

THE TRAINING OF PROBLEM-SOLVING
AND INQUIRY

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MICHAEL JAMES LOUPE
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THESIS



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THE TRAINING OF PROBLEM-SOLVING AND INQUIRY

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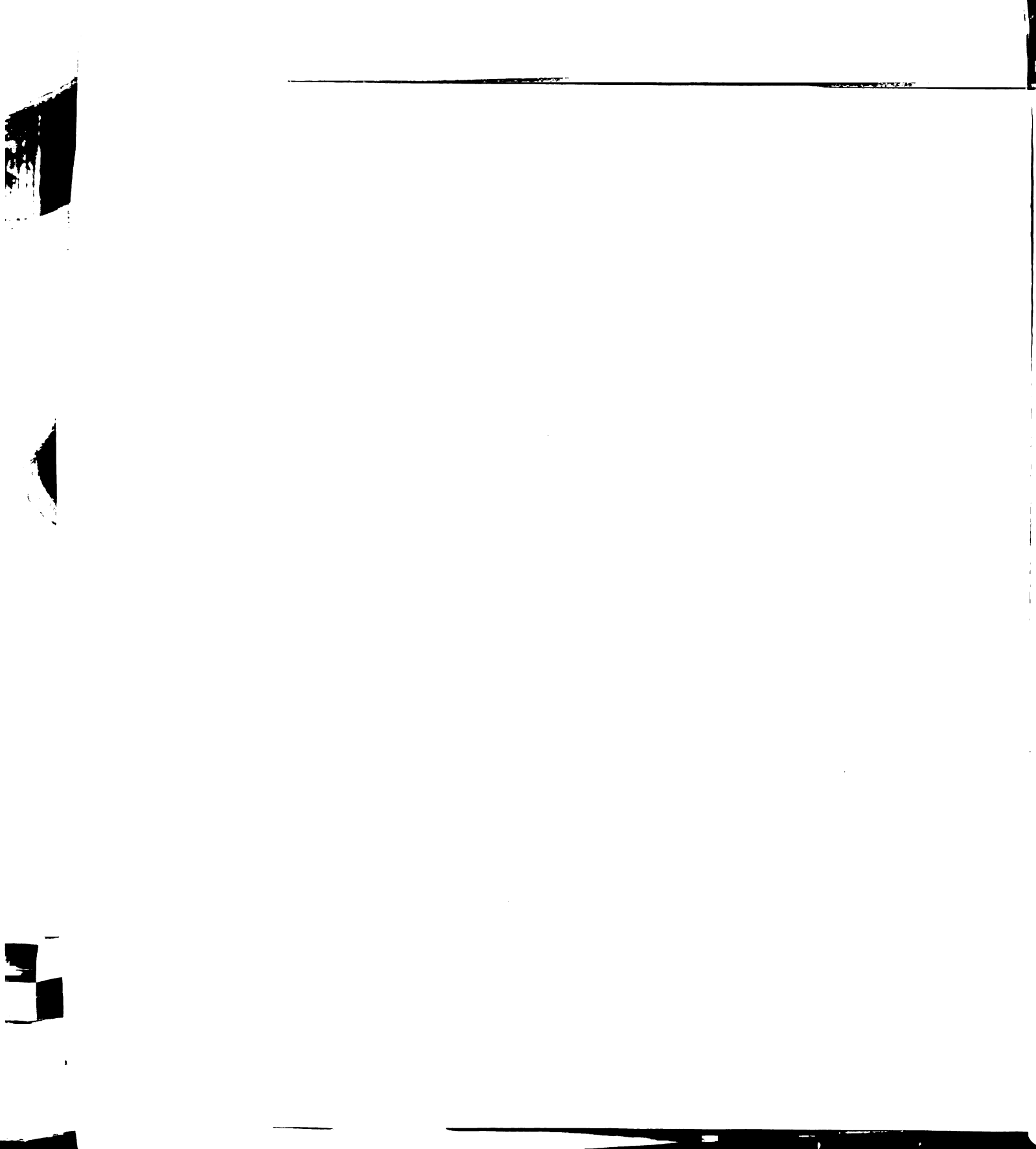
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ABSTRACT

THE TRAINING OF PROBLEM-SOLVING AND INQUIRY

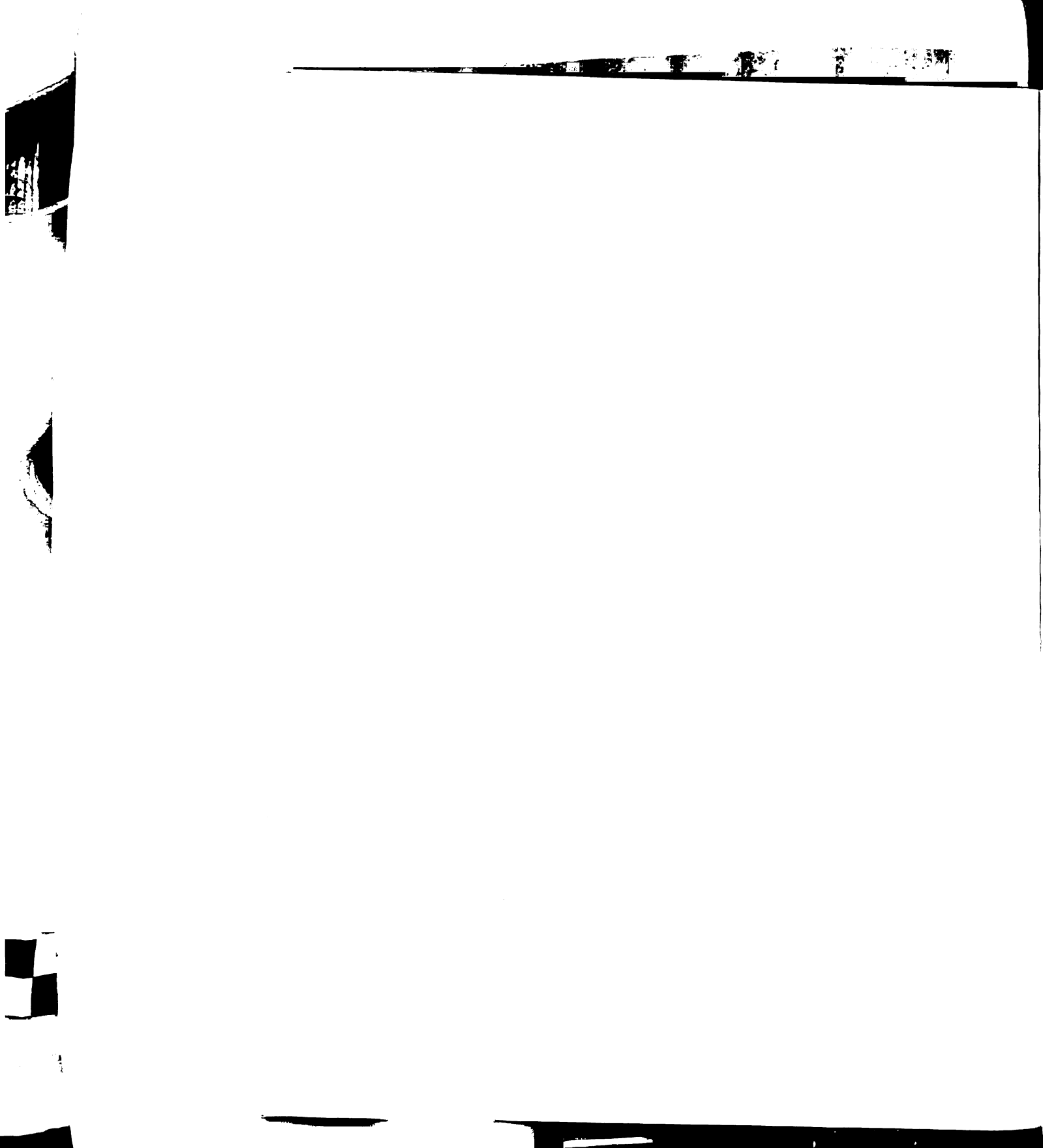
By

Michael James Loupe

The present writer and Richard M. Piper (1969) collaborated in a two-part experiment, the purpose of which was to improve the inquiry performance and effectiveness of a group of female college sophomores. The goal was to train subjects in either problem-solving strategies (present study) or openness (Piper, 1969) and then determine whether the training improved inquiry in an entirely different situation, the Teacher's In-basket, an in-basket type simulation of a teaching situation. The training situation differed enough from the Teacher's In-basket that transfer to the In-basket could be ascribed entirely to learning of the strategy independent of content.

The experiment had two phases: (1) Training and immediate post-testing to determine if the training had any immediate effects, and (2) Administration of the Teacher's In-basket to see if the training had any transfer value.

The characteristics of the problem-solving training were derived from a number of sources including classical experimental problem-solving research, equipment trouble-shooting, and inquiry research employing simulation. The training included training in problem sensing, problem formulation, hypothesis generation, hypothesis selection, search and



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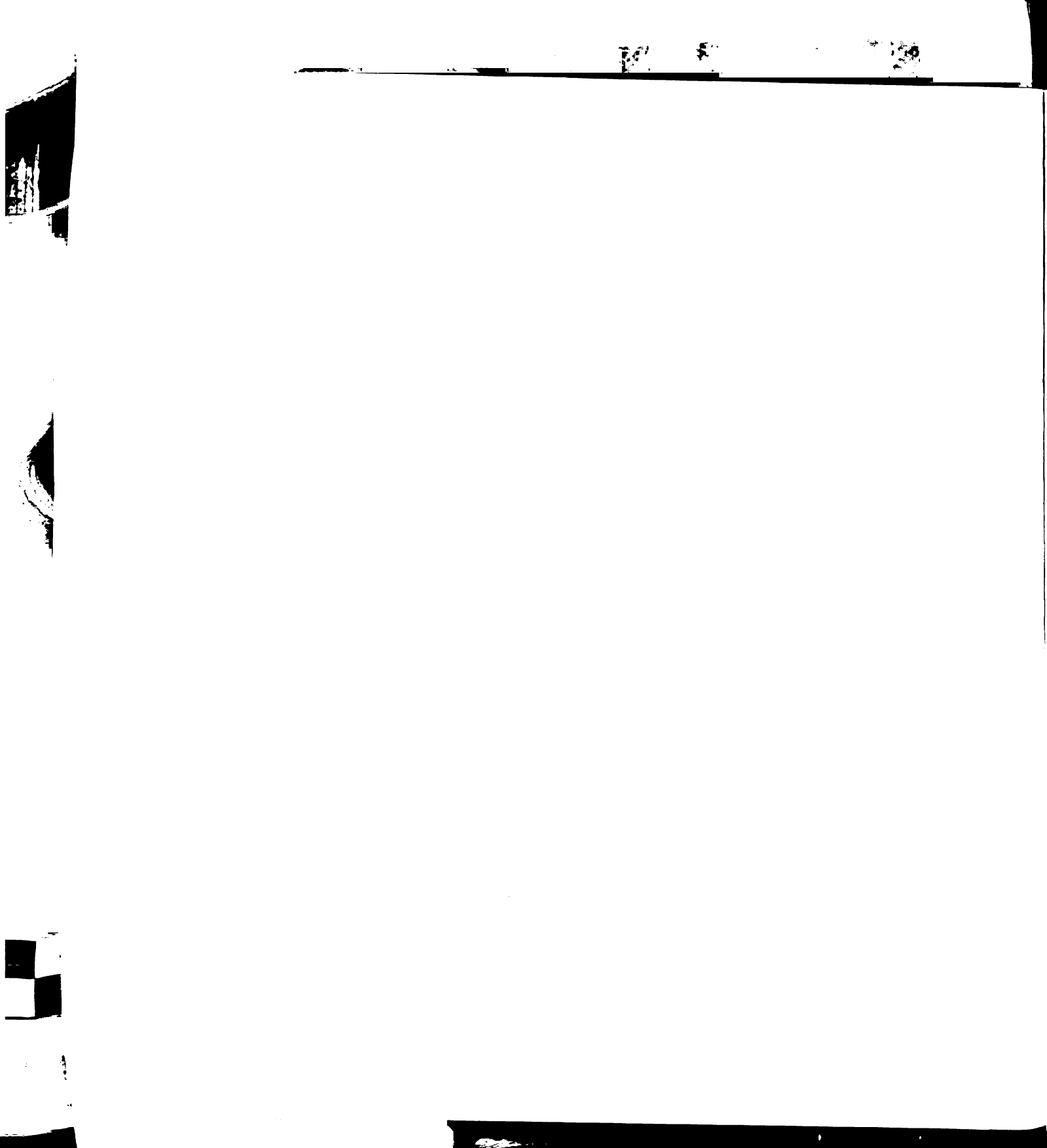
resolution or reformulation. The training took place in small groups of six to eight and was distributed over three, one-hour sessions.

Detective mysteries were used as the basic material in that they could illustrate the process clearly and provide subjects with individual practice, yet maintain independence of content with the Teacher's In-basket. The materials were highly structured but were designed for group use where an instructor elicited contributions from the subjects, compiled the collected contributions of the group and provided verbal guidance and reinforcement.

Seeking-style was another major factor in the experiment. Seeking-style, a composite of personality measures (Inventory of Beliefs, Barron's Complexity Scale, Word Associations, Political Position) was expected to predict one's commitment to involve himself in inquiry. Seeking-style was used as a selection variable and thus was considered an entering characteristic. Seeking-style was used in this study to provide replication of former research (Shulman, Loupe and Piper, 1968) and to look for interactions between training and seeking-style.

Results indicated that it was possible to train problem-solving skills and that these skills had transfer value into the inquiry situation. Problem-solving training increased the diversity of information consulted in inquiring into a problem. It also appeared to increase the competence with which problems were resolved. It did not result in significant changes in other process measures.

Seeking-style did not account for significant differences in inquiry within the Teacher's In-basket. This result was explained by considering the nature of the In-basket task and the entering characteristics of the group.



Michael James Loupe

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CHAPTER 1

INTRODUCTION

Men have asked questions of themselves and of the world around them during all of recorded history. Techniques of systematically posing questions and organizing the information gathered have been codified many times as systems of logic or scientific method. This questioning, gathering and organizing information is part of the process known to Dewey (1938) as inquiry. It was the purpose of this study to train people to be effective inquirers; to be more effective in gathering and organizing information about problems, and to be more effective in sensing them. Two approaches to the training were taken. The first was an attempt to improve inquiry performance by training in problem-solving techniques which are relevant to a wide range of topics, such as problem formulation and hypothesis formation. That attempt is the focus of this document. The second approach, training in openness, proposed to improve inquiry performance by effecting changes in personality characteristics thought to be determinants of inquiry. The investigation of openness training is treated in detail by Richard M. Piper (1969).

Dewey (1938) defined inquiry as the:

controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole . . . inquiry is competent in any given case in the degree in which the operations involved in it actually do terminate in the establishment of an objectively unified existential situation. (pp. 104-105)

He elaborates further by saying that inquiry begins when a situation is judged to be problematic and has progressed well when one can identify the problem or problems presented by the situation. Inquiry reaches its most competent, complete level when the ideas generated during the inquiry are put into actual practice and data gathered from observation of the working system are organized into a coherent whole with the other facts. To Dewey, then, inquiry begins when one realizes that a problem exists but does not yet understand its nature. It continues with correct identification of the problem, recognition of the facts relevant to it, and finally with implementation of a trial solution. Inquiry is competent to the degree that the actual problem is solved and the nature of the problem is understood.

Two characteristics of this definition are particularly important. First, Dewey notes that although the problem is usually an objective reality, inquiry does not begin until someone senses it. Inquiry begins with the act of problem sensing. If the problem is directly given to the subject and the solution is then sought, this is not by Dewey's definition a total inquiry. Second, an objective solution to the problem is desirable and indicates competence in inquiry; likewise do understanding and integrating of the facts. Solution itself is not the sole criterion of effective inquiry. What is described here as inquiry differs in two ways from what is normally considered problem-solving. First, inquiry includes the step of sensing the problem, while in problem-solving research, the subject is usually given a problem. Inquiry is well underway before one actually knows what the problem is (Dewey, 1938). Secondly, problem-solving, as is implied by the name, is often evaluated wholly on the basis of the solution which, to be sure, is a criterion of inquiry effectiveness; but it certainly is not the complete criterion.

What are the characteristics which affect one's competence as an inquirer? Shulman (1965) reasoned that there were a number of personality characteristics which would, in part, determine one's effectiveness as an inquirer. Openness or nonstereopathy should aid in sensing problems and formulating them realistically in terms of situational constraints, rather than personal biases and sets. Because of the complexity of the inquiry process, individuals who preferred complexity would probably be more willing to engage in inquiry than those who did not. Those people having these characteristics (plus others such as word-association fluency, liberal politics, high willingness to risk, and preference for discussion rather than lectures) were called Dialectical seekers after the dialectical mode of teaching which Shulman felt they would be predisposed to use. Those having the opposite set of characteristics were called Didactics. Dialectical seekers were predicted to surpass Didactic seekers in inquiry competence.

In order to study inquiry in an experimentally controlled situation which simulated realism and allowed for individual sensing of problems, Shulman (1963) developed the Teacher's In-basket. This is a simulated situation using the in-basket technique (Frederiksen, et. al., 1957) in which the subject role-plays a beginning teacher (see Chapter 3 for a detailed description of the technique). The Teacher's In-basket was used by Shulman, Loupe and Piper (1968) to check the above predictions regarding the determinants of inquiry, and to describe the behavioral processes of the inquiring individual. Within a sample of teachers-in-training, personality type or seeking-style as it was called, was a significant determinant of inquiry performance. Seeking-style predicted quantitative measures of the inquiry process such as amount of information used, problems sensed, and time spent, as well as the qualitative outcome measure of inquiry competence.

The second phase of the research by Shulman, Loupe and Piper (1968) involved analyzing the characteristics of the inquiry behavior itself to see if these characteristics reflected differences in the outcomes of inquiry. One such analysis involved looking at the sequence in which subjects consulted different types of information. The more subjects shifted between types of information, the more effective was their resulting inquiry. A possible explanation was that this shifting was a result of comparisons being made between different pieces of information.

Both the Dialectical-Didactic personality types and the behavioral measures such as shifting were significantly correlated to the dependent measures of inquiry and yet were correlated among themselves at a relatively low level. This indicated that the behavioral process measures such as shifting were not as highly related to the personality determinants of inquiry as had been hypothesized. These two categories of variables could be considered as relatively independent, both having an influence on inquiry performance and outcomes. Thus, there seem to be two relatively separate components which influence the inquiry behavior of the individual: A personality component which tends to influence the amount of inquiry in which one engages, and an intellectual component which tends to influence the way one uses information and inquires while in the situation.

These results provided the basic rationale for the present overall experiment. If seeking-style and behavioral strategy are two relatively independent components which affect inquiry and its outcomes, then inquiry performance should be predictably changed by a change in either component.

As was mentioned earlier, this study was primarily concerned with changing inquiry via training in general problem-solving strategies.

The basic hypothesis was that subjects so trained would surpass those given a control training, both in inquiry competence and in certain measures of the inquiry process such as shifting and information sources used.

In order to test the hypothesis, a procedure was developed to give short-term training to subjects in techniques of problem-solving and inquiry. Following training, subjects were observed in inquiry as they role-played a teacher in the Teacher's In-basket. The basic features of the training procedure were derived from a wide range of sources (including Dewey, classical problem-solving literature and applied trouble-shooting) to assure generality of the process. Subjects were taught to: (a) look for problems, (b) relate all available information to the problem, (c) develop as many explanatory hypotheses as possible, (d) select a likely hypothesis and determine how to test it, (e) search for pertinent information in accord with the testing plan and reformulate the problem in terms of the new information. These skills were taught in the context of solving detective mysteries, to avoid overlapping in content with the Teacher's In-basket. Thus, if inquiry performance did improve, it could be attributed to learning of the strategy alone and not to familiarity with the content.

This particular research project has both theoretical and applied relevance. Theoretically, it is concerned with questions about the effects of relatively short-term training in openness or problem-solving on inquiry performance. Will problem-solving skills learned in one content domain facilitate inquiry performance in a different content domain? Likewise, will teaching a person about openness and how to behave as if he were open, influence his predisposition to inquire?

The applied relevance of this research derives from the importance of the inquiry process. If inquiry skills are general enough that training in a set of general problem-solving strategies in one content domain transfers to another, it may be well to consider instruction in these skills per se. For example, Shulman, Loupe and Piper (1968) speculate that inquiry ability and teacher effectiveness are related. If so, and if inquiry is in fact "teachable," then this would imply incorporating instruction in these skills into teacher preparation programs.

Overview

In Chapter 2 the research relevant to inquiry and training in problem-solving is reviewed, followed by a description of Methodology in Chapter 3. Chapter 4 contains a summary of the experimental results which are discussed in Chapter 5. Chapter 6 contains a final summary, the conclusions, and a discussion of implications.

CHAPTER 2

REVIEW OF LITERATURE

As was mentioned in Chapter 1, the research by Shulman (1963) and Shulman, Loupe and Piper (1968) was based on the theoretical typology of the Dialectical and Didactic seeking styles. The basic hypothesis in both of the former studies was that this typology, representing the two extreme poles of a continuum of seeking style, would predict inquiry performance. In particular, the basic prediction was that subjects identified as Dialectical would surpass those identified as Didactic in their ability to inquire effectively in complex situations. The Dialectical profile included characteristics such as preference for complexity, willingness to take risks, field-independence, fluency of word-association and preference for lecture over discussion. Didactics tended toward the opposite pole on each of these six measures (e.g., field-dependent rather than independent).

The theoretical position was that these tests measured personality characteristics which would predispose the Dialectical seeker to be a more effective inquirer than his Didactic counterpart. He preferred the complex, was open to his environment, was willing to risk, and thus should have been more willing to commit himself to inquiry than the Didactic who had none of these characteristics. The investigators viewed these typologies as anchor points on a continuum of seeking style predispositions along which people were distributed. In order to check the viability of the theory, subjects were chosen to represent the extremes

as closely as possible. They were then placed individually in a situation which would encourage inquiry and allow reliable observation of inquiry behavior, the Teacher's In-basket.

The Teacher's In-basket was designed by Shulman (1963) to provide the opportunity for inquiry within a setting in which the structural cues were minimal (e.g., make out a list of referrals to the school psychologist), and yet the potential situational stimuli were essentially the same from one person to the next. The emphasis was on maintaining realism of situation as well as experimental control in order to answer the research questions in a way that would overcome some of the problems of abstraction found in much experimental research (Rundquist, et. al., 1965).

The Teacher's In-basket was a situational simulation in which the subject was asked to role-play an inexperienced teacher beginning her first teaching job, mid-year. The permanent teacher vacated the classroom two months before and the class had been run by substitutes since. The children were not at the school at the simulated time because it was Record Day, a day to let the teachers catch up on paper work. It was a perfect opportunity for her to deal with administrative tasks and become acquainted with her students' records before meeting them the following day. Potential problems were imbedded in the material which included memoranda and records on each child, among other things. Chapter III will provide a more complete description of the Teacher's In-basket.

In the in-basket situation, the subject may or may not sense a problem and, once he senses it, he may or may not choose to inquire further into it. The information employed in inquiry may vary as may the time spent; and of course, the quality of the inquiry itself may

vary considerably. These facets of inquiry as well as the subject's sequence of search through the information are quantified. Dialecticals and Didactics were predicted to differ on the resulting measures because of differences in their willingness to inquire and their characteristic styles of attack once committed to the process (Shulman, Loupe and Piper, 1968).

The findings of earlier research (Shulman, Loupe and Piper, 1968) by and large supported the theoretical position: Dialecticals were more effective inquirers than were Didactics. In addition, post-hoc analysis uncovered systematic differences in the behavioral patterns of these two groups, differences which were reflected in the increased effectiveness of the Dialectical over the Didactic inquirers.

There was one additional facet to the experiment. Each subject participated in the Teacher's In-basket twice; once each with alternate, but quite equivalent, forms during fall and spring quarters. During the intervening winter quarter, the sixty subjects left campus to student-teach.

Inquiry performance was quantified in a number of ways, each designed to tap a somewhat different facet of the process:

- (a) Problem sensitivity was the number of potentially problematic elements reacted to as problems by the subject.
- (b) Bits was the number of pieces of information to which the subject attended.
- (c) Sources was the number of different kinds of information used in inquiring into a specific problem.
- (d) Competence was a measure of quality of problem resolution reflecting the subject's understanding of the problem.
- (e) Time was the total time spent in the situation.

- (f) Shifting was the total number of times the subject moved from one kind of information (source) to another.

The results indicated that Dialectical inquirers exceeded Didactic inquirers in all of the above measures of inquiry during the second administration and, in most cases, during the first administration. They also indicated that as the influence of seeking style increased from the first to second administration, the influence of G.P.A. on inquiry decreased. Specifically, the Dialectical-High G.P.A. group tended to remain constant in inquiry performance from the first to the second administration, the Dialectical-Low G.P.A. group tended to increase their score markedly, and the two Didactic groups decreased consistently on every measure.

These results indicate that inquiry performance is, in part, a function of personality style. The fact that shifting was highly correlated with the inquiry variables and relatively uncorrelated with seeking style indicates that inquiry may also be a function of a learned strategy, a strategy which encourages shifting. If so, then inquiry performance should be changeable by changing either the seeking style predispositional component or the learned strategy component. As was stated in Chapter I, the focus of this study is on changing the learned strategy component of inquiry performance. Piper (1969) has studied the effect of changes in the affective component.

Since the stated goal of this research is effecting change in inquiry behavior, it is important to specify precisely what is to be considered inquiry. Is it a basic set of behaviors which must be considered as a unit as Suchman (1961) has stated, or can it legitimately be analyzed into its components? Let us begin with the model of inquiry offered by Shulman (1965) which views inquiry in terms of four basic

processes: problem sensing, problem formulation, search, and resolution. This model is based on Dewey's position (1938) that inquiry is the process of transformation of an indeterminate situation into one of determinancy. Other models of inquiry will be compared and contrasted to this one so we may derive the model which formed the basis for the present study's program of training in inquiry.

R. L. Thorndike (1950) reiterated and elaborated upon the basic analysis of inquiry defined by Dewey. Although Thorndike structured his discussion around problem-solving, his definition of the process was broad enough to go beyond the traditional limitations of laboratory studies and was applicable to inquiry as defined in Chapter I. He began by defining a problem in terms of motive: A problem is an unsatisfied motive or need for which the person does not have an immediately available response and which is recognized by the person. Aside from the emphasis on motive, this is not unlike the position of Dewey (1933).

1. Becoming aware of the problem,
 2. Clarifying the problem,
 3. Proposing hypotheses for solution of the problem,
 4. Reasoning out the implications of the hypotheses,
 5. Testing the hypotheses against experience
- (Thorndike, 1950, p. 196).

Thorndike acknowledges the abstract quality of his analysis. He also recognizes that these phases or steps rarely occur in such systematic fashion. Presumably, as research and theorizing in the area of inquiry continue, the conditions under which these various steps occur should be clarified.

It is interesting to note the ties between this analysis and other research in problem-solving -- for instance, the research of Maier (1936) dealing with set. The second phase of inquiry is clarifying the problem (problem formulation), analyzing the problematic situation to determine

the specific conditions placed on the solution by the situation itself. This, of course, has the function of breaking sets which so often interfere with solution (Thorndike, 1950). Phases dealing with hypothesis generation and testing allow one to use all relevant data and logically test out the implications of each, systematically suspending judgment.

Another source for analysis of problem-solving is the literature on equipment trouble-shooting. Due to the complexity of electronic equipment it became apparent that if men were to go from observable symptoms to diagnosis and repair malfunctions economically, systematic strategies were necessary. Bryan (1962) derived a nine-stage analysis of trouble-shooting that was essentially an elaboration of the above, stated in terminology pertinent to trouble-shooting:

- (a) Symptom recognition: Initial awareness of a problem,
- (b) Symptom elaboration: Exploration of stimulus situation to define the problem,
- (c) Formulation of hypotheses,
- (d) Selection of hypothesis to test,
- (e) Formulation of a testing plan including criteria for accepting or rejecting hypothesis,
- (f) Acquisition of system status information via use of half-splitting techniques,
- (g) Interpretation of discrete datum,
- (h) Organization of all information,
- (i) Selection of alternative hypothesis,
- (j) Confirmation of hypothesis.

The value of a number of the steps in this analysis has been confirmed by research in trouble-shooting. Moore, Saltz and Hoehn (1955) demonstrated the value of steps "c," "d," and "e" by giving subjects instruction in preplanning. Preplanning consisted of generating as many hypotheses as possible to explain the observed symptoms. Subjects then selected an hypothesis to test and formulated a testing plan complete with criteria for accepting or rejecting the hypothesis. They found, not surprisingly, that the preplanners were significantly better trouble-shooters than the controls. What this implies is that the analysis of

trouble-shooting (inquiry or problem-solving) is probably not an analysis of actual observed behavioral sequences but rather a prescription; trouble-shooting will be effective if done in this manner.

