinate behavior to "verbally formulated intentions". If forced to combine his motor reaction with the appropriate verbal mediation, the performance of a retardate should improve significantly.

Not all the evidence points to verbal-motor dissociation as the basic deficit for retardates, however. Rosen and Kivitz (1965) failed to find any substantial dissociation between verbal and motor systems of retardates. Forced verbal mediation or coding of motor responses may, therefore, not be as crucial as Luria suggests.

Retardate learning problems have also been viewed as problems of storage (lipman, 1963); of retrieval (Stedman, 1963); or of categorizing, whereby retardates do not put data into effective chunks and are therefore overloaded (Spitz, 1966).

Denny (1964) suggests that the retarded show poorer short-term memory, rapidly fading stimulus traces, and shorter duration of attention; they are more stimulus bound, and have a generalized deficit with regard to language behavior. The optimal training conditions would be where the main principle was to insure elicitation of the correct response without evoking incorrect responses.

Robinson and Robinson (1965) report that retardates make less use of verbal mediators in their thought processes and use words poorly in the formulation and communication of ideas. They suggest that for training one should attempt to broaden vocabularies, and employ concrete objects as much as possible rather than using words alone.

Related Research

In examining the research literature, we see that the findings are as equivocal as the theories with regard to optimal input conditions for successful learning.

Sheridan (1968) found that verbal labels of either the relevant dimension (black vs. white) or the relevant dimension plus name (black vs. white pipe) significantly improved discrimination learning for retardates with an M.A. of seven years, but not for those with an M.A. of four years, relative to non-verbalized stimuli. He suggested, following developmental learning theories, that his findings had implications for changes in educational methods with retardates.

Kliebhan (1966) studied the effects of three conditions in a workshop for retarded adolescents. Her conditions were: expectancy (setting production goals), imitation (exposure to a model worker), and the traditional verbal instructional method. She found significant improvement in production using either expectancy or imitation, relative to instructions.

Rosen and Kivitz (1965) investigated auditory vs. motor vs. verbal inputs for learning Morse code with educable retardates. They also studied cross-modal output as well as same-modal output. They found no significant differences between uni- or cross-modal conditions. They found the verbal input-verbal output the most accurate condition for imitation of the code, however, and the motor input-motor output condition the least effective.

Masters and Branch (1969) report an interesting experiment utilizing instructional vs. modeling inputs in a word-related task. In the instructional condition, subjects were instructed to "say a word related to the word shown in such a way that it would normally precede or follow the stimulus word." In the modeling condition, subjects were told, "We want you to say words like 'open' or 'close', for example, to stimulus word 'door'." They found the instructional condition superior to the modeling condition, and suggested that incorrect rules were adopted by the modeling subjects. They had to extract a rule, where the instructional condition gave a rule verbatim.

A study by Corsini (1969) examined four methods of instruction for a short-term memory task with pre-school children. The instructions were of the nature, "Put the red ball in the blue box and the yellow ball in the green box." These were presented: 1) verbally, 2) via concrete operations only, 3) via verbal and concrete operations simultaneously, and 4) via verbal followed by concrete operations. Corsini found the combined verbal conditions best, followed by verbal only, followed by concrete only, for the pre-schoolers.

A second experiment (Corsini, 1970) was done, utilizing a verbal-twice condition, in which the verbal-only instructions were repeated twice. The combined verbal and concrete operations were still superior to the verbal-twice condition, thus ruling out redundancy alone as the important factor.

Would these findings hold for more typical learning situations, as well as for short-term memory tasks? Or did Corsini obtain his results partly because short-term memory relies more on auditory cues than visual? Would his findings hold for retardates?

Statement of the Problem

Would a concrete-plus-verbal condition help a retardate to attend better to the stimuli and to code them better, or would the combined-input method interfere with learning for the retardate, because of an inability to process as much information as a normal subject? Would straight verbal or straight modeling input instructions be preferable for retardate training? Would the chaining paradigm be preferable to these other three methods?

The present study was designed to explore these questions, and to examine the behavioral techniques of modeling and chaining in contrast to verbal and combined instructions as they may be utilized in retardate training.

METHOD

Subjects

The subjects in the present investigation were 32 mildly and moderately retarded (IQ 40-60) male and female adults (age 16 and over) who were employed at the time of the investigation in a sheltered workshop.

Ss were run in a repeated measures design, removing the necessity of equating groups for IQ or MA. Each S was tested under each of the four different training conditions.

A first follow-up study was run, using Ss 1 through 16, and a second follow-up study was also run, using Ss 17 through 32.

Procedure, Initial Study

The initial study involved teaching the Ss an assembly task. Five bead-like plastic snap-lock objects were to be assembled using a different training method for each of four different pattern sequences. The objects were assembled on the basis of form and color. The patterns were designed so that each pattern utilized two colors and two forms, all similar forms being the same color. Each of the four patterns repeated one color-form combination from a previous pattern, combined with one new color-form combination, in order to equate for any positive or negative transfer effects.

