THE EFFECTIVENESS OF MODELING AND VIDEOTAPE FEEDBACK
ON PERSONAL PROBLEM SOLVING

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ABSTRACT

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Methods to improve male college students' ability to solve personal problems were investigated. The techniques used were having a subject watch a model's performance, having him watch his own on videotape, and a combination of the two. The aspects of a subject's problem-solving behavior studied were the gathering of information about a problem presented to him, the summary and organization of that information, and the generation of solutions. Analysis of variance of the data demonstrated that modeling improved the quantity, and videotape feedback the quality, of the information sought. Only limited evidence of improvement in solutions was found. Correlational analyses yielded evidence for the effects of the training interventions in the areas of the organization of information and of solutions, in that for the control group, prediction of posttest from pretest behavior was possible, but not for the treatment groups. The implications of the results for the possibility of a form of psychotherapy consisting of teaching general strategies for the solving of personal problems were considered.

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"...If the alternatives are side by side, choose the one on the left; if they're consecutive in time, choose the earlier. If neither of these applies, choose the alternative whose name begins with the earlier letter of the alphabet. These are the principles of Sinistrality, Antecedence, and Alphabetical Priority--there are others, and they're arbitrary, but useful. Good-by."

"Good-by, Doctor," I said, a little breathless, and prepared to leave.

John Barth, The End of the Road

INTRODUCTION

The possibility of teaching general strategies for solving personal problems, as an alternative to training specific responses, has been receiving attention from those concerned with behavior modification techniques. Goldiamond (1965) has spoken of training the person to analyze his behavioral patterns in problem situations and of teaching him to determine for himself the procedures best suited for changing them. The advantage of such training, if it were to succeed, would lie in its increased generalizability. In addition to being able to function adequately in a previously difficult situation, an individual would be able to deal with future difficult situations as well.

D'Zurilla and Goldfried (1971) have recently reviewed the general psychological literature on problem solving and have discussed its relation to treatment. Their definitions of the situations and processes involved serve as a useful introduction to the area. A "problematic situation" is defined as one with which an individual must deal in order to function effectively, and one in which "no effective response alternative is immediately available [p. 108]." "Problem solving" is then defined as

> a behavioral process, whether overt or cognitive in nature, which (a) makes available a variety of potentially effective response alternatives for dealing with the problematic situation and (b) increases the probability of selecting the most effective response from among these various alternatives [p. 108].

Effective problem solving is said to have five stages: general orientation, problem definition and formulation, generation of alternative solutions, decision making, and verification. An "effective solution" is

> a response or pattern of responses which alters the situation so that it is no longer problematic to the individual and at the same time maximizes other positive consequences and minimizes other negative ones [pp. 108-109].

Deficits in problem-solving ability can occur at any stage in the process. The end result in every case is that "effective solutions" are not selected.

Some attempts have been made to identify the factors leading to poor problem solving. Bloom and Broder (1950) found in their studies of solving academic examination problems that unsuccessful students attempted to provide solutions immediately and, if they could not solve it on the first attempt, stopped working on the problem altogether. In a true "problematic situation," where no effective response is immediately available, an impulsive response is likely not to be a successful one. An immediate response also insures that a better one will not be generated: "the immediate production of solutions interferes with the chances of cognitive reorganization and of identifying alternative response patterns [Johnson, 1972, p. 210]."

Even if the problem solver proceeds slowly, however, ineffective solutions can result from an inability to seek and use information. As Crutchfield (1969) has pointed out, in order to solve problems effectively, individuals must learn to separate relevant from irrelevant information and to recognize in what areas they need information. The successful problem solvers in Bloom and Broder's study were able to identify the key information required to solve elements of a problem, while those who were unsuccessful spent too much time on the irrelevant aspects.

An investigation of personal problem-solving ability in adolescence by Spivack (1964) has led him to conclude that a common difficulty may be the inability of the individual to generate alternative courses of action. The individual may simply be unaware that more than one response is open to him in a situation. Spivack compared the performance of middle-class boys assigned to residential treatment because of behavior problems with that of boys of similar economic and social background. The boys were asked to complete stories given to them. They were told the beginning of the story, in which the protagonist desired a certain outcome, and the ending, in which the desire was fulfilled. The task was to connect the beginning and the ending, showing the steps the protagonist took to reach the goal. The "means-end" thinking of the boys in treatment was shown to be impulsive; that is, they did not think out judicious steps toward the goal but rather tended to choose the most immediate, and often inadvisable, method. They were also able to generate fewer responses to the stories than were the normal control subjects. In a recent series of studies, Spivack and his colleagues (Platt & Spivack, 1972; Shure & Spivack, 1972) have found similar deficits in "means-end" thinking in both psychiatric patients and disturbed children. These findings are consistent with Rotter's view that an inappropriate behavior may often be maintained, not because of lack of insight, but because the individual does not know a more effective response (Rotter, 1970). He suggests helping the individual generate alternative courses of action as a form of therapy.

Training in problem solving has been the topic of a number of studies. Two assumptions are implicit in such research: that problem solving is trainable, and that the process can be broken down into steps which are each affected by training.

The first assumption, that problem solving is trainable, underlies studies of training various types of problem solving. In some studies the topic has been academic or creative problem solving, while in others, the skill to be trained was personal problem solving. If differences in original ability are controlled, the assumption that problem solving is trainable is supported when gains in problem-solving ability are found following training.

Those who assume that problem solving is trainable see it as a skill which is not synonymous with intelligence. In a study involving training in productive thinking (Covington, Crutchfield, & Davies, 1966), gains in problem-solving ability occurred in children of average and below average intelligence as well as in children of above average intelligence. Bloom and Broder (1950) attempted to improve the academic record of poor problem solvers. Their experimental and control groups were matched for ability on aptitude tests, but the groups differed in that the experimental group had a poorer academic record in spite of the equivalence in aptitude. The training procedure consisted of having other students, previously identified as successful problem solvers on the basis of academic performance, serve as models. These models were asked to solve a sample examination problem aloud. Subjects in the experimental group of poor problem solvers attempted the same problem, and then compared their performance with that of the model. The subjects were instructed to strive to modify their behavior to match that of the model. After such training the record of the experimental group improved to a level nearly identical to that of the control group.

Research in training creativity in problem solving must also assume that training can be effective. An example of training in creative problem solving that has been used extensively in industry is the brainstorming method of Osborn (1963). Brainstorming assumes that problem solving can be trained by focusing on the generation of solutions. Studies on brainstorming have shown that this method yields the greatest number of superior solutions (Brilhart & Jochem, 1964; Osborn, 1963; Parnes, 1961; Parnes & Meadow, 1960). Typically in studies of the effectiveness of the technique, subjects are asked to discover creative uses for a familiar object. They are instructed to follow two principles: to defer judgment on an idea until after all the ideas have been generated, and to produce as many ideas as possible, since "quantity breeds quality." Groups trained in brainstorming have generated superior solutions when compared to a control group (Parnes & Meadow, 1960).

It is clear from these studies that changes do take place in problem-solving behavior with various types of training, when the problems to be solved are cognitive in nature. Research in training personal problem solving must also assume that it is a trainable skill. Sarason and Ganzer have undertaken research attempting to improve the personal problem-solving ability of juvenile delinquent boys (Sarason, 1968; Sarason & Ganzer, 1969a, 1969b, 1973). In their studies they have used problem situations which are of particular concern to these boys, such as their dealings with authority figures and vocational planning. They identified the troublesome situations in discussion with the subjects themselves. The emphasis in training procedures was on modeling and behavioral rehearsal, the hypothesis being that the boys would learn the socially appropriate behaviors of the models and exhibit them outside the training sessions. Short-term evaluation indicated that a group given modeling training showed more improvement than a group required to role-play in the situations but which had no model. Informal follow-up gave some evidence that the change in behavior was maintained after the boys left the juvenile center. Sarason and Ganzer's studies support the assumption that personal, as well as academic or creative, problem solving can be trained.

A second assumption which is made by most investigators is that problem solving can be broken down into steps and that, although these steps do not always occur in sequence, they can be separated for purposes of study or training. For example, Gagné (1966) has defined the process as having four stages:

statement of the problem, defining the problem, searching for and formulating hypotheses, and verifying the solution. Merrifield, Guilford, Christensen, and Frick (1962) assumed in their factor-analytic study of the skills involved in solving a wide range of problems that problem solving was a process with five stages: preparation, analysis, production, verification, and reapplication. Clearly, the number of steps suggested and the names given to them vary; perhaps more important than naming the stages is to define the behaviors involved and the training procedures to be used in each stage of problem solving.

With regard to the training procedures to be used, a third assumption underlying research in problem solving is that there are individual differences in the ability to solve problems. It is assumed that some individuals have not developed the appropriate skills, or have learned an inadequate strategy for solving problems. The best training procedures may be those which are involved in the original development of a strategy--for example, watching other people solve problems, and receiving feedback on the success of one's solutions. Training would serve to make these processes more salient, to encourage the intentional learning of a good strategy rather than the incidental learning involved in the original development of a problem-solving strategy.

