THE UNIVERSITY OF MANITOBA

A COMPARISON OF TWO REINFORCEMENT STRATEGIES IN THE VOCATIONAL SKILL TRAINING OF THE RETARDED

by

Sandra J. Koop

A Thesis

Submitted to the Faculty of Graduate Studies

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A dissertation submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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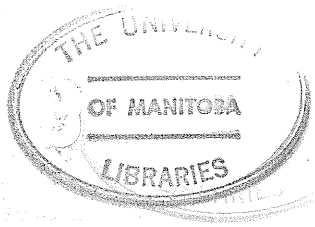

ABSTRACT

In teaching workshop tasks to the retarded, Gold (1976) has recommended the use of minimal social reinforcement. Other behavioral practitioners and researchers working with the retarded have emphasized the use of frequent social, edible and/or token reinforcers in early training. Empirical evidence is necessary to examine the relative effectiveness of alternative reinforcement procedures that are available. Three experiments compared the use of minimal social reinforcement (MSR) in a "standardized" Gold training procedure to that same procedure combined with "extra" (contingent) social and edible reinforcement (SER) to teach assembly tasks of varying complexity to severely retarded clients in a one-to-one training situation. A multi-element design with counterbalancing of reinforcement conditions across tasks and clients was used. The tasks in Experiment 1 were a three-speed bicycle brake and a spincast fishing reel, each consisting of 12 parts. For Experiment 2, a "man" and "car" were designed as tasks from Lego building blocks, each consisting of 5 parts. Two abstract designs, also constructed from Lego blocks and each consisting of 20 parts, were used as tasks in Experiment 3.

In all three experiments, the SER condition generally facilitated the learning of a task to criterion in terms of time, number of trials, and total number of errors. In addition, clients required more prompting between steps of the task and made a larger proportion of errors on learned steps in the MSR condition, than they did in the SER condition.

ACKNOWLEDGEMENT

I am grateful to my Advisor, Dr. Garry Martin, and the other members of my committee, Drs. Joseph Pear and Glen Lowther, for their advice and support. I would also like to thank the following people for their cooperation and many helpful suggestions: Terry Tutte and the staff at Spruce Cottage, Dickie Yu, Eric Suthons, Gord Quinn, and Barb Roscoe. Finally, I would like to express special appreciation to my sister, Julie, and to my parents, John and Marjory Koop, for their continuing support and encouragement.

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INTRODUCTION

Martin and Pallotta-Cornick (1979) conducted an extensive review of the literature concerning behavior modification with the retarded in sheltered workshops. They found that the majority of this research focused on production (i.e., modifying rates of existing behaviors) with relatively few studies done on training (i.e., the acquisition of new behaviors). This was attributed, in part, to the expectations held by workshop staff that severely and profoundly retarded workers were able to perform only simple tasks. The staff therefore accepted contracts only for simple tasks which required little training. There have, however, been several demonstrations that severely, profoundly, and moderately retarded individuals are capable of performing more complex tasks including bicycle brake assembly (Gold, 1972), oscilloscope cam switch assembly (Bellamy, Peterson & Close, 1975), electromechanical relay panel assembly (Tate & Barhoff, 1967) and saw-chain assembly (O'Neill & Bellamy, 1978). A training technology designed to teach more complex tasks to severely and moderately retarded individuals is emerging. An active researcher in this area, Marc Gold, has developed a training program entitled, "Try Another Way" ("Try Another Way" Film Brochure, Note 1), and "Task Analysis" (Gold, 1976). An outline of Gold's "Try Another Way" program can be found in Table 1.

Insert Table 1 about here

Martin and Pallotta-Cornick (1979) outlined several areas of research needed to improve the existing training technology, including a comparison of training formats and a comparison of different reinforcement

Table 1

An Outline of the "Try Another Way" Training Package

(taken from Martin and Pallotta-Cornick, 1979)

Preliminary:

1. Divide task into "appropriate" training steps.
2. Set up training tray and setting.

General Rules

1. Uses total task presentation format (learner performs all of the steps on every trial).
2. Uses essentially a non-verbal training procedure.
3. No eye contact is made with the learner during training and no responses are made to verbal inquiries from the learner.
4. "Errors and the reduction of errors are seen as important to give task credibility both for learner and for those observing him." (Gold, Note 2, p. 5)
5. Errors are corrected as they occur.
6. Appropriate task responses (both manipulative and discriminative) are met with silence.

More Specific Rules

1. Trainer sits on the left and typically demonstrates a complete trial.
2. On subsequent trials, trainer may use some pointing and gesturing to get the learner started (and sometimes to keep him going).
3. Eye contact attempts, distractions, and other undesirable behavior by the learner are typically ignored.
4. One verbal phrase, "Try another way," is consistently used to cue the necessity of correction of a discrimination error, and corrected errors are reinforced with a "good".
5. Manipulation errors are handled with verbal and/or physical assistance with the assistance faded quickly over trials. Corrected manipulation errors are not reinforced.
6. "Good" (and sometimes additional social approval and/or touching the learner's back) is used at the end of each training trial.
7. The learner continues until he reaches criterion, which is 6 out of 8 trials error-free.
8. Typically, four trials are run per day, during a session lasting about 20 or 25 minutes.

systems. Although there is extensive literature dealing with reinforcement systems during production, little has been written about the use of reinforcement during training. The use of frequent social, edible and/or token reinforcers in early training has been commonly emphasized by behavioral practitioners and researchers working with the retarded (e.g., see Gardner, 1971; Gibson & Brown, 1976; Martin, Murrell, Nicholson & Tallman, 1975; Neisworth & Smith, 1973). However, Gold (1972, 1973, 1976) used only social reinforcement and emphasized the importance of minimal social reinforcement. He suggested that certain tasks have strong reinforcing properties for the worker and that more should be done to increase the level and value of the work the retarded do instead of focusing on more powerful reinforcement systems (Gold, 1973). Levy, Pomerantz and Gold (1976) suggested that "high frequencies of praise and criticism lead to increased reliance on the trainer at the expense of active formulation of problem-solving strategies" (p. 238), and that silence following a correct response will be reinforcing to the client if it is alternated only with criticism (i.e., indication that an error has occurred). Gold (Note 2) stated, "In such a situation, if nothing is being said or done, the learner learns to continue working: No news is good news" (p. 6). Levy et al. (1976) also justified their use of a minimal social reinforcement procedures on the basis that this created a more "quiet, business-like session" and treated the client as a "dignified adult developing vocational competency" (p. 5). Gold (Note 3, p. 6) criticized the practice of reinforcing "any little positive behavior" because it assumes the client has very little ability and could support the client's low self-concept. In spite of the emphasis placed on the use of minimal social reinforcement by Gold and his colleagues and emphasis to the contrary by

other behavioral practitioners, the fact remains that empirical comparisons of reinforcement strategies during training of complex tasks with the retarded have not been made. Although Friedenberg and Martin (1977) found that tangible reinforcement may be necessary to maintain performance of an inherently nonreinforcing task after the task has been learned to some criterion, they did not compare reinforcement strategies during training. Empirical evidence is necessary to examine the relative effectiveness of alternative reinforcement procedures that are available. The following three experiments compared the use of minimal social reinforcement (MSR) in a modified "Try Another Way" training strategy to that same strategy combined with "extra" social reinforcement plus edible reinforcement (SER), while training six tasks to severely and moderately retarded clients. Tasks of varying degrees of complexity were used to test Gold's (1976) suggestion that extra reinforcers may not be necessary with more complex tasks.

METHOD

Clients

A description of the clients is given in Table 2. All were residents

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Insert Table 2 about here

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of the Manitoba School for the Retarded, a provincial institution for the retarded. Dean, Mark, Tommy and Benny, four severely retarded males, participated in the first two experiments. Teresa, a moderately retarded female, replaced Mark in the third experiment because he was unable to make the required color discriminations necessary to assemble the tasks.

Experimental Design

The basic research design was a multi-element design within clients

Table 2

A Summary of Characteristics of Clients Participating in These Experiments

Name	Age	Mental Age	Level of Retardation	Diagnosis	Years of Institutionalization
Dean	20	3 yr 8 mo[a] (I.Q. = 34)	severe	encephalopathy	13
Mark	18	2 yr 2 mo[a] (I.Q. = 24)	severe	autism	11
Tommy	21		severe	encephalopathy	13
Benny	20	2 yr 3 mo[a]	severe	Down's syndrome	13
Teresa	19	44[b]	moderate	autism	10

[a]Stanford Binet

[b]WAIS

with counterbalancing of reinforcement conditions and tasks across clients (for descriptions of this design, see Martin and Pear, 1978; and Ulman and Sulzer-Azaroff, 1975). Specifically, two tasks were involved and each client learned one of the tasks under the MSR condition and the other task under the SER condition. The two reinforcement conditions were then compared within each client. The multi-element design assumes that the two tasks are of equal difficulty. Thus any differences in performance between the two can be attributed to the experimental manipulation and not to differences between the two tasks.