The above analyses include the same basic set of components: Problem sensing, problem definition or formulation, hypothesis formation (not included by Shulman), search and resolution. One might make the generalization that the more closely one's inquiry behavior approximates this analysis (without placing ordering restrictions) the more effective an inquirer such a person will be. This generalization is supported by Fattu (1964) in a review of results of trouble-shooting research. The good trouble-shooter actively looked for symptoms. He was aware that problems would occur and attempted to sense them immediately. In contrast, the ineffective trouble-shooter actively checked symptoms only half of the time and often began remedial action or came to a conclusion too soon and, thus, the solution was ineffective. Finally, when the correction did not return the system to working order, the poor problem solver tended to continue checking within the same subsystem, while the good problem solver broke set and returned to verification of symptoms, considering once again the whole system.

From the above discussion one might conclude that there exists a general strategy for problem-solving but, because different types of problems have vastly differing external structures, it might also be that strategies for solution are dependent upon the structural characteristics of a situation, i.e., problem-solving is situation specific. Miller and Slebodnick (1958) approached the structure vs. strategy question from a pedagogical position. Their study was a simple comparison between the effects of training in trouble-shooting strategies and training in the concept of data flow (structure) on subsequent trouble-shooting

performance. The trouble-shooting training consisted of instruction in the general strategies of (a) narrowing trouble to a chain of suspected components via deduction, (b) making checks via half-splitting, a search strategy similar to conservative focussing, and (c) identifying the malfunctioning unit. Structural training centered on logic and flow of data within the piece of equipment. Results indicated that the group trained in strategy was faster than the structurally trained group.

Rundquist, et. al. (1965) substantiated these findings in a setting very different from the applied trouble-shooting situation: The traditional laboratory concept-learning situation. Subjects were trained (a) to respond to the structural (dimensional) characteristics of a set of stimulus materials identical in structure to that of the criterion task or (b) to use conservative focussing to solve problems such as number series and matrices which were structurally unlike the criterion task. Although results were difficult to interpret because of methodological problems, the strategy trained group did better than the structure trained group in terms of time to solution (less) and number of correct initial hypotheses.

The strategy training discussed above dealt primarily with strategies of hypothesis testing. However, it appears that for complex realistic inquiries, training in strategies of search planning and information organization may be more effective than hypothesis testing strategies such as half-splitting and scanning. Miller and Folley (1953) prescribed half-splitting as the solution to the complexities of trouble-shooting problems. Simply stated, half-splitting is a search strategy similar to conservative focussing (Bruner, Goodnow and Austin, 1956) in which the subject selects the point at which to make a binary check which will eliminate the maximum number of possible alternatives. Later,

Goldbeck, et. al. (1957) trained one group of subjects in half-splitting and a second group in deductive selection of possible trouble units within which the malfunction might be located. Results indicated that half-splitting was successful only when problems were very simple. Otherwise training in logical deduction (including hypothesis generation) was more effective in facilitating trouble-shooting.

Finally, Goodnow and Pettigrew (1956), in training subjects to solve a simple alternation problem, concluded that a major factor in problem-solving involves the attention that the inquirer gives to the events or information presented. Instruction or training which has the effect of directing attention toward the events should improve performance. This was hardly a striking or new finding, and yet they felt it was worthy of reiteration because many training procedures or instructions required the subject to attend so closely to his own responding that attention was directed away from the events from which information was to be gathered. On the basis of this research (Goldbeck, et. al., 1957; Goodnow and Pettigrew, 1956), it was decided to eliminate hypothesis testing routines from the present training procedure.

In accord with the above research on problem-solving and inquiry, the cognitive training procedure included training in:

- (1) problem sensing -- careful attention to information presented and inspection of such material to detect discrepancies between the information and one's general expectations for the situation or between pieces of information within the situation.
- (2) problem formulation -- specification of interrelationships among bits of information within the problematic situation and the specification of limits and conditions placed on the solution by the problem itself.

- (3) hypothesis construction -- generating a number of possible causes of the problematic situation.
- (4) hypothesis selection -- selection of an hypothesis to test and specification of a testing plan and criterion for accepting or rejecting it.
- (5) search and resolution -- inspection of information in accord with the testing plan, including re-emphasis of problem sensing and problem reformulation.

The above training took place in small groups of six to eight. Using simulated problematic situations and anecdotes, each of the steps was explained to the subjects, after which it was discussed and practiced by the subjects. The results of each step were discussed to point out the benefits of proceeding in such a systematic manner.

Probably one of the most important phases of the training is the problem sensing and formulation, both in the original situation and during search. As the subject searches for information to test an hypothesis, he will sense new problems and uncover new information that may add to or change the basic nature of the problem as formulated. He must then reformulate the problem and re-evaluate his hypotheses. The process is analogous to the continual restructuring, which is the basis for the learning by discovery approach as discussed by Bruner (1960). However, the purpose of the proposed research is not to facilitate inquiry by extended practice in inquiry as done by Suchman (1961) and Crutchfield and Covington (1963). The purpose is to facilitate inquiry by Didactic training in specific components of effective inquiry.

Suchman's inquiry training (1962) demonstrated that inquiry performance could indeed be modified by experience. The particular nature of

the experience was extensive practice in asking questions to gather data. The problems set for the students (fifth grade) were movie simulations of apparent scientific anomalies. The task was to discover the cause for the observed discrepancy by asking questions which could be answered with a simple "yes" or "no." The experimenter answered questions and guided the students' questioning by requiring additional formulation when the question was not a simple binary test. This training experience extended over a period of twenty-four weeks and resulted in marked facilitation of inquiry performance on the part of the students. As can be seen from the nature of the training, there appears to have been no explicit model of inquiry underlying the training. The only skill explicitly taught was question asking. This would follow from Suchman's position (1961) that inquiry is a monolithic ability, not properly analyzed into components. The only way for Suchman to teach inquiry is through experience with inquiry. However, as Rundquist (1965) put it, "in the applied setting /as opposed to the lab abstraction of concept attainment/, it is precisely because of the inefficiency or inappropriateness of training-through-doing that pre-training procedures are introduced." (p. 26)

Crutchfield and Covington (1963) came closer to training inquiry based on a prescriptive analysis of the process such as developed here. The Productive Thinking Program (1966) employed extended practice in inquiry with emphasis on hypothesis generation and strategy planning. One of the distinctive features of that particular approach was that the steps and procedures learned were made explicit, subjects were told to think of a number of possibilities and were rewarded for doing so. However, neither the research by Suchman nor by Crutchfield and Covington demonstrated changes in the inquiry process itself within a situation distinct from that of the training. Facilitation of classroom

discussion was noted, but no clue was given as to changes in the inquiry process itself. The present study examines changes in this process by testing trained subjects with the Teacher's In-basket, a situation entirely independent of the problems and setting of the training situation.

Another type of approach to changing inquiry behavior that has been incorporated into the present study involves manipulation of temporary fluctuations in performance via cueing (as opposed to basic changes in capability via training). Colgrove (1968) demonstrated that in a problem-solving situation, subject performance could be significantly improved by providing a cue. Subjects were given the Changing Work Procedures problem in which they were given data on work efficiency of three men on an assembly line. The problem was to make a series of administrative decisions involving the men in order to maintain work efficiency and resolve dissention among the workers. Subjects cued to be original offered more solutions to the problem than those not cued.

In addition to the training of problem-solving skills, the present study includes the cueing of specific subjects to examine whether changes in capabilities resulting from the training are made more manifest in subsequent performance on the Teacher's In-basket when a cue is provided.

A practical problem which had to be dealt with in constructing the training concerned transfer. It was necessary that the training include no content material which overlapped the Teacher's In-basket (the transfer task). However, transfer is a function of stimulus and response similarity in the training and testing situations. This posed a problem because to the degree that the situations (training and testing) did overlap, the experimental conclusions would be ambiguous. The problem involved maintaining task similarity without content overlap.



When Andrews, Cronbach and Sandiford (1950) wrote their article on transfer, similarity had been defined in as disparate terms as identical elements and perceptions of similarity. Andrews, Cronbach and Sandeford (1950) made some suggestions about maximizing transfer of instruction which seemed to consider both of these positions. According to them, transfer is facilitated if: (a) students expect to use what they are learning in different situations, (b) the generalizations are meaningful and are practiced as behaviors, not just verbalisms, and (c) students can recognize the new situation as a special case of the old.

These suggestions were accounted for in the present training procedure by (a) emphasizing that the strategies being taught were pertinent to teaching, (b) providing materials with which to practice and refine the skills, (c) emphasizing the structural nature of the problems to be solved rather than that of the specific situations in which they were cast. The procedure itself is described in full in the following chapter.

The present experiment was composed of two phases. Phase I included training of problem-solving skills followed by an immediate post-test. Phase II was administration of the Teacher's In-basket and analysis of the observed inquiry performance. Stated generally, the hypotheses were that subjects trained in the problem-solving strategy would exceed subjects receiving an irrelevant training in a number of facets of the inquiry process. They should exceed controls in problem sensitivity because the training emphasized looking carefully at information in order to find problems. Generation of hypotheses and planning of a search plan should lead subjects into a more diverse inquiry pattern and, thus,

should increase the number of sources of information consulted and the amount of shifting engaged in. Finally, this type of inquiry should result in increased competence of problem resolution.

CHAPTER 3

METHODS

Subjects

Sixty female students in the beginning undergraduate course in Educational Psychology at Michigan State University were selected from approximately 160 females taking the screening battery. Subjects were not selected at random from a large population but were selected purposely to represent two ideal types here called Dialectical and Didactic.

A Dialectical subject was defined as a person scoring above the median on at least three of the four screening tests. Conversely, a Didactic subject was defined as one who scored below the median on at least three of the four tests. Since our interest was in selection of extreme subjects, subjects with all four test scores either above or below the median were chosen first. Only then were subjects who scored consistently on only three tests chosen. These subjects (with one deviant score) were selected on the basis of the proximity of their deviant score from the median. Thus the thirty subjects most extreme in the Dialectical direction and the thirty most extreme in the Didactic direction were selected from the 160 subjects taking the selection tests.

At the time of testing all subjects were informed that only certain people would be contacted on the basis of their test scores (cognitive styles) for further participation. They were told that those who agreed

to participate would be paid \$1.50 per hour for approximately six hours of work over a seven-day period and that, in addition, they would learn some things relevant to teaching. Subjects were contacted by telephone and approximately 90% agreed to participate. Those declining generally did so because of very heavy work and class schedules and/or family responsibilities. All subjects were paid \$1.50 per hour and a \$2.00 bonus if they kept all appointments. They were also told that their work was valuable only if they completed all phases of the study and, thus, they would be paid only if they completed all work.

Selection Tests

The selection battery consisted of four group-administered inventories and tests which took approximately thirty-five to fifty minutes to complete. The four measures comprising the battery were Word Associations (Getzels and Jackson, 1962), Complexity (Barron, 1967), Political Position (Shulman, Loupe and Piper, 1968) and the Inventory of Beliefs (Stern, Stern, and Bloom, 1956).

The Word Associations test consists of a list of twenty-five words, each of which have a large number of distinct meanings (e.g., coil, punch, host, etc.). The subjects' task was to give as many meanings for each word as possible within a time limit of ten minutes for all twenty-five words. The instructions suggested that definitions need not be written out but that in most cases, meanings could be indicated by simply writing down one word (e.g., bark -- tree, dog, seal, boat). The test differs from the traditional word association techniques which ask the subjects to give words which the stimulus word brings to mind, not necessarily words which suggest a definition of the stimulus word. The Word Associations score was a composite of the total number of different meanings (three

in the above example) and the total number of responses given (four in the above example). Word Associations correlated .42 with the MSU Reading Test and .45 with CQT Total in research by Shulman, Loupe and Piper (1968).

The Complexity scale consists of thirty statements designed to elicit a statement of preference for either simple or complex situations (e.g., "I like to have a place for everything and everything in its place." "Some of my friends think my ideas are impractical, if not a bit wild.") The subject either agrees or disagrees with each item. A high score indicates preference for complexity, ambiguity, the unpredicted, the assymetrical, etc. Complexity correlated .50 with the Inventory of Beliefs and -.06 with CQT Total in research by Shulman, Loupe and Piper (1968).

The Politics Scale is a simple, four-item self-report form asking subjects about the political positions of their parents and themselves. Each of the four items is scored in the direction of liberal politics, thus a high score indicates reported liberalism. This Political Scale is a revision of the one used by Shulman, Loupe and Piper (1968). In that research, Politics correlated .23 with the Complexity Scale, .36 with the Inventory of Beliefs, and .39 with Word Associations.

The Inventory of Beliefs is a collection of 100 items or statements based on cliches and slogans of ten heard in the 1950's dealing with such topics as politics, labor and religion. The inventory was developed by Stern, Stern, and Bloom to measure stereopathy -- nonstereopathy, or roughly the equivalent of openness and non-authoritarianism. The Inventory of Beliefs correlated -.42 with Rokeach's Dogmatism Scale (1960)

and .08 with CQT Total (Shulman, Loupe and Piper, 1968). The median reported reliability is .86 (Stern, Stern and Bloom, 1956).

Design

The experimental design consisted of three factors: Training, cueing, and seeking-style. The three levels of training were problem-solving training, openness training, and control. Cueing and seeking-style were both dichotomous (cueing vs. no cueing, Dialectical vs. Didactic). As indicated in the description of the subject sample, subjects were selected to most closely approximate the Dialectical and Didactic seeking-style types. Subjects in each of these two groups were assigned randomly to one of six combinations of the treatment and cueing factors. Thus the total experimental design consisted of three crossed factors ($3 \times 2 \times 2$) having twelve individual cells and five subjects per cell.

		Problem-solving	Openness	Control	
Dialectical	cue	5	5	5	15
	no cue	5	5	5	15
Didactic	cue	5	5	5	15
	no cue	5	5	5	15
		20	20	20	60

Figure 1. Factorial Structure of Experiment Showing the Number of Subjects Per Cell

Training

All training took place in groups of six to eight subjects which met for four one-hour sessions, the first three of which were devoted to training and the last to testing.

Problem-Solving

As stated in Chapter 1, the central problem of this document is facilitating inquiry performance through training in problem-solving. The problem-solving training consisted of reading, discussion, and both individual and group practice in the components of inquiry: problem sensing, problem formulation, hypothesis generation, hypothesis selection, search and resolution or redefinition. The objectives of the training were that, given a situation with unidentified potentially problematic elements, the subject would:

- (a) carefully inspect the situation, looking for discrepancies either between her expectations and the information or between bits of information in the situation,
- (b) formulate the problem by systematically relating all available information to the problematic situation,
- (c) generate a number of possible hypotheses which could explain the problem as formulated,
- (d) select an hypothesis to test and specify a testing plan including criteria for accepting or rejecting the hypothesis,
- (e) search the available information in accordance with the testing plan and either resolve the problem and cease inquiry or use the resultant information to reformulate the problem.

The instructional materials were primarily excerpts taken from Sherlock Holmes mysteries. These were used both as illustrations and as a basic materials for instructional exercises. In addition to the mystery stories, puzzle type problems were used as illustrative exercises.

Three additional problems were constructed in which there was a brief, one-paragraph statement of a problematic situation followed by sixteen to twenty-three pages, each of which contained an additional piece of information (see Appendix A). The subject matter of the problem and the indexing system which gave access to the materials were different for each of the three problems according to the purpose for which it was constructed.

The first of the three dealt with the problems of a playground supervisor. Each subject was given a complete table of contents for the problem. The purpose of this problem was not to instruct or test but to demonstrate the relevance of strategies to problem-solving before instruction began. Thus, it did not matter that the subject's hypotheses and questions might have been structured by the index.

The second problem, a murder mystery, was organized formally in the same manner as the first; however, no indexing aids were provided the subject. Because subjects worked with this problem for thirty to forty-five minutes with continuous feedback and discussion, it was important that the content of the mystery problem did not overlap with the content of the Teacher's In-basket to avoid facilitating their in-basket performance simply by teaching them to use the particular content contained therein. It was also important that the subjects were not constrained in their hypothesizing and questioning of a list of sources. When using this problem, subjects raised hypotheses and asked the instructor for the location of the information source thought to contain the answer.

The third problem (see Appendix B), involving an unemployed salesman, was designed as a test of problem-solving ability to be used as a training post-test for all subjects. To function as a test it was desirable that the constraints to hypothesizing and questioning be

minimal, that the same set of information be equally available to all subjects and that the indexing be self-contained to allow completely individual work on the problem. Thus, the material was indexed as a branching program with general categorical indexes and specific sub-indexes available to the subjects by following particular branches. After each piece of information or index the subject was given the option of seeking additional information or completing the program by proposing a solution.

This particular training employed materials of high intrinsic interest, techniques of individual questioning and constant immediate feedback to maintain high subject involvement and reinforce the target behaviors of the training. As was mentioned above, the training took place in three one-hour sessions. Each session was ended by raising a problem for subjects to consider overnight. They were also given two brief puzzle problems to do between sessions. Although the time required out of class totalled only about thirty minutes, subjects reported working on problems with friends and roommates and were very anxious to find out the "answers" and gain closure. The purpose of the unfinished problems was to take advantage of the lack of closure to maintain curiosity and aid recall of the past day's activities as in the Zeigarnik phenomenon. The homework problems were simply to gain an additional exposure to training related materials and provide additional practice and illustration of the principles discussed and practiced during the day.

First Training Session

At the beginning of the first training session subjects were told that their individual participation was necessary. They were encouraged

to ask questions or make comments at any time. They were then told that the purpose of the next few meetings was to train them in problem-solving skills. The next few minutes was devoted to arousing interest and motivation. They were told that their time would be well spent since traditional teacher training did not adequately prepare teachers either to sense or solve problems in the classroom. Brief anecdotes to illustrate the importance of problem-solving abilities to both the preactive and reactive (Jackson, 1966) phases of teaching were elicited from the group. Then the subjects were asked to take five to ten minutes to solve the problem (by finding the cause of the situation) of a playground director who was having difficulty getting children to come to her ghetto area playground (see Appendix A). The problem was in book type format but was administered in the same way as the Rimoldi-type tab tests (1960). Each subject was asked individually what she thought the problem was and a group answer was compiled. This was compared to a model answer. The problem was constructed so as to lead an individual into stating any one of three possible solutions. To reach the "best" answer, which involved an interaction among at least three factors, subjects were told they must follow a particular strategy and this was briefly illustrated. Subjects were then told that research had shown that the best problem solvers in many fields (medicine, teaching, trouble-shooting, etc.) all seemed to use a particular technique or strategy, the strategy that they would learn over the next three days. Further, those people identified as good problem solvers were considered to be superior practitioners within their fields of endeavor.

At this point the formal instruction began. Subjects read a four-page explanation of the steps (see Appendix A) stopping after reading



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about each step to discuss important points and ask questions about the examples. The balance of the first meeting was concerned with explaining and practicing the phases of problem sensing and problem definition with the major emphasis being placed on attention to detail. As an example, subjects were asked what they could tell about a person simply from examining a pair of his (or her) glasses. The instructor asked each subject for contributions and listed them on the chalk board.

Subjects then read a brief excerpt from Sherlock Holmes' "The Adventures of the Golden Pincenez" in which Holmes describes the culprit down to details such as size, posture and facial expression from cues found in a pincenez. A pair of eyeglasses was passed around among the subjects. The group was instructed to look for characteristics of this particular pair of glasses which would aid in describing the owners. Each subject was asked for at least one contribution. All points were listed on the chalk board and the group then proceeded to relate the pieces of information into a tentative description of the wearer and the circumstances under which the glasses were worn (definition of the problem).

The first day of each training session ended by passing out a list of clues found by Sherlock Holmes at the scene of a murder in "The Lauriston Garden Mystery." Subjects were to take the list home and "define the problem" or describe the culprit and the scene as carefully as possible by interrelating the clues provided. They were also given two short puzzle-problems to solve overnight as illustrations of problem sensing and problem defining.

Second Training Session

The second day began by discussion of the home assignments. Each subject was asked what he thought was the important information in each problem and how the information and the problem statement were related in order to reach a solution. From the contributions a group description of the Laureston Garden case was generated. Subjects then read the description offered by Sherlock Holmes. Comparisons were drawn between the group description and that of Holmes. The manner in which both the group and Holmes related the discreet data into a meaningful description was briefly discussed.

At this point, the focus shifted from problem sensing and problem definition to hypothesis generation. Subjects reread the description and examples of hypothesis generation and selection (see Appendix A) and briefly discussed the purpose of these steps. It was emphasized that by generating as many hypotheses as possible which could account for the problematic situation, they would avoid the error of unknowingly committing themselves to a particular solution before having gathered sufficient information to make a decision logically. Subjects were told that the good problem solvers -- troubleshooters, teachers, physicians, etc. -- consciously and consistently use this technique (hypothesis formation) and it has proven to be very successful. A simple medical example of hypothesis formation was used as illustration.

The balance of the second session was devoted to group practice in hypothesis formation. Key passages were selected from two Sherlock Holmes short stories, "The Adventure of the Norwood Builder" (pp. 498-500, 503), and "The Adventure of the Three Students" (pp. 596-597, 600-601), to present sets of information and clues from which the problem could be

defined and hypotheses generated. The excerpts were selected to present sequential sets of critical information necessary to solve the mysteries.

The group read the information one set at a time. After reading, individuals were asked what the basic problem was and what important information and clues were presented. The instructor listed these on the board until the set was exhausted then asked selected subjects to define the problem by relating all of the clues found. Subjects were then asked to generate as many hypotheses that would account for the information as possible. Each hypothesis was acknowledged and reinforced without being evaluated, much as in a brainstorming session.

The next step was to read the subsequent excerpt, extract the important clues and details from it, redefine the problem in terms of the complete set of information and generate additional hypotheses. The group then compared the solution generated by Sherlock Holmes to the hypotheses generated by the group and noted the points of correspondence and difference. This proved to be a very effective technique of providing feedback and reinforcing the generation of multiple explanatory hypotheses.

This (second) session ended with the group having proceeded part-way through the second exercise of the type described above. They were asked to continue reading -- noting important details, redefining the problem and generating explanatory hypotheses. They were to return to the next session ready to discuss the problem. In addition they were given a third such exercise taken from "The Yellow Face" (pp. 353-358) to do overnight.

Third Training Session

The third and final training session began with a discussion of the homework problems. Individual subjects were asked what clues they considered important and what hypotheses they had. These were listed on the board and the group compared their hypotheses to Holmes' solutions. The major purpose of this session was to recombine the steps in the problem-solving analysis which were practiced in previous sessions; namely, problem sensing, problem definition and hypothesis generation, and complete the process through hypothesis selection, search and resolution or redefinition.

A mystery story was constructed to act as the vehicle for the group to practice these skills. The mystery was presented in booklet form, each page containing a single piece of information in the form of an interview, letter or document. Subjects read the first page, a one-paragraph description of the problem situation, and were told that their task as a group was to decide who committed the crime and why. All the available information had been gathered and compiled in their booklets but was available only upon request from the instructor. They were to request a source of information and the instructor would then tell them which page to consult. After they had read the new information the instructor asked the following questions:

- (1) Were there any new problems in the information?
- (2) What were the important details presented?
- (3) How did the new findings relate to the problem definition (problem redefinition)?
- (4) Was the hypothesis under test confirmed or disconfirmed?
- (5) Were there any new hypotheses?

- (6) Which of the possible hypotheses should we test
and where would you expect to find relevant information?

The answer to the last question became the request for the next source of information. The instructor maintained a cumulative list of information, clues and hypotheses on the chalk board before the group. This was the final training exercise and was undertaken to integrate the skills practiced previously with practice in hypothesis selection, search and redefinition or resolution into a concentrated guided group experience in systematic problem-solving.

Openness Training

The openness training consisted of discussion, lecture and role-play aimed at teaching subjects the behavioral and attitudinal components of the model "open" person. The procedure was very value laden in an attempt to arouse a commitment to openness as well as teach the attributes of the concept (see Piper, 1969 for further elaboration).

Control Training

The control training consisted of highly structured (programmed) lecture and discussion about concept learning, generalization and discrimination, transfer, and suggestions as to how teachers could implement these principles and facilitate the learning of concepts by their own students. The material was taken directly from School Learning by Stephen Yelon (1969). The purpose of this training was to develop experimental involvement and thus control for the Hawthorne Effect. The subject matter was potentially interesting and valuable to prospective teachers yet considered to be enough removed from the experimental task (Teacher's In-basket) that there would be no transfer.



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Post-Testing

The fourth meeting was essentially the same for all subjects regardless of training. Subjects met as a group, one to three days after training, for post-testing. There was no additional instruction at this meeting. Two post-tests, the Dogmatism scale and the problem-solving test (see Appendix B) were administered to all subjects. In addition, control subjects took a short examination on concept learning and instruction, the topic of their training sessions.

The Dogmatism scale was used as a post-test for the openness training because an open person should not be dogmatic. The Dogmatism scale was scored in three ways: (1) The simple algebraic sum, which is essentially a scale from "right" authoritarianism or dogmatism through "openness" to "left" authoritarianism; (2) The sum of the absolute deviations toward either left or right authoritarianism from an optimum score of "openness"; and (3) The number of items with which the subject disagreed (agreeing with an item is considered a dogmatic response).

The reader will recall that the problem-solving test included a statement of a problem and approximately twenty pages of information, indexed as a branching program, which was available to be used in obtaining a solution (see Appendix B). In taking the problem-solving test, a subject was instructed to do the following: First, write down the number of each page as it was read; and second, when personally satisfied that she knew what the problem was, record her proposed answer on the sheet and stop working. Thus, two scores were generated from the problem-solving test which were analogous to two scores (bits and competence) derived from the Teacher's In-basket. The first, Problem-Solving Steps (P.S. Steps), was the total number of content pages consulted in solving the problem (analogous to bits). The second, Problem-Solving Quality (P.S. Quality), was a rating of the solution offered against a standard model (see Appendix B).

Competence was scored by matching the characteristics of the offered solution with a model solution. The score was simply the total number of matching characteristics. In order to avoid the possibility that personal characteristics of the experimenters would influence the subjects, both experimenters shared responsibility for all three types of training groups.

The Transfer Task

The basic purpose of this study was not to test the feasibility of training people in problem-solving techniques and strategies, but to test the effect of such training upon subjects' inquiry performance in realistic, teacher-relevant situations. A major research concern was maintaining external validity, an approximation of real-world tasks in the experimental situation. As Rundquist et. al. (1965) put it, "concept attainment tasks are much too simple for the purpose of answering applied questions regarding the efficacy of different kinds of extensive training." (p. 26) Thus, in order to test the hypotheses it was necessary to maintain reality of task (external validity), and at the same time, experimental control (internal validity) over the stimulus inputs into the situation. Further, it was necessary that the cognitive processes of the inquirer be as accessible as possible to the observer in order for him to record the process of inquiry as well as the solution to the problem situation.

To these ends the Teacher's In-basket was employed. The In-basket provided the realism necessary to maintain external validity and was composed of a specific set of materials into which problems were built to stimulate maximum inquiry. Role-playing was used to encourage a

degree of emotional involvement with the situation to further simulate a real teaching situation. Subjects were asked to think aloud in order to make their thoughts available to the observer. Thus, it was possible to determine what general information source the subject was accumulating, whether the subject perceived the situation or information as problematic, and whether the information assisted the subject in resolving a problem.

The Teacher's In-basket consists of the complete set of current and past records on a fictitious class of fifteen sixth graders in Ridge Forrest Elementary School, Ridge Forrest, Michigan. The In-basket materials include memoranda, telephone messages, tasks and lists to be completed, test scores, schedules, etc. Finally, a school principal and "reference memory" are available for consultation over an intercom with programmed answers to anticipated questions.

The subject was brought into a one-way observation room and told that this was her new classroom in Ridge Forrest School. She was seated behind the teacher's desk and asked to wear a small microphone. On the desk was an intercom, the in-basket, a folder containing current report cards, cardexes, attendance book and discipline anecdotes, and pencil and paper. She was then briefly introduced to the situation; that she was a new teacher taking over this sixth grade class in December after a succession of substitutes have been presiding for two months. There were many things to do while she was role-playing a teacher in this situation. She was asked to make the situation as real as possible and act as if this were indeed her class. Next she was told that the success of the research depended entirely on her ability to think out loud. Since the research interest was in following her thoughts throughout

the situation it was necessary for her to make all thoughts verbal, whether she deemed them relevant or not.