Of the procedures which have been used to train problem solving, modeling would seem to be especially effective for transmitting problem-solving strategies. Watching another person is certainly one of the ways in which an individual learns his original problem-solving strategy, and it therefore may be effective in training. Bandura has noted that

> when inability to function effectively is due mainly to faulty or deficient behavior, modeling is not only the most appropriate, but often an essential, means of developing requisite skills and interpersonal competencies [1971, p. 703].

Since ineffective problem-solving behavior is often hypothesized to be due to a deficit in the requisite skills, a training method dependent on shaping emitted behavior through differential reinforcement would be premature; a method such as modeling which would increase the probability of the desired behavior being emitted by the subject could prove effective (Bandura, 1969; Bourdon, 1970; Krumboltz & Thoresen, 1964). Modeling seems to be a considerably more effective way of transmitting complex behavior than does merely instructing the subject how to perform the behavior. For example, Frankel (1971), in a study involving counseling behavior, found that a group which observed a model improved more than a group which was given reading describing good counseling behavior.

Of the three possible effects of modeling suggested by Bandura (1971), observational learning, response facilitation, and the strengthening or weakening of inhibitions, training in problem solving would seem to involve primarily the first two. Through watching a model engage in problem solving, the observer could acquire new patterns of behavior which do not exist in his repertoire in integrated form. In addition the model's behavior could serve as a discriminative stimulus for aspects of behavior which are already part of the observer's repertoire; those behaviors for which the model is reinforced could subsequently come to have a higher probability of being performed by the observer, while "poor" or negatively reinforced behavior could come to be less probable. For this reason, as in the study by Frankel (1971) cited above, the models may be instructed to exhibit "poor" or ineffective behavior as well as good behavior in order to allow the subjects to discriminate between them.

There is some evidence that the effect of modeling is greatest when the model verbalizes his strategy explicitly. Meichenbaum conducted a study on the therapeutic effects of modeling and verbalization on snake phobias (1971). The group which showed the greatest behavior change was one which observed an initially fearful model who talked to herself about what she was doing. Meichenbaum suggests that the model's verbalizations added information which was beneficial. Further support for the effects of verbalization in modeling comes from Meichenbaum and Goodman's study on teaching impulsive children to control their behavior (1971). In their study the model engaged in explicit verbalization of his method of solving a problem. A group of children which observed the verbalizing model and received instruction in verbalizing performed significantly better on several cognitive tests than a control group which received no modeling or training. Modeling with verbalization has also been found to produce better transfer of a newly acquired concept to a new situation than did modeling alone (Rosenthal, Moore, Dorfman, & Nelson, 1971). The modeling of a strategy, with verbalization of the components of that strategy, would seem to be a good method of training problem solving because of the added information which verbalization conveys.

Several studies have shown that in order to effect maximum behavior change, modeling should be followed by guided rehearsal of the modeled responses (Bandura, 1971). In a study by Friedman (1968) on facilitating assertive behavior, behavioral modeling and rehearsal was found to be the most effective method, resulting in three times as much assertive behavior as in a pretest. Meichenbaum and Goodman, in the study cited above (1971), found that modeling plus training and rehearsal was more effective than modeling alone in teaching impulsive children self-control. Rehearsal, when accompanied by differential reinforcement, can serve both to provide the subject with more information on his performance, and to demonstrate to him the efficacy of the modeled behavior. Further, if rehearsal is accompanied by feedback information on performance, rather than solely by reinforcement, the subject can not only acquire new knowledge about the task, but can also learn to apply that knowledge consistently (Hammond & Summers, 1972).

One method of providing feedback on rehearsal is to make a videotape record of performance. Studies on videotape feedback in group psychotherapy generally show that the treatment group improves significantly more than a control group which has therapy but no videotape feedback (Armstrong, 1964; Moore, Chernell, & West, 1965). Videotape has also been used to give individuals feedback on their behavior in such situations as a student learning counseling (Frankel, 1971), and a mother learning to better control her child (Bernal, Duryea, Pruett, & Burns, 1968).

Because difficulty in problem solving is assumed to result from a deficit in effective strategies, modeling has been proposed as a good procedure for training more effective behavior. The learning of new strategies is not complete, however, unless the subject is given the opportunity to rehearse the behavior and to receive feedback on his performance. In addition to modeling, then, rehearsal and videotape feedback are suggested as methods of training.

One aim of giving training in each of the stages of problem solving would be to reduce the tendency of the individual to give an immediate solution to a problem. The method that Meichenbaum and Goodman have devised for teaching an impulsive child to talk to himself (1971) has the function of inhibiting such immediate, and ineffective, behavior. In general, any method which required the individual to follow a specific series of steps would insure that an immediate solution would not be produced.

A behavior required in the early stages of the problem-solving process is the gathering of information relevant to the problem. Modeling has been found effective in several studies in changing information-seeking behavior (Krumboltz & Thoresen, 1964; Lamal, 1971; Rosenthal, Zimmerman, & Durning, 1970). For example, Krumboltz and Thoresen (1964) studied information seeking in educational and vocational counseling. Subjects who listened to a model being reinforced for seeking vocational information displayed more information-seeking behavior in a follow-up assessment than did subjects who were themselves reinforced for any information seeking they did in the course of a discussion. In a study involving information seeking in the classroom (Suchman, 1964), children who listened to audiotapes of questions they had asked about physics demonstrations improved the quality of questions they asked on a posttest.

Another recognized feature of the problem-solving process is the organization of the information once it is obtained (Crutchfield, 1969; D'Zurilla & Goldfried, 1971). Requiring an individual to summarize the information and to state explicitly what he knows about the problematic situation may improve both subsequent information seeking and solution formulation. Asking him to choose the items of information which are the most important would require him to organize the information. Several studies have shown that when an individual verbalizes either the procedures he is using in a task, or the principle he has learned from a task, he is able to perform better on a subsequent test than an individual who does not verbalize his procedure or the principle involved (Davis, Carey, Foxman, & Tarr, 1968; Ervin, 1960; Gagné & Smith, 1962). For example, Gagné and Smith (1962) found that subjects who were required to verbalize why they chose their moves on a disk transfer problem performed better on subsequent problems of a similar type than did subjects who were not asked to verbalize their reasoning.

Once the relevant information has been gathered and organized, the subject must start to generate alternative solutions to the problem. Modeling may be an effective procedure for influencing individuals to generate many solutions and for training them to reflect over alternatives. Since a general strategy rather than specific behavior is to be conveyed, the question of the rules to be followed by the model for generating solutions is important. Researchers in the brainstorming technique argue that better solutions are produced using their method simply because the subject is encouraged to think of as many solutions as possible without passing judgment (Osborn, 1963). Studies testing the brainstorming method find that the better solutions are generated in the latter stages of production (Parnes, 1961). Gerlach, Schutz, Baker, and Mazer (1964) suggest, however, that supplying the subject with the criteria for a good response may result in his generating the better solutions earlier. The results of a study by them indicated that the criteria-cued group produced slightly (though not significantly) more superior solutions than did the brainstorming group. A similar result was also found in a study by Johnson, Parrott, and Stratton (1968) using five types of problems. Both studies found that the brainstorming group produced the best solutions in the latter stages of production, but that the criteria-cued group produced their best solutions earlier.

It must be kept in mind, however, that the type of problems used in studies of brainstorming ensure that better solutions will be unusual ones. In solving personal problems, a highly unusual and creative solution may not always be an effective or a practial solution. People in the real-life environment of the individual may react badly to behavior which is unexpected. Training a subject or client to produce solutions according to criteria which would both satisfy him and promote effective interpersonal behavior would seem to be important. In most cases, a good solution would be one which considered all persons and circumstances involved and which would minimize the negative consequences resulting from other people's reactions. But a poor problem solver may be in the habit of judging his responses only by the criterion of whether it satisfies him alone, and for the present moment. Evidence that individuals with a deficit in problem solving do have difficulty in considering any but their own view comes from Bloom and Broder (1950). Their unsuccessful problem solvers introduced their personal views to the detriment of their performance. In order to perform effectively, individuals must have good knowledge of the requirements of a solution. An effective method of training, then, would seem to require that modeling and feedback on videotape emphasize the appropriate criteria for a solution, and explain how the solution chosen meets the criteria.

It would be important in any study of training in problem solving to establish measures of each feature of the behavior one was trying to affect. For example, if subjects were required to ask questions in order to gain information, one measure of a change in behavior could be simply the number of questions asked. To measure the quality of questions, two methods have been developed by Rimoldi (Rimoldi, 1955, 1960; Rimoldi

& Erdmann, 1967). One, a normative "utility index" for each question, is arrived at by having judges rate the relevance of the questions. The second, a "utility score," is a score for a subject and is calculated as the sum of the utility indices of the questions asked divided by the number of questions asked. The higher the utility score, the more relevant the questions asked, so that improvement is measured by an increase in scores.