Data Collection

The data sheet used was a matrix on which columns represented trials and rows represented steps of the task. Each client's level of performance was rated according to one of the following four levels on each step, and his/her score was placed in the cell corresponding to that step:

Level 3 - Client performed the step correctly with no help from the trainer. The response was initiated within 10 seconds after the completion of either the previous step or, for Step 1, after the initial command to begin work was given.

Level 2 - Client responded correctly within 10 seconds to specific instructions which specified the target behavior for that step according to the task analysis.

Level 1 - Client performed the step correctly when given specific instructions plus gestural prompting. One extra verbal prompt was also given if necessary.

Level 0 - Client performed the step correctly only when physical guidance (i.e., actual physical contact) was given, as well as the initial instructions and one extra verbal prompt.

Training Procedure

Each client was trained individually by the same trainer on all tasks. The client was seated at a table containing the training tray and a box for finished products. The trainer stood either to the client's left or behind the client when conducting a session.

Clients received a morning and afternoon training session each day, one session on each task. For each client, the order in which the tasks were trained was randomly selected within each session day, as was the order in which the four clients were trained. Each session consisted of four trials or 20 minutes of total session time, whichever occurred first. All trials were completed each session.

All clients were trained on both tasks using a total task presentation format, that is, on each trial the client was trained on every step beginning with the first and continuing on to the completion of the task. A trial was initiated when the trainer gave the general command for the task. If the client did not initiate a response within three seconds or made an error, the trainer increased guidance to Level 2, and proceeded through the levels in a similar manner until the step was performed correctly. Then the trainer recorded the level of guidance necessary for that step to be performed correctly and continued training the next step in the same manner. Each level of guidance was given only once before increasing guidance to the next level.

Nonspecifc prompts such as "what's next?" or "carry on" were given if the client stopped responding or appeared distracted. Only one nonspecific prompt per step was given on each trial. If the client responded correctly after receiving a nonspecific prompt, Level 3 was recorded. If further guidance was necessary for correct performance this was given, and the appropriate level was recorded. The trainer recorded the number of nonspecific prompts given in each session on a wristcounter.

A step was considered learned if the client performed it at Level 3 for three consecutive trials. If further help was needed on a step after it had reached criterion it was corrected using a combination of verbal, gestural, or physical guidance as was seen to be necessary by the trainer. An attempt was made to minimize the reinforcing aspects of such interactions by avoiding eye contact, minimizing the duration of verbal comments, and ensuring that any physical guidance was as brief as possible. A task was considered learned when the client performed three out of four consecutive trials with no errors.

Experimental Conditions

Minimal social reinforcement. In this condition, performance other than Level 3 (i.e., no help) was considered to be an error. To be consistent with Gold's (1976) procedure, the steps in both tasks were classified as to whether they involved mainly discrimination or manipulation skills. Corrected discrimination errors were followed by "good" from the trainer. Correction of manipulation errors did not receive social approval. At the end of each session, the trainer thanked the client for helping. No further social approval was given. The trainer avoided eye contact with the client during each trial. Correct responses were met with silence, except for completion of the last step on each trial

which was followed by "good" and/or a pat on the back from the trainer.

Social plus edible reinforcement. Social approval consisted of short positive comments such as "good job" or "super". These were contingent on the client's performing a step at a level that was equal to or better than the best of his/her previous performances, until that level reached criterion. Any regression to levels requiring more guidance was corrected without social approval. For each step, criteria for learning the four levels were: five consecutive trials for Level 0; and three consecutive trials for Levels 1, 2, and 3. For the first trial, the client had to equal or exceed his/her baseline performance on each step to receive social approval for that step.

In addition, clients had the opportunity to earn edibles consisting of small candies, nuts, raisins, and pieces of fruit. Before each trial the client was shown a variety of edibles and asked to select those that he/she would like to work for on the next trial. Plastic cups were either attached to the back of certain compartments of the tray, or, if no tray was used, placed directly behind certain parts of the task on the table. If no errors were made on the steps involving a part paired with a cup (i.e., picking the part up and attaching it), the trainer would drop one edible into the cup. The last opportunity to earn an edible always coincided with the last step of each trial. The placement of the remaining opportunities varied from trial to trial, based on the trainer's subjective judgment as to where they would be most effective.

At the end of each trial the client collected the edibles he/she had earned during the trial. This was accompanied by praise and feedback from the trainer as to whether the client could have earned more. The client had the option to consume the edibles after each trial or to

store them until the end of the session. Clients were thanked for their participation at the end of each session.

Dependent Variables

Trials to task criterion. This consisted of the number of trials a task took to reach criterion for each client under each reinforcement condition.

Errors. Any score less than three on a specific step was considered to be an error. The cumulative number of errors per trial on each task was graphed for each client.

Errors on learned steps. A step was considered learned if it was performed on three consecutive trials at Level 3. The percent of errors made on individual steps after they had reached criterion, but before the task criterion was met, was calculated for each trial. The number of errors on steps that reached criterion was divided by the total number of steps that reached criterion by that trial. This result was then cumulated across trials.

Time on task (TOT). TOT was recorded for each session by starting a stop watch for each trial after the general command to begin work was given, and stopping it after completion of the last step, and before edibles were dispensed in the SER condition.

Total session time (TST). TST included the time just before the general command was given on the first trial until social approval was given for the last step of the last trial. If edibles were given, this did not include the time the client spent consuming them after the last trial.

Nonspecific prompts. These consisted of short comments such as "what's next?" which were given if the client stopped responding or was

distracted. Only one per step was given on each trial. Correct performance after a nonspecific prompt was scored as Level 3. The total number of nonspecific prompts given in each reinforcement condition was compared.

Retention. Retention tests for each experiment were given from six weeks to four months after each client reached criterion on each task. During a test, the client was given three trials on a particular task. Errors were corrected and recorded in the same manner as during training. Social approval was given only at the end of each trial. No edibles were given.

Reliability

Observer reliability was assessed by an experienced observer who sat about four feet away from the trainer, such that neither the observer nor the trainer could see what the other was recording. Both trainer and observer recorded the levels of guidance on separate data sheets. Inter-observer reliability was calculated by dividing the number of agreements by the total number of agreements plus disagreements per trial and multiplying by 100. In all cases the trainer's data was used when analyzing the results.

EXPERIMENT 1

Apparatus

The training tasks were a three-speed bicycle brake and a spin-cast fishing reel, each consisting of 12 parts. The parts were placed in the compartments of a tray which was 1.3 m long, in the order in which they were to be assembled. A maximum number of four edibles could be earned during each trial in the SER condition. These were displayed in clear plastic cups that were attached to the back of the tray.

The tasks were originally equated by Pallotta-Cornick, Suthons, Yu and Martin (Note 3) in terms of both the number of steps in each and the number of movements required to perform each step. In addition, experienced workshop staff evaluated the difficulty of each step on a scale of 1 (very easy) to 5 (very difficult). The mean difficulty of all raters for all steps was 3.7 for the brake and 3.9 for the reel. Actual research using these tasks indicated that the brake was learned more rapidly than the reel (Pallotta-Cornick et al., Note 3). An analysis of this data revealed that for the brake, no particular step was consistently difficult for all clients. However, four steps of the reel took consistently longer to reach criterion than any of the other steps. The task analysis for the reel was therefore revised to simplify these specific steps. The final arrangements of steps for both tasks are shown in Table 3. Each task analysis consisted of 11 discrimination and 15

Insert Table 3 about here

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manipulation steps, as indicated in Table 3.

Table 3

Task Analyses for the Bicycle Brake and Fishing Reel

Bicycle Brake	Fishing Reel
1. Pick up the housing.	1. Pick up the body assembly.
2. Pick up the axle.	2. Pick up the crank shaft.
*3. Put the axle into the housing.	*3. Put the crank shaft into the body assembly.
4. Turn the housing upsidedown without letting the axle fall out.	4. Pick up the center shaft.
5. Pick up nut A.	*5. Put the center shaft into the body assembly.
*6. Screw nut A onto the axle.	6. Move the lower flap inside. (Give to the trainer who locks it in and returns it to the client.)
7. Turn the housing over with the axle touching the table.	7. Move the top flap over the center shaft.
8. Pick up the planet cage.	*8. Turn the body assembly over with the bottom facing up.
*9. Put the planet cage onto the axle and into the housing.	9. Pick up the spool.
10. Pick up washer A.	*10. Put the spool onto the body assembly.
*11. Put washer A onto the axle and into the housing.	11. Pick up the spinner head.
12. Pick up washer B.	*12. Put the spinner head onto the center shaft.
*13. Put washer B onto the axle and into the housing.	13. Pick up the nut.
14. Pick up wahser C.	14. Screw the nut onto the center shaft.
*15. Put washer C onto the axle and into the housing.	*15. Turn the body assembly such that the spinner head faces into the plam with the crank shaft pointing up.
16. Pick up the gear ring.	16. Pick up the back cover.
*17. Put the gear ring onto the axle and into the housing.	*17. Turn the back cover so the red dot (hole) faces up and the open face is away from the palm.
18. Pick up the dust cap.	*18. Put the body assembly into the back cover.
*19. Screw the dust cap onto the housing.	*19. Turn the body assembly such that the spinner head faces upwards.
20. Pick up the driver.	*20. Pick up the front cover such that the large opening faces away from the palm.
*21. Put the driver onto the axle and into the dust cap.	21. Screw the front cover onto the back cover.
22. Pick up nut B.	22. Pick up the handle.
*23. Screw nut B onto the axle.	*23. Put the handle onto the crank shaft.
24. Pick up nut C.	24. Pick up the nut.
*25. Screw nut C onto the axle.	25. Screw the nut onto the crank shaft.
26. Put the brake into the box.	26. Put the reel into the box.

