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Cognitive Complexity-Simplicity and Problem-Solving Processes

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COGNITIVE COMPLEXITY--SIMPLICITY

AND

PROBLEM--SOLVING PROCESSES

BY

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of Loyola University in Partial Fulfillment of
the Requirements for the Degree of
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CHAPTER I

THE PROBLEM

The purpose of this investigation is to explore the relationship between personality and an individual's approach to a real-life problem. Although some investigators have considered problem-solving behavior as dependent solely on cognitive functions, quite independent from other aspects of the person, (Duncker, 1945) the position taken in this study is that the relationship between personality and cognition interacts in such a way that they are inseparable (Allport, 1955; Fenichel, 1945; Maslow, 1954; Frenkel-Brunswik, 1954; Wertheimer, 1959).

The method used in this experiment to assess an individual's problem-solving behavior is the Rimoldi Technique (1955, 1960) which consists in presenting a problem, along with questions that may be asked in solving it. A record is kept of the specific questions asked so that number, order and utility in terms of the group of subjects may be considered in analyzing the data.

The unit of measurement of personality (Allport, 1958) used in this experiment is called a construct and the personality style of the individual is his construct system. This is the basis of Kelly's theory of personality (1955). An individual's construct is based on his way of perceiving other individuals and events and in this sense is a reflection of his personality and comparable to other units of personality measurement. These constructs or percepts are the basis for understanding and

predicting human behavior within Kelly's framework. He points out, however, that we are interested not only in what people predict but also in the similarities or differences in their manner of arriving at these predictions. In relating this to the area of problem-solving, he stated:

When one makes a choice he involves himself in a selection. Even if the choice is no more than a temporary hypothesis explored in the course of solving a mathematical problem or in looking for a lost screwdriver, he must perceive himself as being modified through the chain of ensuing events (1955, p. 65).

Consequently, the solution given to a problem is essentially a prediction and each question asked during the process of arriving at that solution is a reflection of the individual's personality as measured by his construct system. Thus, differences in construct systems should be reflected in different approaches to problems.

Bieri noted that there were differences in number of constructs possessed by individuals and attributed these differences to early learning experiences in the sphere of interpersonal relationships. He showed (1955, 1956) in his work that people with a large variety of personal constructs (cognitively complex persons) were able to look at and predict other peoples' behavior more accurately than those with only a few constructs (cognitively simple persons). The complex individuals are the ones who are able to subsume and understand another's system of constructs well and hence, make accurate judgements. Those who are limited in number of constructs often are subjective and unable to see things as they really are.

In the present study, the subject will be requested to make a prediction, based on information gained throughout the duration of the problem. The end result is not the particular concern here since the emphasis is on the processes throughout the course of the task. Each question selected is based on a choice made by the particular individual and since every choice is a reflection of the individual's personality (as measured by personal construct units) differences in construct system should be related to differences in problem-solving processes. Those with more limited systems, as measured by Bieri, focus on different kinds and amounts of information than those with large and varied systems. Since the person with the larger number of personality constructs is not limited or narrow in viewpoint, is capable of understanding other construct systems and is, in general, objective, he should proceed in a real-life problem situation in a manner similar to experts in the area, i.e. psychotherapists trained in objectively diagnosing psychological problems. From this stem the two major hypotheses to be tested:

1. There is no difference between the problem-solving performances of cognitively complex and cognitively simple subjects.
2. There is no difference between the cognitively complex and cognitively simple subjects when scored on norms developed from experts in the area of real-life problems.

CHAPTER II

REVIEW OF THE LITERATURE

This review of the literature will be divided into three sections. The first will concern the area of personality factors and problem-solving; the second will deal with the REP Test and Bieri's concept of cognitive simple and cognitive complex; and the third will review problem solving methodology.

A. Personality and Problem-Solving. Of all the studies in the area which seem to be relevant, only four can actually be considered entirely related to this experiment in that they are concerned with problem-solving processes and with personality. These will be considered first.

Bloom and Broder (1950) in research designed primarily to explore problem-solving processes found variations in approach of successful and unsuccessful problem-solvers. In a group of 39 subjects from the University of Chicago, used in the experiment, six were found to be academically very successful and six academically non-successful on the basis of grades on achievement tests and aptitude test scores. The problem-solving characteristics of these extreme groups of students were studied in an attempt to find differences in problem-solving methods. They noted that the difference between the two groups was not in amount of relevant knowledge possessed but that the unsuccessful group differed in four large ways, the last of which included such things as lack of confidence in ability, introduction of personal considerations

into problem solving, lack of flexibility in thinking and a lack of objectivity. After a second follow-up study, in which 27 students were used, it was concluded that,

dislike for various subject fields, their feelings of inadequacy, their fear of problems which look too difficult and complex, their personal and social values, and their lack of success in previous efforts—all these emotional factors lead them to refuse to attempt certain problems or to give up the attack on a problem after little consideration. These emotional aspects of problem-solving are serious and must be overcome if the individual is to do thinking and problem-solving anywhere near the level of which he is capable. (1950, p.38).

Because of the small number of subjects in each experiment and the exploratory nature of their design, the conclusions drawn by Bloom and Broder must be viewed with caution. Furthermore, it is probable that the rigidity and personalized behavior they describe is correlated significantly with the achievement and aptitude tests used to form the two groups originally, and thus, may have little to do directly with the problem-solving experiment they conducted.

In an effort to show how subjectivity and personal conviction affect logical thinking Bloom and Broder chose a syllogistic problem in which the student was to reach a logical conclusion. The subject reported that although the one answer seemed more logical, the other was what he believed so he chose the second erroneous one. It might be noted that this is in keeping with an experiment by Morgan and Morton (1944) in which 64 syllogisms were given to 171 psychology students at Northwestern University. They wished to see if conclusions were related to how the syllogism was structured and secondly, if this

relationship became more marked when the terms of the syllogism were related to personal conviction. The findings were all positive.

Unfortunately, it is unclear what procedures were employed to evaluate degree of personal conviction. Hence, although their findings were positive, it remains questionable as to what the results actually mean.