Performance in the summary stage could be measured by taking the number of items included in the summary as a percentage of the total received through questions, and by scoring the information included according to the judged ratings. The items the subject chooses as important, reflecting the organization he imposes on the information, could be scored by their utility indices.

As in the case of questions asked, the change in the solutions generated by the subject could be measured by the number he is able to generate. To assess the adequacy of solutions, those a subject generates could be scored for quality in terms of judges' ratings. Using the criteria set forth by D'Zurilla and Goldfried (1971), the possible solutions ought to be rated as to how well they eliminate the problem while maximizing all positive consequences. The solutions the subject offered as those possible in the situation, and the one he chose as the best solution, could be scored with these ratings.

In the present study a comparison was made between the effects of modeling, videotape feedback, and a combination of the two on the development of problem-solving strategies. Subjects were required to follow a set procedure in solving the problem, which prevented the immediate generation of a solution. Baseline performance in the stages of problem solving was measured, following which the subject received training. A post-training assessment of performance was obtained to measure the effects of the treatments.

The population chosen for the study was first-year college students. Adolescence is a period in which personal problem solving becomes particularly important because of the changing expectations in terms of independence. Entering college is an event which precipitates many such problems for the individual in late adolescence. The subjects in this study were not selected for having particular difficulties in problem solving. Since there was a wide variation in initial abilities, the attempt to improve the problem solving of this unselected group provided a stringent test of the training methods.

Previous studies on personal problem solving (Goldfried & D'Zurilla, 1969; Sarason & Ganzer, 1969a, 1969b, 1973) have pointed out the importance of using problems which are typically encountered by the subjects. First-year college students were therefore consulted as to typical problems they face. In order to eliminate sex differences in response to problems and to models (Bandura, 1969; Krumboltz & Thoresen, 1964), only male subjects and male models were used.

METHOD

Subjects

Fifty-six male student volunteers served as subjects in the experiment. All were enrolled in first year English or mathematics courses at Sir George Williams University. The median age of the subjects was 18 years, the range from 17 to 29 years.

Procedure

The experiment was designed to include a pre-training test, a training period, and a post-training test. All subjects were treated similarly during the pre- and posttests. Differential treatment was determined by the training condition to which they were assigned. The pretest, which established a baseline performance, and the posttest were both audiotaped for later scoring. During these tests the subjects were required to engage in finding a solution to one of six "problems" devised for the study. They were told:

> This is an experiment in solving real-life problems. I'm interested in how you would advise someone to deal with his problems, based on your own past experience.
>
> I am going to tell you the main outline of a problem that someone could run into. By itself, it may not be enough information for you to decide what he should do. So after I give you the outline, I want you to ask me for whatever information you think it would be important to know in order to help the person solve the problem.

> and I'll give you that information. For example, if I told you that someone was trying to decide whether to buy a car, you'd probably ask me whether he could afford it.

After a subject had asked the questions he thought necessary, he was asked to summarize the information he had and then to pick out the three most important items of information he had obtained through his questions. Following this, the experimenter asked him to suggest possible solutions to the problem: "Now I'd like you to tell me the things the person could do in this situation. For now, tell me the things that he *could* do, not just what you would advise him to do." After he had given solutions, he was asked to choose the best, the one that he would advise the person with the problem to choose.

Training Conditions

The subjects were randomly assigned to one of four training conditions: modeling, videotape feedback, modeling plus videotape feedback, and the control condition. There were 14 subjects in each condition. In all conditions subjects were presented with two additional "problems." Thus each subject in the experiment was exposed to four of the "problems." The order was counterbalanced to control for possible differential quality of problems; five orders were selected randomly for use in the study.

Modeling. After the pretest, a subject in the modeling condition was shown videotapes of two different people each solving a problem similar to the one he had just worked on. (The modeling tapes are available on request from the experimenter. Mean scores and ranges for the models for each of the measures taken are shown in Appendix B.) In order to facilitate attention to the model, and, as a result, matching behavior (Bandura, 1969; Sarason & Ganzer, 1969a, 1969b), the subject was told that the people he would be watching were skilled at solving this type of problem.

The models, male students aged 20 to 30 years, solved a problem using the same procedure as had been called for on the part of the subject in the pretest: asking questions, summarizing the information, picking out the important items, stating solutions, and choosing the best. As the model worked on the problem, he commented on his strategy; he made statements on the relevance of his own questions, on the criteria the best solution must meet, and on how his chosen solution in fact met them. In order to help the subject discriminate good performance from poor performance, the model made mistakes and corrected himself (Meichenbaum & Goodman, 1971); for example, each asked at least one irrelevant question and withdrew it, commenting that it was not important to the problem.

Videotape feedback. In the videotape feedback condition the training session involved videotaping the subject himself while he was solving the two training problems. Because the initial experience of seeing oneself on videotape is engrossing to most people and anxiety-provoking to some (Berger, 1970; Moore et al., 1965), subjects were given the opportunity to view themselves on videotape for several minutes before the training began; about half wanted to do so.

After the subject's performance was taped, the videotape was played back to him. During the replay, the experimenter gave the subject feedback on his behavior: on the relevance of the questions asked, on the completeness of the summary, on the importance of the three items of information he chose, and on the quality of solutions in terms of appropriate criteria. The experimenter also made suggestions as to how the performance could be improved. The comments made by the experimenter were, insofar as was possible, similar to the statements made by the models on their own behavior.

The second training problem was presented upon completion of the replay. The procedures followed were the same.

Modeling and videotape feedback. Subjects in the modeling and videotape feedback group first observed a model solving one of the problems, as in the modeling condition, and then solved a problem themselves which was videotaped and replayed as in the videotape feedback condition.

Control. The control condition was an active condition in that subjects solved two problems between the pretest and the posttest problems, but received no special training.

Equipment

The videotape equipment used was a Sony portable videorecorder taking ½-inch tape, model AV-3400, and a Sony video camera with a zoom lens, model AV C-3400, which was mounted on a tripod. The tapes were shown on a Toshiba portable television, model V902DC.

The "Problems"

Six "problems" were devised after informal consultation with college-level students. The six problems chosen were reported by all students questioned to be familiar to themselves or to their friends.

Only the bare outline of a problem was presented to the subject, but the background material was prepared in advance by the experimenter and the judges. Judges were three graduate students in psychology, two female and one male. Prior to testing, the experimenter and the judges tried to think of all possible questions and solutions. These were then rated for relevance and adequacy. After the testing, the judges met again to rate any additional questions and solutions which had been brought forward by the subjects. (See Appendix A for the outlines of the problems and sample questions and solutions.)

The rating scale was a 15-centimeter line, with no markings along it except at the end points. The judges marked a point along the line to indicate their assessment of the relevance of a question. A mark at the extreme left of the line indicated that the question was judged to be "very irrelevant"; the far right indicated it to be judged "very relevant."

Solutions were rated according to the criteria set out by D'Zurilla and Goldfried (1971). These ratings were also made on a 15-centimeter line, the extreme left indicating a poor solution and the extreme right an excellent solution.

The judges' markings were measured with a ruler to the nearest millimeter; the mean of the three ratings was taken to be the rating for that question. Rating scores could vary from 0.0 to 15.0. These mean ratings constituted a normative "utility index" for the questions and solutions (Rimoldi, 1955, 1960).

Measures and Scoring

The number of questions asked, the sum of the ratings for the questions, and the mean of the ratings were computed for each subject for both his pretest and his posttest.

In scoring the summary, the ratings of the questions which the subject had asked to obtain the information were used. There were three scores calculated for the summary: the proportion of information obtained through questioning that was included in the summary, the sum of the ratings, and the mean rating of the information. In addition the mean rating of the three most important items chosen by the subject was computed. The mean rather than the sum was used since not all subjects chose three items; the number in fact chosen ranged from none to five.

The number of solutions, the sum of the ratings of the solutions, and the mean rating were obtained for each subject for pretest and posttest.

It should be pointed out that the <u>mean</u> rating scores for the questions, the summary, and the solutions were confounded by the number of scores on which they were based, since, as Johnson et al. (1968) have shown, the overall quality of the items produced is affected by the quantity. These mean scores may not, therefore, be as meaningful a measure of a subject's performance as the other measures used.

In addition to these scores which reflect the total output of the subject, several more qualitative measures were calculated. One was the amount of essential information about the problem that the subject requested. Essential information was defined as the questions it would be necessary to ask in order to be able to generate solutions which had been given ratings of 10.0 or greater on the 15-point scale. (Only nine out of the 56 subjects gave a solution with a rating of 10.0 or greater.) For the six problems, the number of such essential questions ranged from nine to fourteen; the percentage of these questions that the subject asked in pretest and posttest was computed. Two other measures used were the rating scores assigned to the advised solution, that is, the solution which the subject designated as the one he would give as advice, and the rating of the "best" or highest-rated solution, if this was different from the advised solution.