*Discrimination steps. All others are manipulation steps.

Baseline Procedure

Two baseline measures were taken for each client on each task, one for performance on the total task and the other for performance on individual steps. The order in which tasks were baselined was counterbalanced across clients.

Total task baseline. This procedure was that described by Pallotta-Cornick et al. (Note 3). All the items necessary to complete one task were placed in front of the client. The trainer then gave a general command such as, "Make a fishing reel. Do all you can. Make one like this," while showing the completed product. The client was allowed one minute to respond. If he had not initiated responding in this time the trainer proceeded with the testing of individual steps. If the client initiated responding within one minute the trainer recorded the steps performed until either all the pieces were used or the client had stopped responding for one minute.

Individual steps baseline. The trainer tested individual steps sequentially starting with Level 3 and increasing levels of guidance until the client performed the step correctly. For example, for Step 1 on the brake, the trainer gave the general command to make a brake. If the client initiated a correct response within 10 seconds, Level 3 was recorded. If specific instructions were necessary for correct performance, Level 2 was recorded. Level 1 was recorded if extra instructions and gestural prompts were necessary for correct performance. Finally, if physical guidance was also necessary for correct performance, Level 0 was recorded. Each step of the sequence was tested once in this manner.

No social approval or edibles were given for performing a specific step correctly during baseline. Approximately every two minutes the

trainer would ask the client to perform a simple response other than the task, such as "Point to your ear," which was given social approval and/or edibles. This was done to maintain attending behavior by the client.

Results

During the baseline, none of the clients could perform either task when all the parts were placed before them and only the general command to make a brake or a reel was given. Scores for each individually tested step were summed together and divided by 78 (i.e., 26 cells with scores of Level 3). Each was then multiplied by 100 to obtain a rough measure of the percent of the total task that each client could perform before training. These results are presented in Table 4. None of the clients achieved

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Insert Table 4 about here

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perfect performance when the steps were tested individually. Scores ranged from 37.1% to 56.4% on the brake, and from 26.9% to 46.2% on the reel.

Interobserver reliability was assessed on 19% of all sessions and sampled all clients in both conditions. The average interobserver reliability rating for all clients on both tasks was 97% with a range from 85% to 100%.

Three of the clients reached criterion on both tasks. Benny reached criterion on the brake, but training on the reel was discontinued after 42 trials when he went to summer camp.

In spite of the attempts made to equate the two tasks, a task effect was found; that is, the brake was learned more readily than was the reel. [This task effect was consistent with other studies which utilized these two tasks and were being run concurrently (Suthons, Martin, Yu & Koop,

Table 4

Percent of Total Task Performed

During the Individual Steps Baseline

On the Brake and Reel Tasks

	Task	
Client	Brake	Reel
Dean	39.7	28.2
Mark	56.4	44.9
Tommy	37.1	46.2
Benny	38.5	26.9

Note 4; Yu, Suthons, Martin & Koop, Note 5)].

As Figure 1 illustrates, when the easier task (brake) was learned

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Insert Figure 1 about here

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under the SER condition, the differences were large and were always better under the SER condition. However, when the more difficult task (reel) was learned under the SER condition, the differences in terms of cumulative errors and the number of trials to task criterion were relatively small. Dean learned the reel in fewer trials but made more errors in the SER condition than he did on the brake in the MSR condition. Mark reached criterion on the brake (MSR condition) in fewer trials than he did on the reel (SER condition), but he made slightly more errors in the MSR condition.

Table 5 shows the cumulative percent errors made on individual steps

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Insert Table 5 about here

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after they had reached criterion but before the task criterion was met. Three of the four clients made more errors on learned steps in the MSR condition. Mark made approximately the same number of these errors in both conditions.

TOT and TST are shown in Figure 2. Both TOT and TST were longer on

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Insert Figure 2 about here

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the reel than on the brake for all clients, indicating a task effect.

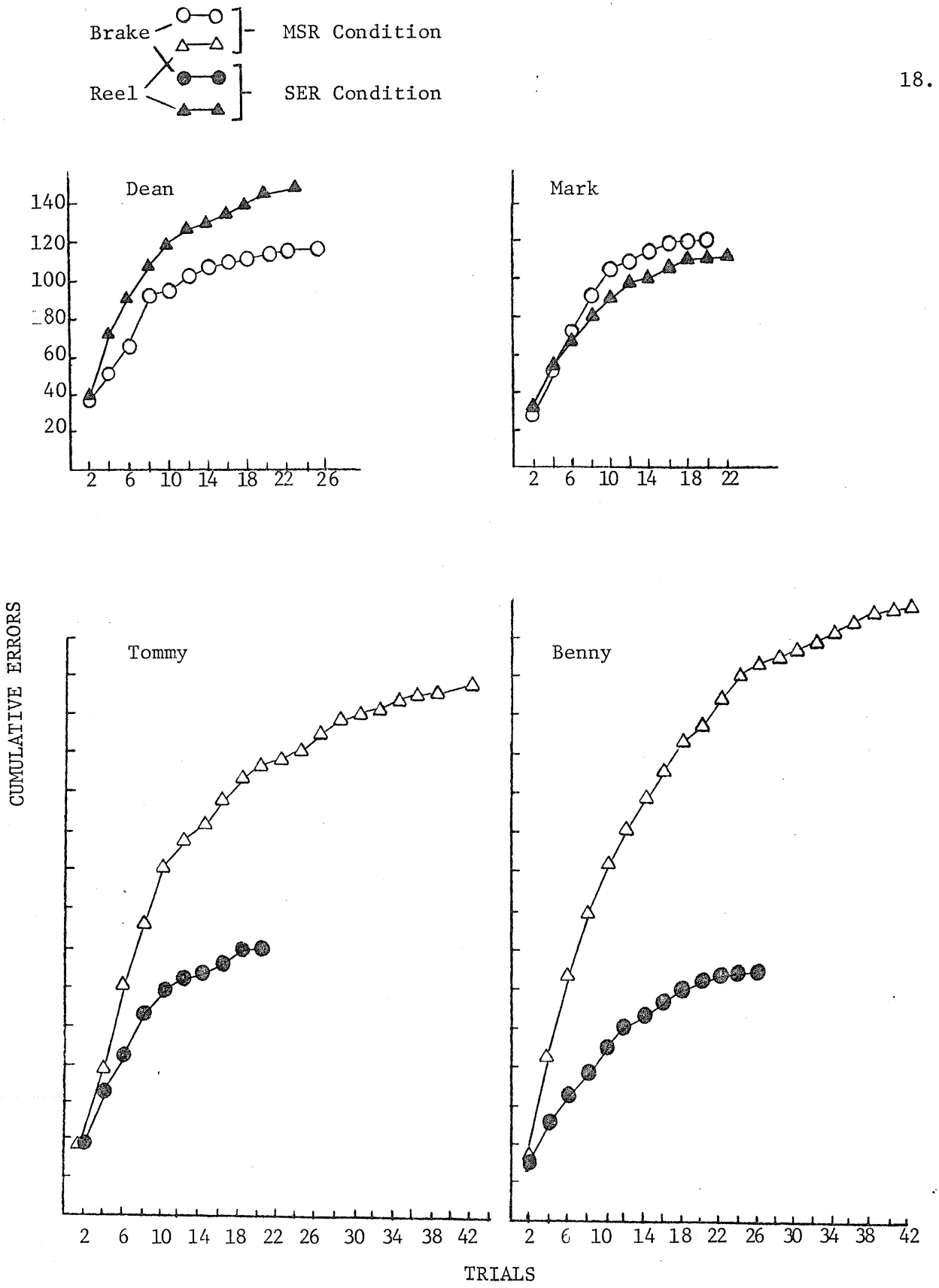

Figure 1. Cumulative errors to task criterion in each reinforcement condition for clients on the brake and reel tasks.