Gaier (1951) employed the method of stimulated recall developed by Bloom and Broder (1950) in an experiment relating personality variables to the learning process. Free floating anxiety, negativism, and rigidity as measured by the Rorschach were related to the conscious thoughts of students in a classroom situation and to the results of aptitude and achievement tests. In gathering the "conscious thoughts", recordings of class sessions were made and later played back to the student while he recalled his experiences at that time. Complete ideas were considered "idea units" and were recorded. Sixty four interviews with 11 students were conducted. Results showed anxiety readiness to be negatively related to general level of performance on aptitude tests and all of the comprehensive tests except that calling for rote memory. High anxiety characterized those who spent time thinking about themselves in negative terms. Rigidity correlated positively with performance calling for rote memory but negatively with problems calling for new modes of attack and unfamiliar concepts. Rigidity was correlated also with thinking about self in negative terms. Negativism, although not significantly related to aptitude or achievement test scores, was related to critical ideas about self and others and criticism of ideas expressed in class. The

authors concluded that relationships do exist between personality and the learning process and that in relation to aptitude and achievement tests, items should be classified according to type of cognitive process required since different personality characteristics are related to different types of cognitive processes.

This is an excellent example of mapping out an area using correlational methods, but it is difficult to see how the authors can draw such a generalized conclusion. The findings based on such a method of study require more strenuous control and manipulation of variables in order to be confirmed.

Goldner (1957) described a group of 19 Freshman students at the University of Chicago in whole-part approach to problem-solving and flexibility and rigidity in problem-solving. He considered these variables to be closely related to personality characteristics. The subjects were given a number of tasks which differed in degree of structure so that different methods of attack could be measured. These were the Rorschach, A Function Test, two Anagram Tests, a Block Design Test and a Stencil Test. The results indicated whole-part consistency for individuals throughout all tasks. However, individuals who were rigid in structured situations were not necessarily those who were rigid in unstructured ones so that this variable seemed more closely related to the task given. In unstructured tasks, flexibility and rigidity were found to be two separate processes while in structured ones, this did

occur. The important implication here seems to be that 1) in the area of problem-solving the specific type of task, whether structured or not is closely related to personality so that caution must be used in making generalizations 2) it is important to consider the distinctions made in Chapter I between personality traits and a system of personality. Rigidity, as opposed to manner of approach to a situation, is often indicative of anxiety at a given time and more likely to appear if problem-solving seems threatening. Thus, in addition to subjects who might be considered generally "rigid people", there are subjects who react to momentary anxiety as felt in an ambiguous situation, by responding in a rigid way.

Blatt and Stein (1950) conducted a study which was designed to explore characteristics of problem-solving processes and to make correlations between these and certain personality variables. Thirty five males, all Ph.D chemists were used in this research. Problem-solving processes were recorded using a PSI apparatus developed by Rimoldi and John and were then classified as to efficiency on the basis of four factors. Efficiency was defined as the absence of unnecessary names or questions and was then correlated with the individual subject's Miller-Analogy Test; Levinson's F Scale; Allport-Vernon-Lindzey Scale of Values; Taylor Manifest Anxiety Scale and the Freeman Anxiety Scale. Results showed significant positive correlation between Efficiency and Aesthetic Value and negative correlations between efficiency and social value and combined anxiety measures. These were trends toward a positive

correlation between efficiency and the Miller Analogy Test and a negative relationship with Theoretical Scale and the authoritarian and political measures. The authors concluded that the "individual's capacity to respond to the structural requirements of the problem may be obstructed by needs which are not relevant to the situational demands or which are of such intensity as to interfere with the problem-solving process itself (p. 210)".

Since the problem in the experiment was a well-ordered, rational type that called for objectivity in thinking, it is possible that the aesthetic individual, because of his uninvolvedness with practical matters could remain more detached, hence objective, than the political or theoretical individual who brings to bear certain ideas and interests which might hinder objective thinking. That the desire to respond in a socially acceptable way is negatively correlated with achievement in problem-solving, was shown by Nakamura (1958) using 141 students at the University of California in Berkeley. In this situation the students could respond independently or in a manner like other students since answers of others were available. The better problem-solvers were not those influenced by a desire to conform but were independent thinking students. It is not surprising that anxiety and authoritarianism are negatively correlated since these characteristics are known to impede clear thinking.

Another area of interest is that which concentrates on outside factors which may influence personality and hence, problem-solving.

Harris, (1950) in an investigation with 49 undergraduate college students hypothesized that persons under stressful conditions would persist more rigidly in a mental set in solving problems than individuals under non-stressful conditions. He used a modification of Luchen's problem in order to induce set, and stress was induced by creating a threat to the individual's self-esteem. The subjects in the stress group did not tend to establish the set any more readily than the non-stress subjects although the stress group took longer to solve the problems. These findings appear to be in contradiction to an experiment by Beier (1951) in which anxiety was induced by means of a structured Rorschach interpretation. This group consisted of 62 graduate students who had volunteered partly because a personality interpretation was to be given them and hence, they must be considered a biased sample. The subjects were given measures of intelligence, abstract reasoning and visual-motor ability, before and after the Rorschach interpretation and the results showed less flexibility and more disorganization in the performances of the experimental group than the control subjects. Differences in these two studies may be accounted for by differences in the types of subjects used, tasks employed and the amount and kind of stress involved. Beier's population was not a normal one (as ascertained by the Rorschach) and his method of inducing stress by giving "bad" Rorschach interpretations may have been more effective in creating sufficient anxiety to cause momentary disruption of certain abilities. In a group of subjects already concerned about personality interpretation, this was really a

doubly stressful condition and may have taxed them beyond their anxiety threshold. A study by Travers (1955) was actually more in keeping with Harris' results and also verifies the fact that the type of problem given is important since no correlation was found from problem to problem. In his study with 130 Air Force men, problems of different types were administered to one group and under stressful conditions and to a second group and under normal conditions. Both groups had been administered the Taylor Manifest Anxiety Scale and were scored high, medium or low on performance. No significant differences in performance were found between the high and low anxious subjects before and after threat, but the mid-anxious group responded with more disorganization of performance after stress. With regard to the type of problem, the author felt that problems differ in the extent to which they tend to evoke inappropriate responses. He found that there were differences in response to a set problem as opposed to a highly complex administrative problem.