Reliability of the judges' ratings was measured by computing W, the Coefficient of Concordance (Siegel, 1956), for each set of questions and solutions. The Ws ranged from .71 to .92, with a mean of .80. This corresponds to a mean Spearman rank order correlation coefficient of .70.

Since some subjective decisions were required in scoring a subject's performance, an independent rater scored two randomly selected protocols. The Pearson product-moment correlation between his scoring and that of the experimenter was .9975.

Differential quality of problems was analyzed by computing the Kruskal-Wallis ranked one-way analysis of variance on pretest scores for each measure. Only five orders of problems were selected for the study, and, as a result, one problem of the six was not used in the pretest and one problem which appeared in the pretest did not appear in the posttest. Any effect this incomplete ordering might have had would be felt equally across groups since the orders were counterbalanced across conditions.

The following analyses showed a significant difference among problems: number of questions asked, $\underline{H}$ (4) = 12.92, $\underline{p} < .05$; sum of the ratings of questions, $\underline{H}$ (4) = 16.96, $\underline{p} < .01$; mean rating of questions, $\underline{H}$ (4) = 23.39, $\underline{p} < .01$; sum of the ratings of the summary, $\underline{H}$ (4) = 12.67, $\underline{p} < .05$; mean rating of the summary, $\underline{H}$ (4) = 14.86, $\underline{p} < .01$; mean of the three most important items, $\underline{H}$ (4) = 17.00, $\underline{p} < .01$; and the percentage of the essential questions asked, $\underline{H}$ (4) = 14.13, $\underline{p} < .01$. Table 1 shows the mean rank for each of the problems on these measures. The only consistent relationship was that in each case the highest mean rank was that of problem number 2. The outline of this problem was: "This person has been having problems with his girlfriend lately because she has been difficult to get along with." The situation presented to the subject was more vague in this problem than in the others; apparently subjects had to ask more questions to establish the nature of the situation. It is also possible that problems with a girlfriend are more difficult for them to handle than other situations, and so this problem evoked more interest.

TABLE 1

MEAN RANKS FOR EACH PROBLEM ON THE MEASURES FOR WHICH SIGNIFICANT DIFFERENCES WERE OBTAINED (KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE BY RANKS)

Measure	Problem Number				
	2	3	4	5	6
Number of questions asked	36.6	28.2	26.6	16.0	34.2
Sum of ratings of questions	41.1	23.2	26.6	17.2	33.6
Mean rating of questions	41.8	13.6	27.8	35.9	23.4
Sum of ratings of information in summary	42.0	26.5	25.8	23.3	23.6
Mean rating of information in summary	41.6	18.8	30.1	27.8	24.0
Mean rating of three most important items	44.1	23.2	21.4	26.8	25.5
Percentage of essential questions asked	39.2	17.3	30.2	24.2	31.7

RESULTS

The quantitative scores obtained on both the pretest and the posttest were analyzed by one-way analyses of variance. No significant group differences were found during the pretest on any of the measures taken (see Appendix C for source tables), indicating that the groups were adequately equated before treatment.

The analysis of variance for the sum of the ratings of questions during the posttest (Appendix E, Table 1) yielded a significant treatment effect, $F\ (3,52) = 3.89$, $p < .05$. The experimental group means were all greater than that of the control group. The Tukey (a) test for group differences (Winer, 1962) showed that each of the experimental groups differed significantly ($p < .05$) from the control group and that no experimental group was significantly different from any other. (See Appendix B for a table of mean scores.)

For the measure, number of questions asked, an analysis of covariance, with pretest scores as the covariate, was computed. The analysis of covariance provided a more exact test than would the analysis of variance since Pearson product-moment correlations between pretest and posttest scores (modeling $r\ (12) = .38$, videotape feedback $r\ (12) = .79$, modeling and videotape feedback $r\ (12) = .51$, control $r\ (12) = .48$) were sufficiently high. The treatment effect was significant,

F (3,51) = 4.59, $p < .01$. The experimental group means on the posttest were all greater than that of the control group. The Tukey (a) test showed that both of the modeling groups were significantly different from the control group: modeling vs. control, $p < .01$; modeling and videotape feedback vs. control, $p < .05$. A graph of the regression lines is shown in Figure 1. It can be seen from the figure that for a given number of questions asked on the pretest, subjects in the modeling groups asked more questions on the posttest than did subjects in the control group.

None of the other analyses of variance of the quantitative measures yielded significant treatment effects. There were no differences among treatments for the measures involving summary or organization on the information, or for the measures dealing with solutions.

Analyses of variance were computed for each of the qualitative measures on both pretest and posttest scores. As in the case of the quantitative measures, there were no significant group effects on the pretest.

In the posttest there was a significant treatment effect for the percentage of essential questions asked, F (3,52) = 2.95, $p < .05$. Comparison of the combined means of the experimental groups with the mean of the control group (modeling $\bar{X}$ = 25.79, videotape feedback $\bar{X}$ = 27.64, modeling and videotape feedback $\bar{X}$ = 24.36, control $\bar{X}$ = 13.57) using Scheffé's test showed that the combined treatment groups were significantly different from the control group ($p < .05$). Comparison of the

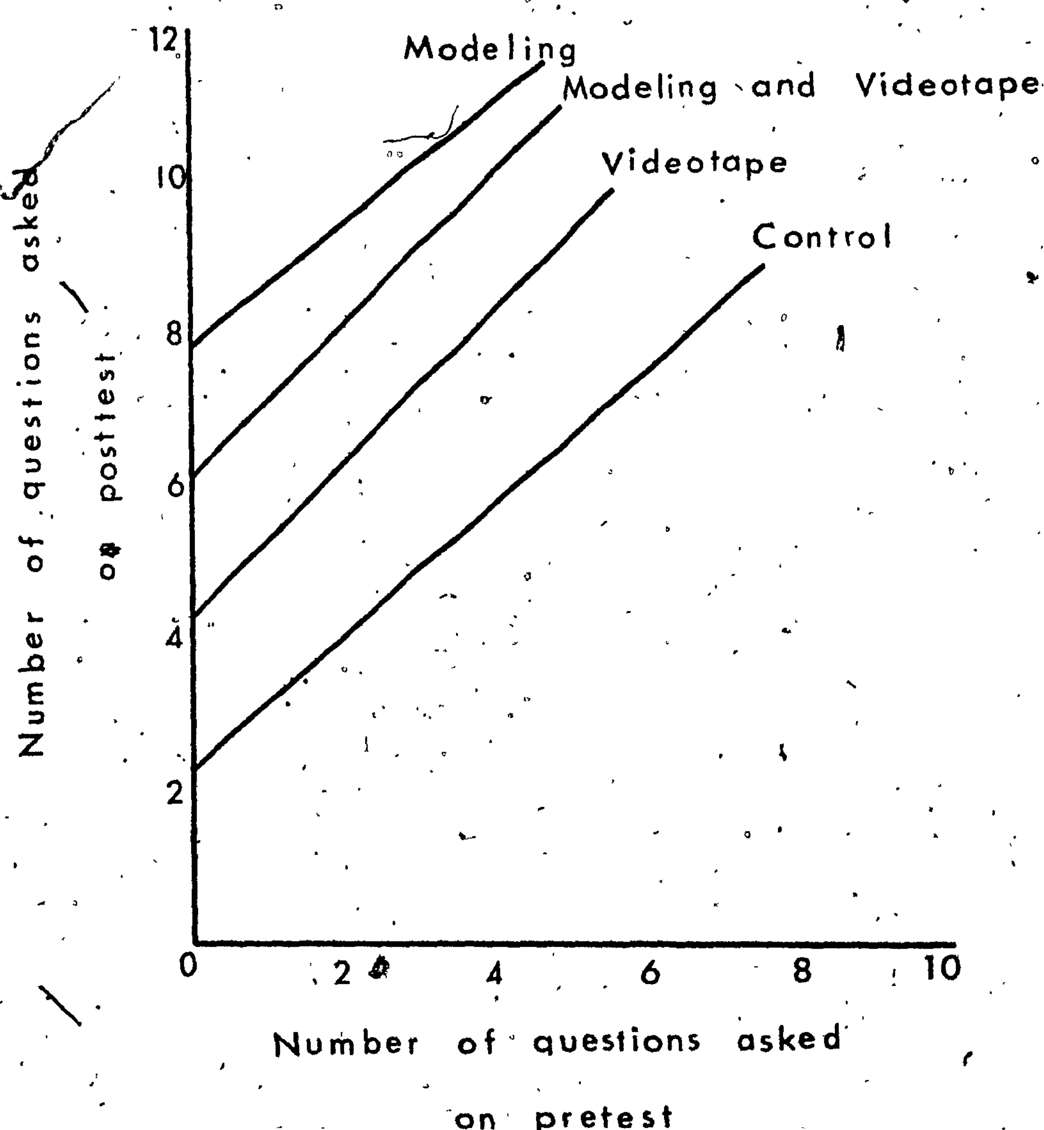

Figure 1. Regression lines for number of questions asked on pre- and posttest

individual groups using the Tukey (a) test, however, showed that only the videotape feedback group was significantly different from the control group ($p < .05$). The effects of the treatments on this measure can be seen clearly from the graph of pretest and posttest scores in Figure 2.