Table 5

Cumulative Percent Errors on Learned Steps

In Each Reinforcement Condition

On the Brake and Reel Tasks

	Condition	
Client	MSR	SER
Dean	.83[a]	.46[b]
Mark	.62[a]	.61[b]
Tommy	3.91[b]	1.77[a]
Benny	2.33[b]	1.57[a]

[a] brake

[b] reel

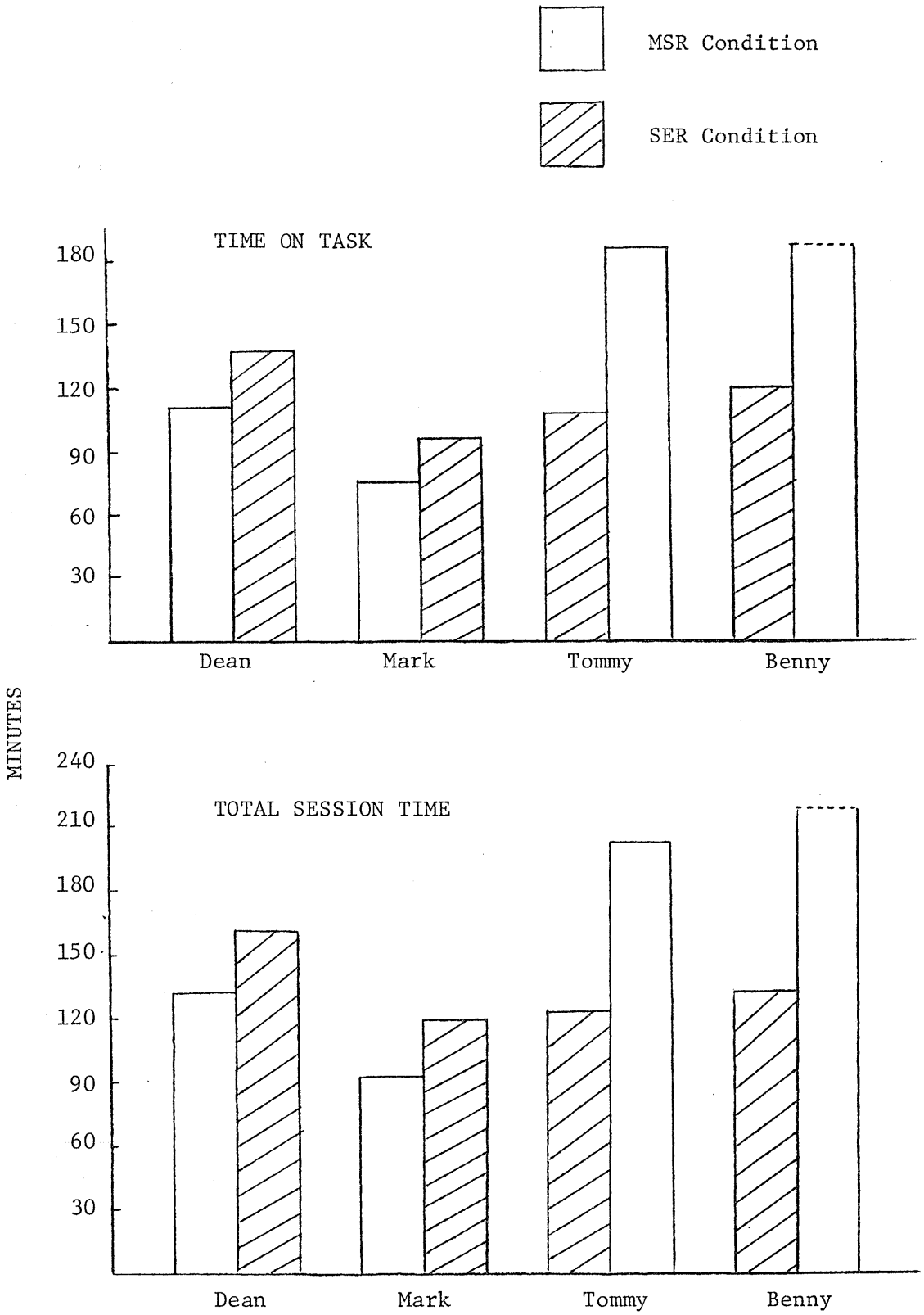

Figure 2. Time on task and total session time for clients on the brake and reel tasks under both reinforcement conditions. For each client, the first histogram represents the brake, with the second representing the reel. A dotted line across the top of the histogram indicates that task criterion was not met.

However, the difference was much larger when the reel was learned under the MSR condition and the brake under the SER condition, than when the tasks were learned under the reverse conditions.

The total number of nonspecific prompts given in each condition are shown in Table 6. More nonspecific prompts were given while training

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Insert Table 6 about here

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the reel, regardless of reinforcement condition. When the reel was learned under the SER condition and the brake under the MSR condition, this difference was very slight. However, when the conditions were reversed for each task, many more nonspecific prompts were given during the MSR condition than during the SER condition.

The results of the six-week retention test are shown in Table 7.

Insert Table 7 about here

There were no consistent differences across clients in error rates on the three trials.

Three of the clients had slightly faster TOT and TST scores on the tasks learned under the MSR condition. Dean had a slightly faster TOT on the reel (SER condition), but there was no difference between the two tasks in TST.

Three clients were given two less nonspecific prompts on the tasks learned under the MSR condition than on those learned under the SER condition. Benny, however, was given six more nonspecific prompts on the reel (MSR condition) than on the brake (SER condition).

Table 6

Total Number of Nonspecific Prompts Given in Each Reinforcement Condition To Clients on the Brake and Reel Tasks

	Condition	
Client	MSR	SER
Dean	32[a]	37[b]
Mark	32[a]	38[b]
Tommy	66[b]	44[a]
Benny	103[b,c]	50[a]

[a] brake

[b] reel

[c] task criterion was not met

Table 7

Values of Several Performance Variables

For Each Client on a Six-Week Retention Test

Of Brake and Reel Assembly

Client	Errors		Time On Task (TOT)(Min)		Total Session Time (TST)(Min)		Nonspecific Prompts	
	MSR	SER	MSR	SER	MSR	SER	MSR	SER
Dean	5[a]	2[b]	12	11	14	14	0	2
Mark	3[a]	5[b]	11	13	13	15	10	12
Tommy	8[b]	8[a]	8	12	10	15	3	5
Benny	7[b]	7[a]	10	12	14	15	8	2

[a] brake

[b] reel

EXPERIMENT 2

Apparatus

The training tasks were representations of a "car" and a "man" built with Lego building blocks, each consisting of five parts. The parts were placed in a row on the table in the order in which they were to be assembled. A maximum number of two edibles could be earned each trial in the SER condition.

The tasks were equated in terms of the number of steps and the type of disciminations required for each step. Task analyses are shown in Table 8. Each task analysis consisted of four discrimination steps and

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Insert Table 8 about here

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six manipulation steps, as indicated in Table 8.

Baseline Procedure

Due to the simplicity of these tasks, only a total task baseline (as described in Experiment 1) was run. It was assumed that the clients could have learned much of the tasks from an individual steps baseline procedure, thereby confounding the comparisons.

Results

On the baseline, none of the clients performed either task correctly when all the parts were placed before them and only the general command to make a "car" or a "man" was given.

Observer reliability was assessed on 50% of all sessions, and sampled all clients in both conditions. The average rating for all clients on both tasks was 99% with a range from 90% to 100%.

Table 8

Task Analyses for the "Car" and the "Man"

"Car"	"Man"
1. Pick up the base.	1. Pick up the feet.
2. Pick up Block 1.	2. Pick up the legs.
*3. Attach Block 1 to the base.	*3. Attach the legs to the feet.
4. Pick up Block 2.	4. Pick up the body.
*5. Attach Block 2 to the base.	*5. Attach the body to the legs.
6. Pick up the cab.	6. Pick up the arms.
*7. Attach the cab to Block 1.	*7. Attach the arms to the body.
8. Pick up the hood.	8. Pick up the head.
*9. Attach the hood to Block 2.	*9. Attach the head to the body.
10. Put the car in the box.	10. Put the man in the box.

*Discrimination steps. All others are manipulation steps.

As shown in Figure 3, three of the clients reached task criterion

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Insert Figure 3 about here

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in fewer trials in the SER condition, and all clients made fewer total errors in this condition.

Table 9 shows the cumulative percent errors made on individual steps

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Insert Table 9 about here

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after they had reached criterion. Dean made no such errors in either condition. Three of the clients made a greater proportion of errors on learned steps in the MSR condition than in the SER condition. These differences were relatively small when compared to the other two experiments. As previously described, the percent errors on learned steps are calculated for each trial by dividing the total number of errors made on learned steps by the total number of steps that have reached criterion. Since these tasks had fewer steps than those in the other experiments, this calculation tended to have smaller numbers in the denominator, which inflated the scores (when compared to the other experiments).

TOT and TST are shown in Figure 4. All clients learned both tasks

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Insert Figure 4 about here

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to criterion in two sessions. Dean and Mark took slightly longer in the MSR condition in both TOT and TST. Tommy and Benny took approximately the same amount of TOT and TST in each condition.