After this rather brief verbal introduction the subject was given a short period of training in thinking aloud. She was given three line sketches of teachers in various situations and was asked to tell a story about each. The object was not to train the subject to tell stories but to get her verbalizing and she was told so. Following the stories, she was given a written description of the situation (see Appendix D) and was asked to read it aloud. Questions about the situation itself were answered but requests for direct structuring of the task such as "But what should I do?" were met with the reply, "Do what you would do if you were this teacher." Subjects were then shown samples of all information sources and were instructed in the use of the intercom and reference memory. Reference memory was to provide the subject with information which she probably would know if she were the teacher, such as information about school policy, testing methods, test interpretation and general "scuttlebut." Because most of the subjects were taking their first education course and had no knowledge of testing methods or ability to interpret test scores, this function of reference memory was emphasized in an attempt to make up for a lack of content knowledge.

It was mentioned that subjects had use of the cumulative records and medical records for each student. These contained information on achievement and aptitude tests, intelligence tests, attendance records, family data, health records, hearing and vision tests, immunization records and special help records from the time of the students' entrance into the school system. Transfer records were also available as a part of the cumulative records. It was explained to the subject that

since these were usually found in the principal's office or in the guidance office filed with all students' records, their use of these records would be restricted to simulate this condition. They were placed on a table across the room from the subject and she was told to use them as she wished with the restriction that she not take the folder of records back to her desk but select the record(s) for the particular student(s) in whom she was interested. The material on her desk were for her unrestricted use; she could do anything except write on them.

The current materials included progress reports for each student listing grades in academic subjects, citizenship and work habits, attendance, age, height and weight for the current year. Permanent elementary school records of achievement tests, intelligence tests, family data and significant comments for the current year were available on cardex file cards for each child. The teacher's record book contained an up-to-date attendance record for each child for the year plus eight discipline reports on selected children clipped to the record book. The subject was not restricted in her use of reference memory or the school principal as potential sources of information.

On the desk was the in-basket containing memos and jobs which had been accumulating for lack of a permanent teacher. Imbedded within the in-basket were tasks, letters and memos designed to structure the situation to the degree that all subjects would at least attempt to undertake the same basic set of tasks: Identify those students who must see the school psychologist for testing and interviews, make out a list of students to be referred for special enrichment or remediation tracks, etc. The purpose was to give the subject a set of tasks which would lead her into inquiry, which would require that she make use of student records and thus expose herself to potentially problematic information.

The choice of whether to continue inquiring or not was up to the subject but the in-basket tasks were constructed to expose her to a minimal amount of problematic information and allow the opportunity of continued inquiry if the subject so chose. The subject was observed in the above situation by a single observer who also functioned as reference memory and the school principal, and thus was in contact with the subject via intercom. The observer was separated from the subject by a one-way mirror. The "teacher's" desk was situated in such a way that the observer could see everything the subject was doing, what information she was reading and, even what she was writing. Everything the subject said was heard by the observer. The observer's job was to dictate a complete log of everything the subject did during her two to three hour stay in the situation. Everything the subject said, looked at, read, wrote, was recorded by the observer so that the log was, in fact, an accurate compressed time record of the subject's behavior. Interpretation of the subject's behavior was not attempted during observation. Scoring and interpretation were reserved until after all observations had been made.

A number of steps were taken to reduce the possibility of observer bias:

- (a) The observer was not aware of the cognitive characteristics of the subject used in selection and blocking, nor was he (she) aware of the academic ability of the subject as indicated by his G.P.A.
- (b) In addition to the two people responsible for the group training, a third person was involved in the observation and every attempt was made to schedule subjects so that the person observing the subject was not the same person who had trained the subject. Although it was not possible to maintain a perfect "double blind," scheduling overlaps were such that the observer could not be certain of the training treatment

which the subjects had undergone. Finally, the method of recording afforded much greater accuracy in observation than had been possible in the earlier study (Shulman, Loupe and Piper, 1968).

Dependent Variables

A number of scores were abstracted from the observations in order to represent in quantitative form the inquiry behavior of the subject.

A number of potential problems were imbedded in the in-basket and in the student records. They were of two basic types, the first being a simple violation of expectancy or deviation from the subjective "average" situation. An example of this type problem is the fact that Ronald Mayer, one of the characters developed in the in-basket, has straight A's on his report card. One simply doesn't expect a student to get such grades consistently, rather the expectation for the "average" student is more likely to be that he get B's and C's, maybe even an occasional D. The second kind of problem is also a violation of expectancy. This expectancy is generated by the information itself, i.e., it is a conflict between sources of information. Ronald Mayer had straight A's on his report card but his permanent record indicates his last tested IQ was 91. One simply doesn't expect a student with an IQ of 91 to get straight A's.

The experimenters and the writers of the Teacher's In-basket had arbitrarily identified some 250 such potential problems, potential because a situation is not truly a problem until sensed. Although identification of these problems was somewhat arbitrary in terms of average expectancies it was also quite exhaustive. On occasion a subject would sense a legitimate problem not formerly identified; these were carefully evaluated to see if they did in fact meet the criteria specified above

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for a potential problem. If a subject indicated through her behavior that she sensed a problem, it was scored as such. Thus the Problem Sensitivity Score was simply the total number of problems sensed by a particular subject.

Since use of information is important to the process of inquiry and problem-solving, two measures of information usage were used. Bits was simply the number of times a subject consulted any source materials, including her own written notes, for information. For example, if a subject looked at a report card, a cumulative record, the sociogram, the same report card again, and the sociogram (in that sequence) this would be considered five "bits" even though he returned to two sources. This score then was an index of the total amount of information.

Information sources, on the other hand, was a measure of diversity in information usage. For scoring purposes the Teacher's In-basket was divided into ten basic problem areas. A record was kept of the different sources consulted within each area. There were 12 sources categories: In-basket, sociogram, CTP summary, community maps, reference memory, report cards, cardex files, cumulative records, medical records, attendance book, discipline anecdotes, and newsletter. Thus, if a subject looked at a report card, a cumulative record, the sociogram, the same report card again, and the sociogram, the number of sources consulted is only three (if they all concern a particular problem). For any one problem area a source was tallied but once. Two scores were generated from the sources data: Total Sources, the total sources used across all ten problem categories; and Mean Sources, the total number of sources used divided by the number of problem areas into which the subject inquired. Because all subjects did not inquire into the complete set of problems, the two scores were not simple transformations of each other.

The only score calling for a qualitative interpretation of the subject's performance was Competence. For each of the ten above-mentioned problem areas the problem resolution reached by the subject was judged as to the understanding of the problem it demonstrated. Model resolutions to each problem were written out at varying levels of complexity, the lowest of which was simple recognition of a contributing problem and the highest of which represented the fullest understanding of the problem that could be achieved with available materials (see Appendix C). These model solutions were then rated 1-5 according to their complexity and the effort necessary to gather appropriate information. The subject's problem resolution was compared to this standard in scoring for competence. Her competence score on each problem was simply the scale value (1-5) of the model answer which most closely matched the characteristics of the offered resolution (see Appendix C).

As a general index of inquiry performance the scores for problem sensitivity, mean sources and competence were standardized, and summed yielding the score called General Inquiry. Time was also variable, since a subject remained in the situation until she called on the intercom and said she was done. Time varied considerably across subjects with a range of 90 to 180 minutes.

The problem-solving training made no attempt to influence subjects to spend more time inquiring but simply attempted to improve their skills and make their efforts more effective. It is possible that such training would allow subjects to reach a tolerable resolution more quickly, thus they would take less time than if untrained. It is also possible that a factor which influences termination of inquiry is the frustration of finding one's self ineffective in work. If this is the case, training should increase time spent simply by making the subject more effective.



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Thus two sets of scores were used, the raw scores as described above and ratios of the scores with time, to separate efficiency and effectiveness in inquiry from commitment.

This same rationale was used to generate yet another score, Mean Competence. Because the training only attempted to increase competence of solution within a problem and did not attempt to influence subjects to make an added commitment to inquire, competence was averaged only for the general problem areas into which the subject inquired.

The final score derived from the logged observations was more a reflection of the cognitive processing style of the subject than were the former measures. Operationally, Shifting was the total number of times the subject shifted his search from a bit of information in one source category to information in another (see page 41 for listing of sources), e.g., if a subject compared a report card, cardex, and the attendance book, this would be scored as two shifts, from report card to cardex and cardex to attendance book. However, if the same subject looked through the set of 15 report cards, no shifts would be involved.

Shifting analysis was developed in the former study (Shulman, Loupe and Piper, 1968) in order to operationalize the theoretical description of the Dialectic. A major characteristic of the Dialectic as a style of argument or persuasion is that differing positions are developed, compared, juxtaposed and finally synthesized. Thus a Dialectical seeker should employ this style in her inquiry; she should do a lot of comparing and contrasting sources of information. This would tend to lead her into much shifting among information sources. In the Teacher's In-basket, information regarding any particular child was scattered throughout a number of sources and was never contained wholly within one source. However, it was possible to gather information

either by shifting or by progressing systematically through the information sources.

Summary of Design and Methods

Before the hypotheses are stated, it would be well to review and summarize the design and methods to clarify the tie between the statistical hypotheses and the experiment itself. A two-stage experiment was developed to test the effects of particular types of training on subsequent inquiry performance of sixty female subjects taking an introductory course in Educational Psychology. Subjects were selected in order to fit two theoretical types which were predicted on the basis of prior research to determine differences in inquiry performance and effectiveness. The types, Dialectical and Didactic, were operationalized in terms of a composite profile of four measures: Preference for complexity (Barron, 1967), liberality of political position, word association fluency, and degree of non-stereopathy (Inventory of Beliefs, Stern, Stern and Bloom, 1956).

Subjects selected were randomly assigned to the six treatments which were combinations of two factors. The first factor of training had three levels: Openness training, problem-solving training, control training. The second treatment factor was presence or absence of a specific cue in the instructions during the second stage of the experiment.

Following training, all subjects took a series of post-tests to judge the immediate effect of training.

The second stage of the experiment involved placing each subject individually in a simulated teacher situation for a period of two to three hours and observing her inquiry behavior. A number of measures of inquiry performance were derived from the observations including:

1. number of Problems Sensed;
2. number of information Bits consulted;
3. number of Information Sources categories consulted;
4. number of Shifts made between source categories;
5. amount of Time spent inquiring;
6. rated Competence of problem resolution.

A number of scores were derived from these primary scores to equate for time spent and problem areas investigated.

Hypotheses

Hypotheses stated here are general to the total experiment or specific to the problem-solving training, those specific to the openness training are found in Piper (1969).

1. The mean for the Dialectical group will exceed the mean for the Didactic group in all of the above primary measures of inquiry.

This hypothesis is based on theoretical positions and empirical findings of Shulman, Loupe and Piper (1968) using a similar test composite to predict inquiry performance.

2. The mean for the problem-solving group will exceed the mean for the control group in the following measures of inquiry: problem sensitivity, competence, information sources, shifting.

The reader will recall that the problem-solving training designed to give the subjects skills to enhance their inquiry ability. There was, however, no direct attempt made in this training to develop an increased commitment to inquire. One question of interest will be to see if increasing subjects' skills in inquiry results in their spending an

increased amount of time in inquiry. However, this will not be put to planned statistical test as the experimenter has no theoretical justification for predicting one result over the other. Thus, the above hypotheses will be tested in two ways: With the primary inquiry scores and with these scores adjusted to account for differential time expended and problem areas investigated. Problem sensing and shifting will be adjusted by dividing the scores by total time; competence and information sources will be divided by the number of problem areas investigated.

3. The mean for the cued group will not differ from the mean for the uncued group.
4. Cueing will interact with training such that the mean for the cued and trained groups will exceed the mean for the uncued, trained groups; however, the two untrained groups will not be different from each other.

The above two hypotheses simply express the author's feeling that the very brief and simple verbal instruction or cue was not adequate to provide an enduring set or to recall a particular behavior pattern unless it was familiar and well-practiced as was the case with trained subjects.

5. Training will interact with seeking-style such that the difference in group means between trained and untrained Dialecticals will be less than between trained and untrained Didactics.

The results of the experiment including tests of the above hypotheses are presented in Chapter 4 and interpretation of the results follows in Chapter 5.

CHAPTER 4

RESULTS

The basic purposes of this chapter are to inspect the data carefully, codify them, and organize them into a meaningful form which can be interpreted according to the purposes of this experiment. The following scheme will be used to organize and report the data in order to aid the reader in interpretation. First, the characteristics of the present sample will be described. The degree to which this sample replicated that of Shulman, Loupe and Piper will be discussed. Second, the effectiveness of the training in achieving improvements in problem-solving ability will be explored in terms of the problem-solving post-test. Third, the intercorrelations between the dependent inquiry variables measured in the transfer situation will be explored. Fourth, the experimental hypotheses will be tested and finally, the relationships between seeking-style, inquiry and intellectual measures such as CQT Total and G.P.A. will be explored.

Characteristics of the Sample

The importance of this particular section is two-fold. First, the results of the experiment will be more meaningful when the reader understands some of the psychometric characteristics of the sample for these would certainly have influenced how the subjects learned and responded in the experimental setting. Second, a very central part of this research design involves replication. The experimental hypotheses predicted replication of a number of findings regarding seeking-style and inquiry

reported by Shulman, Loupe and Piper (1968). Further, the inquiry behavior of groups fitting two carefully identified personality types was described in detail by Shulman, Loupe and Piper (1968). The present study set out to make predictions on the basis of those descriptions. The experimenter had a set of expectancies against which to compare the results. This allowed the possibility of considering non-replication of results as a function of non-replication in sample characteristics. A number of comparisons are made in this chapter with the results of Shulman, Loupe and Piper. These comparisons are always with the results of the first administration of the Teacher's In-basket.

TABLE 4.1

MEANS AND STANDARD DEVIATIONS FOR DIALECTICAL AND DIDACTIC SEEKERS ON BELIEFS, COMPLEXITY, CQT TOTAL AND G.P.A. FOR THE PRESENT STUDY AND FOR THE STUDY BY SHULMAN, LOUPE AND PIPER*

		Present Study		Shulman, Loupe and Piper	
		(1969)		(1968)	
		Dialectical N=30	Didactic N=30	Dialectical N=21	Didactic N=25
Beliefs	Mean	68.00	52.07	65.57	54.72
	S.D.	7.71	6.47	7.20	7.80
Complexity	Mean	19.13	11.90	16.09	8.28
	S.D.	4.24	3.85	4.22	2.25
GPA	Mean	2.68	2.55	2.68	2.61
	S.D.	.56	.51	.48	.53
CQT Total	Mean	131.60	127.63	133.76	123.96
	S.D.	24.85	18.60	17.81	25.25

*Word Associations and Politics are not compared here because slight differences in scoring and item content make the raw distributions non-comparable.

Table 4.1 shows the means and standard deviations on the Inventory of Beliefs, Complexity, CQT Total and G.P.A. for the present sample and for that of Shulman, Loupe and Piper (1968). In the present sample Dialecticals and Didactics appear to be only slightly more differentiated with regard to Beliefs and G.P.A. than the former sample while at the same time less differentiated with regard to CQT Total. None of these differences approach significance. In general, the samples appear to be quite similar with regard to seeking-style and intellectual ability. However, it must be remembered that CQT Total is not a measure of current status. CQT Total was taken from the University Registrar's files and indicates one's score at the time of entry to Michigan State University. The sample used by Shulman, Loupe and Piper consisted exclusively of college seniors in elementary education. The present sample consisted of sophomores interested in both elementary and secondary education. Thus, the sample was replicated psychometrically but differed in terms of college status and occupational interests.

It has been demonstrated that the mean status on a number of variables was approximately the same in this sample and in the sample used by Shulman, Loupe and Piper (1968). The present group replicated the former group in measured entering characteristics. Another method of checking for replication would be to compare intercorrelations among the selection measures for the two groups. Although there is no absolute criterion against which to determine similarity of intercorrelation pattern, if the intercorrelations appear to be similar this is evidence that the two samples have similar characteristics.

TABLE 4.2

CORRELATIONS AMONG SEEKING-STYLE PREDICTOR VARIABLES
IN THE PRESENT STUDY AND IN THAT OF
SHULMAN, LOUPE AND PIPER*

	Present Study (1969), N=60					Shulman, Loupe and Piper (1968), N=56				
Beliefs	1	x				1	x			
Complexity	2	.62	x			2	.50	x		
Politics	3	.58	.29	x		3	.36	.23	x	
Word Association	4	.37	.36	.20	x	4	.36	.29	.39	x
		1	2	3	4		1	2	3	4

*For a N of 60 the probability of a correlation = .25 occurring by chance = .05, for N = 56, the critical value of r = .26.

Table 4.2 shows the intercorrelations among the four seeking-style predictors for the present sample and for that of Shulman, Loupe and Piper. A high degree of intercorrelation existed in both samples among the four variables. The patterns of intercorrelation appear to be quite similar although the sample correlation values with Beliefs appears to be slightly higher in the present sample than in the former sample. In general, the replication of the former sample in the present study is striking, particularly considering three factors: (a) The Word Associations and Politics scales were modified slightly in the present study, (b) the samples differed with regard to college status and homogeneity of major, and (c) the campus political climate has changed quite drastically in the past two years. These factors would tend to mitigate against replication; yet, in terms of tested entering characteristics, the two samples appeared quite similar.

Now that the replication of sample characteristics has been established, the focus will change to consider the effects of the training. The entering characteristics of the sample will be considered again when the experimental hypotheses are formally tested.

Immediate Effects of Training

The reader will recall that the present study was a two stage experiment: the first stage being the training and the second being transfer of the learned skills to the Teacher's In-basket situation. Before any differences in performance on the Teacher's In-basket can be attributed to the training, it must first be established by immediate post-test that the training was effective in achieving the stated objectives. In order to determine the effect of the training, the problem-solving group was compared to the control group on the problem-solving post-test. Since the hypotheses stated that the problem-solving training would increase competence or quality of problem resolution, that measure (P.S. Quality) will be used for the comparison.

TABLE 4.3

MEANS AND STANDARD DEVIATIONS COMPARED FOR THE PROBLEM-SOLVING
AND CONTROL GROUPS ON P.S. QUALITY

		Problem-Solving N=20	Control N=20	t	p
P.S. Quality	Mean	4.45	3.45	2.04	.025*
	S.D.	1.67	1.43		

*One-tailed test.

Table 4.3 indicates that the problem-solving training did, in fact, succeed in increasing inquiry competence within subjects so trained. The trained group differed significantly from the group given control training. Thus, any transfer effects of the training can be justifiably attributed to the effects of the training itself. Similarly, if there are no effects, it will be because the skills did not transfer, not because the training did not work. But, before the transfer effects of training are tested, it would be well to consider the characteristics of the dependent variables themselves.

Characteristics of the Dependent Variables

There were a number of measures of the inquiry process which were observed and recorded in the Teacher's In-basket. The variables measured aspects of the quantity of inquiry engaged in (Bits, Time), diversity of materials used (Sources, Mean Sources), amount of comparison between sources (Shifting), completeness of inquiry (Competence), and the sensitivity to the discrepant (Problem Sensitivity).

To ascertain that the dependent variables have essentially the same meanings as in prior studies (Shulman, Loupe and Piper, 1968), we can compare the means and standard deviations on the variables of the present study with those of Shulman, Loupe and Piper.

Comparison of the means and standard deviations for four basic inquiry variables indicates that the Teacher's In-basket functioned basically the same way in the present study as in the past. Likewise, the correlations among the inquiry variables within the present study replicated those found in Shulman, Loupe and Piper (see above section on correlations.) The means and standard deviations varied little

TABLE 4.4
COMPARISON OF MEANS AND STANDARD DEVIATIONS
OF BASIC INQUIRY SCORES FOR
SHULMAN, LOUPE AND PIPER (1968)
AND THE PRESENT STUDY (1969)*

		<u>Shulman Loupe and Piper</u>	<u>Present</u>
Problems	Mean	67.81	77.1
	S.D.	17.48	16.75
Sources	Mean	5.84	5.77
	S.D.	1.09	1.17
Bits	Mean	215.42	186.55
	S.D.	48.16	50.88
Time	Mean	120.00	129.35
	S.D.	20.37	31.77

*Competence is not compared because of
scaling differences in the two studies.

despite two important differences in the studies: (a) The subject population in Shulman, Loupe and Piper (1968) consisted of senior elementary education majors; in the present study the population had a much broader base; (b) The recording methods were refined for the present study allowing more accurate scoring of most of the variables; (c) Subjects were trained for the purpose of changing inquiry performance in the present study. The procedures used in the present study probably allowed for more accurate scoring of Problem Sensitivity while at the same time slightly underestimating Bits.

Evidently, then, level of the dependent variables measured in the Teacher's In-basket remained relatively constant across samples. Thus, not only did the present sample replicate the selection characteristics

of the sample in Shulman, Loupe and Piper, but it also replicated the overall inquiry performance of the former sample. To aid the reader in interpreting the results presented later in this chapter and in Chapter 5, it would help to discuss the intercorrelations between the dependent variables measured in the Teacher's In-basket.

TABLE 4.5

INTERCORRELATIONS AMONG DEPENDENT MEASURES OF INQUIRY, N=60*

Bits	1	x							
Time	2	.54	x						
Total Sources	3	.65	.53	x					
Mean Sources	4	.56	.48	.84	x				
Shift	5	.90	.48	.75	.68	x			
Problems	6	.41	.41	.60	.52	.51	x		
Competence	7	.21	.35	.39	.29	.33	.63	x	
Mean Competence	8	.00	.20	.25	.38	.09	.37	.71	x
	1	2	3	4	5	6	7	8	

*For N=60, the probability of a correlation .25 occurring by chance = .05.

The correlations in Table 4.5 indicate that the dependent measures of inquiry were intercorrelated at a rather high and significant level. The high correlations among Shifts, Bits and Sources reflect the dependency between these measures in scoring. Bits placed the upper limit on Shifts and Sources defined the lower limit. If a person never consulted two consecutive pieces of information in the same source category Shifts would equal Bits. Likewise, if a person gathered all desired information in a particular problem from a source category and

never returned to it, Shifts would equal Sources. The other correlations indicate significant relationships between the process and outcome measures of inquiry with one notable exception. Mean Competence, one's competence in resolving those problems into which he inquired, was significantly correlated with Mean Sources (.38) and Problem Sensitivity (.37). It was uncorrelated with Bits (.00) and Shifting (.09). Evidently Competence in problem resolution was related to the diversity of one's search primarily with regard to the problem under investigation. The amount of overall searching (Bits) gave no clue as to one's effectiveness in problem resolution (Competence).

Table 4.5 also shows the correlations of Problem Sensitivity, Bits, and Shifts with Time. The correlations of the primary scores are very similar to the corresponding correlations found by Shulman, Loupe and Piper (1968). This indicates a rather high constancy of these particular relationships over time and across subject samples. Problems, Bits, and Shifting were significantly related to the time spent in inquiry. The more time, the more problems sensed, the more bits of information used the more cognitive shifting in which the subject engaged.

Finally, before the hypotheses are tested, it is necessary to define the relationship between the problem-solving test and the dependent inquiry measures of the Teacher's In-basket. To the degree that they measure the same things one would expect training to effect performance on the In-basket.

Table 4.6 shows the correlations between the scores derived from the problem-solving test, P.S. Steps and P.S. Quality, and the inquiry variables of the Teacher's In-basket. The problem-solving test was a paper and pencil situation in which the subject was to take on the role

TABLE 4.6

CORRELATIONS BETWEEN SCORES ON THE PROBLEM-SOLVING TEST
AND DEPENDENT INQUIRY VARIABLES, N=60*

	<u>P.S. Steps</u>	<u>P.S. Quality</u>
Bits	.31	.16
Time	.24	.48
Total Sources	.36	.39
Mean Sources	.33	.37
Shifts	.31	.24
Problems	.19	.33
Competence	.28	.39
Mean Competence	.22	.33
General Inquiry	.33	.45

*For N=60, the probability of a correlation .25 occurring by chance = .05.

of an employment counselor and find out why the man in the situation could not keep a job. The basic problem was stated. Information to solve the problem was available through a branching index system. P.S. Steps was the number of pages of information consulted and P.S. Quality was the rated completeness of the solution. All but three of the eighteen correlations between the problem-solving test and the In-basket measures are significant. Interestingly, P.S. Steps was most highly correlated with Bits, and Sources, measures of amount of inquiry. P.S. Quality was more correlated with Time, Competence and General Inquiry. In the problem-solving test the task was well defined; in the Teacher's

In-basket, it was not. The problem-solving test included but one basic problem, the Teacher's In-basket included many. There was no direct content overlap between the two situations other than both were in the realm of social sciences. However, evidently the structural nature of the two tasks was similar; both required inquiry through use of various source materials in an unspecified sequence, with point of termination and amount of inquiry needed to be determined only by the participant. Thus, there was some reason to suspect that the differences between training groups found in the training post-test would be found in the transfer task as well. The next section will test the experimental hypotheses to see what effect training, seeking-style and cueing had on subsequent inquiry performance.

Tests of the Hypotheses

Before testing the hypotheses it would be well to review the nature of this particular experimental design. The research reported here is only part of a broader research project being carried out by this writer and Piper (1969). There were two training procedures, problem-solving and openness, to be compared with the control. In addition there were two other experimental factors, seeking-style and cueing, each of which had two levels. The comparisons between the two levels of seeking-style (Dialectical and Didactic) and the two levels of cueing (Cued or Non-cued) were germane to both studies. However, tests for transfer of training for individual treatments could only be made post-hoc. The hypotheses of the two studies overlapped with regard to the dependent variables and thus orthogonal planned comparisons were not possible. Hypotheses concerning training were tested by Analysis of Variance for an overall training effect. In this section, each hypothesis will be tested separately.

TABLE 4.7

**MEANS AND STANDARD DEVIATIONS OF INQUIRY VARIABLES AND POST-TEST SCORES
FOR THE THREE TRAINING GROUPS**

		<u>Control</u> <u>N=20</u>	<u>Problem-Solving</u> <u>N=20</u>	<u>Openness</u> <u>N=20</u>
P.S. Steps	Mean	9.25	8.90	9.70
	S.D.	5.30	3.82	5.23
P.S. Quality	Mean	3.45	4.45	4.20
	S.D.	1.43	1.67	2.61

Bits	Mean	170.85	186.70	202.10
	S.D.	46.40	48.90	54.61
Time	Mean	119.10	129.25	139.70
	S.D.	29.37	24.78	37.91
Total Sources	Mean	53.40	58.75	55.90
	S.D.	12.29	12.65	11.80
Mean Sources	Mean	5.61	6.27	5.44
	S.D.	1.22	1.07	1.11
Shifts	Mean	113.25	137.10	137.70
	S.D.	42.04	48.39	54.42
Problems	Mean	75.50	78.65	77.15
	S.D.	16.61	14.90	19.19
Total Competence	Mean	25.45	26.40	26.70
	S.D.	3.36	3.65	3.97
Mean Competence	Mean	2.74	2.90	2.71
	S.D.	.26	.34	.39
General Inquiry	Mean	144.90	153.90	151.45
	S.D.	24.91	21.69	28.33
Problems/Time	Mean	.65	.63	.58
	S.D.	.15	.16	.14
Bits/Time	Mean	1.47	1.46	1.52
	S.D.	.33	.37	.31
Shift/Time	Mean	.95	1.08	1.02
	S.D.	.25	.38	.29

Training

We have observed that the problem-solving group was significantly higher than the control group on P.S. Quality, the competence measure of the problem-solving test, demonstrating that the training did have an immediate effect on those trained.

Table 4.7 summarizes the scores on the problem-solving test and the Teacher's In-basket for the three training groups. The only contrast in which there was a clear effect for training was for Mean Sources ($F = 2.98$, $p = .06$). Thus, the training succeeded in increasing the diversity of the source base which subjects consulted during inquiry. This was expected. However, differences in Mean Competence, Problem Sensitivity and Shifting were also hypothesized. Closer inspection of Table 4.7 shows that, within this sample, the problem-solving group exceeded the control group on those measures and all other dependent measures of inquiry (however, it must be remembered that many of the differences were quite small). The interpretation is difficult--the hypotheses were supported with regard to Mean Sources and formally rejected with regard to the other variables although a definite trend was observed.

Seeking-Style

Another of the hypotheses regarded seeking-style. Dialectical seekers were expected to surpass Didactic seekers in all measures of Inquiry. Table 4.8 lists the means and standard deviations necessary to test this hypothesis.