In the case of the scores for the advised solution, the treatment effect only approached significance, $F(3,52) = 2.25$, $p < .10$. As in the case of the essential questions, however, the means of the three experimental groups were all greater than that of the control group (modeling $\bar{X} = 6.21$, videotape feedback $\bar{X} = 5.75$, modeling and videotape feedback $\bar{X} = 5.39$, control $\bar{X} = 3.69$). Figure 3 suggests that improvement on this measure occurred only in the modeling and in the videotape feedback groups. In fact, subjects in the control group decreased in their scores on this measure. There was no significant treatment effect in the quality of the solution offered by the subject which was rated highest by the judges.

Subjects often failed to choose their solution with the highest rating as their advised solution. During the pretest, 30 out of the 56 subjects did not choose their solution with the highest rating as their advised solution; in the posttest 34 out of the 56 did not do so. There was no significant relationship between group membership and whether the advised solution was the best of the ones mentioned (pretest $\chi^2(3) = 3.73$, $p > .05$; posttest $\chi^2(3) = 3.60$, $p > .05$).

Pearson product-moment correlations were calculated between pretest and posttest scores on all measures (Appendix F).

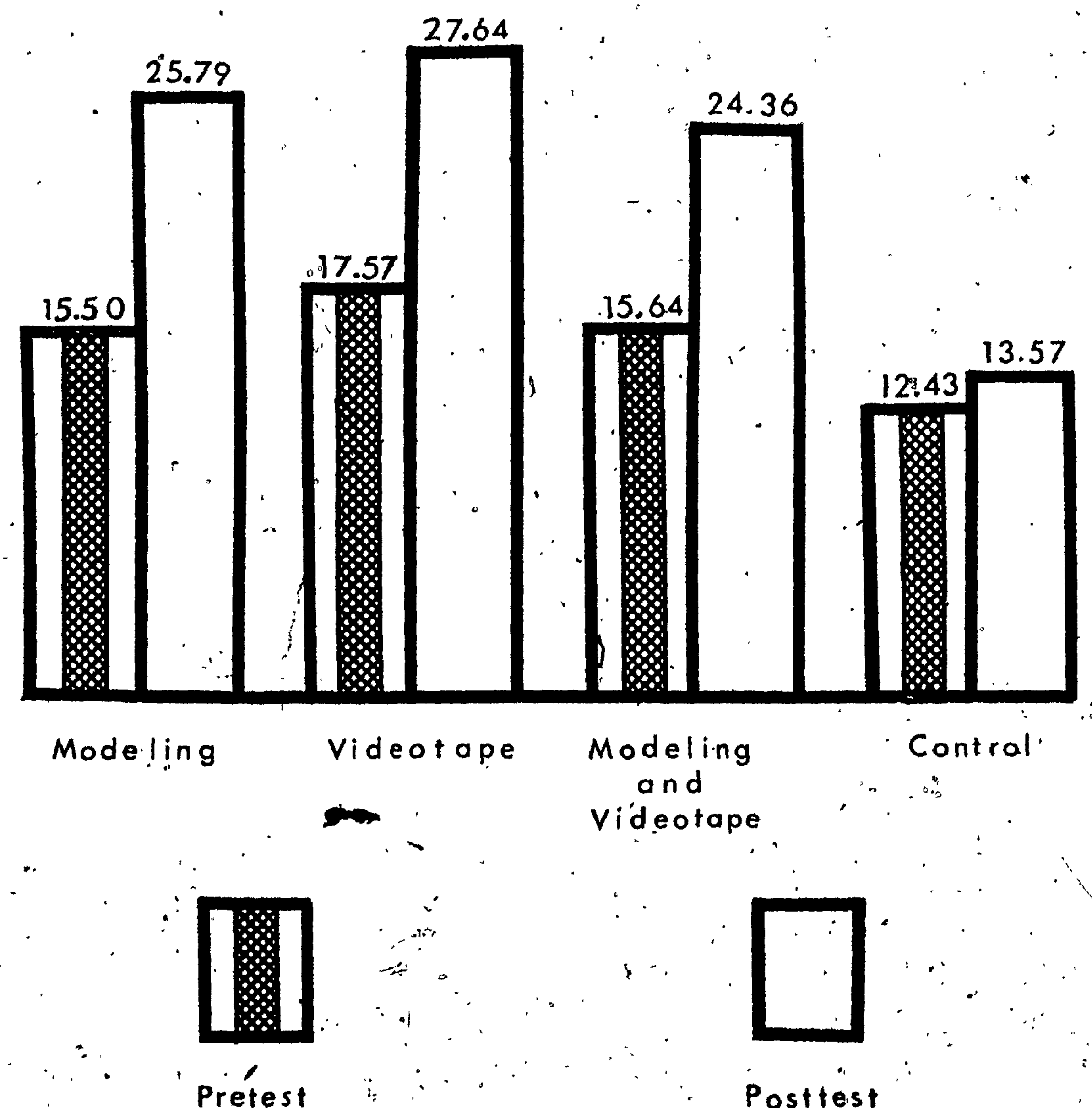

Figure 2. Percentage of essential questions asked

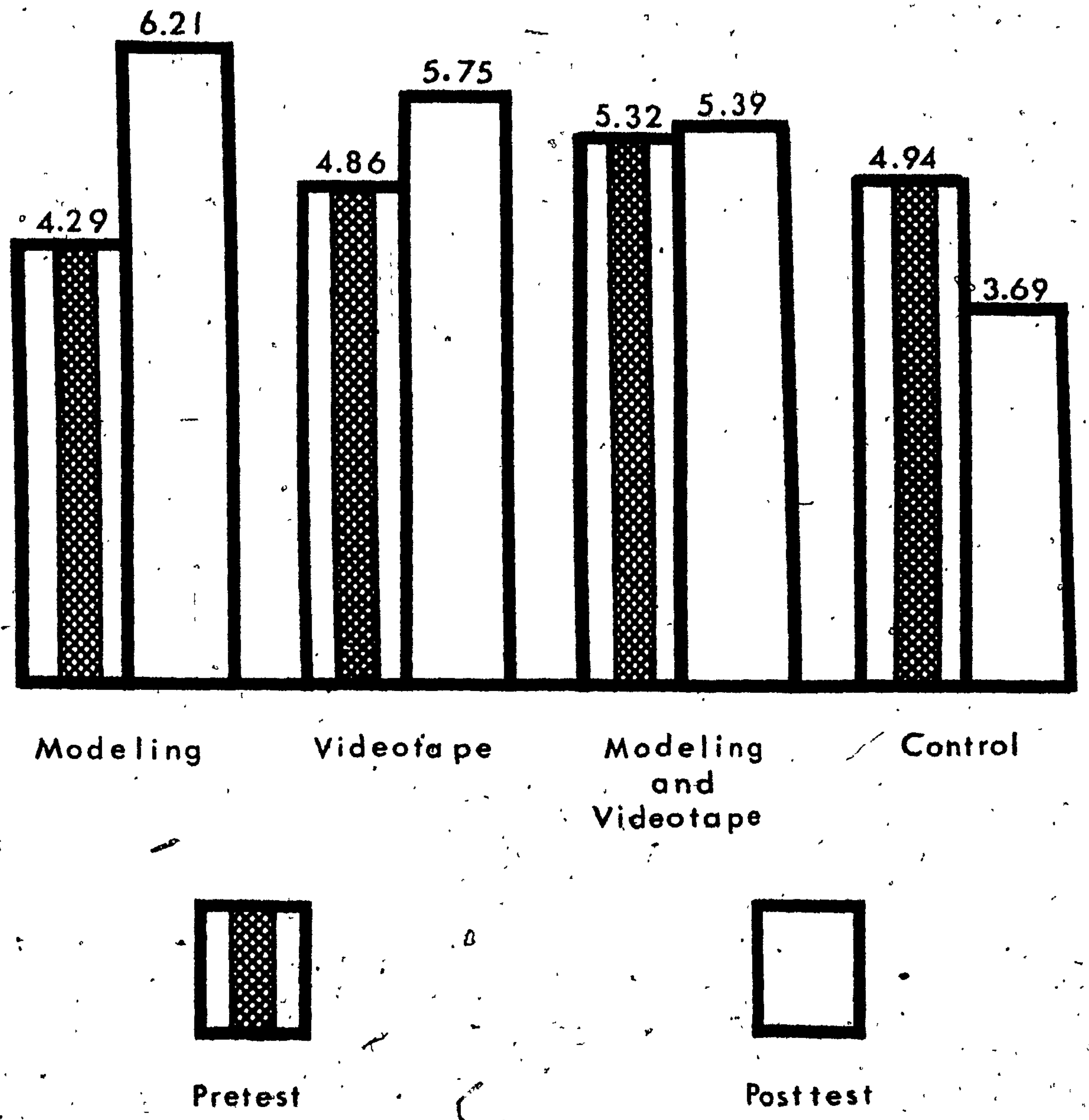

Figure 3. Rating (on a scale from 0.0 to 15.0) of advised solution

On a number of these measures, significant positive correlations were obtained for the control group, whereas no such relationship between pre- and posttest scores was obtained for the experimental group. The measures in which this tendency was observed were the following: the three most important items of information, number of solutions, sum of the ratings of solutions, mean rating of solutions, and the solution with the highest rating (Table 2).