From these studies, it would seem that, generally speaking, stress induced in relatively normal subjects does not greatly affect basic thinking, although it may cause subjects to take more time in problem-solving or manifest anxiety in some visual-motor functioning. Thus, it seems that the personality factors seen in problem-solving are relatively stable. Beier's experiment indicates, however, that if the stress is of the kind that threatens basic security and if it is induced in subjects already less than normally secure in themselves, that effects can be seen. Travers suggests that the kind of problem in this situation is also of

great importance.

In summary, it has been seen that personality traits are related to problem-solving behavior. Those having an adverse effect on it are subjectivity (Bloom and Broder 1950), rigidity (Bloom and Broder, 1950; Morgan and Morton, 1944; Gaier, 1951; and Goldner and Blatt, 1957) lack of confidence (Bloom and Broder, 1950), feelings of inadequacy and anxiety (Bloom and Broder, 1950; Gaier, 1951; and Blatt, 1957) and conformity (Nakamura, 1958). Other personality factors that seem to influence problem-solving are personal values (Blatt, 1957) and mode of approach (Goldner, 1957). Although generally these influences are seen in all types of problems given an individual, there are differences found in the way a subject approaches a complex as opposed to a set problem (Travers, 1955) and a structured as opposed to an unstructured problem (Goldner, 1957) so that the influence of the problem itself must be considered. Although induced stress has at times certain influences on problem-solving, the main factor seems to be the general over-all personality of the individual in the stressful situation. Stress does not seem to create poor problem-solving methods but it does increase them if they are present.

B. Cognitive Complexity-Simplicity. The personality dimension under consideration (Cognitive complexity-simplicity) and the instrument used to measure it (the modified REP Test) were developed by Bieri (1955) and are based on Kelly's theory of personal constructs.

Kelly (1955) devised the Role Construct Repertory Test as a method of assessing an individual's constructs and to see how these constructs

were used by individuals to understand and predict the behavior of others. This was devised mainly as a diagnostic and research instrument.

Bieri (1955) modified this original instrument and used it as a measure of complexity. He defined complexity (1961) as a measure of the degree of differentiation in the cognitive system for perceiving others. He hypothesized that there should be a significant positive relationship between complexity and accuracy in predicting and understanding others' behavior based on the assumption that a person with more variability in his construct system should be better able to accurately appraise another than an individual with little variability or complexity (cognitive simplicity).

In Bieri's first research (1955) 22 female and 12 male subjects, all students, were given the modified REP Test and the Situation Questionnaire. The latter was the predictive instrument, consisting of twelve social situation items in which the subject had to select the appropriate one. He later predicted the responses of two classmates on this same questionnaire. A second hypothesis was that a significant negative relationship would exist between cognitive complexity and assimilative projection, i.e. assumption that classmates would choose the same items as the subject on the basis of insufficient information. Both hypotheses were supported by the data, thus suggesting that an accurate appraisal and understanding of another's behavior is related to complexity, while subjectivity and projection are related to a lack of complexity (simplicity). It is unfortunate that so few subjects were

used in the research and that predictive statistics were not applied to a larger number. Consequently, his conclusions should be viewed with caution.

In a study similar to Bieri's on predictive accuracy, Levanthal (1957) makes the following assumptions:

The predictions of an observer about the behavior of another person are a product of the observer's hypotheses regarding the particular individual. The accuracy of his predictions (understanding) depends on the validity of his conceptualization. His hypotheses are, in turn, a function of the information available about the person to be judged and of the judge's typical way of categorizing information or forming concepts about others. (p. 176).

From these assumptions, he hypothesized that the more information provided, the more accurate would be predictions; secondly, the complex judges would predict more accurately than simple ones. Modified REP Tests were given 253 students and from these 14 subjects were selected to be interviewed and 56 to be judges - half of whom were high in complexity and half of whom were low (cognitively simple). Information about those to be interviewed was presented on tapes with each type of judge, judging each type of interviewee. Judgments were made on the basis of two different amounts of information. Judges were then asked to complete a multiple choice questionnaire as they felt the subject had. Complex judges tended to be more accurate, but this did not reach significance. Simple judges, however, tended to increase in accuracy when more information was provided. The experimenter does not feel that this would have occurred if the subjects had been allowed to select what they considered to be additional useful information. It is at this level that

differences would seem to occur. Secondly, the use of a multiple choice device in this type of experiment is questionable.

Plotnick (1960) analyzed the predictive behavior of 129 social work graduate students and found a relationship between complexity and predictive ability. The task given the subjects was to predict the responses of three patients on an acceptance of authority scale. The patients were rated high, medium and low on authority acceptance. High complexity subjects predicted mean authority scores in terms of the rank order of the patient's scores. This was not true of the low complexity subjects. Thus, from these studies there does seem to exist a relationship between complexity and the ability to understand and predict behavior accurately.

Bieri and Blacker (1958) wished to test the generality of cognitive complexity, i.e. to see if the cognitive system of the individual was manifested consistently in different stimulus situations. Forty male undergraduate students were given the modified REP Test as the personal stimuli and a modified Rorschach as non-personal stimuli. Complexity on the Rorschach depended upon the number of determinants used and the number of types of content. There were significant positive relationships found between the complexity of the subject's perceptions of people and complexity of inkblots with regard to content and determinants, thus suggesting that "the individual's learning experiences in the realm of interpersonal relationships provide the basic core from which his cognitive system for construing his world is developed. (p. 116)"

That the authors consider the Rorschach "non-personal", however, is open to question. Their definition of complexity on the Rorschach also seems to be irrelevant since it is analogous to complexity as defined in the REP Test. Had they employed scores from the Rorschach which theoretically reflect different degrees of complexity, such as M, FM, F, their study would have been more meaningful and to the point.

In a second study using the Rorschach, Bieri and Messerley (1957) predicted that experience type as measured by the M:Sum C in the Rorschach would be related to cognitive complexity. Sixty two female undergraduate subjects were given modified REP Tests, modified Rorschach and the Gottschaldt Embedded Figure Test. Results were positive. The extratensive subjects were significantly higher in complexity than were the introversive. The data suggests that complex subjects are more responsive to the environment than simple subjects.