Each pattern consisted of three objects of one form and color and two objects of a different form and color. The two types of objects appeared in the sequence in alternate position, except that once in each sequence two like objects appeared in adjacent positions. Over the four pattern sequences the two adjacent like objects occupied positions 1 and 2, 2 and 3, 3 and 4, or 4 and 5. The patterns are depicted in Table 1.

A Latin-square design was used. It assured that each S received a different sequence of pattern-method combinations, and E used a different order for each S. Ss were asked to identify each object by color before beginning training, to assure that all Ss knew the appropriate color names.

The four training methods were: 1) verbal instruction by E followed by assembly of the objects by S, 2) concrete assembly by E followed by assembly of the objects by S, 3) verbal instruction combined with concrete assembly by E followed by assembly of objects by S, 4) concrete assembly up to the final unit by E, followed by assembly of the final unit by S, followed then by assembly by E up to the last two units, then the last three, and so on, with S completing the chain.

The four training methods will be referred to as: 1) verbal, 2) modeling, 3) combined, and 4) chaining.

Instructions for the verbal method followed the pattern: "Listen carefully, and do as I say....Take a green one (pause while S picks up a green object), put on a yellow one (pause while S complies), put on a green one (pause while S complies), put on a green one (pause while S complies), put on a yellow one" (pause while S complies). Instructions for the modeling method were: "Watch carefully, and do as I do." (E paused after each step to allow S to imitate.) Instructions for the combined method were: "Watch and listen carefully, and do as I do." ("Take a green one......".) For the chaining method, instructions were: "Watch carefully, and when I stop, you finish it."

Each of the four learning conditions was characterized by incremental input; i.e. for verbal, modeling, and combined conditions on the first trial (training) S repeated each step immediately after it was verbalized or demonstrated in the input session, and then was asked on the second trial (test) to construct the entire pattern on his own, without further instruction. (If he could not, the next trial was again a sequential training trial.)

In the chaining method, E constructed the chain to the prescribed level (up to the last unit on Trial 1, up to the last two units on the next training trial, up to the last three units on the next, etc.), pausing one second between steps. When the prescribed level was reached, S was required to finish the pattern with no further instruction. When S failed to complete the chain, E again assembled up to the unit where S previously had been correct, and then required S to complete the chain.

A trial consisted of one attempt (completed or not) at assembling the pattern units, by either E or S (training or test). Training continued for each pattern until the criterion of two successive test assemblings was accomplished by S.

A stopwatch was used to record the time for each S on each method. Timing was begun when the first unit was picked up (by E or S depending upon the method) and stopped when the criterion was reached for each method. A record was also kept of the number of trials for each problem for each S.

No reinforcement other than the social reinforcement involved in the verbal feedback was used. Each time S correctly completed a trial, E said, "Good." Each time S incorrectly completed a trial, E said, "That's not quite right," and a new trial began. This feedback was recorded on a cassette recorder for later validation of equality of reinforcement for all methods.

Procedure, Feedback Validation

Thirty undergraduate male and female college students listened to a tape recording of the verbal feedback. Before listening to the tape, Ss were instructed that the tape contained 40 feedback verbalizations for four types of training methods. The methods were explained to the Ss, and they were given sheets of paper numbered from 1 to 40. Ss were instructed that there were ten feedback verbalizations for each training method, in random order, and they were to guess which feedback verbalizations were associated with which methods. E then played the tape for the Ss, and after each feedback verbalization was heard, Ss wrote opposite the appropriate numbers on their papers their guess as to the method with which it was associated.

Procedure, First Follow-up

Approximately three weeks after the initial study, a follow-up study was done, using half of the initial Ss. The same assembly task was re-taught by the four methods, using the same snap-lock objects and patterns as in the initial study, and the same instructions were given. A Latin-square design was again followed. The order of presentation was changed, so that Ss received method-pattern combinations different from those of their previous tasks.

The purpose of the follow-up was to investigate whether the initial findings would have reliability over time.

Procedure, Second Follow-up

Approximately three weeks after the first follow-up, a second follow-up was accomplished, using the remaining half of the Ss from the initial study. The training task was changed this time.

Ss were now taught a sorting task. Four different types of nails were sorted into five different colored containers. The containers were ten-ounce plexiglas glasses covered with red, orange, yellow, green or blue construction paper. The glasses were placed two inches apart in front of the Ss.

The nails to be sorted consisted of 1) four-inch long round nails, 2) three-inch flat nails, 3) one-inch short round nails, and 4) two-inch curved U-shaped nails. Ss were asked to identify all nails by name before beginning training, and nails were referred to as "long nails," "flat nails," "short nails," and "U-nails."

Patterns were devised which were analogous to those employed with the snap-lock objects. Thus, each pattern utilized two nail types, with each of the four patterns repeating one type from the previous pattern combined with one new type. Each pattern consisted of three nails of one type and two nails of a different type. The two types of nails appeared in the pattern sequence for sorting in alternate position, except that once in each sequence two like nails were in adjacent positions. Over the four pattern sequences, the two adjacent like nails occupied positions 1 and 2, 2 and 3, 3 and 4, or 4 and 5. The patterns are depicted in Table 2.