Table 4.8 shows that, within the sample, Dialecticals surpassed Didactics in all measures of inquiry. However none of the differences on measures from the Teacher's In-basket were either psychologically or

TABLE 4.8

**MEANS AND STANDARD DEVIATIONS FOR DIALECTICAL AND
DIDACTIC SEEKERS ON SELECTED INQUIRY MEASURES**

		<u>Dialectical</u> <u>N=30</u>	<u>Didactic</u> <u>N=30</u>
Problems	Mean	78.10	76.10**
	S.D.	16.35	17.37
Kits	Mean	189.87	183.23 *
	S.D.	52.14	50.27
Time	Mean	133.07	125.63**
	S.D.	35.92	27.15
Mean Sources	Mean	5.84	5.7 *
	S.D.	1.24	1.11
Competence	Mean	26.33	26.03 *
	S.D.	3.05	4.21
Shifts	Mean	129.60	129.10
	S.D.	53.71	44.80
General Inquiry	Mean	152.20	147.97 *
	S.D.	24.23	25.97
P.S. Quality	Mean	4.46	3.60
	S.D.	2.27	1.57

*This contrast was significant beyond $\alpha=.05$ during one administration in the study by Shulman, Loupe and Piper (1968).

**This contrast was significant beyond $\alpha=.05$ during both administrations in the study by Shulman, Loupe and Piper (1968).

statistically significant. Interestingly, Dialecticals performed significantly better on the problem-solving post-test (P.S. Quality) than did the Didactics. Thus, with regard to the problem-solving test, the hypothesis was correct. With regard to the Teacher's In-basket the hypothesis was rejected.

To describe the relationship between seeking-style and inquiry further we can look at the intercorrelations between the individual variables pooled into the seeking-style predictor and the inquiry variables themselves.

TABLE 4.9
CORRELATIONS BETWEEN SEEKING-STYLE PREDICTORS
AND INQUIRY VARIABLES, N=60*

	<u>Beliefs</u>	<u>Complexity</u>	<u>Politics</u>	<u>Word Association</u>
Bits	.14	.14	.14	.19
Time	.02	.13	.05	.14
Total Sources	.12	-.04	.00	.35
Mean Sources	.03	-.10	-.05	.26
Shifts	.07	-.01	.07	.11
Problems	.02	-.04	-.04	.14
Competence	.02	-.02	-.05	.18
Mean Competence	-.04	-.08	-.13	.13
General Inquiry	.07	-.02	-.04	.26

*For N=60 the probability of a correlation .25 occurring by chance = .05.

Table 4.9 shows that the only significant correlations between the seeking-style predictors and inquiry are with Word Associations. This, of course, is counter to the findings of Shulman, Loupe and Piper. Chapter 5 will address this discrepancy and attempt to explain it in terms of sample characteristics. The next section will be concerned with the effect of cueing and interactions.

Cueing and Interactions

TABLE 4.10

MEANS AND STANDARD DEVIATIONS OF INQUIRY VARIABLES
FOR THE CUED AND NON-CUED GROUPS

		Cued N=30	Non-cued N=30
Bits	Mean	184.77	188.33
	S.D.	45.08	56.83
Time	Mean	126.73	131.97
	S.D.	33.74	30.06
Total Sources	Mean	55.13	56.90
	S.D.	11.08	13.44
Mean Sources	Mean	5.75	5.79
	S.D.	1.15	1.21
Shifts	Mean	127.27	131.43
	S.D.	44.20	54.20
Problems	Mean	76.30	77.90
	S.D.	17.59	16.13
Competence	Mean	26.10	26.27
	S.D.	3.76	3.59
Mean Competence	Mean	2.81	2.75
	S.D.	.38	.29
General Inquiry	Mean	148.77	151.40
	S.D.	25.36	24.98
Bits/Time	Mean	1.53	1.44
	S.D.	.36	.30
Shifts/Time	Mean	1.05	.98
	S.D.	.35	.28
Problems/Time	Mean	.64	.61
	S.D.	.17	.14

Table 4.10 presents the means and standard deviations necessary to test the third hypothesis that the means for the cued group will not exceed those of the non-cued group against the alternative that the cued group will exceed the non-cued group. As can be seen from the table, the means for the two groups did not differ. In fact, they were almost identical. If any trend is to be seen, it is that the cued group scored lower on the basic inquiry measures and moved at a quicker tempo. However, the sample differences are very small indeed. These results tend to confirm the present writer's feeling that a simple cue alone would be insufficient to influence one's performance in a situation as complex and open as the Teacher's In-basket.

Although no effects for cueing were expected, the fourth hypothesis predicted that cueing would interact with training such that the means for those groups both cued and trained would exceed those trained but not cued. No such difference was expected within the control-trained groups.

TABLE 4.11
COMPARISON OF MEANS FOR THE TREATMENT X CUEING INTERACTION*

	<u>Cued</u>			<u>Non-Cued</u>		
	Control N=10	Problem Solving N=10	Open N=10	Control N=10	Problem Solving N=10	Open N=10
General Inquiry	149.7	158.6	138.0	140.1	149.2	164.9
Problems	80.4	81.1	67.4	70.6	76.2	86.9
Mean Sources	5.74	6.57	4.95	5.47	5.98	5.92

*In considering the interactions, means will be presented only for those interactions significant beyond $\alpha=.10$.

Analysis of variance showed that there were statistically significant interactions between training and cueing for three inquiry variables, General Inquiry ($F = 3.47$, $p = .04$), Problem Sensitivity ($F = 4.50$, $p = .02$) and Mean Sources ($F = 2.56$, $p = .09$). However, the nature of the interaction was contrary to that stated in the hypothesis. Comparison of the means in Table 4.11 shows that cueing facilitated performance of the control group and the problem-solving group. This is contrary to the author's expectation but is consonant with other experimental literature on cueing in less complex situations (see Colgrove, 1968). However, inquiry performance of the cued, openness group was considerably lower than that of the non-cued openness group.

TABLE 4.12
MEANS FOR SELECTION X CUEING INTERACTION

	Dialectical		Didactic	
	<u>Cued</u> N=15	<u>Non-Cued</u> N=15	<u>Cued</u> N=15	<u>Non-Cued</u> N=15
Bit/Time	1.42	1.55	1.59	1.37
Shift/Time	.91	1.07	1.15	.94

The final hypothesis that training will interact with seeking-style was not supported. None of the contrasts were significant.

One additional result which does not relate to the experimental hypotheses involves the interaction of selection x cueing. Table 4.12. shows the means for Bits/Time ($F = 3.10$, $p = .08$) and Shifts/Time ($F = 4.09$, $p = .05$). The net affect of this interaction was that cueing tended to slow the inquiry tempo (the rate at which the inquirer used

information, shifted, etc.) for Dialectical seekers and increase the tempo for Didactic seekers. There were very few differences noted in the results and yet many were expected. Before the results are summarized it might be well to look at the relationships between CQT, G.P.A. and inquiry to see if this might provide grounds for interpretation of the results in the next chapter.

CQT, G.P.A. and Inquiry

TABLE 4.13

CORRELATIONS BETWEEN CQT TOTAL, COLLEGE GRADE POINT AVERAGE
AND THE DEPENDENT INQUIRY VARIABLES, N=60

	<u>CQT Total</u>	<u>G.P.A.</u>
Bits	.10	-.05
Time	-.07	-.09
Total Sources	.25	.22
Mean Sources	.28	.28
Shifts	.04	-.02
Problems	.31	.24
Competence	.14	.15
Mean Competence	.18	.24
General Inquiry	.28	.24

Table 4.13 shows the correlations of inquiry with CQT Total and G.P.A. The correlations between G.P.A. and mean sources (.28), problem sensitivity (.24), mean competence (.24) and total sources (.22) indicate that G.P.A. was more related to quality of inquiry within

a problem than overall commitment to inquire. Interestingly, CQT Verbal and Numerical scores correlated with different inquiry measures. CQT Verbal correlated significantly with Problem Sensitivity (.29) and Competence (.37). CQT Numerical correlated significantly with Mean Sources (.28) and Problem Sensitivity (.31). Overall General Inquiry correlated .22 with CQT Verbal, .25 with CQT Numerical, and .28 with CQT Total. Within the present study it appears that there was more relationship of inquiry with intellectual ability than with seeking-style. However, although significant, these correlations were very small indeed.

Summary

- (1) Results of the experiment demonstrated consistency of the Teacher's In-basket as a research instrument. Means of inquiry measures and their intercorrelations remained stable across subject pools and years. Likewise, the concept of seeking-style types was confirmed by replication of the intercorrelations between seeking-style components.
- (2) However, seeking-style was not a significant determinant of inquiry performance in the present study. The differences between Dialectical and Didactic group means were in the predicted direction, but the magnitude was not sufficient to make them reliable.
- (3) The training groups differed significantly only in Mean Sources. However, in this sample the problem-solving group differed from the control group on all measures of inquiry and all differences were in the predicted direction,

although the differences were not large enough to justify generalizing.

- (4) Cued subjects did not differ significantly from non-cued subjects in overall inquiry performance.
- (5) Cueing interacted with training such that it tended to decrease inquiry performance of those trained in openness.
- (6) Selection interacted with cueing such that inquiry tempo (Bits/Time, Shifts/Time) was increased for Didactics and decreased for Dialecticals.

In Chapter 5 the author will look more closely at some of these findings and attempt to explain and interpret the results of this experiment.

CHAPTER 5

DISCUSSION OF RESULTS

One of the basic premises of this research was that inquiry effectiveness was a function of two very different factors; commitment to inquire, which determined the quantity of inquiry in which one engaged (Time, Bits); and skill or effectiveness once engaged in inquiry (Mean Sources, Mean Competence, Shifting). Commitment to inquire was thought to be determined by personality characteristics such as openness and preference for the complex. Thus, the personality composite was called seeking-style predisposition. Skill or effectiveness in inquiry was thought to be related to the skills of information organization and search variously connected with problem-solving, scientific inquiry, etc. Both of these factors (commitment and effectiveness) were felt to contribute to the overall outcome of inquiry; namely, competence of problem resolution.

This experiment also distinguished between entering characteristics and newly learned skills and attitudes. Commitment to inquire considered as an entering characteristic, was measured by using a composite of personality measures collectively called seeking-style. It was manipulated as a learned set of predispositions by Piper (1969) through the use of training in openness. Skill or effectiveness in inquiry was manipulated in the present study through training in problem-solving, but in neither study was skill in inquiry explicitly considered as an entering characteristic.

This distinction between entering characteristics and new learning is of prime importance when considering the results. Inquiry performance measured in the Teacher's In-basket was explicitly considered a function of commitment to inquire and skill in inquiry. Both facets of commitment (entering characteristic and new learning) were considered. Only one facet of inquiry skill was considered: the newly learned strategy. The other facet of inquiry skill, knowledge and skill possessed by the subject at the beginning of the study, was ignored and was presumed to be randomly distributed. However, the results indicate that these entering skills may have had a major effect on subject's performance. We will attempt to reconstruct the group nature of these skills later in this chapter (particularly with reference to seeking-style). However, the principle emphasis of this chapter will concern commitment as an entering characteristic (seeking-style) and the newly learned strategies of problem-solving.

A third factor in the experiment of less central interest was cueing. It was thought that cueing might aid the subject in transferring newly learned abilities to the Teacher's In-basket and thus aid the experimenter in distinguishing between inquiry performance and capability. With cueing, performance would presumably be closer to the level of capability than without. Results showed no overall main effect for cueing; thus, it will be discussed only in terms of its interactions with entering characteristics and new learning.

Predicted Commitment: Seeking Style

One of the basic hypotheses of the study was that Dialecticals would be more effective inquirers than Didactics and that this would be due largely to a greater commitment to inquire on the part of the

Dialecticals. It was thought that this commitment would be reflected in increased Time and greater inquiry effectiveness. However, the means of the Dialectical and Didactic groups differed very little on any of the inquiry variables. Dialecticals spent an average of seven minutes longer in inquiry than Didactics. In the research by Shulman, Loupe and Piper (1968) this difference was more on the order of twenty minutes, or 2 1/2 times the present differential. Dialecticals in the study by Shulman, Loupe and Piper (1968) were significantly better inquirers during the first administration of the Teacher's In-basket in terms of Problems Sensed and Time Spent. In that study it was not until the second administration that the Dialecticals were clearly superior inquirers to the Didactics on the other inquiry criterion measures. However, the present sample of Dialectical seekers did not even exceed the Didactics in Time, the most clearcut indication of commitment to inquire. The problem is to consider a number of alternative explanations for the discrepancy.

The first possibility is that differences in intelligence or aptitude in favor of the Didactic group may have confounded the findings. The results did show a small, but significant, relationship between CQT Total, G.P.A. and inquiry. However, there were no differences between Dialecticals and Didactics with regard to those measures.

Another alternative to consider is that the effect of cueing may have interacted with seeking-style to mask the effects of seeking-style. Cueing did, in fact, interact with seeking-style and in a disordinal manner. The effect of cueing on Dialectical subjects was precisely the opposite of its effect on Didactic subjects. This is most apparent on the measures of inquiry tempo.

Recall that tempo was the rate at which one inquired while in the situation. Tempo measures were derived by simply dividing Time into another inquiry measure such as Bits or Sources (Bits/Time, Sources/Time). The resultant ratio described the number of Bits, Sources, etc. per minute used by the inquirer and thus gave an indication of the pace at which she inquired as opposed to her overall amount or quality of inquiry.

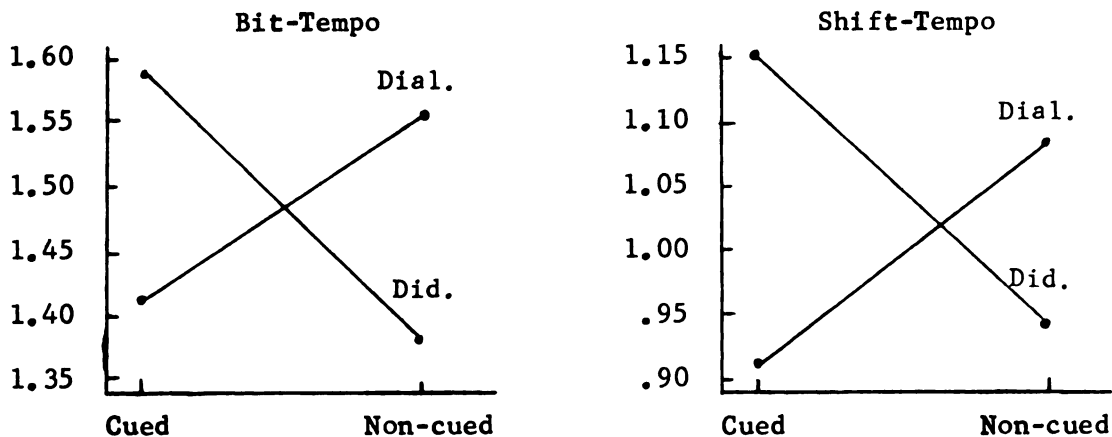


Figure 2. Mean Scores for Dialectical and Didactic, Cued and Non-Cued Groups on Bit and Shifting Tempo

Figure 2 shows that for Dialectical subjects, cueing had the effect of slowing inquiry tempo and for Didactics it had the opposite effect of increasing tempo. Both of these interactions were significant (Bits/Time, $F = 3.10$, $p = .08$; Shifts/Time, $F = 4.08$, $p = .05$, see Tables D-6 and D-7). Cueing may have had this strange effect because the cue itself was too ambiguous or, because when cued to behave in a rather undefined manner, one assumes that this requires a basic change in behavioral style, away from one's preferred style.

This interaction can also be explained by inspecting the CQT scores. Figure 3 shows the mean CQT Total scores for Dialectical and Didactic, cued and non-cued groups. Notice that the pattern is exactly the opposite from that of the tempo scores. It could be that intellect has the

effect of slowing one's tempo thus allowing careful consideration of information. This is borne out to some degree by the correlation between CQT Total and Bit tempo ($r=.31$).

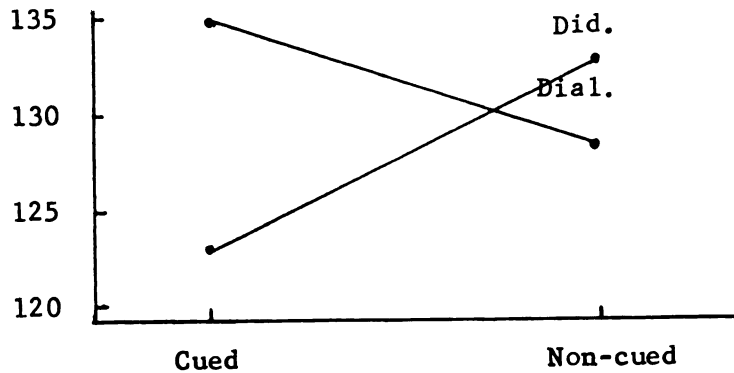


Figure 3. Mean CQT Total Scores for Dialectical and Didactic, Cued and Non-Cued Groups

However, as we have already seen, CQT or G.P.A. do not supply legitimate explanations for the findings of no differences between Dialecticals and Didactics, nor do interactions or sampling errors. In Chapter 4 we established very clearly that the present sample was a close replication of the sample used by Shulman, Loupe and Piper in which Dialecticals and Didactics did differ in commitment to inquire (Administrations I, II) and competence of inquiry (Administration II only). Yet the present sample just as clearly did not replicate those findings.

The only entering characteristics not replicated by this sample were status measures such as age, number of years in college, college major, etc. Presumably, such differences in status would indicate differences in status and variability on skills which would greatly influence ability to inquire effectively in the Teacher's In-basket situation. In particular, skill in problem-solving and familiarity with the late elementary

educational setting were probably different in the two samples. The members of the present sample, for the most part, were beginning students in education considering education as a professional choice. They certainly were not as committed to their choice in terms of time spent and energy exerted as the members of the previous sample. Also, their interests in education were not necessarily with elementary aged children. It is fair to assume that a group homogeneous in its commitment to elementary education would probably have more knowledge about the nature of children's problems at that age than a group whose members were not so homogeneous in interest.

Another facet of non-replication involves specific knowledge about the In-basket. Students in their final year of teacher preparation would, most likely, have some knowledge about testing procedures and would be able to interpret simple normed testing scores. Likewise, they would probably have some average expectancies regarding social interactions, physical appearance and academic abilities of an hypothetical group of students. It is doubtful to this writer that a group of college sophomores in the introductory course in education would possess such sophistication.

It is very possible that in a situation as complex as the Teacher's In-basket, supplementary stores of information such as Reference Memory are simply not sufficient to make up for a deficit in knowledge. Without a minimal amount of this particular knowledge it is doubtful that one could even see a problematic situation. As such, commitment to inquire and perceptual sensitivity to the discrepant would be irrelevant. Seeking-style is a viable dimension only when working in a realm with which all are familiar. This generalization is supported by the finding that Dialecticals were superior to Didactics in P.S. Quality, a measure

of competence on the problem-solving test (see Table D-2, $F=2.84$, $p=.10$). In a situation in which all had sufficient entry skills to operate adequately, seeking-style was a relevant dimension.

Actual Commitment: Time in Inquiry

Prediction of commitment to inquire via the seeking-style dimension did not meet with notable success in the present study although there appeared to be at least one cogent explanation for the lack of results. However, we have not yet addressed a more central question: To what extent does actual commitment to inquire influence inquiry performance? Time spent in inquiry will be used as an indication of actual commitment to inquire.

The reader will recall that time spent in inquiry was correlated with other inquiry variables, such as Bits, which tended to reflect overall amount of inquiry. Results showed that those remaining in the situation longer also chose to inquire into more problem areas. Time indicated overall amounts of inquiry. However, there were also qualitative differences in inquiry which were related to time spent.

The correlations between Time and the ratio of the primary measures with Time disclosed a pattern of tempo which may be a characteristic of the process of inquiry. Table 4.1 shows these correlations. Notice the high and significant negative correlations between the Bits and Shifts ratios and Time. This pattern can be interpreted in two ways. First, there may have been a ceiling effect such that once a person spent a certain amount of time in the situation she had used all of the available bits. Second, those that took more time in the In-basket may simply have moved at a slower pace. The second alternative is supported by the $-.37$ correlation between Shifts Tempo and Time. Clearly, there is no ceiling for shifting. Shifting is simply a style

TABLE 5.1

COMPARISON OF THE CORRELATIONS OF INQUIRY VARIABLES
AND TEMPO VARIABLES WITH TIME, N=60*

	<u>Time</u>
Bits	.54
Shifts	.47
Problems	.41
Bits/Time	-.56
Shifts/Time	-.37
Problems/Time	-.12

*For N=60, the probability of a correlation of
.25 occurring by chance=.05 (two-tailed test).

measure and gives no direct index of quantity of information used. Notice, however, the correlations between Problem Sensing tempo and Time (-.12). There is no systematic way in which overall time spent influences one's tempo in sensing problems.

Those spending more time in the In-basket moved at a slower pace and yet sensed more problems. To borrow an analogy from Shulman, the film speed (intelligence) of the cameras (inquirers) may have been the same, but the light was rather dim (structure of the task), so a slowing of the shutter produced a better picture. Moving quickly and spending little time may have proved an inefficient strategy because it did not allow sufficient exposure to sense problems. Thus, commitment to inquire (Time) had its effect on inquiry performance (increased Sources, Shifts, Problem Sensed, and Competence increased with Time) not only through a simple increase in Time spent. Commitment to inquire seemed to determine qualitative aspects of the inquiry process. Those spending a long time

in inquiry were slower moving but this slow tempo evidently enabled them to make more effective use of the information available. Thus, they sensed more problems and resolved them more competently.

Changes in commitment to inquire as a function of training and the effects of such changes on subsequent inquiry behavior are discussed in full by Piper (1969). The basic findings of that research indicate that short-term training can affect changes in commitment. Subjects so trained spent more time and used more bits of information during inquiry than subjects not given training. However, these changes in commitment were not reflected by concomitant changes in inquiry competence. This, as well, may be due to a masking of effects by large variation in subjects' entering characteristics. That a change in commitment to inquire can be induced was demonstrated; that such a change has an effect on the outcomes of inquiry was not.

Skill in Inquiry: New Learning

The other phase of the present study involved training subjects in problem-solving in order to improve the effectiveness of their inquiry efforts. As was mentioned in the introduction and review of literature, the characteristics of the problem-solving training were derived from a number of sources to insure generality and transfer from the training to testing situations. Also, there were two stages to the experiment; the first to establish if the training procedure worked and the second to check for transfer of the skills into the Teacher's In-basket situation.

In Chapter 4, the results were analyzed by analysis of variance to test the main experimental hypotheses. Additional analyses presented in this chapter to compare the problem-solving group to the control will make use of t tests. Because there were two training treatments to be

compared with one control, all comparisons of interest were not possible within an orthogonal set of planned comparisons. Therefore, the t tests presented in this chapter comparing the groups on the Teacher's In-basket were done only for exploratory purposes and cannot be considered fully legitimate tests of hypotheses. Because they are not orthogonal with a similar set of F tests presented by Piper (1969) the probability levels reported are adjusted to $2 \times \alpha$. Thus, the actual alpha level of the test is less than or equal to that reported. To review the hypotheses, the problem-solving group was expected to surpass the control group in P.S. Quality (the problem-solving post-test), Mean Sources, Shifts, Problems and Mean Competence.

TABLE 5.2

MEANS AND STANDARD DEVIATIONS ON SELECTED VARIABLES
COMPARED FOR THE PROBLEM-SOLVING AND CONTROLS GROUPS**

		Problem-solving N=20	Control N=20	t	p
				—	—
P.S. Quality	Mean	4.45	3.45	2.04	.025
	S.D.	1.67	1.43		
Mean Sources	Mean	6.27	5.61	1.82	.10 *
	S.D.	1.07	1.22		
Shifts	Mean	137.10	113.25	1.66	.20 *
	S.D.	48.39	42.04		
Problems	Mean	78.65	75.50	.63	.80 *
	S.D.	14.90	16.61		
Mean Competence	Mean	2.90	2.74	4.52	.002*
	S.D.	.34	.26		
General Inquiry	Mean	153.90	144.90	1.30	.20 *
	S.D.	21.69	24.91		

*Because these tests are not orthogonal with a similar set of comparisons found in Piper (1969), the reported probabilities have been adjusted to the maximum, $2 \times \alpha$. To the degree that the tests are independent of those in Piper, the actual probabilities are reduced.

**These tests are one-tailed because the hypotheses are directional.

Table 5.2 compares the means and standard deviations for the problem-solving and control groups on the problem-solving post-test and on the inquiry variables. As stated in Chapter 4 the problem-solving group was significantly better on P.S. Quality than the control group ($t = 2.04$, $p < .025$). The training evidently succeeded in improving competence of inquiry in relatively simple situations. An overall analysis of variance showed a main effect for training on that variable ($F = 2.98$, $p = .06$). Table 5.2 confirms the effect by showing that the problem-solving group exceeded the control group in Mean Sources. The p value for the t test is greater than that for the F test because the openness group was actually lower than the control group on Mean Sources. It also shows that the problem-solving group exceeded the control group in Mean Competence. The direction of the differences on all of the variables listed is provocative. It appears that the problem-solving training has a positive effect on inquiry performance but the effect is unambiguous only with regard to Mean Competence and Mean Sources.

An increase in Mean Sources was clearly to be expected if the objectives of the training were met. This was a clear demonstration of transfer of the problem-solving strategy since the training procedure never aimed directly at increasing diversity of search. It was assumed that if the inquirer generated hypotheses, developed testing plans, searched according to the testing plan, and finally, used information to reformulate the problem, this would result in a greater diversity of information used to solve a problem. This assumption was supported. It has been demonstrated that planned, systematic inquiry results in use of a wider range of information. It also appears that this broader information usage results in more competent problem resolution although this cannot be said with as much certainty.

The hypotheses of the experiment also predicted an advantage in Shifting, Problems and General Inquiry. The results here are much less clear. There appears to be a trend toward training advantage in these areas but the interpretation of such trends is purely speculative. The differences are of considerable magnitude, and yet many are not large enough to be considered significant.

Acknowledging the possibility that the training did effect inquiry performance positively, one must ask about the nature of the effects. First, the training was short term and very compact. Its effects may have been somewhat labile. This can be seen in comparing the correlations of P.S. Quality with other inquiry variables within groups (Table 5.3). The correlations of P.S. Quality were substantially lower in the problem-solving group than in the control group, with all variables except General Inquiry, Problems and Competence.

The subsequent inquiry skills of the control group were reflected quite accurately by the problem-solving test. This was not so with the problem-solving group. It may be that skills which they demonstrated at the time of the problem-solving test were deteriorating by the time of the Teacher's In-basket -- thus, the reduced correlations. Notice also that the problem-solving training may have reduced the correlation between CQT Total and some measures of inquiry performance. The comparison of correlations between CQT Total, Bits, Time and Competence were most striking. Within the control group these variables were highly correlated. The bright subject consulted more bits of information, took more time and solved more problems competently than did her dull counterpart. Within the problem-solving group this was not so. The bright subject tended to take less time and solve fewer problems than did her dull counterpart. However, those which she did solve were well done.

TABLE 5.3

WITHIN-GROUP CORRELATIONS OF CQT AND P.S. QUALITY
WITH INQUIRY VARIABLES*

	Control N=20		Problem-Solving N=20	
	CQT Total	P.S. Quality	CQT Total	P.S. Quality
General Inquiry	.47	.57	.10	.44
Bits	.55	.58	-.04	.01
Time	.26	.54	-.23	.02
Total Sources	.38	.59	.10	.25
Mean Sources	.35	.61	.36	.24
Shifts	.36	.65	-.04	.20
Problems	.40	.47	.30	.40
Competence	.43	.39	-.14	.35
Mean Competence	.30	.30	.25	.14
P.S. Bits	.26	.55	-.12	.20
P.S. Competence	.18	x	.21	x

*For N=20, the probability of a correlation of .44 occurring by chance=.05.

In general, the problem-solving training tended to improve the quality of problem resolution (Mean Competence) through increasing the use of varied sources and increasing the amount of comparison between sources of information. It did not substantially increase the number of problems sensed or overall competence because it did not aim at, nor did it accomplish, an increase in general commitment to inquiry as did the openness training.

Summary

In summary, the fact that entering characteristics which would directly affect one's inquiry ability were not considered in the experimental design probably is a very important contributor to the lack of significant results. Seeking-style was found to be a significant determiner of inquiry performance (as it was in the past) except that it effected inquiry performance only on the problem-solving post-test. Seeking-style as here measured is a rather powerful determiner of inquiry performance, but only when certain necessary conditions are met. The prime condition is that all subjects enter the situation with the complete set of prerequisite skills and knowledge. With this condition met, Dialectical seeking-style leads to improved inquiry effectiveness through increasing commitment to inquire.

Commitment to inquire seems to have ramifications beyond simple amounts of time spent. It tends to slow one's tempo to the point that information used is thoroughly used and problems within information are sensed.

The study also demonstrated that short term training or problem-solving strategies was possible. To a certain extent these skills transferred into a very complex situation requiring considerable time and effort. The magnitude of the transfer effects was not as great as expected, nor were the effects of the training particularly stable. However, it is encouraging that transfer did occur at all. This demonstrates that there does exist a general set of problem-solving or inquiry strategies and that these strategies are teachable.