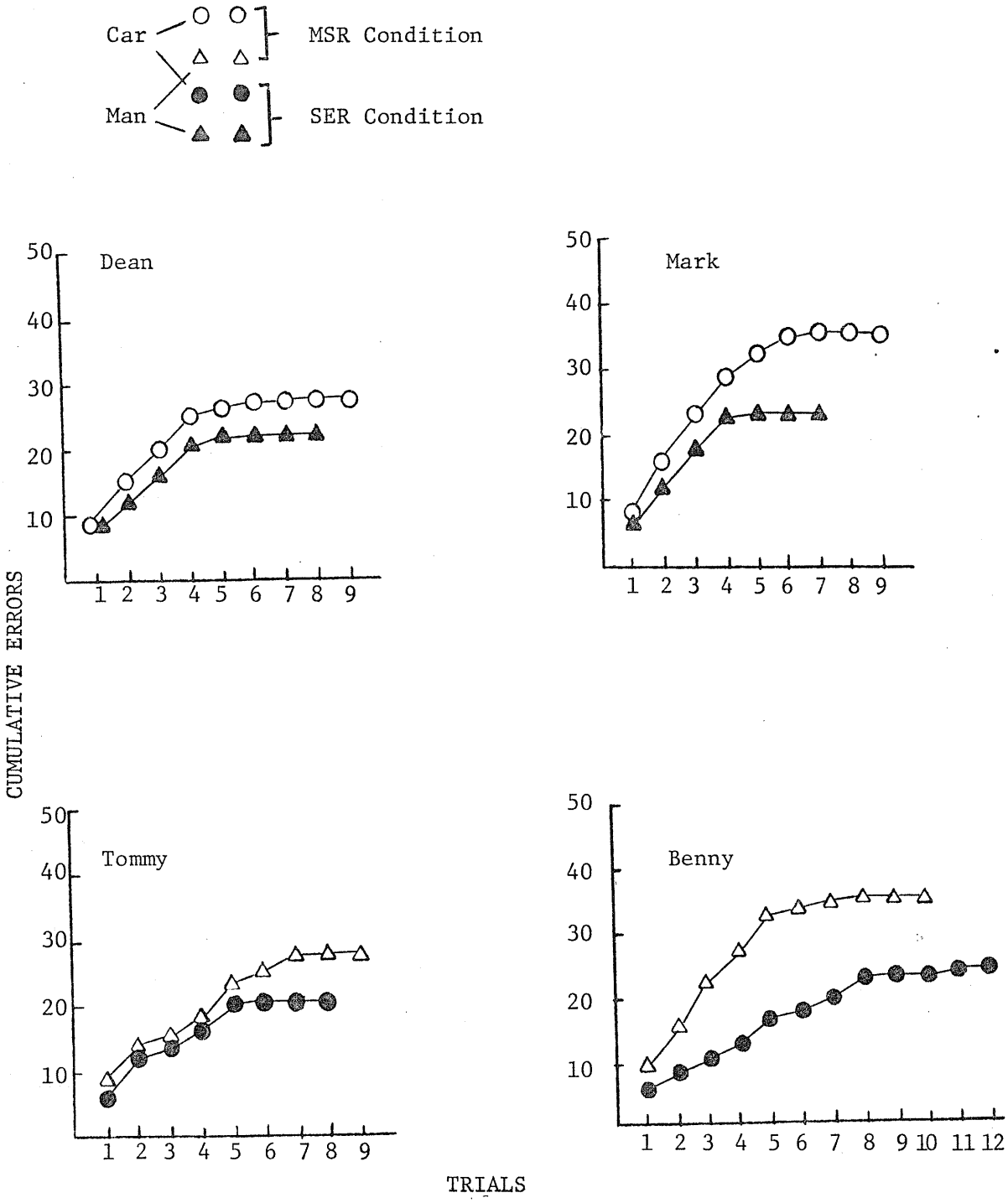

Figure 3. Cumulative errors to task criterion in each reinforcement condition for clients on the "car" and "man" tasks.

Table 9

Cumulative Percent Errors on Learned Steps

In Each Reinforcement Condition

On the "Car" and "Man" Tasks

	Condition	
Client	MSR	SER
Dean	.00[a]	.00[b]
Mark	.33[a]	.00[b]
Tommy	.66[b]	.00[a]
Benny	1.00[b]	.25[a]

[a] "car"

[b] "man"

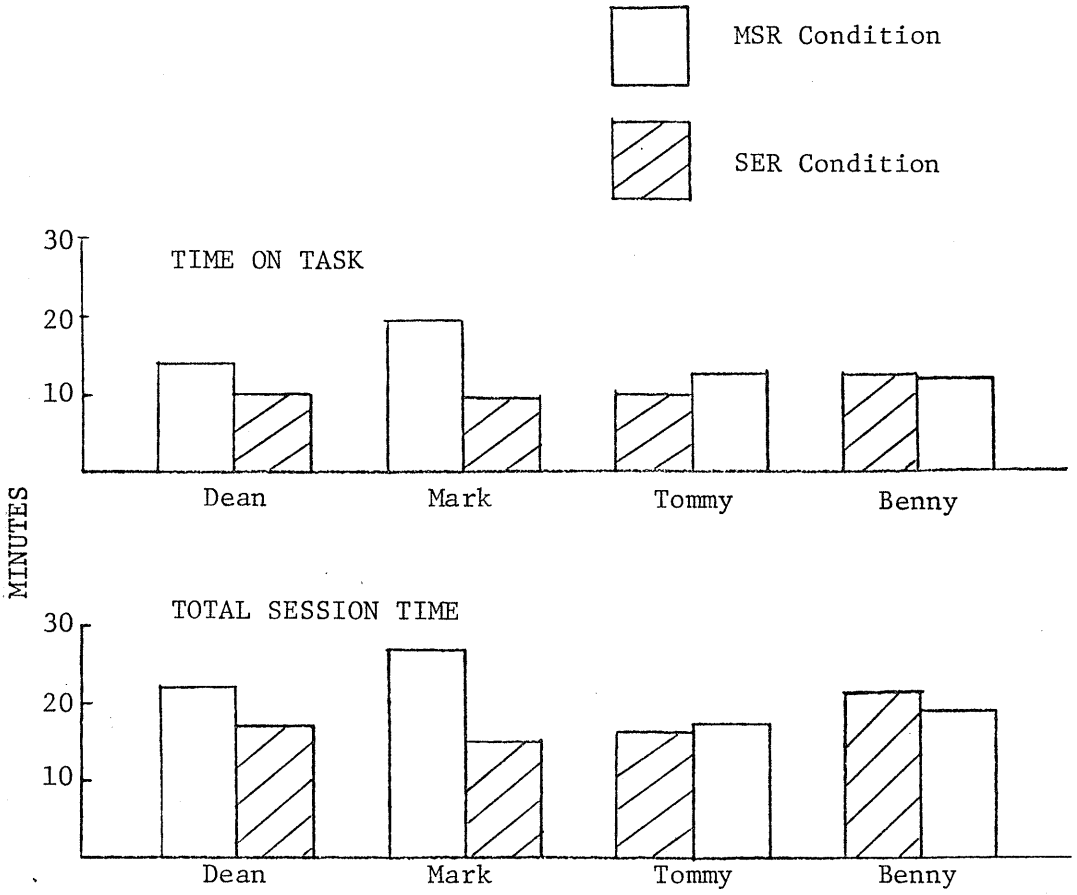

Figure 4. Time on task and total session time for clients on the "car" and "man" tasks under both reinforcement conditions. For each client, the first histogram represents the "car", with the second representing the "man".

The total number of nonspecific prompts given in each condition are shown in Table 10. Mark had six more nonspecific prompts given in

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Insert Table 10 about here

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the MSR condition than in the SER condition. The other three clients showed little or no differences between the two conditions.

The results of the four-month retention test are shown in Table 11.

Insert Table 11 about here

Across all clients there were little or no differences between tasks learned under different reinforcement conditions for the dependent variables error rate, TOT, TST, or nonspecific prompts.

Table 10

Total Number of Nonspecific Prompts Given in Each Reinforcement Condition To Clients on the "Car" and "Man" Tasks

	Condition	
Client	MSR	SER
Dean	2[a]	1[b]
Mark	9[a]	3[b]
Tommy	1[b]	1[a]
Benny	0[b]	0[a]

[a]"car"

[b]"man"

Table 11

Values of Several Performance Variables

For Each Client on a Four-Month Retention Test

Of "Car" and "Man" Assembly

Client	Errors		Total On Task (TOT)(Min)		Total Session Time (TST)(Min)		Nonspecific Prompts	
	MSR	SER	MSR	SER	MSR	SER	MSR	SER
Dean	2[a]	2[b]	4.5	5.5	7.0	7.0	0	0
Mark	4[a]	6[b]	5.2	5.0	7.0	7.0	2	4
Tommy	0[b]	1[a]	4.1	4.5	6.0	6.0	0	0
Benny	4[b]	3[a]	4.1	3.8	6.0	5.0	3	4

[a]"car"

[b]"man"

EXPERIMENT 3

Apparatus

The training tasks were two abstract designs constructed from Lego building blocks. Each task consisted of a Lego baseboard, cut to 19 cm by 20 cm, on which Lego blocks could be attached. There were 20 blocks of four different sizes in each task. The clients were trained to attach the blocks one by one to the baseboard, following a specified sequence. The correct position for each block was cued by one to three dots, painted on the baseboard, depending on the size of the blocks. The color of the dots alternated for each block between red and white. One design was made up of alternating blue and white blocks (BW design), and the other of alternating red and black blocks (RB design). Figure 5 shows a

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Insert Figure 5 about here

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pictoral representation of the two designs. The parts of the task were placed in a row in front of the client, as in Experiment 2. A maximum of five edibles could be earned each trial in the SER condition.