The five objects per pattern, and the similar patterns were an attempt to make this follow-up study similar to the initial task. A Latin-square design was again used, along with the same four training methods. The same instructions were followed as in the initial study; however, instructions for the verbal method for this task were, "Listen carefully and do as I say.....Put a short nail in the red cup (pause while S complies), a long nail in the orange cup (pause), a short nail in the yellow cup (pause), a long nail in the green cup (pause), a long nail in the blue cup" (pause).

The differences between this follow-up study and the initial study were: 1) a sorting rather than an assembly task, 2) size and shape pattern cues plus container color cues rather than only shape and color pattern cues, 3) a discontinuous task in which each step could not be visually connected to previous steps, rather than the visual connection of steps.

The purpose of the second follow-up was to investigate whether the initial findings would have generality for a different type of workshop task.

RESULTS

The data were analyzed both parametrically and non-parametrically. Because the data were skewed and did not completely meet the assumptions of normal distribution and homogeneity of variance necessary for parametric analysis, and because of an interest in order relations, the Friedman rank-order analysis of variance was used for a non-parametric index. "This test may well be the best alternative to the ordinary two-way analysis of variance. The result should compare well with F when both classical and order methods do apply" (Hays, 1965).

Since order tests are relatively low-powered tests as compared with parametric tests, and, since with N and alpha being equal, there is more risk of a Type II error, the parametric Latin-square analysis of variance (Winer, 1962) was also used. A further reason for this parametric test was to test for interaction effects.

"Unless there is reason to suspect a fairly extreme departure from normality, it is probable that the conclusions drawn from the data using an F test will not be seriously affected. Moderate departure from homogeneity of variance should not seriously affect the inferences drawn from the data" (Ferguson, 1959).

The data were analyzed with an alpha level set at .05.

Results, Initial Study

Table 3 depicts total time (seconds), mean time (seconds), and time-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 4) for time indicated no significant interaction effects, no significant pattern effects, no significant method effects, and no significant order effects.

Three Friedman rank-order analyses of variance (see Table 5) of the time data indicated no significant differences among methods, among patterns, or among orders of presentation.

Table 6 shows total number of trials, mean number of trials, and trial-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 7) for trials indicated no significant interaction effects, no significant pattern effects, and no significant order effects. There was, however, a significant methods effect.

A Newman-Keuls procedure for comparison of multiple means (see Table 8) showed the chaining method to be significantly different from each of the other three methods.

Three Friedman rank-order analyses of variance (see Table 9) of the trials data indicated no significant differences among patterns, and no significant differences among orders of presentation. There was a significant difference among methods. Sign tests (see Table 10) indicated the chaining method to be significantly different from each of the other three methods. Thus, there was good consistency between the parametric and non-parametric analyses.

A non-significant Chi-square was obtained for the analysis of verbal feedback, indicating approximately chance level estimates of which recorded feedback comments were associated with the four different methods (see Table 11).

<u>Results, First Follow-up</u>

Table 12 sets forth total time (seconds), mean time (seconds), and time-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 13) for time indicated no significant interaction effects, no significant method effects, no significant pattern effects, and no significant order effects.

Three Friedman rank-order analyses of variance (see Table 14) of the time data indicated no significant differences among methods, among patterns, or among orders of presentation.

Table 15 depicts total number of trials, mean number of trials, and trial-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 16) for trials indicated no significant interaction effects, no significant method effects, no significant pattern effects, no significant order effects.

Three Friedman rank-order analyses of variance (see Table 17) of the trials data indicated no significant differences among patterns, or among orders of presentation. There was a significant difference among methods. Sign tests (see Table 18) indicated the chaining method to be significantly different from each of the other three methods.

Since the $\underline{F}$ for methods approached significance at the .05 level, and had a probability of .06, it was judged there was again good agreement between the parametric and non-parametric analyses.

Table 19 shows time scores and Kendall Tau correlation coefficients for each of Ss 1-16 for their time scores across methods for the initial and first follow-up studies. All of the correlations were positive, and the Binomial test (Siegel, 1956) probability associated with this correlation distribution was $\underline{p} < .001$.

Table 20 depicts trials scores and Kendall Tau correlation coefficients within Ss 1-16 for their trials scores across methods for the initial and first follow-up studies. The correlations were again all positive, and the Binomial test probability associated with this distribution was also $\underline{p} < .001$.

Results, Second Follow-up

Table 21 shows total time (seconds), mean time (seconds), and time-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 22) for time indicated no significant interaction effects, no significant method effects, no significant pattern effects, and no significant order effects.

Three Friedman rank-order analyses of variance (see Table 23) of the time data indicated no significant differences among methods, among patterns, or among orders of presentation.

Table 24 gives total number of trials, mean number of trials, and trial-rank totals for the four training methods, the four patterns, and the four orders of presentation.

The Latin-square parametric analysis of variance (see Table 25) for trials indicated no significant interaction effects, no significant pattern effects, and no significant order effects. There was a significant method effect.