TABLE 2

CORRELATION COEFFICIENTS (PEARSON r) BETWEEN PRETEST AND POSTTEST SCORES

Measure	Correlation			
	Modeling	Videotape	Modeling and Videotape	Control
Three most important items of information	.10	.32	.23	.62*
Number of solutions	.45	.16	.13	.70**
Sum of ratings of solutions	.36	-.09	-.20	.64*
Mean rating of solutions	.04	-.09	-.26	.73**
Highest-rated solution	-.01	.12	.07	.70**

*$p < .05$

**$p < .01$

DISCUSSION

The three aspects of problem solving studied which could have been affected by training were the gaining of information about the problem, the summary and organization of that information, and the generation of solutions.

Analysis of posttest scores for those measures dealing with asking questions showed that training, and modeling in particular, led subjects to seek more information in dealing with the problem. In terms of the quality of information requested, it was the videotape feedback condition that changed the subject's behavior the most, as shown by the results for the percentage of essential questions asked. It would appear that modeling was effective in teaching the subject that he should gather <u>more</u> information, but that videotape feedback was a better method for helping him to discriminate the <u>important</u> information.

The implication of these findings seems to be that, while modeling may be effective in increasing the breadth of an individual's behavioral repertoire, selective reinforcement may be necessary to train him how to use the newly acquired behavior. A model can teach an individual the basic skills involved in a new behavior, but he needs information on his performance in order to refine the behavior. In a therapeutic situation this could be accomplished by videotape feedback, by role playing, or by discussion of situations the individual has encountered outside therapy.

The group which received both modeling and videotape feedback did not perform significantly better than the other groups on the measures involving information gathering, or on any other measures. Although modeling and rehearsal might have been expected to provide the best treatment (Bandura, 1971; Friedman, 1968), watching a model only once and receiving feedback only once may have been insufficient training, and the complicated procedure may have confused some subjects. Further, Sarason and Ganzer (1973) noted that some of their subjects who observed a model, and then viewed their own performance on videotape, expressed frustration at not being able to do as well as the model. If modeling and videotape are used in combination, it may be necessary initially to provide training which would improve the individual's performance enough to overcome any frustration he may feel about the procedure.

The ability of the subjects to summarize the information from the questions they had asked was not significantly affected by the training procedures. Subjects did not benefit by watching a model or by viewing their performance and receiving feedback on it. It may be that the task of summarizing did not, in fact, require new learning. All that was required by the experimenter was that the subject remember as much as possible of the information he had gained from asking questions. In retrospect it seems reasonable that modeling might affect the subject's approach to asking questions, and the scope and detail of questions he asked, but in no way affect his ability to summarize what he had learned.

As was noted in the results, subjects often failed to choose their solution with the highest rating as their advised solution. It would seem, as Johnson et al. (1968) point out, that training a person to generate high-quality solutions to a problem does not guarantee that he will be able to recognize them as "good" solutions. Even though training in the treatment conditions included the technique suggested by Johnson et al. of stating criteria for solutions, this did not change the frequency of choice of the highest-rated solution as the advised solution.

The requirement that subjects choose as their advised solution the one among those mentioned that was rated highest by independent judges may have been too much to expect. Subjects in the experimental groups did tend to choose better, i.e., higher rated, solutions as their advised solution than did subjects in the control group. This, however, was the only direct evidence of an effect of training on the solutions generated.

The limited evidence of improvement in the solutions offered by subjects seems to imply that the training procedures used were inadequate. Two features of the subjects' behavior may give some indication of how the methods might be improved. One feature was that the subjects did not show any increase in the number of solutions they generated following training, and the other was that they often did not recognize their best solution. An increase in the number of solutions would be beneficial since many of the solutions rated highest by the judges were combinations of several solutions, delineating all the actions the individual should take to deal with every facet of the problem. A subject would first have to think of all the component solutions in order to be able to combine them into one high-quality solution. Therefore including in the training certain features of the brainstorming method, those requiring the subject to generate as many solutions as he can, combined with requiring the subject to set out the specific criteria that the ideal solution must meet, may improve the quantity of solutions and their quality. To improve the subject's choice of the solution he considers best, Johnson et al. (1968) have devised judgment training techniques which may be included in the training.

In addition to making the direct comparison between conditions by means of analysis of variance, it is possible to make some statements about the effects of treatments on the ability to predict post-treatment from pre-treatment behavior. The measure dealing with the organization of information--the three most important items measure--and most of the measures dealing with solutions gave evidence of treatment effects when the correlation between pretest and posttest scores was computed. Whereas for the control group there was a significant correlation, meaning that prediction from pre- to posttest behavior was possible, this was not the case for the experimental groups. The absence of a significant correlation indicates that the influence of training was variable. In every experimental group for these measures, the effect on a subject of treatment was not predictable from his pretest behavior.

Organizing information, and generating and judging solutions are behaviors which involve judgment and creativity. Improvement in the performance of these stages in problem solving would require changing subtle aspects of behavior. In contrast, in the first step in solving the problem, when a subject compared the model's asking of questions with his own behavior, the difference would be obvious to him: the model asked more questions, taking an empirical approach to the problem presented to him. (Subjects in the modeling conditions asked an average of 3.57 questions in the pretest; the models asked an average of 20.33 questions.) Differences between the model's behavior and his own in organizing the information and in generating and judging solutions would be much less clear than the simple message that the experimenter expected the subject to request more information. Subjects in the modeling conditions did increase the number of questions they asked.

It appears to follow from the above that when the desired change is simply to increase in frequency a particular kind of behavior, the training procedure which is most effective in doing that will be effective with all individuals. Training an individual to take an empirical approach may be the necessary first step in problem solving, and the appropriate training procedure for all individuals would seem from this study to be the modeling of the new skill, followed by feedback to train its best use. When, however, the behavior to be altered is more subtle, involving judgment, the effect of treatment appears not to be predictable. These conclusions have interesting implications for the often-heard assertion that any therapeutic intervention will have some positive effect. While this statement may be true for some aspects of behavior change, unfortunately when the behavior change desired is subtle and complex, it seems that the treatment must be matched to the client.

Evidence for individual differences in the effectiveness of modeling has been found by Sarason and Ganzer (1973). In their work with delinquents, they have studied the effectiveness of modeling on individuals who are highly anxious, as measured by the Test Anxiety Scale (TAS). In their study they found that for high TAS subjects, modeling was a more effective treatment in inducing behavior change than was a discussion group. They also found that the effectiveness of particular treatments differed in subjects having different diagnoses. Other researchers have found personality characteristics which predispose subjects to be sensitive to modeling cues. Some of these tendencies, as summarized by Stewart (1971), are dependency, lack of self-esteem, and having been frequently rewarded in the past for displaying matching responses.

Individual differences in reactions to videotape feedback may influence its effectiveness as a training tool. Seeing oneself on videotape can induce favorable behavior change in some but can have a disorganizing effect on other individuals

(Bailey & Sowder, 1970; Berman, 1972). Sarason and Ganzer (1973) found that, while modeling was a beneficial treatment for high TAS subjects, videotape playback produced deleterious effects with other high TAS subjects, probably because it was seen as a stressful experience. Both modeling and videotape feedback are potentially powerful tools in therapy. But, like other forms of therapy, they will not benefit all individuals when the behavior change required is not specific and immediately clear.

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APPENDIX A

PROBLEM OUTLINES, SAMPLE QUESTIONS, AND SAMPLE SOLUTIONS

PROBLEM 1

Outline

This person finds he has trouble settling down to study. He finds other things to do, and his mind wanders.

Questions	Judges' Rating[a]
Q: Where does he study? A: Some at the library during the day; mostly at home at night.	14.8
Q: Is there any particular subject he has difficulty concentrating on? A: Yes, physics and English.	12.3
Q: Do his friends stay at school at night? A: Not usually.	7.1
Q: What does his father do for a living? A: Office manager.	1.7

Solutions	Judges' Rating[b]
Stay at school at night, bringing dinner from home; study something else when he gets bored, then go back to it; to keep his mind from wandering, make notes, do problems, underline, etc.	13.6
Tell himself he can talk to friends or listen to the stereo after accomplishing X amount of work, making sure to make X a reasonable amount.	11.9
Say no to friends who sidetrack.	7.6
Get a girlfriend and study with her.	0.6

[a]Rating scores could vary from 0.0, which indicated that the question was judged to be "very irrelevant," to 15.0, which indicated that the question was judged to be "very relevant."