The tasks were equated in terms of the number of steps, the number of same-size blocks, and the type of discrimination necessary to correctly position each block. A task analysis is shown in Table 12. Only one

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Insert Table 12 about here

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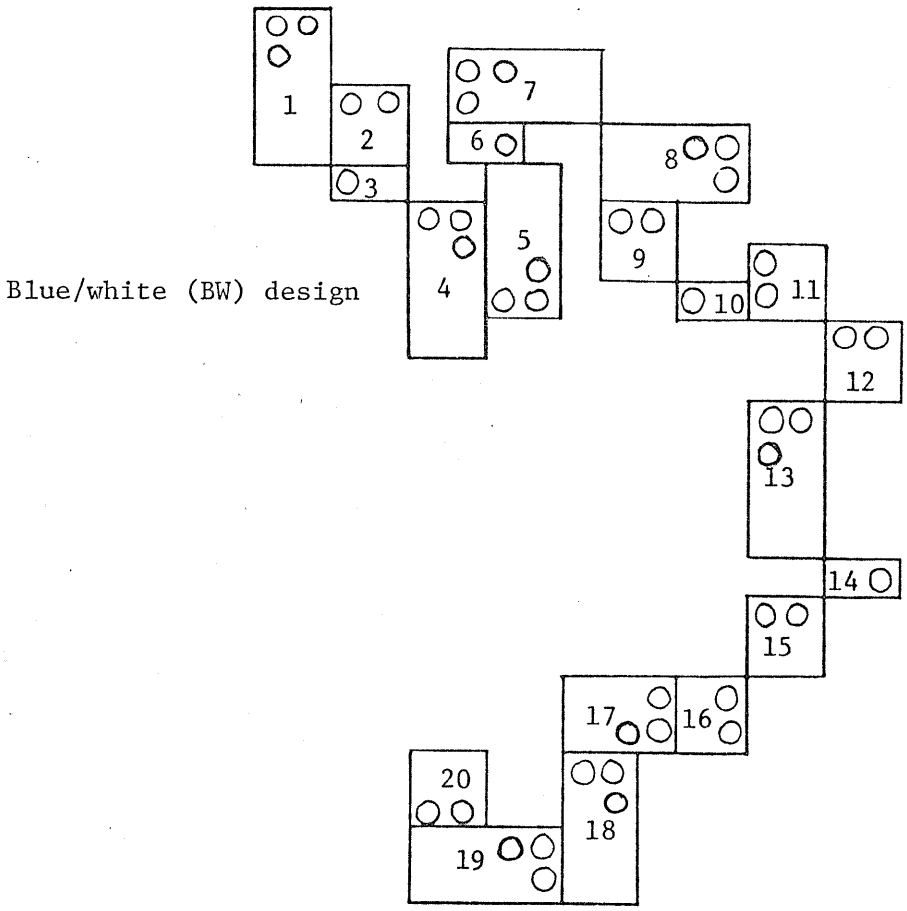
task analysis is given since the responses were identical for both tasks except for the positioning of the blocks.



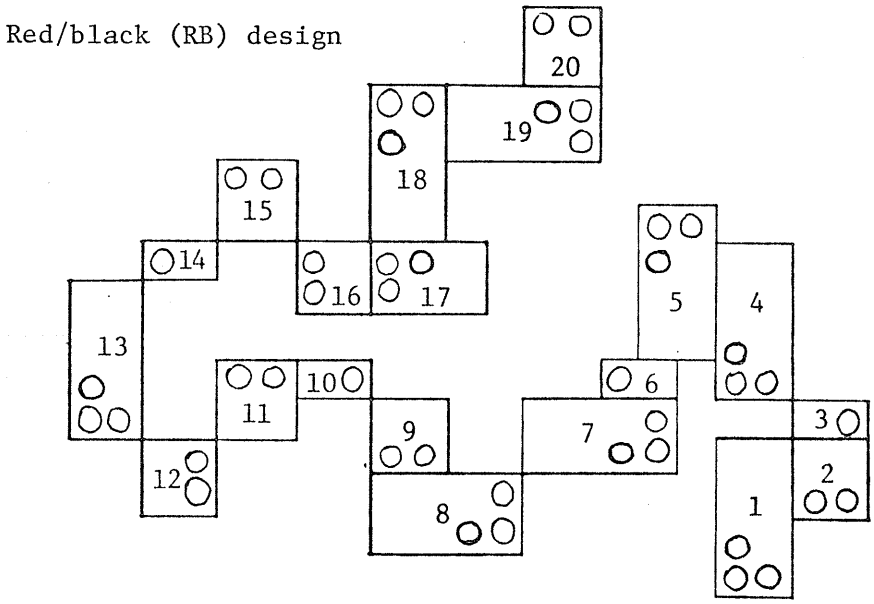


Figure 5. Schematic representation of the abstract design tasks. The circles represent dots painted on the base board.

Table 12

Task Analysis for Both Abstract Design Tasks

1.	Pick up the first piece.	21.	Pick up the next piece.
*2.	Attach the piece to the board.	*22.	Attach the piece to the board.
3.	Pick up the next piece.	23.	Pick up the next piece.
*4.	Attach the piece to the board.	*24.	Attach the piece to the board.
5.	Pick up the next piece.	25.	Pick up the next piece.
*6.	Attach the piece to the board.	*26.	Attach the piece to the board.
7.	Pick up the next piece.	27.	Pick up the next piece.
*8.	Attach the piece to the board.	*28.	Attach the piece to the board.
9.	Pick up the next piece.	29.	Pick up the next piece.
*10.	Attach the piece to the board.	*30.	Attach the piece to the board.
11.	Pick up the next piece.	31.	Pick up the next piece.
*12.	Attach the piece to the board.	*32.	Attach the piece to the board.
13.	Pick up the next piece.	33.	Pick up the next piece.
*14.	Attach the piece to the board.	*34.	Attach the piece to the board.
15.	Pick up the next piece.	35.	Pick up the next piece.
*16.	Attach the piece to the board.	*36.	Attach the piece to the board.
17.	Pick up the next piece.	37.	Pick up the next piece.
*18.	Attach the piece to the board.	*38.	Attach the piece to the board.
19.	Pick up the next piece.	39.	Pick up the next piece.
*20.	Attach the piece to the board.	*40.	Attach the piece to the board.

*Discrimination steps. All others are manipulation steps. manipulationsteps.

Baseline Procedure

Due to the repetitive nature of the steps in these tasks, an individual steps baseline was not run. The total task baseline was modified to prevent clients from seeing the completed design before training, under the assumption that learning might occur. Instead, a different design and the necessary blocks were given to each client, and he/she was asked to duplicate that design on a different baseboard.

Results

In the match-to-sample baseline, all four clients picked up and attached the 20 pieces of the baseline task to the Lego sheet. However, none of them attached any of the 20 pieces correctly.

Interobserver reliability was assessed on 34% of all sessions. The average rating for all clients on both tasks was 97% with a range from 80% to 100%.

Three of the clients completed both the original tasks. Benny learned at a much slower rate. Therefore, on Trial 31 for Benny, both tasks were simplified equally by completely painting in the area on which the blocks were to be placed. Benny reached criterion on both of the modified tasks after 49 trials.