Chapter 6 will conclude this document with a summary of results and a final discussion of implications.



CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS

The present writer and Richard M. Piper (1969) collaborated in a two-part experiment, the purpose of which was to improve the inquiry performance and effectiveness of a group of female college sophomores. The goal was to train subjects in either problem-solving strategies or in openness and then determine whether the training improved inquiry in an entirely different situation, the Teacher's In-basket.

A person is inquiring when he asks questions concerning problems he has sensed and to which he seeks answers. The person is engaging in inquiry when he first senses that something, albeit undefined, is "wrong." Inquiry continues as the person focusses on a particular problem or problem-set, gathers information, tests hypotheses, reformulates the problem and gradually transforms the originally ambiguous, indeterminate situation into a situation of determinacy; he comes to know what is wrong, understands the situation, and if possible and appropriate, makes changes to eliminate the problem (Dewey, 1938). Such is the process which this research attempted to make more effective.

The basic rationale for the combined experiment was derived from previous research on inquiry by Shulman, Loupe and Piper (1968). They found that seeking-style, a composite of personality measures such as non-stereopathy, preference for complexity and willingness to risk, was a significant determinant of individual inquiry performance. They also found that the amount of shifting among information sources during

inquiry was significantly related to the competence of the inquiry, yet was not significantly related to seeking-style. Seeking-style was thought to affect inquiry by creating a commitment to inquiry -- the greater the commitment, the more extended the period of actual inquiry. Shifting, indicating the use of particular problem-solving strategies, had its effect on inquiry by increasing the competence of the inquiry in which one was engaged. Unlike seeking-style, it was not strongly related to the time spent in inquiry.

The present research aimed at facilitating inquiry through changing problem-solving skills; in one study, and the seeking-style determinants of inquiry, in a second investigation. The research reported here concerns changes in inquiry performance as a function of learned problem-solving techniques. Research dealing with changes in inquiry as a function of changes in seeking-style is reported by Piper (1969).

The present writer derived an idealized model of the problem-solving process from a number of sources and attempted to teach the strategies of the model in order to improve inquiry performance. The training procedure used detective mysteries as content to insure that subsequent changes in inquiry performance could be attributed to the strategy learned, rather than to familiarization with specific facts or principles.

The specific skills taught in the problem-solving training were problem sensing, problem formulation, hypothesis generation, hypothesis selection, search and reformulation or resolution. This procedure differed from Shulman's (1965) analysis of the inquiry process by adding the organizational steps of hypothesis generation and hypothesis selection. The problem-solving training was expected to increase inquiry competence by improving the effectiveness of the inquirer once he had

become engaged in the process. It was not expected to affect his fundamental commitment to inquiry.

This study also investigated differences in problem-solving effectiveness of Dialectical and Didactic seekers -- the seeking-style types of Shulman (1965) and Shulman, Loupe and Piper (1968) -- in order to provide a replication of previous findings and to determine if training had differential effects within these two types.

In addition to training and seeking-style, the experiment included studying the effect of cueing on inquiry. Cueing was included primarily to insure test transfer would occur from the training to the in-basket situations.

The general results were as follows:

1. Seeking-style was not a significant predictor of inquiry performance in the Teacher's In-basket; it was a significant predictor only on the simple problem-solving test used as the final stage of the training program. The problem-solving test was very simple in nature and required only that the subject have minimal general knowledge. The Teacher's In-basket, however, included much technical information about school policy, testing, and social interaction which one would not expect the average college sophomore to have mastered. Some subjects brought a wealth of this information with them into the in-basket; others brought none. It is very possible that seeking-style is a meaningful determinant of inquiry only when intellectual prerequisites have been met by all subjects (as with the present samples' performance on the problem-solving test, or Shulman, Loupe and Piper's sample of college seniors on the Teacher's In-basket). Otherwise, effects due to

predisposition may be masked by variation in performance due to differences in knowledge or aptitude.

2. Some small changes in inquiry behavior were effected by the training. Problem-solving training did increase the variety of information used in solving a problem (an indication of usage of problem-solving techniques). Openness training (Piper, 1969) did increase time spent and information used (an indication of increased commitment to inquire). Neither training resulted in significant changes in inquiry competence or in problem sensitivity. There were also small sample differences between trained and control subjects on a number of other dependent variables. These differences were always in the direction specified by the hypotheses but were not statistically significant.
3. There was no overall effect for cueing, nor did cueing interact with training as hypothesized.

Conclusions and Implications

The results of this study dealing with seeking-style suggest that research needs to be done to determine the effects of specific content knowledge on inquiry performance and competence within a particular area. This writer has been formally separating the effects of content knowledge on inquiry from those of process knowledge. The present research has addressed itself exclusively to the latter. A worthwhile study of the former might involve instruction of students in the content base of the Teacher's In-basket, such as the meaning of test scores, etc., to see if this significantly affects inquiry performance.

The results also indicate that training subjects in problem-solving strategies resulted in increasing the information source base which a subject consulted during inquiry. However, the changes in performance were not as broad as expected nor did they substantially affect the qualitative index of inquiry outcome, competence of problem resolution.

The differential results of the two training techniques confirms the distinction drawn by Shulman, Loupe and Piper (1968) between seeking-style with its concomitant commitment to inquire, and learned problem-solving strategies. The training procedures were each directed at one of the above factors (seeking-style or problem-solving strategy) and each succeeded, however marginally, in manipulating the target factor without affecting the other. Evidently the magnitude of these marginal changes was not sufficient to improve overall inquiry competence. It might be that seeking-style and problem-solving abilities interact in such a way that training in either component separately results in little change, as in the present study, but a positive change in both factors results in significant (statistically and psychologically) increases in inquiry effectiveness. There were no differences in competence attributable to training.

But why the emphasis on inquiry? Clearly, the ability and willingness to inquire competently are important, desirable and necessary. For example, the writer suspects that these skills and attitudes should markedly enhance the effectiveness of the classroom teacher in preparing for instruction and spontaneously reacting to her students. The relevance of these skills and attitudes is even more obvious in the case of the physician. Active research is now underway to determine those factors which influence a physician's diagnostic ability and to develop systematic ways of training these factors. If the results of

the present study are any indication, such training will be no simple task. Much more time and effort may be needed for such a training to succeed. One also wonders if the effects of training would be more lasting and more effective with younger people who had not yet developed their own patterns of thought and behavior when faced with a problem. These speculations, of course, suggest new and different programs of inquiry into the process of inquiry.

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APPENDIX A

APPENDIX A

PROBLEM-SOLVING TRAINING

The training procedure described here was for the purpose of training problem-solving techniques. A number of excerpts from Sherlock Holmes are included in the materials both as illustrations and exercises. Permission to reprint these excerpts was granted by the estate of Sir Arthur Conan Doyle, M.D.

The procedure makes use of ruleg and occasionally egrule sequencing of instruction. It was designed for use in groups of 6-8 where the instructor maintains a quick pace, directs questions to individuals in the group, stimulates maximum participation from each individual and provides guidance and reinforcement.

Remarks to the students are enclosed in quotation marks and are **pre-**sented in condensed form; those in parentheses are management directions.

Problem-Solving Training

"The purpose of this training is to improve our problem-solving skills. Teacher training simply hasn't done much to help new teachers either recognize or solve classroom problems, and yet in order to teach, particularly at the primary and secondary levels, you must be highly skilled in problem-solving."

"Can anyone tell why?" (ask individuals)

"Before we begin the formal training, I'd like you to take five minutes to approach a relatively simple situation and see if you can decide what the problem is." (pass out playground problem) "Please read the front page." (after all have read it) "For the moment pretend that you individually are the personnel staff. Try to decide what the problem is and how you would remedy it. All of the information you need has been gathered in the form of interviews, records, etc. and is available on the pages indicated in the table of contents. Don't just read through the booklet; only look at the pages which interest you as listed in the table of contents. When you turn to a page write down its number. After having read the information on a particular page, if you think you know what the problem is, write down the answer on your answer sheet; if not and you want more information,

look back to the table of contents and decide what you wish to see next. Any questions? OK, begin."

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(The frames of this problem were presented on separate pages fastened into a booklet.)

To: Personnel Staff

July 27, 1968 Intro.

From: J. Donlevy, Supervisor

Re: Miss Edith Johnson

Miss Johnson has recently brought to my attention the fact that the summer programs at Fisher playground seem to be deteriorating and the local children are not participating. She is extremely concerned about this and has requested that I consider replacing her.

She especially requested the assignment and has worked for the past two summers at other city playgrounds. She seems to have been quite successful and innovative in implementing programs.

Unfortunately, I will be out of state for the next 10 days so I will leave it to your office to decide whether to replace her or help her take care of the situation.

J. Donlevy

Frame 1

COMMENTS ON FISHER CHILDREN; Johnson, Edith

"The children in the Fisher area are nice I guess; I really haven't gotten to know them well. I've tried as hard as I can to help them; I even moved into the neighborhood.

"I set up new crafts programs, organized cultural tours, even set up teams for sporting events but the children stay away. It really doesn't matter what I do with a new program. The children come once and then drop out. I can't keep their interest. It's too bad but they are so attached to their cliques and gangs that it hampers organization for sports and cultural events."

Frame 2

COMMENTS ON JOHNSON by Fisher Children

"Oh, she's nice - but she bugs me about who I play with. I won't play with no one else and anyway, my friends are all right guys. Anyway, it's hot in that park."

"Miss Johnson is a nice lady. She talks to me alot about everything. She wants me to talk like her but my mom says I talk just fine."

"She's OK but not like Mr. Jackson. She all the time wants us clean and stuff. Anyway, it's hot and dusty in the park and you get dirty when you play. I want to make a leather vest but don't have no money so who cares about a vest?"

Frame 3

INTERVIEW: Previous Playground Supervisor

"As you know, I was at Fisher the last two summers always enjoyed the job, and the kids although the pay sure wasn't much for the time I spent.

"The older kids, boys and girls, were big on sports, played alot of baseball and basketball. They had their own pre-arranged groups which were highly competitive so the competitive activities were highly successful as long as no one tampered with the teams.

"They weren't much on crafts although they seemed to get a kick out of watching one demonstrate. No one ever really got involved in the crafts programs -- maybe they didn't like doing those kinds of non-competitive things -- they'd always say, 'Oh, I forgot the money.' I guess the most satisfying times for all of us were just sitting under the trees talking."

Frame 4

July 1967

Dear Mr. Donlevy,

We are writing to express our appreciation for your cooperation in the recreation program and to let you know what an asset Fisher playground has been to the neighborhood. Probably the best thing about it is the shady picnic and recreation area. It is about the only cool place where the kids can play in the summer. The programs are very educational to the children.

Thank you,

Parents of Fisher Neighborhood

Frame 5

January 1968

Dear Mr. Donlevy,

I am writing to request transfer of my position to Fisher Playground for summer of 1968. As you know, I have been quite successful in instituting programs at other parks and playgrounds -- particularly cultural programs to foster racial understanding. I would like to try (on an informal basis) to institute language instruction in spoken English among the children at Fisher. I feel that facility in proper English is extremely important for children of my race in their struggle for rights and equality.

If granted the transfer I will take up summer residence in the Fisher area as I now live a considerable distance from there. Thank you.

Sincerely,

Edith Johnson

Frame 6

July 7, 1968

Dear Mr. Donlevy,

My department has received numerous complaints and reports about children playing in streets and roaming in large gangs in the Fisher playground area. This area has been very calm in the past few years considering gang structure and general environment. This summer seems to be an exception. My department is doing all it can to investigate

the situation and I have added another youth officer. I wonder if something has gone wrong with the recreation program. We will appreciate any help you can give us in this area.

Sincerely,

Frederick P. Meyers,
Chief of Police

Frame 7

EMPLOYEE'S HISTORY: Johnson, Edith

Born: August 17, 1948

Family residence: South Lyons, Michigan

Father's occupation: owns and manages dry cleaning store

Mother's occupation: homemaker

School record: predominantly "A" and "B" throughout elementary
and secondary

Extra-curricular activities: dancing lessons

Currently enrolled at Western Michigan University in speech therapy

Frame 8

OCCUPATIONAL GOALS: Johnson, Edith

Instruction of English as a second language to ethnic and racial groups. Before my fellow Negroes can gain the respect and freedom owed them, they must be able to use standard English to communicate effectively with those not in the immediate community.

Frame 9

JOB DESCRIPTION: Playground Supervisor

Organize and carry out scheduled activities in sports, culture and crafts at local playgrounds in residential areas throughout the city.

Should encourage maximum participation in programs for children from 6-14 years of age.

Duration: June 1 - Sept. 15

Frame 10

APPLICATIONS: Playground Supervisor

N. Kendler - male, age 21

- junior at Michigan State University in education
- applied March 15, notified job was filled as of May 7; unavailable after June 15.

Frame 11

JOB QUALIFICATIONS: Playground Supervisor

1. High school diploma
2. One year college (minimum)
3. Emphasis in college on education
4. Participate in two-week training program

Frame 12

CORRESPONDENCE: Note from Employment Bureau re. playground supervisor

We have no applicants available who meet your qualifications as of this date. It is unlikely that you will be able to find a person with these qualifications who does not yet have a summer commitment.

Frame 13

DESCRIPTION: Playground

Constructed in 1952 on a three-acre site cleared of condemned buildings. At that time playground was partially planted with elms and pine.

Grounds included a wooded picnic and recreation area with sandbox, swing and slide, play area, badminton, volley-ball. Clear area included open field and baseball diamond, one tennis court.

Note: 1968 - Elms removed because of dutch elm disease.

Frame 14

Playground Sports Equipment

Badminton: 1 net, 2 poles, 4 rackets

Basketball: 1 permanent basket, 3 balls

Baseball: 1 permanent backstop, regulation diamond, 2 soft balls,
2 hard balls, catcher's mask, pads and bats (4 hard and
2 soft)

Frame 15

DESCRIPTION: Standard Park Programs

Crafts -- ages 6 through 14

1. leathercraft: making of leather goods, from coin purses
and bookmarks to tooled leather belts, purses, book jackets,
vests and jackets.
(Precut and punched kits for younger children) Cost 50¢
to \$10 dependent on project. Paid by child.
2. ceramics: clay available at cost. All levels of work
possible. Projects taken to kiln Mondays - returned Fridays.

Health -- ages 6 through 14

Informal instruction, often individual, in cleanliness and
disease prevention, diet, etc. Large sports program.

Frame 16

DESCRIPTION: Neighborhood

Inner city ghetto area. Housing primarily in tenement apartments
or in dilapidated homes.

Borders free-way. Streets narrow, poorly lit and heavily trafficked.

Playground is only open area suitable for recreation within walking
distance.

Nearest bus line one mile from area.

Average family size 6
Average family income \$4,100
Average family residence 4 room apartment

Unemployment 10%

Frame 17

DESCRIPTION: Neighborhood as seen by police

Low income, high unemployment, high crime rate.

Rapid increase in reports of kids obstructing traffic, minor vandal-
ism and gangs roaming streets.

Complaints from nearby new dime-store that kids are loitering there. No problems with shoplifting so far -- just hanging around. (Kids say it's cool inside; owner is considering turning off air conditioning.)

(After 5-10 minutes ask individuals what they think is the problem. Read the following model solution.)

"Miss Johnson is a middle-class, suburban Negro who has always attended white schools and associated with white children. She has been successful in previous years and we can only assume that she worked in middle-class, non-ghetto playgrounds. Although she is black she doesn't appear to understand the black children with whom she works, presumably because her background differs quite drastically from theirs.

"She doesn't understand the social structure of the neighborhood and thus her method of team selection threatens to break this up. The children are unwilling to alter their social structure and thus avoid sports.

"She tries to encourage crafts and cultural activities, things which the children seem to avoid for two possible reasons: They do not value them; they can't afford them.

"She is attempting to work with the children to develop their language skills in standard English but seems to be offending them in the process.

"The problem does not rest wholly with Miss Johnson. Playground facilities are sorely lacking. There is a very limited supply of sports equipment and the children must, in every case, supply one kind of equipment for various games which they may not be able to afford, e.g., baseball mits, badminton birdies.

"Finally, the playground had in past years been a shady refuge from the summer sun but the trees were cut down so the children now seek cool in a neighborhood store.

"This solution was reached by beginning immediately with defining the problem: Miss Johnson is having problems with playground but has in past, at other locations, been successful. She seems concerned about her failure and wants to help in remedying situation."

(Then I generated three hypotheses:)

H: "The park is different from those in which she worked before."

H: "The children are different and therefore the way she worked with other kids is not successful here."

H: "Park itself is inadequate."

"Some of the solutions presented here were better than others. Research has shown that those who are the best at problem-solving use a particular method. The ability to use this method or strategy well should make you a better teacher."

(Encourage brief discussion of the importance of problem-solving to teaching, preactive and reactive. Pass out the outline of steps in problem-solving. Have group read the sections to themselves and briefly discuss each section upon completion.)

Steps in Problem Solving

- I. Pay close attention to the situation in order to sense problems.
- II. Define the problem by relating it to all other relevant information which you already possess.
- III. Develop hypotheses by thinking of as many possible causes for the problem as you can.
- IV. Select the best hypothesis; decide what information you would expect if it were actually correct.
- V. Search for the information you need to check the hypothesis. If the hypothesis is confirmed, you have explained successfully at least part of the problem. If it is not confirmed, look at the details in the new information and redefine the problem in relation to it.

A. Problem sensing --

Problem sensing is the first and most important step in problem-solving. Before one can solve a problem he must sense it. People that are the best problem sensors are the ones that always seem to have control of the situation. They know what's going on and make a point to look for things in the situation which are out of the ordinary, which they didn't expect, or which don't fit with other things that they already know. For example: Most of you have probably had an opportunity to address a large group over a p.a. system. If the acoustics of the auditorium were good, you probably couldn't hear yourself speaking over the microphone but rather assumed that your speech was audible to the audience. Electrical systems have been known to fail in the past, and occasionally a hapless speaker who is very nervous and involved in his speaking notes will talk for many minutes much to the dismay of the audience. Such a person is neither a good speaker nor problem solver because he is not sensitive to details, to information about his speaking effectiveness conveyed by visual feedback from the audience. This information is always useful to the speaker (and problem solver). Normally, overlooking such cues would reduce his effectiveness; but on occasion (when the electrical system fails and he assumes all is well) not attending to detail and not looking for problems can have quite an embarrassing if not devastating result. So too with the problem solver. By ignoring information and not looking for problems he can and does often get misled into false assumptions and solutions.

The best way to increase your own problem sensitivity is to expect and look for problems whenever you read something. Anything that departs from the normal, average situation is a potential problem; likewise, anything that "doesn't fit" or seems contradictory may be a problem. Watch for these kinds of things.

B. Problem definition --

Once you have sensed a problem, define it quite precisely before actively beginning to solve it. By problem definition we simply mean careful specification of the relationship between the problem, the information in the problematic situation and information which you already possess.

For example:

If you went to the doctor complaining of insomnia and mentioned that you drank a cup of coffee each night to warm up before retiring, he would define the problem in one particular way and chances are it would be rather simple. If, however, instead of coffee you drank warm milk, you would define the problem in a very different manner. Notice that the initial problem, insomnia, is the same; but when it is related to other information it suggests very different possible causes.

Once you begin to gather information regarding a particular problem, it is very important that you actively use the information by constantly redefining the problem. Let's return for a moment to our illustration. Suppose you complained to your doctor about insomnia and were a heavy coffee drinker. If this were the whole problem he would probably suggest that you reduce your coffee intake. However, if he later discovered that you also had a history of nervous problems and final exams were approaching, he would probably relate the anxiety caused by anticipation of the impending exams with your insomnia. Thus, his diagnosis would change as he obtained more information. Thus problem definition is not a simple action that you do once but is your best description of the problem, encompassing all the information gathered.

C. Hypothesis formation --

Once you have defined the problem, develop as many causal hypotheses as possible. Ask yourself, "What kinds of things could possibly cause the problem?" A major step in training computer trouble shooters, men trained in very sophisticated techniques of problem-solving, includes the generation of as many hypotheses as possible.

But why generate many hypotheses; why not just one? By purposely thinking of as many "causes" as possible you generate hypotheses which could be correct yet ordinarily would not have come to mind. Just because an hypothesis is the most obvious, it probably doesn't mean that it's always correct. It's easier to begin by generating many hypotheses than to find out that your single hypothesis is wrong and then have to come up with another idea. Secondly, you purposely keep yourself open to a number of possibilities rather than deciding what the answer is before you even look for information.

In our example concerning the coffee drinking insomniac, the most obvious hypothesis is that the caffeine is keeping him awake; but he may have emotional problems or financial obligations which he worries about and the coffee is irrelevant, or he may eat rich food and suffer from indigestion in which case the solution might be to take Tums.

D. Hypothesis Selection --

After you have generated a list of hypotheses, you must select the one to check out. Decide which hypothesis seems most likely to be correct and then decide what kind of information you will need to "prove" it right or wrong. Before looking for the information, try to determine its most likely location.

E. Finally, search --

Look for the information needed to check the hypothesis. If your hypothesis is confirmed, you are done with at least this phase; if not, you may wish to check another; but before you do, use the new information. Reconsider your definition of the problem, the new information might have changed the apparent nature of the problem considerably. Of course, once you redefine the problem, it may be necessary to generate and test a new set of hypotheses. Secondly, continue to look for problems in the new information and compare it to the problem definition and information already gathered.

You have probably noticed a number of things about this so-called strategy for inquiring or problem-solving. First and most important is the emphasis on attention to detail. Good inquirers like good physicians, detectives and trouble-shooters consciously attend to detail because this is where problems and clues lie.

Secondly, the purpose of developing and testing hypotheses is two-fold. By generating many hypotheses you purposely remain open to a number of possibilities rather than committing yourself to a single alternative. And by selecting an hypothesis and testing plan you can make most efficient use of the information available.

Finally, the problem definition is, at any time, your most complete statement of the problem. Thus, when it is complete enough for you to make the appropriate decision for action, and you are satisfied with your understanding of the problem, you are done inquiring.

"Let's begin with problem sensing and problem definition -- it is of the utmost importance to pay attention to detail; look for information in the situations. For example, what could you tell me about a person from looking at his glasses?" (Ask each person and construct a list. Pass out the following anecdote.) "Read this. Sherlock was called to the scene of a murder and found a pince-nez."

Sherlock Holmes took the glasses into his hand, and examined them with the utmost attention and interest. He held them on his nose, endeavoured to read through them, went to the window and stared up the street with them, looked at them most minutely in the full light of the lamp, and finally, with a chuckle, seated himself at the table and wrote a few lines upon a sheet of paper, which he tossed across to Stanley Hopkins.

"That's the best I can do for you," said he. "It may prove to be of some use."

The astonished detective read the note aloud. It ran as follows:

"Wanted, a woman of good address, attired like a lady. She has a remarkably thick nose, with eyes which are set close upon either side of it. She has a puckered forehead, a peering expression, and probably rounded shoulders. There are indications that she has had recourse to an optician at least twice during the last few months. As her glasses are of remarkable strength, and as opticians are not very numerous, there should be no difficulty in tracing her."

Holmes smiled at the astonishment of Hopkins, which must have been reflected upon my features.

"Surely my deductions are simplicity itself," said he. "It would be difficult to name any articles which afford a finer field for inference than a pair of glasses, especially so remarkable a pair as these. That they belong to a woman I infer from their delicacy, and also, of course, from the last words of the dying man. As to her being a person of refinement and well dressed, they are, as you perceive, handsomely mounted in solid gold, and it is inconceivable that anyone who wore such glasses could be slatternly in other respects. You will find that the clips are too wide for your nose, showing that the lady's nose was very broad at the base. This sort of nose is usually a short and coarse one, but there is a sufficient number of exceptions to prevent me from being dogmatic or from insisting upon this point in my description. My own face is a narrow one, and yet I find that I cannot get my eyes into the centre, nor near the centre, of these glasses. Therefore, the lady's eyes are set very near to the sides of the nose. You will perceive, Watson, that the glasses are concave and of unusual strength. A lady whose vision has been so extremely contracted all her life is sure to have the physical characteristics of such vision, which are seen in the forehead, the eyelids, and the shoulders."

"Yes," I said, "I can follow each of your arguments. I confess, however, that I am unable to understand how you arrive at the double visit to the optician."

Holmes took the glasses in his hand.

"You will perceive," he said, "that the clips are lined with tiny bands of cork to soften the pressure upon the nose. One of these is discoloured and worn to some slight extent, but the other is new. Evidently one has fallen off and been

replaced. I should judge that the older of them has not been there more than a few months. They exactly correspond, so I gather that the lady went back to the same establishment for the second."¹

(After reading the anecdote, pass around a pair of glasses and ask what they notice about the glasses and what this might say about the wearer. Ask for and reinforce individual contributions and list. Relate all data into a formulation.)

The particular glasses used were a men's style of about 8 years ago, had heavy perspiration stains, mismatched earpieces, and rivets, chipped lens, convex astigmatic lenses, and a rather wide frame.

(Before adjourning the first hour session, pass out the list of evidence abstracted from the Lauriston Garden Mystery and a mirror image problem. Tell students to describe the situation as carefully as possible by relating the pieces of evidence given. Solve the mirror image problem.)

List of evidence:

Man found dead in room, lying on the floor. No visible wounds, look of horror on face, limbs rigid, wearing pointed toed boots. Clothing not rumpled or torn. Corpse had peculiar odor about the mouth.
Furniture in place, room dirty but orderly.
Drops of blood on floor around perimeter of room.
Tracks of square toed boots in dust around perimeter of room.
Stride of square toed boots very long.
Cigar ashes around perimeter of room.
RACHE written on wall with finger dipped in blood. (German word for revenge. Style indicated that it was not written by a German.)
Written over six feet from the floor. Plaster slightly scratched during the writing.

Outside:

Tracks of one cab.
Two sets of footprints leading from street to house, pointed toes and square toes.
Puddle five feet wide on path, pointed toes went around, square toes went over.

(End of first session, approximately one hour.)

¹Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, p. 621

Second Session

(Begin by reviewing take-home assignments. Ask individuals how they solved the mirror image problem.) "It was an exercise in problem sensing and formulation. If you looked carefully at the information you would have seen the simple solution; look in the mirror rather than reading backwards, etc."

(Ask for individual solutions to the second home assignment.) "How do you describe the situation?" (Get contributions from whole group and then pass out Sherlock's description from the same data)

"Come along, Doctor," he said: "we shall go and look him up. I'll tell you one thing which may help you in the case," he continued, turning to the two detectives. "There has been murder done, and the murderer was a man. He was more than six feet high, was in the prime of life, had small feet for his height, wore coarse, square-toed boots and smoked a cigar. He came here with his victim in a four-wheeled cab, which was drawn by a horse with three old shoes and one new one on his off fore-leg. In all probability the murderer had a florid face, and the finger-nails of his right hand were remarkably long. These are only a few indications, but they may assist you."

"You amaze me, Holmes," said I. "Surely you are not as sure as you pretend to be of all those particulars which you gave."

"There's no room for a mistake," he answered. "The very first thing which I observed on arriving there was that a cab had made two ruts with its wheels close to the curb. Now, up to last night, we have had no rain for a week, so that those wheels which left such a deep impression must have been there during the night. There were the marks of the horse's hoofs, too, the outline of one of which was far more clearly cut than that of the other three, showing that that was a new shoe. Since the cab was there after the rain began, and was not there at any time during the morning -- I have Gregson's word for that -- it follows that it must have been there during the night, and therefore, that it brought those two individuals to the house."

"That seems simple enough," said I, "but how about the other man's height?"

"Why, the height of a man, in nine cases out of ten, can be told from the length of his stride. It is a simple calculation enough, though there is no use my boring you with figures. I had this fellow's stride both on the clay outside and on the dust within. Then I had a way of checking my calculation. When a man writes on a wall, his instinct leads him to write above the level of his own eyes. Now that writing was just over six feet from the ground. It was child's play."

"And his age?" I asked.

"Well, if a man can stride four and a half feet without the smallest effort, he can't be quite in the sere and yellow. That was the breadth of a puddle on the garden walk which he had evidently walked across. Patent-leather boots had gone round, and Square-toes had hopped over. There is no mystery about it at all. I am simply applying to ordinary life a few of those precepts of observation and deduction which I advocated in that article. Is there anything else that puzzles you?"

"The finger-nails," I suggested.

"The writing on the wall was done with a man's forefinger dipped in blood. My glass allowed me to observe that the plaster was slightly scratched in doing it, which would not have been the case if the man's nail had been trimmed. Above all, why should the second man write up the German word RACHE before decamping? I confess that I cannot see any possible way of reconciling all these facts."