[b]Rating scores could vary from 0.0, which indicated that the solution was judged to be "poor," to 15.0, which indicated that the solution was judged to be "excellent."

PROBLEM 2

Outline

This person has been having problems with his girlfriend lately because she has been very difficult to get along with.

Questions	Judges' Rating
Q: How is she difficult? A: Lately she easily gets angry and upset over nothing.	13.7
Q: Has anything happened to make her difficult? A: She has family problems and school pressures.	13.3
Q: Does he consider it worth saving? A: Yes, if possible.	13.2
Q: What is her school problem? A: She has matrics coming up and is particularly worried about math.	10.5
Q: Are they welcome at each other's houses? A: Yes.	4.9
Q: How did he meet her? A: In high school.	0.6

Solutions	Judges' Rating
Tell her to go to guidance at her high school, help her in math, and stick with her.	14.0
Tutor her in math.	9.1
See her less often.	6.9
Continue this way.	0.8

PROBLEM 3

Outline

This person shares a bedroom at home with his brother but is finding it difficult to study and to sleep because they keep different hours.

Questions	Judges' Rating
Q: Is there somewhere else at home he can study? A: He could study in his sister's room, but she doesn't like it; he could study in the kitchen, but it's noisy.	12.6
Q: Can he study at school? A: Yes, although the library closes at 11 p.m. and he studies later than that; and he lives far from school.	12.3
Q: Why are their hours incompatible? A: His brother has a paper route, and he goes to bed at 9 p.m., and gets up at 6 a.m.; he likes to study from 7 p.m. to 1 a.m. and sleep from 1 a.m. to 8 or 9 a.m.	11.7
Q: Can he leave home and get his own apartment? A: He can't afford it.	7.9
Q: Why doesn't his sister like him? A: He bugs her.	2.1

Solutions	Judges' Rating
Arrange a car pool so he can stay at school at night, then study in the kitchen and sleep on the couch.	12.9
Make a deal with his sister and study in her room.	9.6
Study at a friend's house.	7.9
Rearrange his hours to conform with his brother's.	1.3

PROBLEM 4

Outline

This person has a paper, which he hasn't finished, due the next day; he still has some writing to do and then typing. A friend calls to say he has two tickets to the Montreal-Boston hockey game that night.

Questions	Judges' Rating
Q: How much writing does he have left? A: One-and-a-half hours.	12.3
Q: How important is the paper? A: Ten percent of the mark in the course.	12.2
Q: Is there anyone who could type the paper for him? A: His sister could, but she's a slow typist and may not finish it that evening; his mother could, but she'd disapprove of his going to the game.	12.2
Q: How would his parents feel if he typed during the night? A: Very angry--they don't like being disturbed, and typing disturbs them.	10.9
Q: Does he like the course? A: He's bored with the way it's taught, but it's all right.	4.7
Q: What faculty is he in? A: Arts.	0.7

Solutions	Judges' Rating
Give the first part to his sister to type now, write the second part, give it to his sister to type, and go to the game.	13.2
Explain the situation to his parents, go to the game, and work during the night.	8.1
Stay home and do the paper.	5.1
Go to the game and don't do the paper.	2.1

PROBLEM 5

Outline

This person has an 8:45 class which he has skipped for about a month, mainly because it's so early. He's beginning to worry about the work he's missed.

Questions	Judges' Rating
Q: Can he approach someone in the class for tutoring? A: He could if the person didn't want much money for tutoring.	12.6
Q: Does he need the course? A: It's a prerequisite for others.	11.9
Q: Can he go to the professor for help? A: He doesn't like the professor.	11.1
Q: What subject is it? A: Math.	9.6
Q: Is he interested in the course? A: Not really; he's taking it because it's a prerequisite.	5.7

Solutions	Judges' Rating
Get notes and assignments from someone in the class; get an old exam; get his friend or someone in the class to tutor him where necessary.	14.0
Get the class notes, speak to the professor, start attending class.	11.9
Get someone's notes from class.	8.1
Take the exam with what he knows now and try to learn it for the final.	3.5
Drop the course.	0.8

PROBLEM 6

Outline

This person's aunt and uncle have just arrived in town. There is to be a big family get-together at his house and his parents expect him to attend. But he wants to do something else that night.

Questions	Judges' Rating
Q: What other thing does he want to do? A: He has a date with a girl he's been interested in for a long time, but he's never actually gone out with her.	11.6
Q: Could he go out with her later in the evening? A: They could go to the 9:30 movie rather than the 7:30, but then they'd have no time to spend after the movie because she has a curfew.	11.6
Q: Could he see his aunt and uncle another day while they're in town? A: No--they're leaving the next day.	10.2
Q: What would the girl think if he cancelled? A: He isn't sure.	10.1
Q: How long has it been since he's seen his aunt and uncle? A: Five years.	8.4
Q: Where do his aunt and uncle live? A: California.	2.0

Solutions	Judges' Rating
Go to the family dinner and then do something else with the girl besides the movie.	12.2
Explain the situation to the girl, go to the later movie, and make another date with her.	8.3
Explain the situation to the girl and go to the family thing.	4.6
Break her curfew.	0.2

APPENDIX B

MEAN AND RANGE OF SCORES FOR PRETEST AND POSTTEST, GROUPS AND MODELS

TABLE 1

QUANTITATIVE MEASURES FOR QUESTIONS

Statistic	Group								
	Modeling		Videotape		Modeling and videotape		Control		Models
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
	Number of Questions Asked								
Mean	3.21	10.21	4.71	9.00	3.93	10.00	3.64	5.43	20.33
Range	0-8	4-24	1-12	2-19	1-9	2-21	1-7	2-13	18-24
	Sum of Ratings of Questions								
Mean	30.34	87.51	43.21	83.29	37.67	84.12	33.11	44.76	213.18
Range	0.0-67.0	32.0-163.3	3.3-111.7	19.7-151.1	6.2-88.6	23.0-156.6	11.4-64.1	13.6-121.8	183.1-255.3
	Mean of Ratings of Questions								
Mean	9.23	8.79	8.96	9.68	9.74	8.78	9.22	8.45	10.47
Range	0.0-12.2	6.4-11.8	3.3-13.2	8.0-13.2	6.2-13.2	6.9-11.5	5.7-11.8	5.7-11.9	10.17-10.76

TABLE 2

MEASURES FOR SUMMARY

Statistic	Group								
	Modeling		Videotape		Modeling and videotape		Control		Models
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
	Percentage of Information in Summary								
Mean	52.79	41.64	65.64	44.79	54.86	48.71	68.57	50.50	69.50
Range	0-100	25-75	0-100	0-100	0-100	15-100	0-100	0-100	56-95
	Sum of Ratings of Information in Summary								
Mean	11.07	35.86	18.31	29.99	20.11	36.47	19.84	22.21	154.80
Range	0.0-27.0	4.1-67.7	0.0-53.8	0.0-74.4	0.0-37.9	11.2-64.8	0.0-52.3	0.0-47.7	106.2-191.2
	Mean of Ratings of Information in Summary								
Mean	7.70	9.47	9.17	9.66	8.81	9.06	8.76	9.29	11.06
Range	0.0-13.5	4.1-12.2	0.0-13.3	0.0-13.2	0.0-13.5	5.6-11.7	0.0-11.7	0.0-12.2	10.62-11.41

TABLE 3

MEAN OF THREE MOST IMPORTANT ITEMS MEASURE

Statistic	Group								
	Modeling		Videotape		Modeling and videotape		Control		Models
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
Mean	6.69	9.94	8.15	9.83	9.29	9.33	7.03	8.26	11.81
Range	0.0-13.3	3.8-12.2	0.0-13.7	7.3-13.2	0.0-13.2	6.1-14.8	0.0-12.6	0.0-12.1	11.00-12.82

TABLE 4

QUANTITATIVE MEASURES FOR SOLUTIONS

Statistic	Group								
	Modeling		Videotape		Modeling and videotape		Control		Models
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
	Number of Solutions								
Mean	3.36	4.00	3.29	3.86	3.79	4.07	2.79	3.43	8.83
Range	1-5	2-6	1-5	1-7	1-6	1-7	1-6	1-6	8-10
	Sum of Ratings of Solutions								
Mean	12.54	18.76	14.78	18.71	18.12	16.41	11.54	14.16	65.62
Range	4.2-29.9	4.2-36.0	2.2-31.9	1.9-54.4	5.8-35.0	3.5-36.0	0.2-35.1	1.8-27.7	54.8-70.7
	Mean of Ratings of Solutions								
Mean	3.90	4.41	4.39	4.74	4.82	4.33	3.90	3.94	7.49
Range	1.4-8.4	2.0-7.2	2.2-8.8	1.0-9.1	2.8-8.4	1.8-7.2	0.2-7.7	2.1-9.0	6.1-8.8