Lundy and Berkowitz (1957) also related complexity to an outside personality factor -- attitude and suscept⁶ibility to other people. A 132 question attitude scale and a modified REP Test were given to intermediate psychology students. The modified REP Test was scored for complexity and for perception of self. One month later the students were given the same attitude questions along with written material stating the attitudes of other college students (peers) and of famous generals (authority figures). Results showed that attitude change occurred more readily in the complex students and least change occurred in the simple. Interestingly, however, the complex subjects changed negatively - that

is they increased the level of their original attitudes. Those most susceptible to outside influence were neither simple or complex. Thus, it seems that simple subjects do not show an openness to outside influences at all while complex individuals avail themselves of information and opinions of others and yet maintain an independent and objective viewpoint.

In a somewhat similar experiment, Berkowitz (1957) studied the relationship between cognitive style, personality and leveling tendency, although here he employed a different measure of complexity than that used formerly. Specifically, he wished to learn if simple subjects would be inclined to level experiences and if ethnocentrism was negatively related to leveling and complexity. Complexity was found to be negatively associated with leveling and ethnocentrism, thus suggesting that simple subjects are more prejudiced and are prone to forget certain aspects of the environment.

A review of the literature in this area has indicated two things. First of all, that complex subjects (Bieri, 1955; Leventhal, 1957; and Plotnik, 1960) are generally better able to understand the behavior of other people, are more accurate in using information available and make sounder judgments. Secondly, it was shown that relationships exist between complexity and personality variables such as introversive-extravertive traits (Bieri and Messerley, 1957); subjectivity and projection (Bieri, 1955) and ethnocentrism and leveling tendencies (Berkowitz, 1957).

C. Problem-Solving Methodology. The area of problem solving may be considered in two ways -- solution to the problems may be studied or

the processes involved in reaching these solutions may be considered. The latter approach was used in this study since the interest is in the relationship between personality and processes. It should be pointed out that studies that infer the processes from the product will not be considered since they are actually concerned with an examinations of products. Particular emphasis will be on methodology.

Wertheimer (1945) and Dewey (1933) were among the first to concentrate fully on processes. Wertheimer, in a series of classical problem-solving studies first observed school children solve typical mathematical problems and found that the processes involved were mechanical and little understood by many pupils. He stressed the importance of understanding and becoming aware of the goal and of choosing freely, a particular means suited to achieving this. He employed retrospection as a method of analyzing processes -- he had the subjects study exactly what method they had employed, after they had solved the problem. Dewey analyzed, in a logical way what had happened during the problem-solving situation. By using retrospection in this manner he was able to divide the actual problem-solving process into a series of logical steps. The main criticism of retrospection as a method of analyzing thought processes is that it is dependant on the subject's memory and on the accuracy of the interpretation of the experimenter - consequently, it is quite subject to error.

Bloom and Broder (1945) in an attempt to analyze problem-solving processes chose problems in which the goals were fairly clear cut and in which the subject's method of attack could be analyzed well. In an exploratory study, 18 subjects, all undergraduate students at the

University of Chicago, were used. Problems were developed from academic and test situations and given to the subjects with the directions to think aloud as they proceeded. When the data was examined, it was noted that distinct differences in thought processes did exist. This led them to a second study, mentioned earlier, where methods employed by successful and unsuccessful problem-solvers were analyzed. Although an improvement over the earlier methods noted and providing an excellent description of problem-solving processes, the data in this experiment is rather cumbersome to handle because it consists of lengthy verbalizations. Those wishing to work with the data must subject it some way to analysis.

A second, entirely different approach to methodology in problem-solving processes was developed by Lazerte (1933). The subject was given a problem to be solved and accompanying this were envelopes, offered him one at a time, in which alternative steps were presented. After the first selection was made, a second envelope with alternatives was given him. Thus, the way he proceeded to the solution could be actually recorded. Buswell, (1956) used a modification of this envelope technique but made it less restrictive than Lazerte. This was accomplished by first conducting a pilot study in which all the approaches used by subjects in solving a problem were considered. These were then broken down into a series of objective steps and in each step the subject could choose one of two alternative procedures, following Lazerte's method. Consequently, various patterns of problem-solving steps were established and compared. Buswell found through this experiment that there was an endless variety of problem-solving patterns used by different individuals, thus,

indicating the need for a very broad, flexible way of measuring processes, rather than a restrictive one.

Bruner, Goodnow, and Austin (1956) in an experiment dealing with concept attainment designed 81 cards, with four attributes each. There were 255 ways of grouping these cards. The task of the subject was to group them on the basis of some attributes that belonged to a certain category. The experimenter had a certain concept in mind which the subject was unaware of and thus, after each card was presented, the experimenter stated if it exemplified the concept or not. The various approaches used by the subjects were classified as strategies and within each strategy different tactics were noted. The most important finding of this well planned research, was that individuals show consistency in approach to problems, even when the problems vary. The main criticism of this very thorough study is that it is limited to concept attainment - one small division of human thinking and secondly, that a great deal is lost in this manner of approach -- starting out with a well-organized system of classification and then fitting individuals into it.

Rimoldi, (1955, 1960) developed a unique method of analyzing problem-solving processes. The subject is presented with a problem and a folder which includes all the necessary and sufficient information to solve the problem. This information is presented on the individually numbered cards, with a question on one side and the answer on the reverse. The subject may select as many of these cards as he wishes and in any order. The data may then be analyzed in a variety of ways. Number of

cards chosen and order should be taken into account; the usefulness (utility index) of the card in terms of a group of subjects may be considered; questions not asked may be examined. These are merely a few of the ways that the data may be considered. The particular methods used in this experiment will be discussed more fully in Chapter III.

The research considered in this section falls into two classes. Those studies that describe verbally, through either retrospective or introspective means what has occurred (Wertheimer, 1945; Dewey, 1933; Bloom and Broder, 1945) and then make it the responsibility of the individual experimenter to categorize it. Secondly, those that begin with preconceived categories and then fit the data into these (Lazerte, 1933; Buswell, 1956; Bruner, Goodnow and Austin, 1956). Naturally, a great deal is lost in this way. In the first method, limits are set after the data is collected, by categorization on the part of the experimenter and in the second method, limits are actually imposed on the subject by restricting his choices. The Rimoldi Technique differs from both of these and is unique in that it gives a maximum amount of freedom to the subject in solving the problem and so sacrifices nothing there and also allows the experimenter many choices as far as analysis of the data is concerned, thus not narrowing this aspect.