My companion smiled approvingly.

"You sum up the difficulties of the situation succinctly and well," he said. "There is much that is still obscure, though I have quite made up my mind on the main facts. As to poor Lestrade's discovery, it was simply a blind intended to put the police upon a wrong track, by suggesting Socialism and secret societies. It was not done by a German. The A, if you noticed, was printed somewhat after the German fashion. Now, a real German invariably prints in the Latin character, so that we may safely say that this was not written by one, but by a clumsy imitator who overdid his part. ²It was simply a ruse to divert inquiry into a wrong channel."

"These were exercises in problem sensing and problem defining. Although the materials had nothing to do with teaching, the ability to sense and define problems adequately does. Can you tell me why?" (Ask individuals)

"Before we continue further, please reread the sections on hypotheses formation and selection. (Reference here is to the summary of problem-solving steps.)

"Today we will be concerned primarily with hypothesis generation and selection -- after you have sensed and defined the problem, how do you

² Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes pp. 32-33.

decide where to look and what kind of information to look for. Hypothesis formation and selection helps you keep an open mind about what you're doing -- you don't begin looking already committed to a specified outcome and you purposely bring to mind possibilities that you may not ordinarily have considered. This has become the most important phase of trouble-shooting training and seems to be one of the major characteristics of creative people -- ability to think of many possibilities."

(Questions, discussion)

"We will begin with an expert example and then practice the skills."

"Remember the anecdote about the pince-nez? Sherlock Holmes found them at the scene of a murder in a professor's library. The library had only one exit, a door which opened to a hall. The hall forked in two directions: One led to the professor's bedroom and the other led outside to the garden. The garden was muddy yet showed no sign of footprints. There was, however, a narrow strip of grass between the flower beds and the dirt path. This ran beside the path from the house to the garden gate. Everyone assumed that the murderer walked out by way of this grass strip to escape without leaving footprints. Sherlock, however, generated another hypothesis and decided to check it out. Read this to see how Sherlock generates and tests his hypothesis. What are the hypotheses mentioned here? How does Holmes test them?"

"A simple case, and yet, in some ways, an instructive one," Holmes remarked, as we travelled back to town. "It hinged from the outset upon the pince-nez. But for the fortunate chance of the dying man having seized these, I am not sure that we could ever have reached our solution. It was clear to me, from the strength of the glasses, that the wearer must have been very blind and helpless when deprived of them. When you asked me to believe that she walked along a narrow strip of grass without once making a false step, I remarked, as you may remember, that it was a noteworthy performance. In my mind I set it down as an impossible performance, save in the unlikely case that she had a second pair of glasses. I was forced, therefore, to consider seriously the hypothesis that she had remained within the house. On perceiving the similarity of the two corridors, it became clear that she might very easily have made such a mistake, and, in that case, it was evident that she must have entered the professor's room. I was keenly on the alert, therefore, for whatever would bear out this supposition, and I examined the room narrowly for anything in the shape of a hiding-place. The carpet seemed continuous and firmly nailed, so I dismissed the idea of a trap-door. There might well be a recess behind the books. As you are aware, such devices are common in old libraries. I observed that books were piled on the floor at all other points, but that one bookcase was left clear. This, then, might be the door. I could see no marks to guide me, but the carpet was of a dun colour, which lends itself very well to examination.

I therefore smoked a great number of those excellent cigarettes, and I dropped the ash all over the space in front of the suspected bookcase. It was a simple trick, but exceedingly effective. I then went downstairs, and I ascertained, in your presence, Watson, without your perceiving the drift of my remarks, that Professor Coram's consumption of food had increased -- as one would expect when he is supplying a second person. We then ascended to the room again, when, by upsetting the cigarette-box, I obtained a very excellent view of the floor, and was able to see quite clearly, from the traces upon the cigarette ash, that the prisoner had in our absence come out from her retreat. Well, Hopkins, here we are at Charing Cross, and I congratulate you on having brought your case to a successful conclusion. You are going to headquarters, no doubt. I think, Watson, you and I will drive together to the Russian Embassy."³

The remainder of this session is devoted to practice in generating hypotheses. Sequential excerpts were selected so that the student can gather a set of information, formulate hypotheses, read the next excerpt and receive additional information and feedback. Students are instructed to read a single section and then stop. Each student is asked to recall a piece of pertinent information from the excerpt. Once the information is exhausted each is asked to supply a problem definition. Hypotheses are then elicited from the group. The emphasis is on any possible explanation conceivable with minimal evaluation as in brainstorming. Then, the group proceeds to the new or final excerpt within the set to gain more information and practice hypothesis formation. Two such sets are provided here.

"I must explain to you, Mr. Holmes, that to-morrow is the first day of the examination for the Fortescue Scholarship. I am one of the examiners. My subject is Greek, and the first of the papers consists of a large passage of Greek translation which the candidate has not seen. This passage is printed on the examination paper, and it would naturally be an immense advantage if the candidate could prepare it in advance. For this reason, great care is taken to keep the paper secret.

"To-day, about three o'clock, the proofs of this paper arrived from the printers. The exercise consists of half a chapter of Thucydides. I had to read it over carefully, as the text must be absolutely correct. At four-thirty my task was not yet completed. I had, however, promised to take tea in a friend's room, so I left the proof upon my desk. I was absent rather more than an hour.

³Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes p. 612.

"You are aware, Mr. Holmes, that our college doors are double -- a green baize one within and a heavy oak one without. As I approached my outer door, I was amazed to see a key in it. For an instant I imagined that I had left my own there, but on feeling in my pocket I found that it was all right. The only duplicate which existed, so far as I knew, was that which belonged to my servant, Bannister -- a man who has looked after my room for ten years, and whose honesty is absolutely above suspicion. I found that the key was indeed his, that he had entered my room to know if I wanted tea, and that he had very carelessly left the key in the door when he came out. His visit to my room must have been within a very few minutes of my leaving it. His forgetfulness about the key would have mattered little upon any other occasion, but on this one day it has produced the most deplorable consequences."

"The moment I looked at my table, I was aware that someone had rummaged among my papers. The proof was in three long slips. I had left them all together. Now, I found that one of them was lying on the floor, one was on the side table near the window, and the third was where I had left it."

Holmes stirred for the first time.

"The first page on the floor, the second in the window, the third where you left it," said he.

"Exactly, Mr. Holmes. You amaze me. How could you possibly know that?"

"Pray continue your very interesting statement."

"For an instant I imagined that Bannister had taken the unpardonable liberty of examining my papers. He denied it, however, with the utmost earnestness, and I am convinced that he was speaking the truth. The alternative was that someone passing had observed the key in the door, had known that I was out, and had entered to look at the papers. A large sum of money is at stake, for the scholarship is a very valuable one, and an unscrupulous man might very well run a risk in order to gain an advantage over his fellows."

"Bannister was very much upset by the incident. He had nearly fainted when we found that the papers had undoubtedly been tampered with. I gave him a little brandy and left him collapsed in a chair, while I made a most careful examination of the room. I soon saw that the intruder had left other traces of his presence besides the crumpled papers. On the table in the window were several shreds from a pencil which had been sharpened. A broken tip of lead was lying there also. Evidently the rascal had copied the paper in a great hurry, had broken his pencil and had been compelled to put a fresh point to it."

"Excellent!" said Holmes, who was recovering his good-humour as his attention became more engrossed by the case. "Fortune has been your friend."

"This was not all. I have a new writing-table with a fine surface of red leather. I am prepared to swear, and so is Bannister, that it was smooth and unstained. Now I found a clean cut in it about three inches long -- not a mere scratch, but a positive cut. Not only this, but on the table I found a small ball of black dough or clay, with specks of something which looks like sawdust in it. I am convinced that these marks were left by the man who rifled the papers."⁴

(Ask individual students:)

"What problems did you sense? What important information relates to the problem? How would you define the problem? What are your hypotheses?"

(After the information has been exhausted proceed to the next section.)

"I should like to have a glance round. What a charming, old-fashioned room! Perhaps you will kindly wait a minute, until I have examined the floor. No, I see nothing. What about this curtain? You hang your clothes behind it. If anyone were forced to conceal himself in this room he must do it there, since the bed is too low and the wardrobe too shallow. No one there, I suppose?"

As Holmes drew the curtain I was aware, from some little rigidity and alertness of his attitude, that he was prepared for an emergency. As a matter of fact, the drawn curtain disclosed nothing but three or four suits of clothes hanging from a line of pegs. Holmes turned away, and stooped suddenly to the floor.

"Halla! What's this?" said he.

It was a small pyramid of black, putty-like stuff, exactly like the one upon the table of the study. Holmes held it out on his open palm in the glare of the electric light.

"Your visitor seems to have left traces in your bedroom as well as in your sitting-room, Mr. Soames."

"What could he have wanted there?"

"I think it is clear enough. You came back by an unexpected way, and so he had no warning until you were at the very door. What could he do? He caught up everything which would betray him, and he rushed into your bedroom to conceal himself."

⁴Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes.

"Good gracious, Mr. Holmes, do you mean to tell me that, all the time I was talked to Bannister in this room, we had the man prisoner if we had only known it?"

"So I read it."

"Surely there is another alternative, Mr. Holmes. I don't know whether you observed my bedroom window?"

"Lattice-paned, lead framework, three separate windows, one swinging on hinge, and large enough to admit a man."

"Exactly. And it looks out on an angle of the courtyard so as to be partly invisible. The man might have effected his entrance there, left traces as he passed through the bedroom, and finally, finding the door open, have escaped that way."

Holmes shook his head impatiently.

"Let us be practical," said he. "I understand you to say that there are three students who use this stair, and are in the habit of passing your door?"

"Yes, there are."

"And they are all in for this examination?"

"Yes."

"Have you any reason to suspect any one of them more than the others?"

Soames hesitated.

"It is a very delicate question," said he. "One hardly likes to throw suspicion where there are no proofs."

"Let us hear the suspicions. I will look after the proofs."

"I will tell you, then, in a few words the character of the three men who inhabit these rooms. The lower of the three is Gilchrist, a fine scholar and athlete, plays in the Rugby team and the cricket team for the college, and got his Blue for the hurdles and the long jump. He is a fine, manly fellow. His father was the notorious Sir Jabez Gilchrist, who ruined himself on the turf. My scholar has been left very poor, but he is hard-working and industrious. He will do well.

"The second floor is inhabited by Daulat Ras, the Indian. He is a quiet, inscrutable fellow; as most of those Indians are. He is well up in his work, though his Greek is his weak subject. He is steady and methodical.

"The top floor belongs to Miles McLaren. He is a brilliant fellow when he chooses to work -- one of the brightest intellects of the university; but he is wayward, dissipated, and unprincipled. He was nearly expelled over a card scandal in his first year. He has been idling all this term, and he must look forward with dread to the examination."⁵

(Ask individual students:)

"What problems did you sense? What important information relates to the problem? How would you define the problem? What are your hypotheses?"

(After the information has been exhausted proceed to the next section.)

"Late last night, or early this morning, an incident occurred at Lower Norwood which points, it is feared, to a serious crime. Mr. Jonas Oldacre is a well-known resident of that suburb, where he has carried on his business as a builder for many years. Mr. Oldacre is a bachelor, fifty-two years of age, and lives in Deep Dene House, at the Sydenham end of the road of that name. He has had the reputation of being a man of eccentric habits, secretive and retiring. For some years he has practically withdrawn from the business, in which he is said to have massed considerable wealth. A small timber-yard still exists, however, at the back of the house, and last night, about twelve o'clock, an alarm was given that one of the stacks was on fire. The engines were soon upon the spot, but the dry wood burned with great fury, and it was impossible to arrest the conflagration until the stack had been entirely consumed. Up to this point the incident bore the appearance of an ordinary accident, but fresh indications seem to point to serious crime. Surprise was expressed at the absence of the master of the establishment from the scene of the fire, and an inquiry followed, which showed that he had disappeared from the house. An examination of his room revealed that the bed had not been slept in, that a safe which stood in it was open, that a number of important papers were scattered about the room, and finally, that there were signs of a murderous struggle, slight traces of blood being found within the room, and an oaken walking-stick, which also showed stains of blood upon the handle. It is known that Mr. Jonas Oldacre had received a late visitor in his bedroom upon that night, and the stick found has been identified as the property of this person, who is a young London solicitor named John Hector McFarlane, junior partner of Graham and McFarlane, of 426 Gresham Buildings, E. C. The police believe that they have evidence in their possession which

⁵Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, pp. 600-601.

supplies a very convincing motive for the crime, and altogether it cannot be doubted that sensational developments will follow.

"Later.--It is rumoured as we go to press that Mr. John Hector McFarlane has actually been arrested on the charge of the murder of Mr. Jonas Oldacre. It is at least certain that a warrant has been issued. There have been further and sinister developments in the investigation at Norwood. Besides the signs of a struggle in the room of the unfortunate builder it is now known that the French windows of his bedroom (which is on the ground floor) were found to be open, that there were marks as if some bulky object had been dragged across to the wood-pile, and, finally, it is asserted that charred remains have been found among the charcoal ashes of the fire. The police theory is that a most sensational crime has been committed, that the victim was clubbed to death in his own bedroom, his papers rifled, and his dead body dragged across to the woodstack, which was then ignited so as to hide all traces of the crime. The conduct of the criminal investigation has been left in the experienced hands of Inspector Lestrade, of Scotland Yard, who is following up the clues with his accustomed energy and sagacity."⁶

(Ask individual students:)

"What problems did you sense? What important information relates to the problem? How would you define the problem? What are your hypotheses?"

(After the information has been exhausted proceed to the next section.)

"I must explain first," said McFarlane, "that I knew nothing of Mr. Jonas Oldacre. His name was familiar to me, for many years ago my parents were acquainted with him, but they drifted apart. I was very much surprised, therefore, when yesterday, about three o'clock in the afternoon, he walked into my office in the city. But I was still more astonished when he told me the object of his visit. He had in his hand several sheets of a notebook, covered with scribbled writing -- here they are -- and he laid them on my table.

"'Here is my will,' said he. 'I want you, Mr. McFarlane, to cast it into proper legal shape. I will sit here while you do so.'

"I set myself to copy it, and you can imagine my astonishment when I found that, with some reservations, he had left all his property to me. He was a strange little ferret-like man, with white eyelashes, and when I looked up at him I found his keen gray eyes fixed upon me with an amused expression. I could hardly believe my own senses as I read

⁶Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, p. 498.

the terms of the will; but he explained that he was a bachelor with hardly any living relation, that he had known my parents in his youth, and that he had always heard of me as a very deserving young man, and was assured that his money would be in worthy hands. Of course, I could only stammer out my thanks. The will was duly finished, signed, and witnessed by my clerk. This is it on the blue paper, and these slips, as I have explained, are the rough draft. Mr. Jonas Oldacre then informed me that there were a number of documents -- building leases, title-deeds, mortgages, scrip, and so forth -- which it was necessary that I should note and understand. He said that his mind would not be easy until the whole thing was settled, and he begged me to come out to his house at Norwood that night, bringing the will with me, and to arrange matters. 'Remember, my boy, not one word to your parents about the affair until everything is settled. We will keep it as a little surprise for them.' He was very insistent upon this point, and made me promise it faithfully.

"You can imagine, Mr. Holmes, that I was not in a humour to refuse him anything that he might ask. He was my benefactor, and all my desire was to carry out his wishes in every particular. I sent a telegram home, therefore, to say that I had important business on hand, and that it was impossible for me to say how late I might be. Mr. Oldacre had told me that he would like me to have supper with him at nine, as he might not be home before that hour. I had some difficulty in finding his house, however, and it was nearly half-past before I reached it. I found him---"

"One moment," said Holmes. "Who opened the door?"

"A middle-aged woman, who was, I suppose, his housekeeper."

"And it was she, I presume, who mentioned your name?"

"Exactly," said McFarlane.

"Pray proceed."

McFarlane wiped his damp brow, and then continued his narrative:

"I was shown by this woman into a sitting-room, where a frugal supper was laid out. Afterwards, Mr. Jonas Oldacre led me into his bedroom, in which there stood a heavy safe. This he opened and took out a mass of documents, which we went over together. It was between eleven and twelve when we finished. He remarked that we must not disturb the housekeeper. He showed me out through his own French window, which had been open all this time."

"Was the blind down?" asked Holmes.

"I will not be sure, but I believe that it was only half down. Yes, I remember how he pulled it up in order to swing open the window. I could not find my stick, and he said, 'Never mind, my boy, I shall see a good deal of you now, I hope, and I will keep your stick until you come back to claim it.' I left him there, the safe open, and the papers made up in packets upon the table. It was so late that I could not get back to Blackheath, so I spent the night at the Anerley Arms, and I knew nothing more until I read of this horrible affair in the morning." ⁷

(Ask individual students:)

"What problems did you sense? What important information relates to the problem? How would you define the problem? What are your hypotheses?"

(After the information has been exhausted proceed to the next section.)

"Yes, Watson, I went there, and I found very quickly that the late lamented Oldacre was a pretty considerable blackguard. The father was away in search of his son. The mother was at home -- a little, fluffy, blue-eyed person, in a tremor of fear and indignation. Of course, she would not admit even the possibility of his guilt. But she would not express either surprise or regret over the fate of Oldacre. On the contrary, she spoke of him with such bitterness that she was unconsciously considerably strengthening the case of the police for, of course, if her son had heard her speak of the man in this fashion, it would predispose him towards hatred and violence. 'He was more like a malignant and cunning ape than a human being,' said she, 'and he always was, ever since he was a young man.'

"'You knew him at that time?' said I.

"'Yes, I knew him well, in fact, he was an old suitor of mine. Thank heaven that I had the sense to turn away from him and to marry a better, if poorer, man. I was engaged to him, Mr. Holmes, when I heard a shocking story of how he had turned a cat loose in an aviary, and I was so horrified at his brutal cruelty that I would have nothing more to do with him.' She rummaged in a bureau, and presently she produced a photograph of a woman, shamefully defaced and mutilated with a knife. 'That is my own photograph,' she said. 'He sent it to me in that state, with his curse, upon my wedding morning.'

"'Well,' said I, 'at least he has forgiven you now, since he has left all his property to your son.'

⁷Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, pp. 499-500.

"Neither my son nor I want anything from Jonas Oldacre, dead or alive!" she cried, with a proper spirit. "There is a God in heaven, Mr. Holmes, and that same God who has punished that wicked man will show, in His own good time, that my son's hands are guiltless of his blood."⁸

(Ask individual students:)

"What problems did you sense? What important information relates to the problem? How would you define the problem? What are your hypotheses?"

(After the information has been exhausted, have group select their best hypothesis and provide them with a conclusion to the actual mystery.)

(At the end of the second session, approximately one hour, pass out the following excerpt with instructions to read at night and complete the problem-solving process through hypothesis formation and selection.)

"It's a very delicate thing," said he. "One does not like to speak of one's domestic affairs to strangers. It seems dreadful to discuss the conduct of one's wife with two men whom I have never seen before. It's horrible to have to do it. But I've got to the end of my tether, and I must have advice."

"My dear Mr. Grant Munro---" began Holmes.

Our visitor sprang from his chair. "What!" he cried, "you know my name?"

"If you wish to preserve your incognito," said Holmes, smiling, "I would suggest that you cease to write your name upon the lining of your hat, or else that you turn the crown towards the person whom you are addressing. I was about to say that my friend and I have listened to a good many strange secrets in this room, and that we have had the good fortune to bring peace to many troubled souls. I trust that we may do as much for you. Might I beg you, as time may prove to be of importance, to furnish me with the facts of your case without further delay?"

Our visitor again passed his hand over his forehead, as if he found it bitterly hard. From every gesture and expression I could see that he was a reserved, self-contained man, with a dash of pride in his nature, more likely to hide his wounds than to expose them. Then suddenly, with a fierce gesture of his closed hand, like one who throws reserve to the winds, he began:

⁸Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, p. 503.



"The facts are these, Mr. Holmes," said he. "I am a married man and have been so for three years. During that time my wife and I have loved each other as fondly and lived as happily as any two that ever were joined. We have not had a difference, not one, in thought or word or deed. And now, since last Monday, there has suddenly sprung up a barrier between us, and I find that there is something in her life and in her thoughts of which I know as little as if she were the woman who brushes by me in the street. We are estranged, and I want to know why.

"Now there is one thing that I want to impress upon you before I go any further, Mr. Holmes. Effie loves me. Don't let there be any mistake about that. She loves me with her whole heart and soul, and never more than now. I know it. I feel it. I don't want to argue about that. A man can tell easily enough when a woman loves him. But there's this secret between us, and we can never be the same until it is cleared."

"Kindly let me have the facts, Mr. Munro," said Holmes with some impatience.

"I'll tell you what I know about Effie's history. She was a widow when I met her first, though quite young -- only twenty-five. Her name then was Mrs. Hebron. She went out to America when she was young and lived in the town of Atlanta, where she married this Hebron, who was a lawyer with a good practice. They had one child, but the yellow fever broke out badly in the place, and both husband and child died of it. I have seen his death certificate. This sickened her of America, and she came back to live with a maiden aunt at Pinner, in Middlesex. I may mention that her husband had left her comfortably off, and that she had a capital of about four thousand five hundred pounds, which had been so well invested by him that it returned an average of seven per cent. She had only been six months at Pinner when I met her; we fell in love with each other, and we married a few weeks afterwards.

"I am a hop merchant myself, and as I have an income of seven or eight hundred, we found ourselves comfortably off and took a nice eighty-pound-a-year villa at Norbury. Our little place was very countrified, considering that it is so close to town. We had an inn and two houses a little above us, and a single cottage at the other side of the field which faces us, and except those there were no houses until you got halfway to the station. My business took me into town at certain seasons, but in summer I had less to do and then in our country home my wife and I were just as happy as could be wished. I tell you that there never was a shadow between us until this accursed affair began.

"There's one thing I ought to tell you before I go further. When we married, my wife made over all her property to me -- rather against my will, for I saw how awkward it would be if my business affairs went wrong. However, she would have it so, and it was done. Well, about six weeks ago she came to me.

"'Jack,' said she, 'when you took my money you said that if ever I wanted any I was to ask you for it.'

"'Certainly,' said I. 'It's all your own.'

"'Well,' said she, 'I want a hundred pounds.'

"I was a bit staggered at this, for I had imagined it was simply a new dress or something of the kind that she was after.

"'What on earth for?' I asked.

"'Oh,' said she in her playful way, 'you said that you were only my banker, and bankers never ask questions, you know.'

"'If you really mean it, of course you shall have the money,' said I.

"'Oh, yes, I really mean it.'

"'And you won't tell me what you want it for?'

"'Some day, perhaps, but not just at present, Jack.'

"So I had to be content with that, though it was the first time that there had ever been any secret between us. I gave her a check, and I never thought any more of the matter. It may have nothing to do with what came afterwards, but I thought it only right to mention it.

"Well, I told you just now that there is a cottage not far from our house. There is just a field between us, but to reach it you have to go along the road and then turn down a lane. Just beyond it is a nice little grove of Scotch firs, and I used to be very fond of strolling down there, for trees are always a neighbourly kind of thing. The cottage had been standing empty this eight months, and it was a pity, for it was a pretty two-storied place, with an old-fashioned porch and a honeysuckle about it. I have stood many a time and thought what a neat little homestead it would make.

"Well, last Monday evening I was taking a stroll down that way when I met an empty van coming up the lane and saw a pile of carpets and things lying about on the grass-plot

beside the porch. It was clear that the cottage had at last been let. I walked past it, and then stopping, as an idle man might, I ran my eye over it and wondered what sort of folk they were who had come to live so near us. And as I looked I suddenly became aware that a face was watching me out of one of the upper windows.

"I don't know what there was about that face, Mr. Holmes, but it seemed to send a chill right down my back. I was some little way off, so that I could not make out the features, but there was something unnatural and inhuman about the face. That was the impression that I had, and I moved quickly forward to get a nearer view of the person who was watching me. But as I did so the face suddenly disappeared, so suddenly that it seemed to have been plucked away into the darkness of the room. I stood for five minutes thinking the business over and trying to analyze my impressions. I could not tell if the face was that of a man or a woman. It had been too far from me for that. But its colour was what had impressed me most. It was of a livid chalky white, and with something set and rigid about it which was shockingly unnatural. So disturbed was I that I determined to see a little more of the new inmates of the cottage. I approached and knocked at the door, which was instantly opened by a tall, gaunt woman with a harsh, forbidding face.

"'What may you be wantin'?' she asked in a Northern accent.

"'I am your neighbour over yonder,' said I, nodding towards my house. 'I see that you have only just moved in, so I thought that if I could be of any help to you in any---'

"'Ay, we'll just ask ye when we want ye,' said she, and shut the door in my face. Annoyed at the churlish rebuff, I turned my back and walked home. All evening, though I tried to think of other things, my mind would still turn to the apparition at the window and the rudeness of the woman. I determined to say nothing about the former to my wife, for she is a nervous, highly strung woman, and I had no wish that she should share the unpleasant impression which had been produced upon myself. I remarked to her, however, before I fell asleep, that the cottage was now occupied, to which she returned no reply.

"I am usually an extremely sound sleeper. It has been a standing jest in the family that nothing could ever wake me during the night. And yet somehow on that particular night, whether it may have been the slight excitement produced by my little adventure or not I know not, but I slept much more lightly than usual. Half in my dreams I was dimly conscious that something was going on in the room, and gradually became aware that my wife had dressed herself and

was slipping on her mantle and her bonnet. My lips were parted to murmur out some sleepy words of surprise or remonstrance at this untimely preparation, when suddenly my half-opened eyes fell upon her face, illuminated by the candle-light, and astonishment held me dumb. She wore an expression such as I had never seen before -- such as I should have thought her incapable of assuming. She was deadly pale and breathing fast, glancing furtively towards the bed as she fastened her mantle to see if she had disturbed me. Then, thinking that I was still asleep, she slipped noiselessly from the room, and an instant later I heard a sharp creaking which could only come from the hinges of the front door. I sat up in bed and rapped my knuckles against the rail to make certain that I was truly awake. Then I took my watch from under the pillow. It was three in the morning. What in this earth could my wife be doing out on the country road at three in the morning?

"I had sat for about twenty minutes turning the thing over in my mind and trying to find some possible explanation. The more I thought, the more extraordinary and inexplicable did it appear. I was still puzzling over it when I heard the door gently close again, and her footsteps coming up the stairs.

"Where in the world have you been, Effie?' I asked as she entered.

"She gave a violent start and a kind of gasping cry when I spoke, and that cry and start troubled me more than all the rest, for there was something indescribably guilty about them. My wife had always been a woman of a frank, open nature, and it gave me a chill to see her slinking into her own room and crying out and wincing when her own husband spoke to her.

"You awake, Jack!' she cried with a nervous laugh. 'Why, I thought that nothing could awake you.'

"Where have you been?' I asked, more sternly.

"I don't wonder that you are surprised,' said she, and I could see that her fingers were trembling as she undid the fastenings of her mantle. 'Why, I never remember having done such a thing in my life before. The fact is that I felt as though I were choking and had a perfect longing for a breath of fresh air. I really think that I should have fainted if I had not gone out. I stood at the door for a few minutes and now I am quite myself again.'

"All the time that she was telling me this story she never once looked in my direction and her voice was quite unlike her usual tones. It was evident to me that she was saying what was false. I said nothing in reply, but turned

my face to the wall, sick at heart, with my mind filled with a thousand venomous doubts and misgivings. What was it that my wife was concealing from me? Where had she been during that strange expedition? I felt that I should have no peace until I found out, yet I shrank from asking her again after once she had told me what was false. For the rest of the night I tossed and tumbled, framing theory after theory, each more unlikely than the last.

I should have gone to the City that day, but I was too disturbed in my mind to be able to pay attention to business matters. My wife seemed to be as upset as I myself, and I could see from the little questioning glances which she kept shooting at me that she understood that I disbelieved her statement, and that she was at her wit's end what to do. We hardly exchanged a word during breakfast, and immediately afterwards I went out for a walk that I might think the matter out in the fresh morning air.

"I went as far as the Crystal Palace, spent an hour in the grounds, and was back in Norbury by one o'clock. It happened that my way took me past the cottage, and I stopped for an instant to look at the windows and to see if I could catch a glimpse of the strange face which had looked out at me on the day before. As I stood there, imagine my surprise, Mr. Holmes, when the door suddenly opened and my wife walked out.

"I was struck dumb with astonishment at the sight of her, but my emotions were nothing to those which showed themselves upon her face when our eyes met. She seemed for an instant to wish to shrink back inside the house again; and then, seeing how useless all concealment must be, she came forward, with a very white face and frightened eyes which belied the smile upon her lips.

"'Ah, Jack,' she said, 'I have just been in to see if I can be of any assistance to our new neighbours. Why do you look at me like that, Jack? You are not angry with me?'