Figure 6 shows the number of trials each client took to reach task

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Insert Figure 6 about here

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criterion and the cumulative number of errors made on each task. Dean and Tommy took more trials to reach criterion in the MSR condition than in the SER condition, while Teresa and Benny required the same number of trials for each task. For Benny this was probably due to the simplified

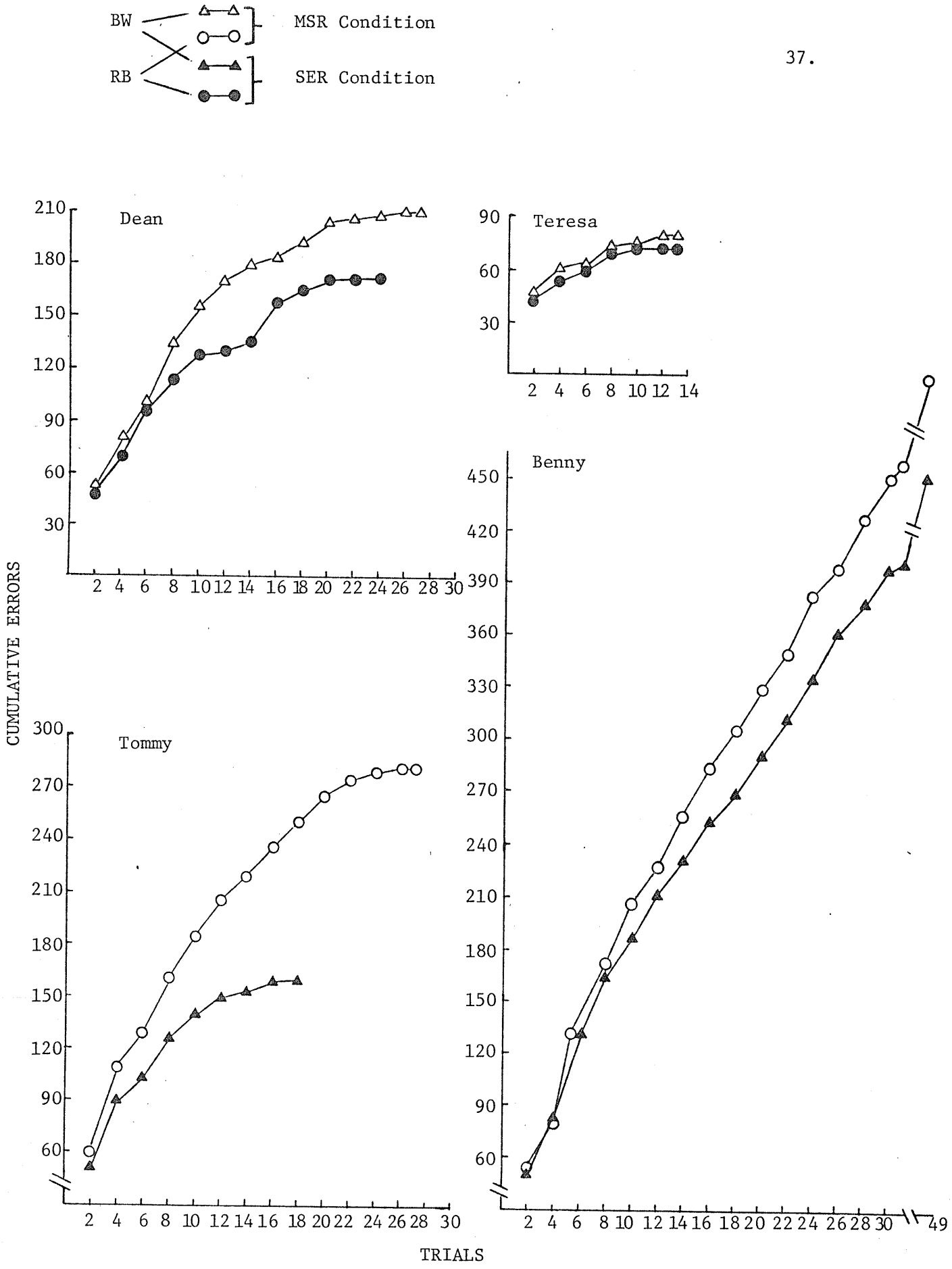

Figure 6. Cumulative errors to task criterion in each reinforcement condition for clients on the abstract design tasks. The broken line in Benny's graph indicates where both tasks were simplified.

procedure, since he had a higher error rate in the MSR condition at the time the tasks were modified. All clients made more total errors in the MSR condition, although for Teresa the difference was very small.

Table 13 shows the cumulative percent errors made on individual

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Insert Table 13 about here

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steps after they had reached criterion. All clients made a larger percent of errors on learned steps in the MSR condition, than they did in the SER condition.

TOT and TST are shown in Figure 7. Teresa showed no differences in

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Insert Figure 7 about here

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either TOT or TST between the two conditions. Tommy had longer TOT and TST in the MSR condition than he did in the SER condition. Dean and Benny had longer TOT and TST in the SER condition.

The total number of nonspecific prompts given in each condition are shown in Table 14. Teresa was given no prompts in either condition.

Insert Table 14 about here

The other three clients were given more nonspecific prompts in the MSR condition than they were in the SER condition.

The results of the four-month retention test are shown in Table 15.

Insert Table 15 about here

Table 13

Cumulative Percent Errors on Learned Steps

In Each Reinforcement Condition

On the Abstract Design Tasks

	Condition	
Client	MSR	SER
Dean	1.25[a]	.66[b]
Teresa	.31[a]	.21[b]
Tommy	1.98[b]	.95[a]
Benny	5.41[b]	3.47[a]

[a] BW design

[b] RB design

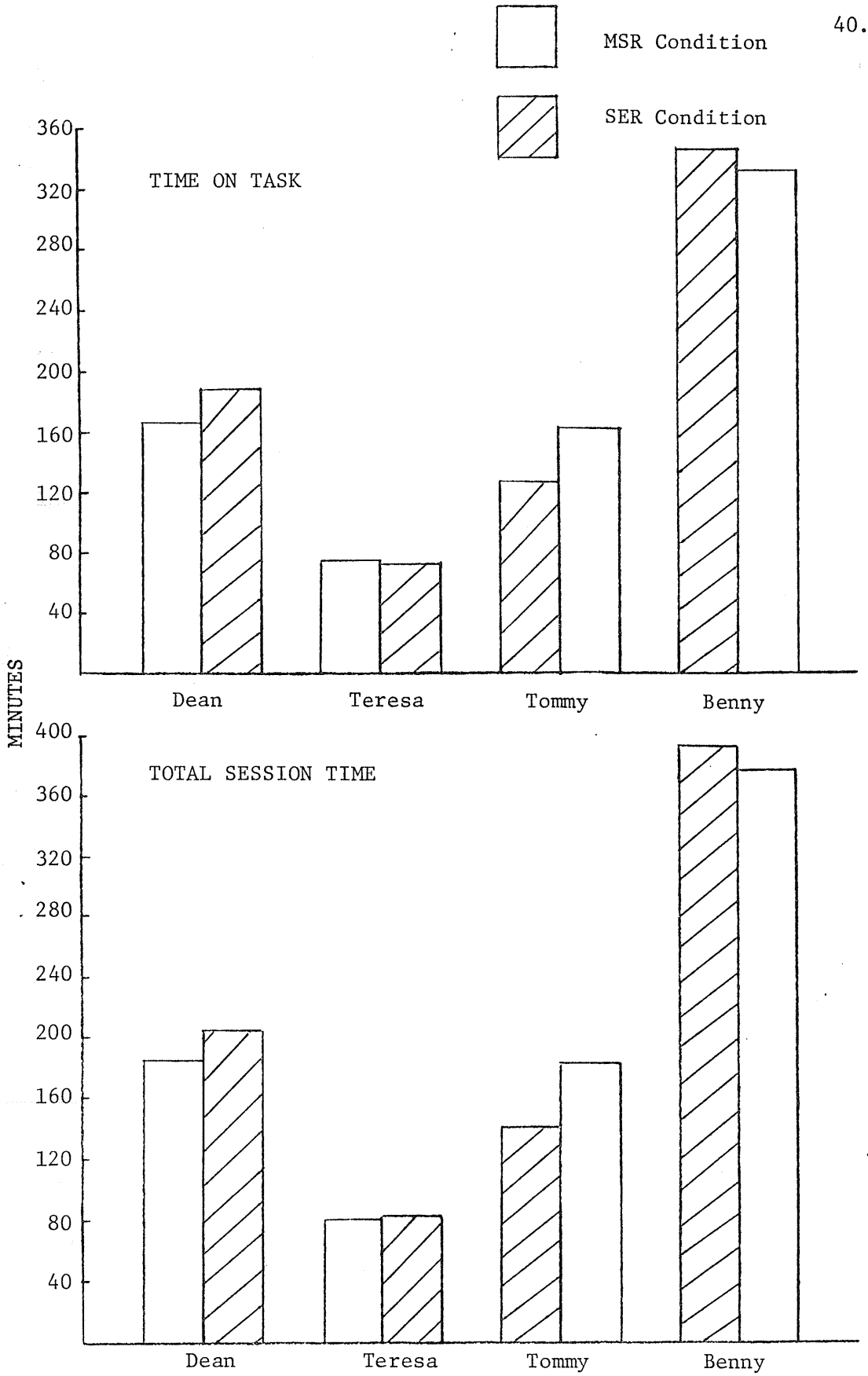

Figure 7. Time on task and total session time for clients on the abstract design tasks under both reinforcement conditions. For each client, the first histogram represents the BW design, with the second representing the RB design.