In summary, personality factors were shown to be related to problem-solving, and cognitive complexity-simplicity, as a particular personality dimension, was shown to be related to an individual's ability to understand, judge and accurately predict the behavior of another individual.

Various methods of analyzing problem-solving processes were reviewed, and of these, the Rimoldi Technique seemed the most suited to this type of experiment because this one permits that maximum freedom be given both subject and experimenter. In this way it appears that differences in individual variability (Complexity-Simplicity) can best be expressed and recorded.

CHAPTER III

METHOD

Assuming that personality and cognition interact in such a way as to be inseparable, the purpose of this study was to determine the relationship between one measure of personality (cognitive complexity-simplicity) and one type of problem-solving behavior (real-life), as measured by the Rimoldi Technique (1955, 1960). It was hypothesized that there would be differences within the two groups of subjects (cognitive simple and cognitive complex) with reference to manner of approach to real-life problems and that secondly, the cognitively complex subjects, because of greater variability and flexibility, would be more similar to experts in problem-solving processes than the cognitively simple subjects.

Subjects

Fifty two subjects were used in this experiment, all of whom were members of the Freshman Class of Loyola University Nursing Extension Program. All students were female, ranging in age from 17 to 21, and were members of a Psychology for Nurses class, meeting at St. Elizabeth Hospital. Both the real-life problem and the modified REP Test were administered during regular ninety minute classroom periods. Students were told that on the day of the test, they would have no regular classroom work, since the experimenter had been granted permission to use the time for research. It was further explained that this research would not effect grades and that all results would be strictly confidential.

They were assured that at the end of the second session, a fuller explanation of the experiment would be given and that they could then ask questions about it. This was done so that the subjects would not experience the stress or tension often present in a test situation.

Materials

The real-life problem used in this study (See Appendix I) was selected from the three problems developed by Meyer (1963) and was Problem B in that research. These problems were developed empirically and in the following way. They were presented to subjects who were asked to pose questions that they would like to have answered in order to gain sufficient information for solving the problem. Fifty five subjects were employed from populations of college freshman, psychology graduate students and social work trainees. For the particular problem used here, Problem B, 111 questions were obtained in this way. Those questions not asked by at least four subjects were eliminated, leaving 36 questions for the actual research. Answers to these questions were then provided by Meyer. In order to provide a consistent picture these answers were taken from clinical case history material and in this instance from an individual suffering from a phobic reaction.

Problem B appeared to be the most appropriate one to use in this research for the following reasons: 1) the content of the problem was judged to be most appropriate and of interest to the particular group of subjects chosen for this work; 2) this problem proved to be approached differently by therapists, normals and patients (significant

at the .01 level) - a necessary condition in testing the present hypotheses;

3) Problem B proved sensitive to cognitive changes occurring with psychotherapy (Meyer, 1963, p. 88).

One form of the Role Construct Repertory Test (REP) developed by Kelly consists of a list of twenty two descriptions of persons from a subjects past life experiences. After the subject named these people, he was asked to make twenty two comparative statements, taking three persons into consideration each time a comparison was made. For example, he might be asked to consider his mother, father and closest friend of the same sex. In his thinking he was to discover in what important way two of them were alike and distinct from the third person. He was told to list this and it became known as a "construct". When this was finished, he was asked to write under "construct" what he considered to be the opposite of this characteristic. By use of a grid composed of a matrix of the twenty two descriptions, the subject was then requested to indicate which of the other persons described also had the "construct" characteristic.

Since Bieri (1955) was interested in only one aspect of personality, that of the complexity of the cognitive system, he modified Kelly's original REP Test. This modification consisted in 1) reducing the number of persons described from twenty two to six, 2) having the subjects make 20 comparisons rather than 22 and 3) omitting the grid comparisons. This modification developed by Bieri was found to reveal essentially the same cognitive system, descriptively speaking, as Kelly's

form of the REP Test (Bieri, 1955, 1961). The Bieri modification of the REP Test has the following advantages: 1) it is shorter and thus quicker to administer, 2) it is less taxing for subjects, since they need only indicate six persons from their past, rather than forcefully recalling twenty two different persons, 3) it is much easier to quantify and handle statistically.

The REP Test employed in this study is that developed by Bieri (1955). He selected six role titles from a larger group of role descriptions because they offered maximum discrimination. These were: 1) your name, 2) your brother closest you in age, 3) your closest girl friend, 4) the most successful person whom you know personally, 5) someone you know personally whom you admire, and 6) someone you know personally you would like to help or whom you feel sorry for. Since Bieri's subjects were all male, it was necessary to make certain changes in the role titles for this study, since the subjects were females. Thus, role two and three were changed to read: 2) your sister closest you in age and 3) your closest boy friend. In case the subject had no sister, she was asked to write the name of the person "most like a sister to her". A copy of the REP test used in this research may be found in Appendix II.

Procedure

Testing. The real-life problem had been administered to the subjects in October, 1962. At that time 50 of the 52 students were present. The subjects were presented with folders containing 3 x 5

cards arranged in numerical order and placed in pockets within the folder. A question appeared on the front of the card and an answer on the reverse side. With this the subject was also given an 8 x 11 sheet of paper which included a statement of the problem. They were told to read over the problem and then to read through all of the questions in the folder. After this was completed, they were asked to select those questions which gave them the necessary and sufficient information to solve the problem. After selecting a card, the number of it was to be recorded on the sheet containing the directions.

The Modified REP Test was administered to the same students in February, 1963. At that time 50 of the 52 subjects were present but the two absentees were not the same ones absent at the first session. Thus, there were actually 48 pairs of Real-Life problems and Modified REP Tests available, although 50 of each had been given to subjects.

Subjects were presented with an 8 x 11 sheet of paper which contained the Modified REP Test. They were told that in the upper portion of the sheet, were listed six role titles, and opposite these they were to write the name of the appropriate individual. The six numbers preceding these role titles were then combined in three's in every way possible, making a total of twenty sorts. In all twenty items, the subject was asked to perceive two of the three individuals as alike in some important way and different from the third.