A Newman-Keuls procedure for comparison of multiple means (see Table 26) indicated the chaining method to be significantly different from the combined method. The chaining method approached, but did not quite reach, significant difference from the verbal and modeling methods.

Three Friedman rank-order analyses of variance (see Table 27) of the trials data indicated no significant differences among patterns, and no significant differences among orders of presentation. There was, however, a significant difference among methods. Sign tests (see Table 28) indicated the chaining method to be significantly different from each of the other three methods. It was felt there was good agreement once again between the parametric and non-parametric analyses.

Table 29 lists time scores and Kendall Tau correlation coefficients for each of Ss 17-32 for their time scores across methods for the initial and second follow-up studies. All scores for these Ss were positively correlated, with a Binomial test (Siegel, 1956) probability of $p < .001$.

Trials scores and Kendall Tau correlation coefficients within Ss 17-32 for their trials scores across methods over the initial and second follow-up studies are given in Table 30. All correlations are again positive and the Binomial test probability associated with this correlation distribution is $p < .001$.

DISCUSSION

The non-significant analyses of variance for time in the initial study suggest that the behavioral techniques of modeling and chaining may have a place in retardate training in the workshop, since they did not require significantly more training time than the more traditional "show and tell" combined method of training and the verbal instruction method.

The significant analyses of variance for trials in the initial study show the chaining method to require significantly more trials than the other three methods, and this might seem to suggest that the chaining method is therefore inferior for workshop use. The discrepancy can be explained, however, by the fact that since there were five items to be assembled in the task, during training with the chaining method, Ss did not have the opportunity to demonstrate criterion of two successive correct independent assemblies until Trial 6, whereas with the other three methods, Ss had the opportunity to demonstrate criterion learning by Trial 3. A few Ss did occasionally reach criterion on Trial 3 with each of the other three methods. Thus, the other methods had a built-in advantage over the chaining method with respect to trials. It is possible, therefore, that the chaining method might not be at a disadvantage for number of trials in a more complex task, where the criterion could not be met in a few trials by any method.

Because the trainer has to do more assembly work using the chaining method, it does place more demands upon him; however, in terms of total time spent with trainees to reach criterion, the chaining method did not significantly differ from the other methods used in this study.

An unexpected finding in the initial study was the large variation in both the time and the number of trials needed by individual Ss on different methods. All Ss differed in time and trials to criterion by different methods, and in many cases these differences were from less than one or two minutes to several minutes. Since order effects, pattern effects, and interaction effects were non-significant, these individual differences were considered an important finding and prompted the two follow-up studies to see if the individual method preferences were reliable over time, and if so, if they would generalize to another task.

The results of the first follow-up again revealed that the time required to learn the task did not differ significantly among the four methods. There was a significant difference in number of trials to criterion in the non-parametric rank-order analysis, again explained by the possibility of obtaining criterion three trials sooner with methods other than chaining.

The high and significant correlation coefficients for time and trials for Ss across training methods over the initial and first follow-up studies revealed that each S indeed had a preferred way of learning. For each S there was a stable method order, with either one or two preferred methods and one or two non-preferred methods showing consistent concordance over time.

The results of the second follow-up study were in good agreement with those of the initial follow-up, with again no significant differences between the four methods for time; a significant difference for trials with the chaining method again different from the other three; and no interaction, pattern, or order effects noted for time or trials. The individual differences were once again the relevant data finding.

The correlation coefficients for time and trials within Ss and across methods for the initial and second follow-up studies were again a significant factor that served to strengthen the preferred-method finding. Each S had a preferred way of learning, or responding to input information, which not only showed consistent concordance over time, but remained stable over different tasks.

It was observed that some Ss responded fastest to either straight verbal information processing or the verbal and combined method. This might suggest that they were still attending to only verbal cues. Other Ss responded best to straight modeling, or a combination of the modeling and chaining, suggesting that for these Ss verbal cues were less important. Some Ss seemed to profit from the combined method, perhaps profiting from the dual coding achieved with both verbal and concrete cues. Chaining was the only method by which one S was able to learn the initial assembly task, and the chaining method was superior for several Ss in terms of time to criterion. Other Ss could utilize the chaining method only until Trial 5, when they had to select the first unit, at which point they could not continue.

Whether the Ss responded differentially due to past learning experiences or whether this phenomenon was due to some attentional factor or underlying physiological differences is not known at this time, and might offer an interesting line of future research.

Conclusion

In conclusion, it is suggested that the behavior modification techniques of modeling and chaining do have a place in the sheltered workshop as training methods. The present study has shown them to be as effective, with regard to time required to reach criterion on two different learning tasks, as the traditional verbal and combined training methods commonly employed in workshops.

Further research is suggested, especially an investigation of the chaining method, in which a longer chain is used; the length of chain and difficulty of the task may be an important variable. It is posited that a long sequence might show the chaining method to require less time and fewer trials to criterion than the other methods examined in this paper, for chaining has been found to be a most successful method of teaching other long sequences of behavior to retardates (Breland, 1965).