"'So,' said I, 'this is where you went during the night.'

"'What do you mean?' she cried.

"'You came here. I am sure of it. Who are these people that you should visit them at such an hour?'

"'I have not been here before.'

"'How can you tell me what you know is false?' I cried. 'Your very voice changes as you speak. When have I ever had a secret from you? I shall enter that cottage, and I shall probe the matter to the bottom.'

"'No, no, Jack, for God's sake!' she gasped in uncontrollable emotion. Then, as I approached the door, she seized my sleeve and pulled me back with convulsive strength.

"'I implore you not to do this, Jack,' she cried. 'I swear that I will tell you everything some day, but nothing but misery can come of it if you enter that cottage.' Then, as I tried to shake her off, she clung to me in a frenzy of entreaty.

"'Trust me, Jack!' she cried. 'Trust me only this once. You will never have cause to regret it. You know that I would not have a secret from you if it were not for your own sake. Our whole lives are at stake in this. If you come home with me all will be well. If you force your way into that cottage all is over between us.'

"There was such earnestness, such despair, in her manner that her words arrested me, and I stood irresolute before the door.

"'I will trust you on one condition, and on one condition only,' said I at last. 'It is that this mystery comes to an end from now. You are at liberty to preserve your secret, but you must promise me that there shall be no more nightly visits, no more doings which are kept from my knowledge. I am willing to forget those which are past if you will promise that there shall be no more in the future.'

"'I was sure that you would trust me,' she cried with a great sigh of relief. 'It shall be just as you wish. Come away -- oh, come away up to the house.'

"Still pulling at my sleeve, she led me away from the cottage. As we went I glanced back, and there was that yellow livid face watching us out of the upper window. What link could there be between that creature and my wife? Or how could the coarse, rough woman whom I had seen the day before be connected with her? It was a strange puzzle, and yet I knew that my mind could never know ease again until I had solved it.

"For two days after this I stayed at home, and my wife appeared to abide loyally by our engagement, for, as far as I know, she never stirred out of the house. On the third day, however, I had ample evidence that her solemn promise was not enough to hold her back from this secret influence which drew her away from her husband and her duty.

"I had gone into town on that day, but I returned by the 2:40 instead of the 3:36, which is my usual train. As I entered the house the maid ran into the hall with a startled face.

"'Where is your mistress?' I asked.

"'I think that she has gone out for a walk,' she answered.

"My mind was instantly filled with suspicion. I rushed upstairs to make sure that she was not in the house. As I did so I happened to glance out of one of the upper windows and saw the maid with whom I had just been speaking running across the field in the direction of the cottage. Then of course I saw exactly what it all meant. My wife had gone over there and had asked the servant to call her if I should return. Tingling with anger, I rushed down and hurried across, determined to end the matter once and forever. I saw my wife and the maid hurrying back along the lane, but I did not stop to speak with them. In the cottage lay the secret which was casting a shadow over my life. I vowed that, come what might, it should be a secret no longer. I did not even knock when I reached it, but turned the handle and rushed into the passage.

"It was all still and quiet upon the ground floor. In the kitchen a kettle was singing on the fire, and a large black cat lay coiled up in the basket; but there was no sign of the woman whom I had seen before. I ran into the other room, but it was equally deserted. Then I rushed up the stairs only to find two other rooms empty and deserted at the top. There was no one at all in the whole house. The furniture and pictures were of the most common and vulgar description, save in the one chamber at the window of which I had seen the strange face. That was comfortable and elegant, and all my suspicions rose into a fierce, bitter flame when I saw that on the mantelpiece stood a copy of a full-length photograph of my wife, which had been taken at my request only three months ago.

"I stayed long enough to make certain that the house was absolutely empty. Then I left it, feeling a weight at my heart such as I had never had before. My wife came out into the hall as I entered my house; but I was too hurt and angry to speak with her, and, pushing past her, I made my way into my study. She followed me, however, before I could close the door.

"'I am sorry that I broke my promise, Jack,' said she, 'but if you knew all the circumstances I am sure that you would forgive me.'

"'Tell me everything, then,' said I.

"'I cannot, Jack, I cannot,' she cried.

"'Until you tell me who it is that has been living in that cottage, and who it is to whom you have given that photograph, there can never be any confidence between us,' said I, and breaking away from her I left the house. That was yesterday, Mr. Holmes, and I have not seen her since,

nor do I know anything more about this strange business. It is the first shadow that has come between us, and it has so shaken me that I do not know what I should do for the best. Suddenly this morning it occurred to me that you were the man to advise me, so I have hurried to you now, and I place myself unreservedly in your hands. If there is any point which I have not made clear, pray question me about it. But, above all, tell me quickly what I am to do, for this misery is more than I can bear."

Holmes and I had listened with the utmost interest to this extraordinary statement, which had been delivered in the jerky, broken fashion of a man who is under the influence of extreme emotion. My companion sat silent now for some time, with his chin upon his hand, lost in thought.

"Tell me," said he at last, "could you swear that this was a man's face which you saw at the window?"

"Each time that I saw it I was some distance away from it, so that it is impossible for me to say."

"You appear, however, to have been disagreeably impressed by it."

"It seemed to be of an unusual colour and to have a strange rigidity about the features. When I approached it vanished with a jerk."

"How long is it since your wife asked you for a hundred pounds?"

"Nearly two months."

"Have you ever seen a photograph of her first husband?"

"No, there was a great fire at Atlanta very shortly after his death, and all her papers were destroyed."

"And yet she had a certificate of death. You say that you saw it."

"Yes, she got a duplicate after the fire."

"Did you ever meet anyone who knew her in America?"

"No."

"Did she ever talk of revisiting the place?"

"No."

"Or get letters from it?"

"No."⁹

Third Session

Begin by going over the home assignment. Elicit hypotheses from each student and then pass out this excerpt containing the solution.

"I will tell you the meaning of it," cried the lady, sweeping into the room with a proud, set face. "You have forced me, against my own judgment, to tell you, and now we must both make the best of it. My husband died at Atlanta. My child survived."

"Your child?"

She drew a large silver locket from her bosom. "You have never seen this open."

"I understood that it did not open."

She touched a spring, and the front hinged back. There was a portrait within of a man strikingly handsome and intelligent-looking, but bearing unmistakable signs upon his features of his African descent.

"That is John Hebron, of Atlanta," said the lady, "and a nobler man never walked the earth. I cut myself off from my race in order to wed him, but never once while he lived did I for an instant regret it. It was our misfortune that our only child took after his people rather than mine. It is often so in such matches, and little Lucy is darker far than ever her father was. But dark or fair, she is my own dear little girlie, and her mother's pet." The little creature ran across at the words and nestled up against the lady's dress. "When I left her in America," she continued, "it was only because her health was weak, and the change might have done her harm. She was given to the care of a faithful Scotch woman who had once been our servant. Never for an instant did I dream of disowning her as my child. But when chance threw you in my way, Jack, and I learned to love you, I feared to tell you about my child. God forgive me, I feared that I should lose you, and I had not the courage to tell you. I had to choose between you, and in my weakness I turned away from my own little girl."

⁹ Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, pp. 353-358.

For three years I have kept her existence a secret from you, but I heard from the nurse, and I knew that all was well with her. At last, however, there came an overwhelming desire to see the child once more. I struggled against it, but in vain. Though I knew the danger, I determined to have the child over, if it were but for a few weeks. I sent a hundred pounds to the nurse, and I gave her instructions about this cottage, so that she might come as a neighbour, without my appearing to be in any way connected with her. I pushed my precautions so far as to order her to keep the child in the house during the daytime, and to cover up her little face and hands so that even those who might see her at the window should not gossip about there being a black child in the neighbourhood. If I had been less cautious I might have been more wise, but I was half crazy with fear that you should learn the truth."¹⁰

The remainder of the third training session is devoted to integrating the skills learned. The vehicle is a set of information about a mystery developed by the author. Information is not indexed for the student. He must request it of the leader. The group is instructed to read the introduction. After reading individuals are asked, "What are the problems here? What information relates to the problem? How do you define the problem? What are your hypotheses? Which hypotheses shall we check? Where would you look to find such information?"

The instructor keeps record of problems and hypotheses for the group. The last question should lead to a request for more information to which the instructor guides the students. After reading the particular frame in question, repeat the above sequence of questioning and data recording. This exercise is designed to take approximately 45 minutes. The third training session ends with a brief review of the steps in problem-solving with an emphasis on the relevance to teaching.

Frame 1

August 1, 1895

Josephine English, aged 48, found dead in her room, bludgeoned with fireplace poker, room ransacked, jewelry and valuables not taken, diary missing. Died mid-evening, between 9 p.m. and midnight.

Frame 2

Summary of last will and testament, Philip McNeil English

June 1875

¹⁰ Sir Arthur Conan Doyle, M.D., The Complete Works of Sherlock Holmes, p. 359.

To James Allen English

Josephine Louise English

Elizabeth Ann English

1000 pounds each immediately. The remaining estate of 750,000 pounds; the house and property are to be divided equally (in title) among the above named however, the real estate is to be kept in tact and not divided or sold. The moneys are to be kept in trust for the above named or their heirs with Josephine Louise English acting as executor of the entire estate.

Frame 3

February 15, 1895

Dear Aunt Josephine,

Thank you for sending my allowance so promptly. Tuition was due and with spring approaching I had begun ordering dresses, hats, and light coats made; you know how difficult it is to resist the pretty colors of spring after such a long, drab winter. It has been warm and sunny here and very soon we expect the flowers to bloom. I hope you in the North are fortunate enough to have an early spring as well.

Auntie, I have wonderful news to share with you. I have recently met a young gentleman named Clayton Harcourt, an attorney here in Atlanta, from a very good family. He has taken me to visit his family at their estate. Of course he hasn't mentioned it yet but I expect that he will ask me to marry him. If so I would like you to meet him; possibly I could invite him home to visit with you and James.

Love,
Virginia

Frame 4

Dear Aunt Josephine,

I have the most wonderful news; Clayton has asked me to marry him and I have accepted. As an engagement gift he gave me the most exquisite emerald and diamond pendant and ring. I'm sure that now you will want to meet him. I must admit to being upset when in your last letter you said you did not want to meet him. When may I bring him to meet you?

Love,
Virginia

Frame 5

Dear Aunt Josephine,

Please do me this one last courtesy of meeting my fiance. It has much importance to both Clayton and me, and we will cause you as little trouble as possible. Clayton has agreed to come at any time so the arrangements will be strictly at your convenience.

In answer to your question, yes Clayton knows about my mother. I told him some time ago. However, we agreed it would be best to keep this from his parents at least for the time lest they become upset and forbid the marriage.

Love,
Virginia

Frame 6

Dear Aunt Josephine,

I am eternally grateful for all you have done for me -- for raising me as your own and sending me to boarding school. You could as well have placed me in an orphanage or foundling home. As you know, I have always respected your judgment; however, please before you write to Clayton's parents allow me to talk to you personally, letters make communication so difficult you know. I shall try to be home by August.

Love,
Virginia

Frame 7

Maid -

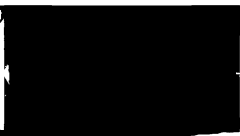
"What an awful tragedy. If she would have only pulled the bell rope we might have been able to help. We couldn't hear anything, of course, since the helpers quarters are in a separate wing of the house.

"You know, we all felt safe in this house even though there are no neighbors except for the old lady across the way, because of the dogs -- they've always been good watch dogs. I can't imagine how anyone could have broken in and then left without being detected by the dogs."

Frame 8

Maid -- about previous evening

"Well, last night seemed very uneventful -- just an ordinary evening. I served supper to Miss Josephine and Miss Lockwood about 7:00 p.m.



While I was cleaning up after dinner Miss Lockwood went to bed. She was complaining of her arthritis and said she would take some medicine. When she does that she usually goes right to sleep and sleeps all night. Miss Josephine went to read in the library and about 8:30 I returned to my quarters to retire."

Frame 9

Maid -- about family

"Well, I'll tell you, this is a funny family. I've lived here for five years and still not figured it out. They don't get together very often, although Mr. James doesn't live far. Seems like whenever he comes, he and Josephine get in an argument about money. She seems to control the purse strings pretty well, and I'd say from the looks of him it's a good thing.

"The other strange thing is the young Miss Virginia who comes to visit two or three times a year, usually around the holidays. She's a delightful young lady, likable, friendly and level headed -- I'd say about eighteen years of age. She calls Miss Josephine "Auntie," but Miss Josephine always reminds me when she leaves that she is really the daughter of a friend. She's certainly not the daughter of James. I've never heard of other family members."

Frame 10

Maid -- about own employment (5 yrs)

"Miss Josephine was a good woman to work for. She had a very regular schedule and never made extra-ordinary demands on me. She did have an occasional party but always notified me far in advance and never invited more than a very few.

"I was always paid on time and my day off was seldom violated."

Frame 11

Maid, where was Virginia?

"Well, I imagine she was on the train because I just sent Oscar to fetch her at the depot this morning."

Frame 12

Neighbor lady, aged 80

"It's so horrible, I can't imagine who would do such a thing to poor Josephine. She was always nice, quiet and kind but she only had a few friends. Had a beau as a young girl but she never did get married.



"She and her father represented the stable side of the family. Her mother, brother and sister were just the opposite -- relatively unstable, irresponsible. But you know, it's funny, everyone liked James and Elizabeth even though they were often into mischief and people just didn't get to know Josephine very well.

"I think that James especially resented Josephine because although he was the eldest of the children, Mr. English always entrusted responsibility to her.

"Strange now I think of it, I haven't seen Elizabeth for years. She was always carefree and independent. I wouldn't be surprised if she upped and ran away."

Frame 13

Miss Lockwood (companion)

"You can't imagine how shocked and upset I am. I've been a friend of Josephine most of my life and her companion for ten years. My room is right next door to her room. I didn't hear a sound last night even though I'm a very light sleeper, so I was even more horrified when I went to awaken Josephine this morning and found this horrible bloody scene. I just can't imagine who could have done such an awful thing."

Frame 14

Miss Lockwood -- about family

"Josephine was a close, close friend of mine. I've known her most of my life -- actually since we were children. She's always been a rather withdrawn but nevertheless shrewd person. Not many people were able to know her well and consequently she had few friends.

"Her relationship with James was at times tense, but I would say this was as much due to her intolerance as to his antics. Since she controlled the estate he had to request money from her which, I'm sure, was the only way that the estate remained. Nevertheless, I recall one incident when he was arrested -- nothing serious -- just being a little disorderly, and Josephine was so upset she refused to post bail for a week. On the whole, James is a good person, and I feel quite close to him.

"As for Virginia, Elizabeth's daughter, we only ever see her two or three times during the year. She's a nice girl, I think she's preparing to marry soon to a southern boy."

Frame 15

Miss Lockwood --

"What were you doing last night?"

"Well, I already told you I was in bed. My arthritis was acting up so I took some medicine and went directly to bed."

Frame 16

Miss Lockwood -- about her health

"I have arthritis, have had for a number of years. It causes me extreme discomfort. I've seen a number of doctors but all they can ever do is prescribe something to deaden the pain."

Frame 17

Medical -- Miss Lockwood

Dr. Coxon -- Jan. 1885

Cronic arthritic condition. Movement of joints painful. Can remain mobile if uses drugs for pain relief however, must be judicious and use only when pain significantly disturbs ability to move about. R_x morphine.

Dr. Whitney -- May, 1886

Difficult case of arthritis which cannot now be treated. R_x morphine.

For use only when absolutely necessary to relieve pain, not to be used continually.

Frame 18

James -- about relationship with family

"I'm sure you've heard about my sister and me by now so there's no sense in covering up. We argued a lot. She had control of the money and doled it out like a monthly allowance -- there was little chance for me to make use of it when I needed large sums. She always looked on me and Elizabeth as incompetents.

"When poor Elizabeth died Josephine consented to caring for her illegitimate daughter. Virginia lived in the house for a few years and then went off to boarding school. While Josephine looked down on Elizabeth and me she was jealous of Virginia because she was both smart, shrewd and likable. She was also getting married, something which Josephine pretended to be happy about but which I think caused her much trouble and personal doubt."

Frame 19

James --

"Where were you last night?"

"I was at the Green Parrot Saloon on the waterfront with a lawyer friend of mine, William Claymore."

Frame 20

William Claymore --

"Were you with James English last night?"

"No, we were together at the Green Parrot two nights ago, the day before his sister died. In fact he was telling me of another argument they had just had. I can't imagine him doing such an awful thing even though they've been arguing for the past 40 years."

Frame 21

Virginia -- about family

"As you know by now, mother was a rather irresponsible woman and as a result of her imprudence I was born out of wed-lock. Mother never married but moved to New York and posed as a widow. She died of pneumonia when I was quite young and Aunt Josephine became my guardian. She sent me to boarding school as soon as I was old enough because being unmarried herself, she felt they could raise me better than she.

"She was a hard woman to get along with but I always tried hard because I was grateful to her for not putting me in an orphanage."

Frame 22

Virginia -- alibi

"Where were you last night?"

"Oh, I didn't arrive from Atlanta until this morning; you can check that with Ilene the maid. She dispatched the grounds keeper to pick me up at the station."

Frame 23

Dispatcher, railroad depot

"Well, sir, the train from Atlanta is generally late. We expected it this morning but it was early this time and got here last night."

Oscar,

"Where was Virginia?"

"Well, I don't know but I just picked her up at the train station this morning."

APPENDIX B

APPENDIX B
PROBLEM-SOLVING TEST

Frame 1

This is a test of problem-solving ability.

In this booklet is included an introductory statement which will describe the problem situation. The rest of this booklet includes information which may or may not be relevant to the problem solution. Your job is to use whatever information you feel necessary to solve the problem while at the same time minimizing the amount of irrelevant information you use. If you feel that a source of information will be of value in solving the problem, use it; if not, don't use it.

Whenever you turn a page in the booklet write its number in order on your answer sheet. For example, the first page you will turn to is page 10. When you turn to page 10, write 10 on your answer sheet, line one.

When you feel you have reached a solution to the problem and think you know what the problem is, write your answer on the answer sheet and stop working. You are to decide why the situation described happened.

At the bottom of each page is a set of instructions. Please read and follow them carefully. You will begin by reading the introduction. After reading the introduction, you may give a solution to the problem or seek more information. Page 2 is a table of contents directing you to the various sources of information. Any questions? Turn to page 10.

Frame 2

Available sources of information

Personal interview with Mr. Pulaski	page 3
Records: school	page 5
employment	page 8
medical	page 9
Other interviews (other people)	page 7
Introduction	page 10

If you do not want to consult one of these sources of information, please turn to the last page for instructions.

Frame 3

During the interview with Mr. Pulaski, information was obtained regarding the family, his personal habits, fellow employees, past employment, past residences and hobbies. If you feel any of this information would be of interest to you, it is available on the following pages:

Family	page 4
personal habits	24
fellow employees	23
past employment	22
residences	17
hobbies	15

If you do not wish to consult any of these information sources, turn to the last page.

Frame 4

Information regarding the family includes Mr. Pulaski's description of his wife, mother-in-law, and children and is available on the following pages:

wife	page 21
mother-in-law	16
children	11

If you do not wish to consult any of these information sources, turn to the last page.

Frame 5

School records for:

Mr. and Mrs. Pulaski	page 13
Children	6

If you do not wish to consult any of these information sources, turn to the last page.

Frame 6

The school records available for John Jr. and for Timothy Pulaski are located on the following pages:

school correspondence with parents	pages 18-20
academic records	30
discipline reports	12

If you do not wish to consult any of these information sources, turn to the last page.

During the interview with
regarding the family, his
employment, past residence
information would be in
the pages.

Family
Personal habits
Religious employment
Past employment
Residence
Hobbies

If you do not wish to
the last page.

Information regarding
of his wife, mother-in-law
the pages.

Wife
Mother-in-law
Children

If you do not wish to
the last page.

Page 2

School records for

Mr. and Mrs. Fulmer
Children

If you do not wish to
the last page.

Page 3

The school records available for John J. and for Timothy Fulmer are
located on the following pages:

Page 18-20
20
12

Personal correspondence with parents
Academic records
Extracurricular activities

If you do not wish to consult any of these information sources, turn to
the last page.

Frame 7

Comments by Mrs. Pulaski about her family and health page 14
Comments about Mr. Pulaski from fellow workers 28

If you do not wish to consult any of these information sources, turn to the last page.

Frame 8

Past employment:

1955 Assistant manager, Safeway Grocers, produce department
1957 Promoted to produce manager
1959 Promoted to assistant store manager
1962 Recommended for promotion to store manager; moved for personal reasons

1962-1964 Used car salesman for Story Olds. Excellent salesman. Dismissed after missing work for one week and coming to work intoxicated for the third time that year.

1964-1966 Salesman for Capital Used Cars. Good worker but unreliable. Dismissed after failing to come in for four days and coming to work intoxicated.

1966-1967 Philp Dodge. Salesman. Dismissed after four months for drinking on the job.

Please turn to last page for further instructions.

Frame 9

Medical history for:

John Pulaski page 27
Muriel Pulaski 25
Children 29

If you do not wish to consult any of these information sources, turn to the last page.

Frame 10

Introduction:

John Pulaski, aged 35, has been referred to you, a caseworker for the state employment bureau. He has been unemployed over the past two months. Mr. Pulaski has lived here in Lansing with his wife and two children for seven years. During his residence in Lansing, Mr. Pulaski has held eight different jobs and has been dismissed from each. He says he is proficient in his work as is substantiated by his salary, which has been considerably above average for a man of his occupation.

An interviewer has already spoken with Mr. Pulaski and has gathered all of the pertinent records. He has been referred to you for aid in securing stable employment. Use whatever information you wish from that available to decide what the problem is and how you might solve it.

Please turn to the last page for further instructions.

Frame 11

Description of children:

"I have two boys, aged 12 and 10. The eldest boy tends to cause trouble in school but is a good boy and a good student.

"The youngest boy is shy and withdrawn, does fair school work and has a crippled arm."

If you wish additional information from the interview, turn to page 3; otherwise turn to the last page.

Frame 12

John Pulaski Jr.

Nov. 1966 - has been constantly disrupting class (Mrs. Jones, gr. 4). Called home for a conference with parents; however, Grandmother came, Mother was ill.

Mar. 10, 1967 - ten unexcused absences. Was asked to remain home until he could bring parent in for a conference. Father works long hours and couldn't come. Grandmother accompanied the boy to school this afternoon.

If you feel that you have solved the problem write the solution on the answer sheet; if not and you would like additional information, turn to page 2.

Frame 13

Educational records, Mr. and Mrs. John Pulaski:

Mr. Pulaski: High School diploma, g.p.a. 2.65
4 yrs. service in Army Quartermasters Corps

Mrs. Pulaski: High School diploma, g.p.a. 2.8

If you feel you have solved the problem, write your solution on the answer sheet; if not and you wish to consult additional information, turn to page 2.

Mrs. Pulaski, self-description:

"I think my health is good. I've never been seriously ill or really even felt weak. However, sometimes I do feel depressed -- like I have failed because of irresponsible action -- really a vague feeling. Fortunately mother lives nearby and helps out. It's been a real blessing having her so close."

If you feel that you have solved the problem, write your solution on the answer sheet; if not and you wish to consult additional information, turn to page 2.

hobbies:

golf
amateur photography

If you would like additional information from the interview, turn to page 3, otherwise turn to the last page.

"My wife's mother is a good woman at heart -- she means well, but she drives me nuts. When she comes over, she takes over the house issuing orders to all -- with the intent of getting things organized and helping out because Muriel is sick a lot. But if she stays for more than a day I can't stand it, so I usually get in an argument with her and get away for a few days until she's done, Muriel's better and she goes home."

If you would like additional information from the interview, turn to page 3, otherwise turn to the last page.

"Before Lansing we lived in Milwaukee for eight years; moved there soon after marriage. I got a job with a grocery chain and worked up to assistant store manager in charge of purchasing and sales. Worked there until we moved. We liked both the town and the job. We moved to Lansing shortly after my father-in-law died."

If you would like additional information from the interview, turn to page 2, otherwise turn to the last page.

Frame 18

Nov. 3, 1965

Mr. Jacobsen, Principal
Center School
Lansing, Mich.

Dear Mr. Jacobsen,

It has come to my attention that my son Timothy has been participating in highly strenuous activities during physical education and recess. Due to his disability, I fear that this type of activity may be quite harmful. Please excuse Timothy from this type of activity in the future as I worry about his safety.
Thank you.

Sincerely,

Mrs. John Pulaski

If you wish to continue with this exchange of letters, it continues on the next page; if not turn to the last page.

Frame 19

Nov. 8, 1965

Dear Mrs. Pulaski,

Upon receiving your letter I consulted with the school nurse and several local pediatricians. They recommend that Timothy continue normal activities. The danger of further injury is very small and they feel it will aid his personal development. I would like Timothy to continue in these activities.

Sincerely,

Fred Jacobsen, Principal

If you wish to continue with the letter exchange, turn to the next page; otherwise turn to the last page.

Frame 20

Nov. 10, 1965

Dear Mr. Jacobsen,

I appreciate your concern with Timothy; however, he has always been a weak boy and I constantly worry for his safety. I fear he may have another accident. Please excuse him from further strenuous activities. Thank you.

Sincerely,

Mrs. John Pulaski

If you think you have solved the problem, write your solution on your answer sheet; if not, turn to page 2 for additional information.

Frame 21

"Muriel is a good wife to me -- very patient above all. However, she is quite nervous and doesn't like to make decisions. She spends most of her time, now that the boys are in school, at her mother's.

"She's been a good mother to the boys, very loving; however, for some reason she does worry quite a bit about our youngest, Timothy, even though it's our oldest boy, John, that upsets her and gets in trouble at school.

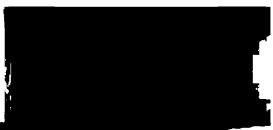
If you wish additional information from the interview, turn to page 3; if not, turn to the last page.

Frame 22

Reactions to jobs:

"Selling cars is OK. I'm a good salesman and make good money but I like the grocery business better. Had a good job in Milwaukee but Muriel insisted on moving here to care for her mother when her father died. I couldn't get a good job with a grocery chain here in town so I went to selling cars."

If you wish additional information from the interview turn to page 3; otherwise turn to the last page.



Frame 23

Description of fellow employees:

"I like the fellows I worked with selling cars. A good bunch of guys and hard workers. We work such long hours that once in a while we go out -- just me and the fellows -- and really do the town. I'd say we get along pretty well together at work and socially."

If you would like additional interview information, turn to page 3, otherwise turn to the last page.

Frame 24

Personal habits:

"Normally I don't have more than a beer at night when I get home. I'm not an alcoholic by any means. Once in a while I go out and have a few with the fellows and drink a little too much, and, well, we go to another place and have a few more and then to another place---. Well, sometimes the next day I just feel too low to work, sick, depressed and I have a couple to perk up. Well, by now you know what usually happens."

If you would like additional information about Mr. Pulaski's personal habits, turn to page 26; if not, turn to the last page.

Frame 25

Appendectomy - age 15
 Rheumatic fever as child. Minor heart damage.
 Thin, nervous woman, slightly underweight, 5'7", 115 lbs.
 General health - good, rarely ill.

If you think you have solved the problem, write your solution on the answer sheet; if not turn to page 2.

Frame 26

"My mother-in-law is what drives me to drink. When she comes over to stay at our house she drives me nuts. It's my only solution."

If you think you have solved the problem, write your solution on the answer sheet; if not and you wish to consult additional information, turn to page 2.

Frame 27

Tonsilectomy as a child. No record of serious disease.
 Back injury incurred while in Army. Still experiences periodic pain as a result. Lasts for a week to ten days and subsides. Otherwise strong and sound. Slightly overweight.

If you think you have solved the problem, write your solution on the answer sheet; if not and you wish additional information, turn to page 2.

Interview with fellow worker:

"John is a pretty good friend of mine -- known him for 4-5 years, since he came here to Capital Used Cars. We get together with the guys once in a while.

"I can't figure out why he keeps losing jobs. I guess he drinks a little too much once in a while. Seems like he complains about his mother-in-law once in a while but who doesn't -- you should see mine!"

If you think you have solved the problem, write the solution on your answer sheet; if not and you wish additional information, turn to page 2.

John Jr. age 12

Diseases:

Mumps, chickenpox, measles. No allergies. Seldom ill. General health good. Immunizations current. No major injuries or illnesses.

Timothy age 10

Diseases:

Mumps, chickenpox. No allergies. Prone to catch colds. General health fair. Immunizations current. Fell off table age 10 mos. and damaged nerves in right arm. Arm weak and smaller than left arm. About 50% functional.

If you think you have solved the problem, write your solution on the answer sheet; if not and you wish additional information, turn to page 2.