Scoring. Theoretically, the subjects with the largest number of percepts would be highest in complexity and thus, the more cognitive

complex individuals. The low scorers, because of an absence of percepts, would be the cognitively simple. This definition was determined from Bieri's research and the scoring of complexity was the same (Bieri, 1955, 1956). Thus in this research, the highest possible score was 20 and the lowest score 1. If in giving a similarity or difference, the subject used a descriptive term that had been used before in a previous sort, no additional score was given. Before this could occur, however, the term used had to be identical with one given earlier.

The real-life problem was scored in three ways following the Rimoldi Technique. First the total number of cards used by a subject was considered (Rimoldi, 1955). Since all subjects had been asked to select what they considered necessary and sufficient information in order to solve the problem, differences in number of cards may be considered indicative of the different amounts of information subjects found they needed in order to reach a solution. The second level at which the data were analyzed considered the empirically derived usefulness of a question, technically called Utility Index. To analyze the Utility Index is to consider the questions in terms of popularity or agreement of item usefulness among the members of a group. It is the frequency with which a card is selected by a particular group divided by the number of subjects in the group (Rimoldi, 1955). Since some questions are asked more frequently than others, certain information can be considered more useful and then given a different weight or value. Thirdly, sequence was considered. This takes into consideration not only the choice but order of choice

(Rimoldi and Haley, 1962) so that comparisons can be made concerning when the subject felt the required information was of most value to him. The sequence score for a subject is arrived at by adding the weights for each card chosen when the order of selection is considered, and dividing by the number of cards selected. Weights for each question when order of selection is considered are obtained by dividing the frequency with which a card is chosen in a particular order by the sum total of selections made by the group (Rimoldi and Haley, 1962).

Statistical Analysis

The Modified REP Test was employed as the independent variable. The sample of subjects was divided into two, using the median score on the REP Test as the cut-off point (McNemar, 1955, p. 15). Those subjects below the median were considered to form the cognitively simple group while those above the median were described as the cognitively complex group.

In analyzing problem-solving performance, first the means and standard deviation of the number of questions used by a subject were calculated for each of the groups of subjects (McNemar, 1955, p.16, 25). The t-test was used to evaluate the differences between the two groups, using the formula for independent samples (McNemar, 1955, p. 109).

Secondly, each subject's performance was scored using a Utility Index derived by the total sample of subjects. This is the measure of expected usefulness of a particular question. A Utility Score was obtained by adding the Utility Indexes for each question selected and

dividing by the number of cards chosen (Rimoldi, 1955, p. 454). Means and standard deviations for the groups were calculated for the Utility Scores and t-tests were employed to compare the groups.

The Sequence Score was arrived at by adding weights for each card selected, considering choice and dividing by the number of cards. After this was obtained for each subject's performance, means and standard deviations for each group were calculated and the t-test applied.

The Pearson Product-moment correlation coefficient (McNemar, 1955, p. 118) was calculated between the scores obtained on the Modified REP Test and each of the measures of problem-solving behavior, i.e. number of cards chosen, Utility Scores and Sequence Scores.

CHAPTER IV

RESULTS

The purpose of this investigation was to test whether there was any relationship between cognitive complexity-simplicity and problem-solving behavior. For experimental purposes, cognitive-complexity was considered the independent variable and problem-solving performance was the dependent variable. The specific hypotheses were 1) there is no difference between the problem-solving performance of cognitively simple and cognitively-complex subjects and 2) there is no difference between cognitively complex and cognitively simple subjects when scored on norms developed from experts in the area of real-life problems.

The Modified REP Test scores, determined by number of constructs used, ranged from 3 to 20. The median score was 16.5. Thus, those twenty four subjects with scores above this were considered complex subjects and those twenty four subjects having lower scores were the simple subjects.

The first level of analysis of the problem solving data consisted of finding the mean number of cards selected by both groups of subjects and determining the standard deviations. Table I shows that there was no significant difference between means or standard deviations. This data suggests that both groups of subjects needed essentially the same amount of problem-solving information in order to draw a conclusion.

In Table II means and standard deviations of utility scores for

Table 1

Means and Standard Deviations of Cards Selected by the Cognitively Simple-Complex Subjects on the Real-Life Problem

| Cognitive Group | N | M ^a | S.D. ^b |
|-----------------|----|----------------|-------------------|
| Simple | 24 | 22.87 | 5.00 |
| Complex | 24 | 22.96 | 5.53 |

^aThe t-test value was .058; not significant ($P < .45$).

^bThe F value was not significant ($F = 1.10$).

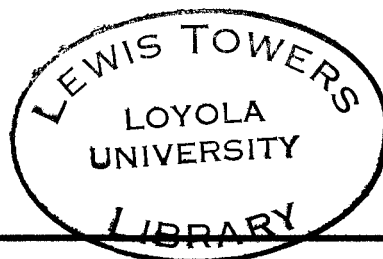
Table 2

Means and Standard Deviations of Utility Scores for Cognitively
Simple-Complex Subjects on the Real-Life Problem

| Cognitive Group | N | M ^a | S.D. ^b |
|-----------------|----|----------------|-------------------|
| Simple | 24 | .698 | .035 |
| Complex | 24 | .704 | .032 |

^aThe t-test value was .60; $P > .30$.

^bThe F value was not significant ($F = 1.09$).



cognitively-simple and cognitively-complex subjects are given. The t-test value was not significant and the data suggest that there was minimum difference between the two groups as far as what was considered useful information. Thus, the first hypothesis could not be rejected when the data were analyzed on these two levels. Consequently, finer analysis of sequence did not seem warranted.

The second hypothesis was that there is no difference between cognitively complex and cognitively simple subjects when scored on norms developed from experts in the area of real-life problems. In order to test this, the expert norms were employed. High scores on this measure would indicate similarity of approach. Since the means and standard deviations of the simple and complex groups were essentially the same, on levels one and two, it was not necessary to rescore the subjects on the expert norms on those levels. An empirical analysis of the two samples in terms of utility indexes verified this.

Table III gives the means and standard deviations of sequence scores for cognitively simple and cognitively complex subjects. The results were not significant. Thus, the second hypothesis could not be rejected. Therefore, it can not be said that the complex subjects differed from the simple subjects in approach to problem-solving, nor were the complex subjects more like experts.