Most importantly, it was found that the retardates in the workshop used in the present study had definite preferred modes of responding to training, and that these preferred methods had both reliability over time and task generalization. This would suggest that training time for retardates in a sheltered workshop might be significantly reduced by matching the retardate with his preferred learning method.

TABLE 1

Snap-Lock Bead Patterns for the Initial and First Follow-up Studies

Item Description	1" Orange octagonal bead	$1\frac{1}{2}$" Blue oval bead	$1\frac{1}{2}$" Yellow accordian bead	1" Green round bead
Name Used	Orange	Blue	Yellow	Green

Pattern I	Orange Blue Orange Orange Blue
Pattern II	Yellow Blue Yellow Blue Blue
Pattern III	Green Yellow Yellow Green Yellow
Pattern IV	Orange Orange Green Orange Green

TABLE 2

Nail Patterns for the Second Follow-up Study

Item Description	1" Short round nail	3" Flat nail	4" Long round nail	2" U-shaped nail
Name Used	Short	Flat	Long	U

Pattern I	Short Flat Short Flat Flat
Pattern II	U U Flat U Flat
Pattern III	U Long Long U Long
Pattern IV	Long Short Long Long Short

TABLE 3

Total Time, Mean Time, and Rank Totals for Methods, Patterns, and Order of Presentation for the Initial Study

	M1	M2	M3	M4
Total Time (Sec.)	8629	8728	8515	9574
Mean Time (Sec.)	269.66	272.75	266.19	299.19
Rank Totals	78.5	75.5	73	93

	P1	P2	P3	P4
Total Time (Sec.)	8873	8401	9184	8991
Mean Time (Sec.)	277.28	262.53	287.00	280.97
Rank Totals	86	69.5	90.5	76

	O1	O2	O3	O4
Total Time (Sec.)	9173	8436	8597	9243
Mean Time (Sec.)	286.66	263.63	268.66	288.84
Rank Totals	78.5	81.5	78	82

TABLE 4

Latin-Square Analysis of Variance for

Time for the Initial Study

Source	SS	df	MS	F
A (Methods)	21797.65	3	7265.88	.119
B (Patterns)	10405.21	3	3468.40	.057
C (Order)	15424.46	3	5141.49	.084
Between Cells	398650.25			
Within Cells	6816114.37	112	60858.16	
Residual	351022.93	6	58503.82	.961

TABLE 5

Friedman Analyses of Variance for Time Data for Methods, Patterns, and Order of Presentation for the Initial Study

Source	ST^2	df	Xr^2
Methods	25840.50	3	4.50
Patterns	26192.50	3	4.51
Order	25612.50	3	.23

TABLE 6

Total Number of Trials, Mean Number of Trials, and Rank Totals for Methods, Patterns, and Order of Presentation for the Initial Study

	M1	M2	M3	M4
Total Trials	239	246	240	374
Mean Trials	7.46	7.68	7.50	11.68
Rank Totals	70	70.5	68	111.5

	P1	P2	P3	P4
Total Trials	279	269	279	272
Mean Trials	8.77	8.40	8.71	8.50
Rank Totals	79	78	85.5	77.5

	O1	O2	O3	O4
Total Trials	270	275	274	280
Mean Trials	8.43	8.59	8.56	8.75
Rank Totals	75	83.5	79	82.5

TABLE 7

Latin-Square Analysis of Variance for

Trials for the Initial Study

Source	SS	df	MS	F
A (Methods)	411.33	3	137.11	4.951*
B (Patterns)	2.39	3	.796	.028
C (Order)	1.58	3	.526	.019
Between Cells	591.18			
Within Cells	3101.87	112	27.69	
Residual	175.88	6	29.31	1.05

*$p < .05$

TABLE 8

Newman-Keuls Procedure for Comparison of Trials Data for Methods for the Initial Study

		M1	M3	M2	M4
Ordered Totals		239	240	246	374
Difference Between Pairs	M1		1	7	135*
	M3			6	134*
	M2				128*

Truncated Range	2	3	4	
9.95 (r,112)	2.80	3.36	3.69	
$9.95\ (r,112)\sqrt{N \cdot MSE}$	83.33	99.99	109.81	

*$p < .05$

TABLE 9

Friedman Analyses of Variance for Trials Data for Methods, Patterns, and Order of Presentation for the Initial Study

Source	S_T^2	*df*	X_r^2
Methods	26926.50	3	24.84*
Patterns	25641.50	3	.778
Order	25644.50	3	.834

*$p < .05$

TABLE 10

Sign Tests for Trials for the Initial Study

Methods		1	2	3	4
Difference Between Pairs	1		N.D.	N.D.	4.18*
	2			N.D.	3.46*
	3				4.07*

*$p < .05$

TABLE 11

Chi-Square Validation for Verbal Feedback

Value	Observed Frequency	Expected Frequency	O-E	$(O-E)^2/E$
Method 1	69	75	-6	.48
Method 2	79	75	+4	.21
Method 3	80	75	+5	.33
Method 4	72	75	-3	.12
	300	300	0	X^2=1.14