Table 14

Total Number of Nonspecific Prompts

Given in Each Reinforcement Condition

To Clients on the Abstract Design Tasks

	Condition	
Client	MSR	SER
Dean	37[a]	26[b]
Teresa	0[a]	0[b]
Tommy	48[b]	26[a]
Benny	135[b]	112[a]

[a]BW design

[b]RB design

Table 15

Values of Several Performance Variables

For Each Client on a Four-Month Retention Test

Of Assembly of the Abstract Design Tasks

Client	Errors		Time On Task (TOT) (Min)		Total Session Time (TST) (Min)		Nonspecific Prompts	
	MSR	SER	MSR	SER	MSR	SER	MSR	SER
Dean	12[a]	13[b]	19.5	21.4	21.7	24.0	0	0
Teresa[c]								
Tommy	17[b]	14[a]	16.2	15.0	19.0	17.9	0	0
Benny[c]								

[a]BW design

[b]RB design

[c]Client was not available for testing

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Only Dean and Tommy were tested since Teresa had been discharged and Benny had gone home for an extended visit. Across both clients there were no consistent differences between tasks learned under different reinforcement conditions for the dependent variables error rate, TOT, TST, or nonspecific prompts.

Discussion

The data indicate that the SER condition facilitated acquisition of both simple and more complex tasks, when compared to the MSR condition. The practical implications of this are seen most strongly in Experiment 1, although the results are somewhat confounded by a task effect. Clients who learned the more difficult task (reel) under the MSR condition took many more trials to reach criterion and made far more errors than they did on the brake (SER condition). However, the clients who learned the more difficult task (reel) under the SER condition reached criterion on it in approximately the same number of trials as they did on the brake (MSR condition) and with comparable error rates.

The training time required to learn the tasks in Experiment 2 ("car" and "man") was too short for differences of practical significance to emerge. However, three of the clients reached task criterion faster in the SER condition and all clients made fewer errors in this condition. Gold defined a complex task as "...one for which a retarded individual requires individualized and extensive training in order to perform the assembly" (1973, p. 41), and he described bicycle brake assembly as a complex task. Therefore, in terms of Gold's criteria, as well as the number of parts and training steps from the task analyses, the "car" and "man" tasks can be considered simpler than the bicycle brake and fishing reel tasks.

The abstract design tasks used in Experiment 3 could be considered complex in terms of the number of parts, training steps, and the length of training time required for a client to learn them. Many of the steps were repetitive, but multidimensional discriminations were required to correctly attach each part. The response requirements for assembling

each task were very similar and it is probable that a high degree of generalization occurred between conditions. In spite of this task similarity, three clients made many more errors in the MSR condition, and two took more trials to reach criterion in this condition. The remaining two clients completed both tasks in the same number of trials, although for Benny this was probably due to the simplification of the tasks since he had a higher error rate in the MSR condition at the time the tasks were modified.

One very consistent finding across all three experiments was that clients made more errors on learned steps in the MSR condition. In this procedure, only corrected discrimination errors received social approval. However, the SER condition required that a response must equal or better previous efforts to receive social approval. The fact that more errors were made on learned steps in the MSR condition suggests that social approval was a more effective reinforcer for correct performance than was silence, and that social approval following a corrected error may result in an increased error rate.

Clients in general were given more nonspecific prompts in the MSR condition than in the SER condition, indicating that they hesitated somewhat more often between steps in the MSR condition (although in Experiment 1 this was confounded by a task effect). In the SER condition clients received social approval for correct completion of a step until step criterion was reached. This also served as feedback, indicating that it was appropriate to go on to the next step. Once the step was well learned (i.e., performed at Level 3 for three consecutive trials) social approval was no longer given. In the MSR condition, a correct response was met with silence. This may have been less effective as

feedback for performing that step. For example, Step 23 of the fishing reel task analysis required the client to put the handle on the crank shaft. Clients would often attach the handle correctly but would then continue to turn it instead of moving on to the next step. In the SER condition the trainer would say "good" as soon as the handle was correctly attached, thus signalling the client to move on to the next step. However, this correct response would be met with silence in the MSR condition and the client might continue to play with the handle until a nonspecific prompt (e.g., "What's next?") was given. Therefore, social approval served both as a reinforcer for correct performance and as a discriminative stimulus to start the next step. Silence was less effective in this capacity since it could also indicate that the trainer was waiting for the client to complete the step.

The contention that high frequencies of praise would lead to greater dependence on the trainer (Levy et al., 1976) was not substantiated. As more steps were learned to criterion, the frequency of praise given throughout a trial declined. The greater number of nonspecific prompts given in the MSR condition may indicate a greater reliance on the trainer in this condition.

A potential criticism of the SER condition might be that it is too time-consuming a procedure for the typically busy workshop staff member. The data show, however, that in terms of total training time this procedure is not more time-consuming even for simple tasks, and may result in much less total training time on complex tasks.

All clients showed good retention on all tasks, regardless of the reinforcement condition under which they were trained. That is, once a task had reached criterion of three out of four consecutive errorless

trials, it was well learned.

It is interesting that Teresa, the new client in Experiment 3, showed virtually no differences on any of the dependent measures. She was also at a higher level of functioning than the other three clients, learning both tasks in only 13 trials. Perhaps for some higher functioning clients the training situation itself is sufficiently reinforcing so that explicitly programmed reinforcers become unnecessary. Further research is necessary to test this hypothesis.

In conclusion, the suggestion that complex tasks have strong reinforcing properties for the worker and that the use of additional programmed incentives may be unnecessary was not substantiated by these three experiments. This research indicates that "extra" reinforcers may be profitably used to teach both simple and complex tasks to the severely retarded.

Reference Notes

1. "Try Another Way" Film Brochure. Available from Film Productions of Indianapolis, 128 East 36th Street, Indianapolis, Indiana 46205.
2. Gold, M.W. Symposium on applying attribution theory to social problems: Vocational skill functioning of the severely retarded. Paper presented at the American Psychological Association, Chicago, Illinois, September, 1975.
3. Pallotta-Cornick, A., Suthons, E., Yu, D., & Martin, G. A comparison of backward and forward chaining to teach packaging and assembly tasks to severely and moderately retarded clients in a sheltered workshop. A poster session presented to the Annual Conference of the Manitoba Behavior Modification Association, Brandon, Manitoba, May, 1978.
4. Suthons, E., Martin, G., Yu, D., & Koop, S. A comparison of modified forward and backward chaining procedures to teach assembly tasks to the severely retarded. A poster session presented to the Annual Conference of the Association of Behavior Analysis, Dearborn, Michigan, June, 1979.
5. Yu, D., Suthons, E., Martin, G., & Koop, S. Comparisons of modified forward chaining and total task presentation formats to teach vocational skills to the retarded. A poster session presented to the Annual Conference of the Association of Behavior Analysis, Dearborn, Michigan, June, 1979.

References

Bellamy, G.T., Peterson, L., & Close, D. Habilitation of the severely retarded: Illustrations of competence. Education and Training of the Mentally Retarded, 1975, 19, 174-186.

Friedenberg, W.P., & Martin, A.S. Prevocational training of the severely retarded using task analysis. Mental Retardation, 1977, 15, 16-20.

Gardner, S.J. Behavior modification in mental retardation. Chicago: Aldine-Atherton, 1971.

Gibson, D., & Brown, R. Managing the severely retarded. Springfield, Illinois: Charles C. Thomas Co., 1976.

Gold, M.W. Stimulus factors in skill training of the retarded on a complex assembly task: Acquisition, transfer and retention. American Journal of Mental Deficiency, 1972, 76, 517-526.

Gold, M.W. Factors affecting production by the retarded: Base rate. Mental Retardation, 1973, 11, 41-45.

Gold, M.W. Task analysis of a complex assembly task by the retarded blind. Exceptional Children, 1976, 43, 78-84.

Levy, S.M., Pomerantz, D.J., & Gold, M.W. Work skill development. In N.G. Haring (Ed.), Teaching severely/profoundly handicapped individuals. New York: Gruen & Stratton, 1976, pp. 231-254.

Martin, G.L., Murrell, M., Nicholson, C., & Tallman, B. Teaching basic skills to the severely and profoundly retarded: The MIMR basic behavior test, curriculum guide and programming strategy. Portage la Prairie, Manitoba: Manitoba Institute on Mental Retardation, 1975.

Martin, G.L., & Pallotta-Cornick. A. Behavior modification in sheltered workshops and community group homes: Status and future. In L.A.

Hamerlynck (Ed.), Behavioral systems for the developmentally disabled: Institutional, clinic and community environments. New York: Brunner/Mazel, Inc., 1979.

Martin, G.L., & Pear, J.J. Behavior modification: What it is and how to do it. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1978.

Neisworth, J., & Smith, R. Modifying retarded behavior. Boston: Houghton-Mifflin Co., 1973.

O'Neill, C.T., & Bellamy, G.T. Evaluation of a procedure for teaching saw chain assembly to a severely retarded woman. Mental Retardation, 1978, 16, 37-41.

Tate, B., & Barhoff, G. Training the mentally retarded in the production of a complex product: A demonstration of work potential. Exceptional Children, 1967, 33, 405-408.

Ulman, J.D., & Sulzer-Azaroff, B. Multi-element baseline design in educational research. In E. Ramp and G. Semb (Eds.), Behavior analysis: Areas of research and application. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1975.