Since the median fell at such a high level, allowing only four units for cognitive-complexity and thirteen units for cognitive-simplicity, the group was obviously skewed. Figure I dramatically

Table 3

Means and Standard Deviations of Sequency Scores^a for Cognitively Simple-Complex Subjects on the Real-Life Problem

| Cognitive Group | N | M ^b | S.D. ^c |
|-----------------|----|----------------|-------------------|
| Simple | 24 | .29 | .16 |
| Complex | 24 | .32 | .18 |

^aSequence Scores are based on norms developed from therapists taking the Problem.

^bThe t-test value was .60; $P > .30$.

^cThe F value was not significant ($F = 1.12$).

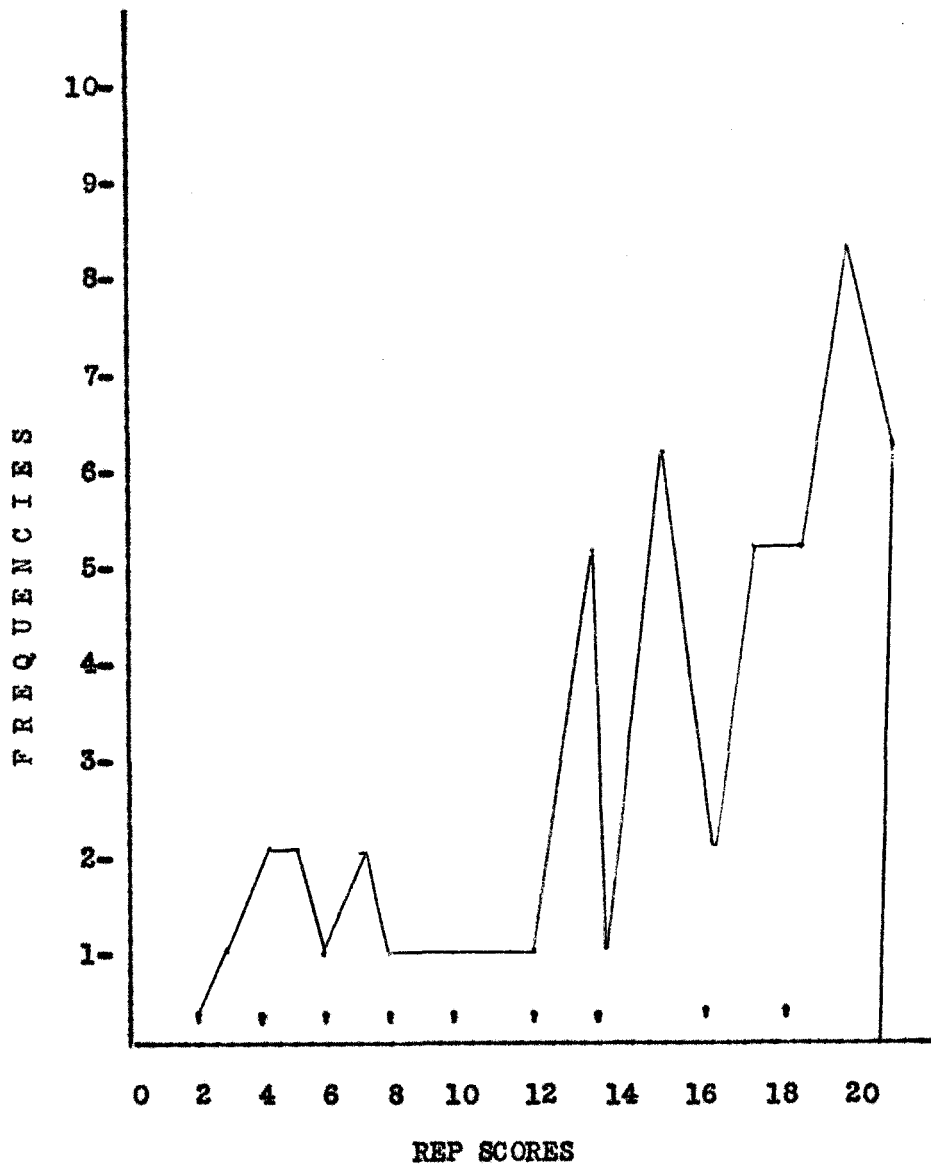


Figure 1. A frequency distribution of the Modified REP Test Scores.

illustrates the severity of the skewness. Although there are indications that the t-test will tolerate considerable relaxation of the basic assumption of normal distribution of scores (Winer, 1962), there was question as to whether this assumption was even approximated with a distribution as shown in Figure I. Thus, it appeared important to re-analyse the data using correlational methods. Subjects were considered as one group, rather than as complex and simple. Results of the Pearson product-moment correlation between the Modified REP test performance and Problem Solving process were not significant, as shown on Table IV.

Although this experiment was concerned with problem-solving processes and Modified REP Test performance, previous work using the REP Test shown in Chapter II, has always dealt with the subjects' ability to understand, predict and draw conclusions about behavior. Thus, although not relevant to this research, it seemed to be important in terms of future research in the area to explore the relationship between problem solutions and REP Test performance to see if relationships at this level would be significant.

In order to determine if differences in personality, as measured by the REP Test were related to problem solutions, the experimenter developed five categories of problem solutions given the real life problem in previous research (Meyer, 1963). Solutions could be categorized as follows: Those recommending 1) Personality changes brought about by better communication and/or counseling; 2) Personality changes in both individuals with vague suggestions as to how this

Table 4
Correlations^a of REP Test Performance with
Problem-Solving Behavior (N = 48)

| Problem-Solving Behavior | Cognitive Complexity ^b |
|-----------------------------|-----------------------------------|
| No. of Cards | -.05 |
| Utility Score | .14 |
| Sequence Score ^c | .04 |

^aPearson product-moment correlation was employed.

^bSubjects were considered as one group (N = 48) and were not divided into groups of Cognitive Complexity or Cognitive Simplicity.

^cSequence Scores are based on scoring norms developed from therapist performance on the problem.

would be accomplished; 3) Personality changes in one individual based on belief that this individual was to "blame" for the problem 4) Changes in outside factors - money, social life, work situation etc. and 5) Separation or divorce.