TABLE 12

Total Time, Mean Time, and Rank Totals for Methods, Patterns, and Order of Presentation for the First Follow-up Study

	M1	M2	M3	M4
Total Time (Sec.)	3102	3004	3190	4370
Mean Time (Sec.)	193.88	187.75	199.38	203.13
Rank Totals	36	37.5	35	51.5

	P1	P2	P3	P4
Total Time (Sec.)	3031	3581	3136	3918
Mean Time (Sec.)	189.44	223.81	196.00	244.88
Rank Totals	36	47.5	32	44.5

	01	02	03	04
Total Time (Sec.)	3469	3757	3289	3151
Mean Time (Sec.)	216.81	234.81	205.56	196.94
Rank Totals	38.5	44	43.5	34

TABLE 13

Latin-Square Analysis of Variance for

Time for the First Follow-up Study

Source	SS	df	MS	F
A (Methods)	76845.69	3	25615.23	.579
B (Patterns)	31615.82	3	10538.61	.238
C (Order)	12840.19	3	4280.06	.096
Between Cells	325906.94			
Within Cells	2122287.00	48	44214.31	
Residual	204605.24	6	34100.87	.771

TABLE 14

Friedman Analyses of Variance for Time Data for Methods, Patterns, and Order of Presentation for the First Follow-up Study

Source	S_T^2	*df*	X_r^2
Methods	6579.50	3	6.73
Patterns	6556.50	3	5.87
Order	6466.50	3	2.49

TABLE 15

Total Number of Trials, Mean Number of Trials and Rank Totals for Methods, Patterns, and Order of Presentation for the First Follow-up Study

	M1	M2	M3	M4
Total Trials	102	103	103	166
Mean Trials	6.38	6.44	6.44	10.38
Rank Totals	32.5	33.5	31.5	62.5

	P1	P2	P3	P4
Total Trials	116	119	118	121
Mean Trials	7.25	7.44	7.38	7.56
Rank Totals	39.5	42.5	38.5	39.5

	01	02	03	04
Total Trials	119	121	116	118
Mean Trials	7.44	7.56	7.25	7.38
Rank Totals	39	39.5	42	39.5

TABLE 16

Latin-Square Analysis of Variance for Trials for the First Follow-up Study

Source	SS	df	MS	F
A (Methods)	188.07	3	62.69	2.61
B (Patterns)	.82	3	.27	.011
C (Order)	.82	3	.27	.011
Between Cells	294.44			
Within Cells	1151.00	48	23.98	
Residual	104.73	6	17.46	.728

TABLE 17

Friedman Analyses of Variance for Trials Data for Methods, Patterns, and Order of Presentation for the First Follow-up Study

Source	ST^2	df	X_r^2
Methods	7077	3	25.39*
Patterns	6409	3	.34
Order	6405.50	3	.20

*$p < .05$

TABLE 18

Sign Tests for Trials for the First Follow-up Study

Methods		1	2	3	4
Difference Between Pairs	1		N.D.	N.D.	4*
	2			N.D.	3*
	3				3,94*

*$p < .05$

TABLE 19

Time Scores and Kendall Tau Correlation Coefficients for Subjects 1-16 Across Methods for the Initial Study and First Follow-up Study

	M1		M2		M3		M4		
Subject	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Tau
1	102	2	92	1	117	3	187	4	1
	107	2	88	1	113	3	150	4	
2	103	3	101	2	219	4	97	1	.66
	105	3	78	1	168	4	100	2	
3	133	3	329	4	102	2	93	1	.33
	126	4	105	3	64	1	92	2	
4	442	3	366	1	601	4	396	2	.66
	496	2	360	1	660	4	640	3	
5	169	1	256	3	224	2	296	4	.66
	128	1	204	2	207	3	400	4	
6	106	1	147	3	129	2	165	4	.66
	78	2	127	3	72	1	147	4	
7	900	2.5	960	4	900	2.5	413	1	1
	780	2	820	4	785	3	590	1	
8	113	1	120	3	116	2	200	4	.66
	66	1	72	2	87	3	132	4	

(Table 19 Continued)

	M1		M2		M3		M4		
Subject	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Tau
9	80	2	316	4	65	1	188	3	1
	168	2	226	4	43	1	214	3	
10	258	3	236	2	205	1	443	4	1
	195	3	166	2	91	1	201	4	
11	960	4	150	1	840	3	767	2	.66
	310	3	126	1	348	4	268	2	
12	92	4	66	2	53	1	72	3	.66
	88	3	86	2	54	1	111	4	
13	74	1	286	4	93	2	186	3	.33
	210	2	216	3	149	1	255	4	
14	206	3	156	2	121	1	221	4	.55
	35	2	50	3.5	34	1	50	3.5	
15	204	2	418	3	150	1	542	4	1
	120	2	175	3	90	1	540	4	
16	221	2	95	1	277	3	543	4	.66
	90	1	105	2	225	3	480	4	

Mean Correlation Coefficient	.72
Modal Correlation Coefficient	.66
Median Correlation Coefficient	.66
Binomial Probability for the Distribution	$\underline{p} < .001$