TABLE 5

QUALITATIVE MEASURES

Statistic	Group								
	Modeling		Videotape		Modeling and videotape		Control		Models
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
	Percentage of Essential Questions								
Mean	15.50	25.79	17.57	27.64	15.64	24.36	12.43	13.57	88.00
Range	0-42	8-56	0-54	7-67	0-36	7-42	0-33	0-42	77-100
	Rating of Advised Solution								
Mean	4.29	6.21	4.86	5.75	5.32	5.39	4.94	3.69	13.32
Range	0.8-9.0	1.3-10.6	2.2-8.4	1.3-10.2	1.6-10.8	0.8-10.4	0.2-8.4	0.3-8.1	12.2-14.0
	Rating of Highest-Rated Solution								
Mean	5.87	7.31	6.84	7.19	7.36	6.79	6.04	6.17	13.32
Range	3.8-9.5	2.6-10.6	2.2-9.6	1.8-10.2	3.9-10.8	3.1-10.4	0.2-10.8	1.8-12.3	12.2-14.0

APPENDIX C

PRETEST ANALYSIS OF VARIANCE SOURCE TABLES

TABLE 1

ANALYSIS OF VARIANCE
NUMBER OF QUESTIONS ASKED

Source	SS	df	MS	F
Between groups	16.76	3	5.59	0.70
Within groups	417.36	52	8.03	
Total	434.12	55		

TABLE 2

ANALYSIS OF VARIANCE
SUM OF RATINGS OF QUESTIONS ASKED

Source	SS	df	MS	F
Between groups	1331.69	3	443.90	0.64
Within groups	35987.73	52	692.07	
Total	37319.42	55		

TABLE 3

ANALYSIS OF VARIANCE
MEAN RATING OF QUESTIONS ASKED

Source	SS	df	MS	F
Between groups	4.45	3	1.45	0.24
Within groups	316.84	52	6.09	
Total	321.29	55		

TABLE 4

ANALYSIS OF VARIANCE
PERCENTAGE OF INFORMATION IN SUMMARY

Source	SS	df	MS	F
Between groups	2561.22	3	853.74	0.70
Within groups	63154.71	52	1214.51	
Total	65715.93	55		

TABLE 5

ANALYSIS OF VARIANCE
SUM OF RATINGS OF INFORMATION IN SUMMARY

Source	SS	df	MS	F
Between groups	757.81	3	252.60	1.58
Within groups	8293.03	52	159.48	
Total	9050.84	55		

TABLE 6

ANALYSIS OF VARIANCE
MEAN OF RATINGS OF INFORMATION IN SUMMARY

Source	SS	df	MS	F
Between groups	16.92	3	5.64	0.32
Within groups	909.22	52	17.48	
Total	926.14	55		

TABLE 7

ANALYSIS OF VARIANCE
MEAN OF THREE MOST IMPORTANT ITEMS OF INFORMATION

Source	SS	df	MS	F
Between groups	58.62	3	19.54	0.93
Within groups	1097.45	52	21.10	
Total	1156.07	55		

TABLE 8

ANALYSIS OF VARIANCE
NUMBER OF SOLUTIONS

Source	SS	df	MS	F
Between groups	7.05	3	2.35	1.06
Within groups	114.79	52	2.21	
Total	121.84	55		

TABLE 9

ANALYSIS OF VARIANCE
SUM OF RATINGS OF SOLUTIONS

Source	SS	df	MS	F
Between groups	358.03	3	119.34	1.61
Within groups	3859.11	52	74.21	
Total	4217.14	55		

TABLE 10

ANALYSIS OF VARIANCE
MEAN OF RATINGS OF SOLUTIONS

Source	SS	df	MS	F
Between groups	4.53	3	1.51	0.41
Within groups	189.79	52	3.65	
Total	194.32	55		

TABLE 11

ANALYSIS OF VARIANCE
PERCENTAGE OF ESSENTIAL QUESTIONS ASKED

Source	SS	df	MS	F
Between groups	189.86	3	63.29	0.40
Within groups	8187.57	52	157.45	
Total	8377.43	55		

TABLE 12

ANALYSIS OF VARIANCE
RATING OF ADVISED SOLUTION

Source	SS	df	MS	F
Between groups	7.56	3	2.52	0.36
Within groups	362.00	52	6.96	
Total	369.56	55		

TABLE 13

ANALYSIS OF VARIANCE
RATING OF HIGHEST-RATED SOLUTION

Source	SS	df	MS	F
Between groups	20.34	3	6.78	1.08
Within groups	327.47	52	6.30	
Total	347.81	55		

APPENDIX D

NUMBER OF QUESTIONS ASKED ON POSTTEST
ANALYSIS OF COVARIANCE, WITH
NUMBER OF QUESTIONS ASKED
ON PRETEST AS COVARIATE

NUMBER OF QUESTIONS ASKED ON POSTTEST
ANALYSIS OF COVARIANCE

Source	Between	Within	Total
SS Y	206.77	1209.78	1416.55
SS X	16.76	417.36	434.12
Sum of products	1.12	406.50	407.62
df	3	52	55
Adjusted SS: X	219.94	813.87	1033.81
df for adjusted SS	3	51	54
Variance estimates	73.31	15.96	

F = 4.59**

**$p < .01$

APPENDIX E

POSTTEST ANALYSIS OF VARIANCE SOURCE TABLES

TABLE 1

SUM OF RATINGS OF QUESTIONS ASKED ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	17120.40	3	5706.80	3.89*
Within groups	76265.56	52	1466.65	
Total	93385.96	55		

*$p < .05$

TABLE 2

MEAN OF RATINGS OF QUESTIONS ASKED ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	11.68	3	3.89	1.92
Within groups	105.54	52	2.03	
Total	117.22	55		

TABLE 3

PERCENTAGE OF INFORMATION IN SUMMARY ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	663.62	3	221.21	0.37
Within groups	31061.93	52	597.34	
Total	31725.55	55		

TABLE 4

SUM OF RATINGS OF INFORMATION IN SUMMARY ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	1846.19	3	615.40	1.81
Within groups	17645.83	52	339.34	
Total	19492.02	55		

TABLE 5

MEAN RATING OF INFORMATION IN SUMMARY ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	2.75	3	0.92	0.13
Within groups	363.09	52	6.98	
Total	365.84	55		

TABLE 6

MEAN OF THREE MOST IMPORTANT ITEMS OF INFORMATION ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	24.51	3	8.17	1.11
Within groups	381.78	52	7.34	
Total	406.29	55		

TABLE 7

NUMBER OF SOLUTIONS ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	3.48	3	1.16	0.40
Within groups	152.07	52	2.92	
Total	155.55	55		

TABLE 8

SUM OF RATINGS OF SOLUTIONS ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	201.74	3	67.25	0.57
Within groups	6137.94	52	118.04	
Total	6339.68	55		

TABLE 9

MEAN RATING OF SOLUTIONS ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	4.53	3	1.51	0.41
Within groups	189.79	52	3.65	
Total	194.32	55		

TABLE 10

PERCENTAGE OF ESSENTIAL QUESTIONS ASKED ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	1679.34	3	559.78	2.95*
Within groups	9866.21	52	189.73	
Total	11545.55	55		

*$p < .05$

TABLE 11

RATING OF ADVISED SOLUTION ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	50.84	3	16.95	2.24 $p < .10$
Within groups	392.80	52	7.55	
Total	443.64	55		

TABLE 12

RATING OF HIGHEST-RATED SOLUTION ON POSTTEST
ANALYSIS OF VARIANCE

Source	SS	df	MS	F
Between groups	10.99	3	3.66	0.54
Within groups	351.68	52	6.76	
Total	362.67	55		

APPENDIX F

CORRELATION COEFFICIENTS (PEARSON r) BETWEEN PRETEST AND POSTTEST SCORES

CORRELATION COEFFICIENTS BETWEEN PRETEST AND POSTTEST

Measure	Correlation			
	Modeling	Videotape	Modeling and Videotape	Control
Number of questions	.38	.79**	.51	.48
Sum of ratings of questions	.10	.79**	.24	.29
Mean rating of questions	-.46	.28	-.03	-.54*
Percentage of information in summary	.04	-.08	.11	.06
Sum of ratings in summary	-.07	.46	-.29	-.14
Mean rating of summary	.10	.45	.02	.26
Mean of three most important items	.10	.32	.23	.62*
Number of solutions	.45	.16	.13	.70**
Sum of ratings of solutions	.36	-.09	-.20	.64*
Mean rating of solutions	.04	-.09	-.26	.73**
Percentage of essential questions asked	.45	.44	-.61*	-.18
Rating of advised solution	-.16	-.28	-.04	.22
Rating of highest-rated solution	-.01	.12	.07	.70**

$^{*}p < .05$
$^{**}p < .01$