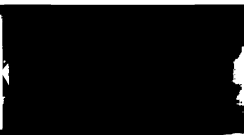
John Jr.

	1963	1964	1965	1966	1967	1968
reading	B	B	C	A	B	B
arithmetic	A	B	B	A	B	A
writing	C	B	B	A	B	A
science	B	B	A	A	B	A
soc. sci.	C	C	B	C	B	B
deportment	P	F	F	F	P	F

Timothy

	1965	1966	1967	1968
reading	B	A	A	A
arithmetic	C	D	D	D
writing	D	C	B	C
science	B	B	B	B
soc. sci.	C	C	D	C
deportment	P	P	P	P

If you feel you have solved the problem, write your answer on the answer sheet; if not and you wish further information, turn to page 2.



If you feel you have solved the problem, write your answer on the answer sheet; if not and you wish further information, turn to page 2.

Scoring Key for the Problem-Solving Test

Mr. Pulaski is intellectually capable of good work.
He is physically fit but may have back trouble.
He drinks too much.
He sometimes misses work or goes in drunk.
He was successful previously but moved to a new city due to father-in-law's death.
He liked the grocery business in which he was engaged.
He was unable to find similar employment after moving.
He would prefer the grocery business to his present job.
His job keeps him away from home for long hours.
His wife is not stable enough to take over his responsibilities when he is gone.
His wife won't make decisions.
She is overly dependent on her mother.
One of her sons had a minor injury due to her negligence.
She is overly protective toward this son.
The other son causes trouble in school.
She sends her mother to take care of the problems with the kids.
She has psycho-somatic symptoms (weakness, etc.).
When she calls her mother in, her mother takes over the house.
This threatens the father's position since mother-in-law is domineering.
He leaves and gets drunk.
This inflames family problems.
The wife spends more time at her mother's.
The mother comes over when the wife is "sick."
The "sickness" is brought on by family troubles.

APPENDIX C

APPENDIX C

COMPETENCE SCORING KEY

Cooper

1. Gathers information but makes no attempt to treat problems.
2. Deals with birthday and/or Friday problems administratively and/or in terms of some solution which ignores Cooper's social alienation and its presumed causes.
3. Deals with birthday and/or Friday problems in terms of Cooper's social alienation.
4. Deals with all symptoms (birthday, Fridays, dropping grades, isolation, low feeling of belonging, inability to work independently) in terms of some unified approach which treats underlying causes (tomboy behavior, age, rural orientation, appearance).

Fagen

1. Gathers information but makes no attempt to treat problems.
2. Relates symptoms (does not bring assignments in, fights with his own friend, ignores his step-sister, gets poor grades, low achievement, poor deportment, absent and tardy) to one of the underlying problems (low ability, step-father, new town, new school, capable and popular step-sister in same class, small in comparison with peers).
3. Relates symptoms to at least two underlying problems.
4. Relates symptoms to at least three underlying problems.

Hoffman

1. Poor RC, low CTP, isolate
2. Grades discrepant with IQ, underachiever, drop in grades, chooses popular kids.
3. Emotional problems, sister coming, poems vs. grades, problem chronic and getting worse, stuttering.
4. Comparing Jane with Shirley, pressure relation between Jane and parents, no best friend.

5. Sister is a star - cannot compete, home pressure getting worse because of sister's visit, reaction formation (stuttering is unconscious rebellion).

Lopez

1. Identifies problems (low RC, low cardex, low CTP, almost isolate, migrant) but proposes no solutions.
2. Identifies problems (oldest in class, dyad, transfer student, absent and tardy, underachiever) but draws no conclusions.
3. Explains problems in terms of cliches or the obvious (slow learner, emotional problems, low motivation, social problem, needs academic help, frustration and blocking, needs extra help, dislikes school).
4. Explains problems in terms of factors which are known to be related to the kinds of symptoms presented (language, culture, parents with low education cannot help, emphasis in migrant community on physical survival, high incidence of absences, frequent moves, poor entry skills, large family but small house, social skills, social discrimination, early maturation, lower class kid in middle class school).

Lyons

1. Borderline CTP, isolate.
2. Older, bigger than most.
3. Twin brother, cleft palate, repeated 4th grade, low feeling of belonging, withdrawal tendencies.
4. Possible speech problem, emotional problem due to brother ahead, possible physical deformity.

Maloney

1. Treats Maloney but makes no attempt to tie anything up.
2. Treats Maloney but takes administrative approach (change seating arrangement, separate boys and girls in P.E.), restates problem without adding anything new, or diagnoses in terms of cliches (feelings of inferiority, emotional problem, cry baby, does not feel part of group, trouble communicating, nothing really wrong, does not know what is wrong).

3. Makes effective approach in terms of specific and known relationships between variables (overweight impedes performance in P.E.; overweight may have a non-physical basis and may need psychiatric attention; overweight may have a physical basis and requires medical attention; assumes that overweight, if it has a physical basis, is either being ignored by physician-father or if under treatment, is not yielding to treatment; recognizes relationships between social problems such as isolation, not working and playing well with others, low CTP, teasing, all these and overweight; need to find some way to help her lose weight).

Moore

1. Aware of math problem but makes no prescription; unaware of band-math conflict.
2. Aware of math problem and makes a prescription; unaware of band-math conflict.
3. Aware of band-math conflict but makes no prescription.
4. Aware of band-math conflict and prescribes for that immediate problem.
5. Aware of band-math conflict; makes prescription which accounts both for immediate band problem as well as long-term math problem.

Rosen

1. Gets facts about his brilliance but makes no recommendations.
2. Prescribes extra work.
3. Prescribes more challenging work or enrichment.

Sieminsky

1. Low RC, absent for CTP, no field trip slip in, popular, bruises, hit Hickman.
2. Behavior problem, disrupts class, very tall and skinny, teased Maloney, father changes jobs often.
3. Unstable family, father deserted and returned, aggressive yet popular, bruise research.

4. Comparisons between parents' jobs and education, home problems in relation to RC and good art grades.
5. Parents incompatible, father aggressive with Stu, Stu identifies with mother, fears father, beaten by father and/or mother, grades better during father's absence.

Fagen-Moore

1. Either one because other is not seen; cross burned; Nigger-lover.
2. Two Williams
3. Calls in to get answer.

Note: In each case the score for any problem is the level reached as indicated by the accompanying numbers. In the cases of Cooper, Lopez, and Maloney the score extended up to a maximum of five depending on how many of the highest level solutions were proposed.

APPENDIX D

APPENDIX D

TABLES OF CORRELATIONS AND ANALYSES OF VARIANCE

TABLE D-1

INTERCORRELATIONS AMONG ALL VARIABLES, N=60

GPA	1									
Beliefs	2	21								
Complexity	3	06	62							
Politics	4	02	58	29						
Word Association	5	22	37	36	20					
Dogmatism	6	-09	-59	-29	-38	00				
Dogmatism (Negative)	7	06	52	24	39	-05	-96			
Dogmatism (Deviation)	8	-04	21	17	10	18	-31	18		
P.S. Steps	9	16	23	09	02	15	-38	40	19	
P.S. Quality	10	29	09	18	14	06	-27	28	-06	
Bits	11	-05	14	14	14	19	-07	10	-05	
Time	12	-09	02	13	05	14	-08	14	-12	
Total Sources	13	22	12	-04	00	35	-11	13	-14	
Mean Sources	14	28	03	-10	-05	26	-06	06	-15	
Shifts	15	-02	07	01	07	11	-06	08	-07	
Problems	16	24	02	-04	-04	14	-07	05	-09	
Competence	17	15	02	-02	-05	18	-12	11	00	
Mean Competence	18	24	-04	-08	-13	13	-08	07	-09	
M.S.U. Reading	19	53	26	14	04	40	-09	00	07	
CQT Verbal	20	45	24	09	09	21	-10	07	-05	
CQT Information	21	34	13	-01	08	18	16	-14	-26	
CQT Numerical	22	33	06	-04	07	19	01	01	-18	
CAT Total	23	49	20	-02	11	26	01	-01	-19	
General Inquiry	24	24	07	-02	-04	26	-12	11	-09	
Bits/time	25	28	-01	-14	-04	-01	01	-08	05	
Shifts/time	26	06	15	06	14	05	-05	04	07	
Problems/time	27	06	04	08	05	-01	-02	00	-03	
		1	2	3	4	5	6	7	8	

TABLE D-1 (Continued)

1												
2												
3												
4												
5												
6												
7												
8												
9												
10	50											
11	31	16										
12	24	48	54									
13	36	39	65	53								
14	33	37	56	48	84							
15	31	24	90	47	75	68						
16	19	33	41	41	60	52	51					
17	28	39	21	35	39	29	33	63				
18	22	33	00	20	25	38	09	37	71			
19	-05	03	11	-02	25	26	06	36	27	32		
20	09	00	09	-03	20	16	02	29	37	09	73	
21	01	-02	06	-04	08	05	-06	22	13	10	57	56
22	06	16	07	-10	27	41	12	18	18	24	39	23
23	08	06	10	-07	25	28	04	31	14	18	75	82
24	33	45	51	52	79	66	64	89	81	54	35	22
25	-05	-10	-18	-56	-01	-04	-05	49	29	21	33	26
26	12	-23	55	-37	17	10	48	04	-11	-19	12	10
27	17	03	64	-12	48	42	79	32	17	-00	06	00
	9	10	11	12	13	14	15	16	17	18	19	20

22	36						
23	80	68					
24	17	25	28				
25	25	20	31	31			
26	11	11	14	04	36		
27	-04	18	07	39	35	81	
	21	22	23	24	25	26	27

TABLE D-2

ANALYSIS OF VARIANCE FOR PROBLEM-SOLVING QUALITY

Sources	df	MS	F	P
treatment	2	.05	1.37	.27
selection	1	.11	2.84	.10
cueing	1	.006	.15	.70
TxS	2	.02	.38	.68
TxC	2	.004	.09	.91
SxC	1	.02	.42	.52
TxSxC	2	.07	1.69	.19
error	48	.04		

TABLE D-3

ANALYSIS OF VARIANCE FOR MEAN SOURCES

Sources	df	MS	F	P
treatment	2	3.94	2.98	.06
selection	1	.31	.23	.63
cueing	1	.02	.02	.90
TxS	2	.34	.26	.77
TxC	2	3.39	2.56	.09
SxC	1	.54	.41	.52
TxSxC	2	.73	.55	.58
error	48	1.32		

TABLE D-4

ANALYSIS OF VARIANCE FOR MEAN COMPETENCE

Sources	df	MS	F	P
treatment	2	.21	1.91	.16
selection	1	.007	.006	.94
cueing	1	.05	.48	.49
TxS	2	.12	1.08	.35
TxC	2	.20	1.81	.17
SxC	1	.29	2.64	.11
TxSxC	2	.002	.01	.99
error	48	.11		



TABLE D-5

ANALYSIS OF VARIANCE FOR SHIFTS

Sources	df	MS	F	P
treatment	2	3889.95	1.64	.20
selection	1	3.75	.002	.97
cueing	1	260.42	.11	.74
TxS	2	2763.15	1.17	.32
TxC	2	4008.72	1.69	.19
SxC	1	4914.15	2.07	.16
TxSxC	2	984.05	.42	.66
error	48	2367.57		

TABLE D-6

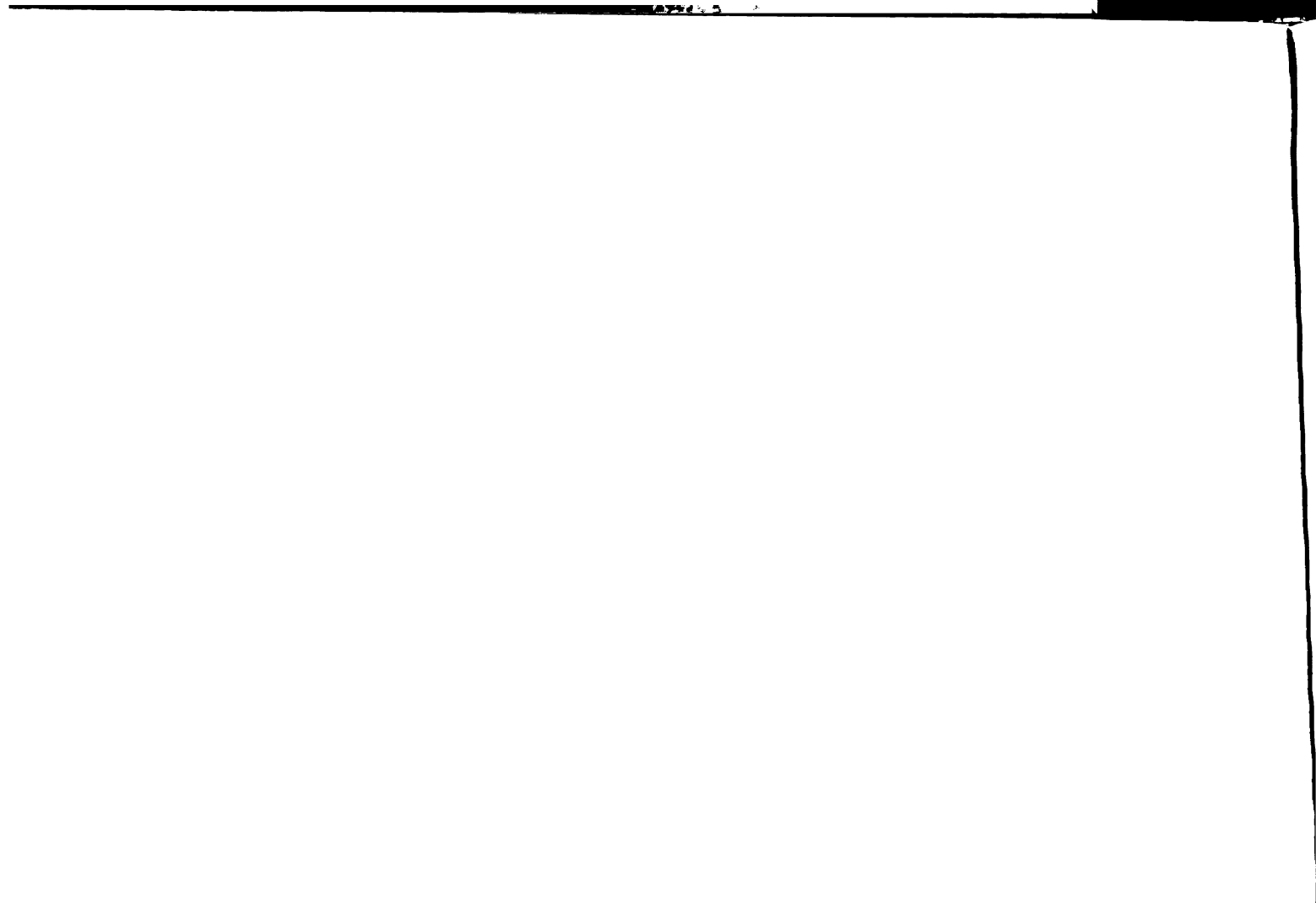
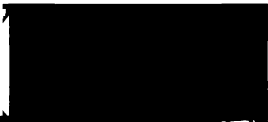
ANALYSIS OF VARIANCE FOR BITS TEMPO

Sources	df	MS	F	P
treatment	2	.004	.03	.97
selection	1	.002	.02	.89
cueing	1	.07	.57	.45
TxS	2	.13	1.09	.35
TxC	2	.09	.74	.48
SxC	1	.38	3.10	.08
TxSxC	2	.08	.68	.51
error	48	.12		

TABLE D-7

ANALYSIS OF VARIANCE FOR SHIFTS TEMPO

Sources	df	MS	F	P
treatment	2	.08	.83	.44
selection	1	.06	.64	.43
cueing	1	.04	.41	.52
TxS	2	.14	1.48	.24
TxC	2	.16	1.65	.20
SxC	1	.40	4.08	.05
TxSxC	2	.03	.32	.72
error	48	.10		



APPENDIX E

APPENDIX E

RAW DATA

TABLE E-1

Student Number	GPA	Inventory of Beliefs	Complexity	Politics	Word Association	Dogmatism Raw
1	296	55	07	12	121	138
2	257	57	13	10	086	105
3	280	45	10	05	102	124
4	205	51	11	16	092	127
5	220	58	22	16	104	107
6	250	62	11	12	105	102
7	212	60	09	12	079	136
8	245	50	18	09	100	140
9	200	68	24	12	107	096
10	230	56	09	17	095	097
11	220	69	15	14	108	093
12	372	60	18	13	102	138
13	254	64	12	08	085	105
14	201	51	13	12	093	157
15	202	64	17	13	095	138
16	290	83	24	18	140	120
17	299	60	16	15	138	088
18	210	56	15	12	102	136
19	374	71	19	18	119	083
20	326	56	10	15	096	110
21	372	67	09	17	125	133
22	220	65	17	13	118	081
23	167	51	13	08	113	122
24	350	49	07	13	104	120
25	220	73	15	17	117	093
26	170	40	09	15	106	139
27	250	53	24	12	090	151
28	237	66	16	13	117	111
29	333	56	15	12	101	151
30	226	58	14	06	090	138



TABLE E-1

Student Number	GPA	Inventory of Beliefs	Complexity	Politics	Word Association	Dogmatism Raw
31	343	62	20	12	151	164
32	198	58	14	15	114	154
33	220	36	15	08	104	178
34	210	52	18	13	113	153
35	256	64	19	14	151	174
36	247	67	23	17	117	148
37	256	75	21	17	126	121
38	245	80	29	16	130	101
39	333	73	16	14	104	068
40	345	68	20	10	133	133
41	214	48	07	13	100	172
42	278	64	21	15	104	097
43	315	50	10	14	094	144
44	310	50	18	09	092	125
45	300	50	12	05	111	136
46	341	79	27	15	113	128
47	194	54	09	18	104	157
48	220	54	15	12	092	144
49	233	48	06	12	114	152
50	280	66	15	12	125	131
51	289	55	12	12	092	141
52	230	72	15	17	118	105
53	305	80	21	18	123	060
54	225	56	21	13	118	115
55	293	42	09	09	123	177
56	231	70	17	14	112	114
57	333	61	11	11	100	149
58	240	79	20	16	124	121
59	260	44	13	04	145	161
60	250	71	25	17	124	086

TABLE E-2

Student Number	Problem Solving Bits	Problem Solving Competence	Bits	Time	Total Sources	Mean Sources	Shifts
1	13	0.4	201	141	82	8.2	156
2	05	0.2	138	157	53	5.3	095
3	09	0.3	189	146	65	6.5	142
4	06	0.4	280	167	64	7.1	227
5	02	0.3	171	128	46	4.6	087
6	04	0.2	103	115	44	5.5	072
7	11	0.3	131	086	37	3.7	085
8	07	0.5	152	169	47	5.2	085
9	07	0.4	190	126	46	5.1	130
10	05	0.3	162	156	43	4.3	108
11	10	0.4	161	120	46	5.1	102
12	10	0.5	156	124	46	7.7	083
13	14	0.5	153	116	52	6.5	121
14	12	0.4	274	150	49	4.9	209
15	05	0.5	158	151	55	5.5	120
16	08	0.2	227	133	56	5.1	121
17	15	0.4	126	096	52	5.8	081
18	11	0.2	207	097	44	4.4	141
19	22	1.1	150	172	49	4.9	096
20	15	0.7	180	110	55	6.8	159
21	04	0.6	168	116	71	6.5	129
22	07	0.5	191	131	68	6.8	159
23	17	0.6	272	153	69	6.3	209
24	07	0.7	242	106	74	7.4	207
25	13	0.3	298	168	79	7.4	245
26	09	0.5	235	173	71	7.1	157
27	07	0.4	184	100	51	6.4	134
28	19	0.5	257	160	74	8.2	214
29	03	0.1	132	099	44	4.4	069
30	14	0.3	190	113	55	5.0	114

TABLE E-2

Student Number	Problem Solving Bits	Problem Solving Competence	Bits	Time	Total Sources	Mean Sources	Shifts
31	09	0.5	258	173	69	7.7	169
32	06	0.4	093	124	43	5.4	060
33	11	0.4	126	121	40	4.4	077
34	04	0.3	128	087	38	4.2	071
35	02	0.0	133	080	42	4.2	072
36	06	0.6	200	112	53	4.8	154
37	06	0.4	179	123	56	5.6	103
38	12	0.3	275	149	59	5.9	197
39	11	0.3	133	068	41	4.1	055
40	17	0.5	256	156	79	7.9	226
41	02	0.2	130	091	38	4.8	092
42	06	0.3	131	085	40	3.6	076
43	11	0.5	168	111	62	6.2	160
44	04	0.4	233	134	60	6.0	178
45	06	0.3	163	111	48	6.0	101
46	06	0.6	237	147	69	6.3	182
47	07	0.1	260	152	49	6.1	153
48	08	0.1	151	091	43	3.9	082
49	06	0.3	146	106	59	5.4	099
50	13	0.4	247	179	85	7.7	220
51	10	0.4	142	092	57	5.2	094
52	06	0.1	230	104	62	6.2	181
53	22	0.4	227	105	55	5.6	106
54	08	0.8	217	141	63	5.7	114
55	11	0.4	239	152	57	5.7	149
56	10	0.5	141	139	49	5.4	085
57	08	0.4	177	150	64	6.4	108
58	09	0.3	167	124	54	5.4	103
59	09	0.3	137	104	63	6.3	099
60	20	1.0	191	171	76	6.9	146

TABLE E-3

Student Number	Problem Sensitivity	Competence	Mean Competence	Bits/ Time	Shifts/ Time	Problem Sensitivity/ Time
1	088	29	2.9	143	111	062
2	089	26	2.6	088	061	057
3	110	33	3.3	129	097	075
4	086	29	2.9	168	136	051
5	075	23	2.3	134	068	059
6	060	23	2.9	090	063	052
7	086	28	2.8	152	099	100
8	074	31	3.1	090	050	044
9	081	24	2.4	151	103	064
10	081	28	2.8	104	069	052
11	060	25	2.5	134	085	050
12	062	21	3.5	126	067	050
13	081	33	3.7	132	110	070
14	063	28	2.8	183	139	042
15	072	27	2.7	105	079	048
16	074	24	2.4	171	091	056
17	088	30	3.3	131	084	092
18	055	21	2.3	213	145	057
19	070	30	3.0	087	056	041
20	085	31	3.1	164	145	077
21	102	28	3.1	145	111	088
22	067	25	2.8	146	121	051
23	100	28	2.8	178	137	065
24	096	28	2.8	228	195	091
25	106	31	3.1	177	146	063
26	066	24	2.7	136	091	038
27	078	23	2.9	184	134	078
28	102	24	2.4	161	134	064
29	071	24	2.7	133	070	072
30	063	21	2.6	168	101	056

TABLE E-3

Student Number	Problem Sensitivity	Competence	Mean Competence	Bits/ Time	Shifts/ Time	Problem Sensitivity/ Time
31	104	29	2.9	149	098	060
32	074	25	2.8	075	048	060
33	073	28	2.8	104	064	060
34	076	24	2.4	147	082	087
35	066	27	2.7	166	090	083
36	082	30	3.0	179	138	073
37	062	28	3.1	146	084	050
38	084	31	3.1	185	132	056
39	045	21	2.6	196	081	066
40	076	30	3.0	164	145	049
41	037	17	2.1	143	101	041
42	056	24	2.4	154	089	066
43	091	26	2.6	151	144	082
44	077	25	2.5	174	133	057
45	069	21	2.6	147	091	062
46	101	25	2.5	161	124	069
47	058	21	2.6	171	101	038
48	036	19	1.9	166	090	040
49	070	22	3.1	138	093	066
50	090	27	2.7	138	123	050
51	083	32	3.2	154	102	090
52	097	29	2.9	221	174	093
53	075	24	2.7	216	101	071
54	085	30	3.3	154	081	060
55	095	26	2.6	157	092	063
56	083	26	2.8	101	062	060
57	098	26	2.6	118	072	065
58	046	21	2.3	135	083	037
59	064	30	3.3	132	095	062
60	082	27	2.7	112	085	048



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TABLE E-4

Student Number	General Inquiry	MSU Reading	CQT Verbal	CQT Information	CQT Numerical	CQT Total
1	185	34	49	51	40	140
2	154	33	65	45	22	132
3	196	37	60	50	29	139
4	170	22	51	40	31	122
5	132	30	62	44	25	131
6	121	24	44	39	23	106
7	145	36	72	59	24	155
8	154	34	55	56	17	128
9	138	33	46	42	28	116
10	147	34	53	34	21	108
11	128	21	36	37	35	108
12	119	38	55	46	48	149
13	168	34	47	41	44	132
14	141	18	34	42	20	096
15	148	24	25	45	17	087
16	142	36	67	66	48	181
17	164	33	54	41	26	121
18	113	23	35	39	25	099
19	151	35	64	49	16	129
20	167	25	57	41	43	141
21	182	41	72	61	46	179
22	151	30	53	33	30	116
23	179	32	60	46	23	129
24	181	34	42	44	44	130
25	199	40	69	53	33	155
26	150	28	52	37	27	116
27	138	31	62	45	17	124
28	174	32	64	54	32	150
29	131	35	70	47	18	135
30	127	24	58	33	20	111

TABLE E-4

Student Number	General Inquiry	MSU Reading	CQT Verbal	CQT Information	CQT Numerical	CQT Total
31	184	46	75	62	46	183
32	134	27	54	40	36	130
33	140	18	32	37	21	090
34	129	28	38	41	31	110
35	134	39	54	46	21	121
36	161	31	54	46	25	125
37	146	47	71	53	46	170
38	170	36	51	36	17	104
39	104	31	52	47	17	116
40	179	42	64	47	36	147
41	086	27	54	41	27	122
42	118	36	67	48	34	149
43	163	34	54	47	27	128
44	150	35	62	43	26	131
45	124	39	68	52	30	150
46	172	33	66	48	19	133
47	119	28	51	57	21	129
48	095	21	45	47	28	120
49	137	33	64	49	23	136
50	184	31	47	33	22	102
51	170	37	63	67	44	174
52	175	28	54	42	23	119
53	143	40	74	51	24	149
54	171	23	41	44	18	103
55	161	37	62	50	32	144
56	147	31	48	46	21	115
57	169	28	64	44	24	132
58	116	25	55	44	20	119
59	158	32	55	46	28	130
60	171	27	56	40	35	131

TABLE E-5

Student Number	Beliefs I	Beliefs II	Beliefs Change
1			
2			
3	45	74	29
4	51	65	14
5	58	74	16
6			
7			
8			
9			
10	56	73	17
11			
12			
13			
14	51	61	10
15			
16	82	86	04
17			
18	56	64	08
19	70	74	04
20			
21			
22			
23	51	62	11
24			
25	73	75	02
26			
27			
28			
29			
30			

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TABLE E-5

Student Number	Beliefs I	Beliefs II	Beliefs Change
31			
32			
33			
34	51	59	08
35			
36			
37			
38	78	80	02
39			
40			
41			
42	64	73	09
43			
44	50	60	10
45			
46			
47			
48	54	61	07
49			
50			
51	55	64	09
52			
53			
54	56	65	09
55			
56			
57	61	65	04
58	79	84	05
59			
60	71	70	01

TABLE E-6

Student Number	Subject Identification Key	
	Training	Seeking Style
1	0	1
2	0	1
3	2	1
4	2	1
5	2	0
6	0	1
7	0	1
8	1	1
9	0	0
10	2	1
11	1	0
12	1	0
13	1	1
14	2	0
15	0	0
16	2	0
17	0	0
18	2	0
19	2	0
20	1	0
21	1	0
22	1	0
23	2	1
24	1	0
25	2	1
26	1	1
27	0	1
28	1	0
29	0	1
30	0	1

Training - 0=Control
1=Problem Solving
2=Openness

Seeking - 0=Dialectical
Style 1=Didactic

Cueing - 0=Cued
1=Not Cued

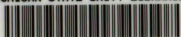
TABLE E-6

Student Number	Training	Seeking Style	Cueing	Subject Identification Key	
				Training	Seeking Style
31	0	0	0	0=Control	
32	1	0	1	1=Problem Solving	
33	1	1	0	2=Openness	
34	2	0	0		
35	0	0	1	0=Dialectical	
36	1	0	1	1=Didactic	
37	0	0	0		
38	2	0	1	0=Cued	
39	0	0	1	1=Not Cued	
40	0	0	1		
41	0	1	1		
42	2	0	0		
43	0	1	0		
44	2	1	0		
45	1	1	1		
46	1	0	1		
47	1	1	0		
48	2	1	0		
49	1	1	1		
50	1	0	0		
51	2	1	1		
52	1	0	0		
53	0	0	0		
54	2	0	0		
55	0	1	1		
56	0	0	0		
57	2	1	1		
58	2	0	0		
59	1	1	1		
60	2	0	1		



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