TABLE 20

Trial Scores and Kendall Tau Correlation Coefficients for Subjects 1-16 Across Methods for the Initial Study and First Follow-up Study

	M1		M2		M3		M4		
Subject	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Tau
1	3	2	3	2	3	2	8	4	1
	3	2	3	2	3	2	6	4	
2	5	1.5	5	1.5	7	4	6	3	.66
	3	1.5	3	1.5	5	3	6	4	
3	5	2	11	4	3	1	6	3	.55
	5	2.5	5	2.5	3	1	9	4	
4	13	3	11	1.5	17	4	11	1.5	.20
	15	2.5	13	1	15	2.5	17	4	
5	5	1	7	2.5	7	2.5	11	4	1
	7	1.5	9	3	7	1.5	15	4	
6	5	2	5	2	5	2	7	4	.78
	3	1.5	5	3	3	1.5	6	4	
7	20	3	20	3	20	3	12	1	.26
	19	2	16	1	20	3.5	20	3.5	
8	5	2	5	2	5	2	11	4	.78
	3	1.5	3	1.5	5	3	6	4	

(Table 20 Continued)

	M1		M2		M3		M4		
Subject	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Tau
9	5 5	2 2	9 9	3.5 4	3 3	1 1	9 8	3.5 3	1
10	9 7	3 3	7 5	1.5 2	7 3	1.5 1	18 10	4 4	1
11	20 7	3.5 2.5	7 5	1 1	20 7	3.5 2.5	18 11	2 4	.20
12	5 3	3 2	3 3	1.5 2	3 3	1.5 2	6 6	4 4	.78
13	3 9	1.5 2.5	9 9	4 2.5	3 7	1.5 1	7 11	3 4	.60
14	7 3	3 2	5 3	2 2	3 3	1 2	10 6	4 4	.50
15	7 5	2 2	13 7	3 3	5 3	1 1	20 15	4 4	1
16	7 5	2 1.5	3 5	1 1.5	9 13	3 3	20 14	4 4	1

Mean Correlation Coefficient	.71
Modal Correlation Coefficient	1
Median Correlation Coefficient	.78
Binomial Probability for the Distribution	$p < .001$

TABLE 21

Total Time, Mean Time, and Rank Totals for Methods, Patterns, and Order of Presentation for the Second Follow-up Study

	M1	M2	M3	M4
Total Time (Sec.)	3939	3793	3382	4627
Mean Time (Sec.)	246.19	237.06	211.38	289.19
Rank Totals	40	37	34	49

	P1	P2	P3	P4
Total Time (Sec.)	3442	4332	3938	4029
Mean Time (Sec.)	215.13	270.75	246.13	251.81
Rank Totals	31	44	43	42

	O1	O2	O3	O4
Total Time (Sec.)	4588	3589	3461	4103
Mean Time (Sec.)	286.75	224.31	216.31	256.44
Rank Totals	45	40	33	42

TABLE 22

Latin-Square Analysis of Variance for

Time for the Second Follow-up Study

Source	SS	df	MS	F
A (Methods)	50303.30	3	16767.76	.373
B (Patterns)	25593.92	3	8531.30	.190
C (Order)	49939.05	3	16646.35	.370
Between Cells	277835.61			
Within Cells	2154265.25	48	44880.52	
Residual	151999.34	6	2533.22	.056

TABLE 23

Friedman Analyses of Variance for Time Data for Methods, Patterns, and Order of Presentation for the Second Follow-up Study

Source	ST^2	*df*	Xr^2
Methods	6526	3	4.73
Patterns	6510	3	4.13
Order	6478	3	2.93

TABLE 24

Total Number of Trials, Mean Number of Trials, and Rank Totals for Methods, Patterns, and Order of Presentation for the Second Follow-up Study

	M1	M2	M3	M4
Total Trials	124	122	115	189
Mean Trials	7.75	7.63	7.19	11.81
Rank Totals	36	33.5	35.5	55

	P1	P2	P3	P4
Total Trials	126	146	148	130
Mean Trials	7.88	9.13	9.25	8.13
Rank Totals	34	47.5	39.5	39

	O1	O2	O3	O4
Total Trials	148	138	131	133
Mean Trials	9.25	8.63	8.19	8.31
Rank Totals	42.5	39	39	39.5

TABLE 25

Latin-Square Analysis of Variance for

Trials for the Second Follow-up Study

Source	SS	df	MS	F
A (Methods)	223.82	3	74.60	2.75*
B (Patterns)	23.19	3	7.73	.285
C (Order)	10.82	3	3.60	.132
Between Cells	410.44			
Within Cells	1301.00	48	27.10	
Residual	152.61	6	25.43	.938

*$p < .05$

TABLE 26

Newman-Keuls Procedure for Comparison of Trials Data for Methods for the Second Follow-up Study

		M3	M2	M1	M4
Ordered Totals		115	122	124	189
Difference Between Pairs	M3		7	9	74*
	M2			2	67
	M1				65

Truncated Range	2	3	4	
q 95 (r, 48)	2.83	3.40	3.74	
q 95 (r, 48) $\sqrt{N \cdot MSE}$	58.86	70.72	77.79	

*$p < .05$

TABLE 27

Friedman Analyses of Variance for Trials Data for Methods, Patterns, and Order of Presentation for the Second Follow-up Study

Source	ST^2	*df*	Xr^2
Methods	6703.50	3	11.38*
Patterns	6493.50	3	3.51
Order	6408.50	3	.32

*$p < .05$

TABLE 28

Sign Tests for Trials for the Second Follow-up Study

Methods		1	2	3	4
Difference Between Pairs	1		N.D.	N.D.	2.32*
	2			N.D.	2.32*
	3				2.67*

*$p < .05$

TABLE 29

Time Scores and Kendall Tau Correlation Coefficients for Subjects 17-32 Across Methods for the Initial Study and Second Follow-up Study

	M1		M2		M3		M4		
Subject	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Tau
17	14	1	419	4	129	3	19	2	1
	30	1	391	4	140	3	38	2	
18	243	3	89	1	125	2	376	4	.66
	95	3	28	2	26	1	320	4	
19	276	3	179	1	215	2	519	4	1
	113	3	48	1	63	2	283	4	
20	411	2	404	1	1204	4	692	3	.33
	660	4	316	1	600	3	540	2	
21	122	1	209	3	184	2	241	4	1
	240	1	531	3	480	2	581	4	
22	106	2	315	4	93	1	184	3	.66
	135	2	245	3	126	1	480	4	
23	236	3	26	1	181	2	252	4	.66
	122	2	80	1	150	3	178	4	
24	236	4	175	2	231	3	126	1	.66
	126	4	29	1	76	3	44	2	

(Table 29 Continued)

	M1		M2		M3		M4		
Subject	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Score (sec.)	Rank	Tau
25	733	4	216	2	247	3	156	1	.66
	368	4	188	1	256	3	210	2	
26	300	4	258	2	100	1	289	3	.66
	372	4	149	3	81	1	124	2	
27	95	1	326	4	244	3	235	2	.66
	73	1	280	4	208	2	240	3	
28	484	3	1380	4	318	2	300	1	1
	720	3	821	4	480	2	368	1	
29	169	1	256	3	224	2	296	4	1
	40	1	240	3	128	2	259	4	
30	514	4	226	2	180	1	358	3	1
	700	4	255	2	208	1	480	3	
31	112	2	75	1	135	3	174	4	.66
	100	1	128	2	240	3	242	4	
32	113	1	120	2.5	120	2.5	365	4	1
	45	1	64	2	120	3	240	4	

Mean Correlation Coefficient	.79
Modal Correlation Coefficient	.66
Median Correlation Coefficient	.66
Binomial Probability for the Distribution	$p < .001$

TABLE 30

Trial Scores and Kendall Tau Correlation Coefficients for Subjects 17-32 Across Methods for the Initial Study and Second Follow-up Study

	M1		M2		M3		M4		
Subject	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Tau
17	3	1	13	4	5	2	6	3	.66
	3	1	14	4	7	3	6	2	
18	7	3	5	1.5	5	1.5	20	4	1
	5	3	3	1.5	3	1.5	20	4	
19	7	2.5	5	1	7	2.5	14	4	1
	5	2.5	3	1	5	2.5	15	4	
20	9	1.5	9	1.5	20	3.5	20	3.5	.88
	20	3	11	1	20	3	20	3	
21	3	1	5	2.5	5	2.5	12	4	1
	7	1	13	2.5	13	2.5	18	4	
22	3	1.5	11	3.5	3	1.5	11	3.5	1
	5	1.5	7	3	5	1.5	12	4	
23	7	2.5	3	1	7	2.5	10	4	1
	5	2.5	3	1	5	2.5	8	4	
24	5	2.5	3	1	5	2.5	6	4	1
	5	2.5	3	1	5	2.5	6	4	

(Table 30 Continued)

	M1		M2		M3		M4		
Subject	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Tau
25	20	4	7	1.5	7	1.5	8	3	.55
	11	4	5	1	7	3	6	2	
26	11	3	9	2	5	1	16	4	.66
	9	4	5	2	3	1	7	3	
27	3	1	13	3.5	9	2	13	3.5	1
	3	1	11	3	7	2	13	4	
28	9	1.5	20	4	9	1.5	10	3	.60
	20	3.5	20	3.5	11	1	15	2	
29	5	1	7	2.5	7	2.5	11	4	1
	3	1	9	3.5	5	2	9	3.5	
30	9	3.5	7	2	5	1	9	3.5	1
	15	3	5	1.5	5	1.5	16	4	
31	3	1.5	3	1.5	5	3	6	4	1
	5	1.5	5	1.5	9	3.5	9	3.5	
32	3	1.5	5	3	3	1.5	13	4	1
	3	1	5	2.5	5	2.5	9	4	

Mean Correlation Coefficient	.90
Modal Correlation Coefficient	1
Median Correlation Coefficient	1
Binomial Probability for the Distribution	$p < .001$

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