The experimenter then categorized the solutions given in this research. There were forty eight solutions given to the problem by the subjects. They were reviewed and placed in the five categories listed above. The first two types of solutions suggesting 1) better communication and/or counseling and 2) personality changes in both individuals were judged as positive since they were similar to the solutions of experts in the field of psychotherapy (Meyer, 1963) and were in fact the goals of the psychiatric center where the patient described in the real life problem was in treatment. Solutions three, four and five were considered negative because they really were not aimed at solving the problem. Solution three simply pointed out what the problem might be, solution four suggested altering the environment and solution five actually suggested that the situation was unsolvable. Thus, for purposes of statistical analysis there were the two groups of solutions - positive and negative.

A biserial correlation (McNemar, 1955, p.192) was calculated between the scores of the Modified REP Test and rating of the adequacy of the solutions offered to the problems. Employing the sampling error of the biserial correlation (McNemar, 1955, p.194), the probability of obtaining the biserial correlation was evaluated against the normal probability curve (McNemar, 1955, p.145).

A correlation of .31 was found to exist between the rating of solutions to the problem and REP Test Performance and this was significant at the .05 level of confidence. This will be discussed in the next chapter.

Chapter V

DISCUSSION

This experiment was based on the assumption that personality and cognition are closely interrelated and consequently, differences in personality would be related to differences in problem-solving behavior. It was expected that those subjects who were cognitively complex and thus, in possession of a greater number of personal constructs would approach problem-solving in a manner different from the more limited cognitively-simple subject. It was also hypothesized that the approach of the complex subjects would be more like the approach of experts (psychotherapists) in the area of real-life problems. Since the results reported in the previous chapter did not verify either hypothesis, some suggestions as to why this occurred might be considered.

In the area of problem-solving many types of problems are used, ranging from complex personal ones to simple set problems (Ray, 1955) as documented in the review of the literature. That individuals approach all types of problems in the same way has not yet been shown. Few researchers have employed problems of the type used here. However, Goldner (1957) pointed out that there were differences in approach to structured vs. unstructured problems and Travers (1955) found that "it is suspected that the variables related to problem-solving effectiveness are very different in the case of difficult complex problems than they are in the case of difficult non-complex problems (p.45)". In his experiment the

complex problems involved real life situations and thus, are comparable to those used here. Bruner, Goodnow, and Austin (1956) gave subjects two types of problems. The first were highly abstract geometric problems and the second were thematic. Differences again were found in the problem-solving which could be attributed to the problem material. Consequently, it is possible that if problems of the sort used by Rimoldi and Devane (1961) had been considered, that is mathematical, geometric and set problems, the results might have been different. Although a large variety of problems were given at that time, they all could be analyzed more easily in terms of logical approach, information usefulness and number of cards actually needed to attain an answer. This is not to say that there was a best or model problem-solving process but the questions and approaches could be analyzed more closely than in a real-life problem where these factors (number, usefulness and approach) are somewhat more subjective.

When the problem in this experiment was used in previous research (Meyer, 1963) differences were found between patient, normal and therapist groups, but these groups were less homogeneous than the student sample used here. This experiment used essentially normal subjects whose thought processes probably differed from individual to individual. These differences were not as marked, however, as one would expect to find between normals and schizophrenics. Thus, it is possible that the personality differences between simple and complex persons, as measured by the REP Test, were not great enough to actually effect thinking as

measured in the problem. It is also possible that although the subjects did not differ in the number of questions, what they considered to be useful information or in sequence, a qualitative analysis (Rimoldi, 1955) of the data may indicate differences in approaches between the two groups. In such an analysis, content might be considered or a check list similar to the one used by Bloom and Broder (1950) could be devised. The shortcomings of this method have been noted earlier; however, it would supplement the data available.

As indicated in the results, there were differences in solutions given the problem by the cognitive complex and the simple subject. This part of the research was exploratory however, and thus, must be evaluated with caution. However, it does appear that although the two groups of subjects proceeded in similar ways, the way they used the information obtained was different.

When the types of solutions are considered it can be seen that the conclusions of the simple subjects were usually drawn directly from the information given. They gathered information regarding a specific personality trait of one person, religious differences, marital adjustment, employment, etc. and then gave an answer definitely suggesting that a change in one of these areas would solve the problem. The complex subjects on the other hand, gathered the same data, but felt that the real difficulty was because of a personality problem on the part of both individuals and viewed the other factors as secondary to this. Some of the complex individuals further suggested better communication and/or

counseling for the individuals. This finding suggests that in addition to considering problem-solving processes or solutions to problems, the way the two are related is of importance. The real distinction here seems to be in terms of just how the information obtained was utilized.

With regard to future research, several things may be suggested. Since personality differences as measured by the Modified REP Test were not reflected in problem-solving approaches to a real-life problem, it should be of interest to repeat the experiment but to alter one of these factors: 1) type of problem used - substituting an abstract or geometric problem 2) type of analysis - qualitative rather than quantitative and 3) type of subjects - a less homogeneous sample. It would also be of interest to do a study, the purpose of which would be to compare and relate problem-solving processes to problem solutions. Although it is known that different approaches can lead to the same solution (Rimoldi and Devane, 1961) it appears that similar approaches can also lead to different solutions, thus, suggesting an important third step between process and solution - that of integration of material. It appears that people differ in the way they interpret and utilize information even when the amount and kind of information are the same and the order of selection of questions is similar.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to test whether personality as measured by the Modified REP Test was related to differences in problem-solving processes and secondly, if cognitively-complex subjects proceeded in problem-solving in a manner more similar to experts in the area of real-life problems, i.e. psychotherapists trained in objectively diagnosing psychological problems.

The review of the literature suggested that personality traits are related to problem-solving behavior. Such things as subjectivity, rigidity, lack of confidence, feelings of inadequacy, anxiety and conformity seem to have an adverse effect on problem-solving. Type of problem given the subject is also an important factor since approaches to structured as opposed to unstructured problems are not necessarily the same.

An investigation of cognitive complexity-simplicity as measured by the Modified REP Test, showed that complex individuals are generally better able to understand the behavior of other people, are more accurate in using information and make sounder judgments (Bieri, 1955; Levanthal, 1957; and Plotnik, 1960). Secondly, it was shown that complexity is related to certain personality variables (Bieri, 1955; Bieri and Messerley, 1957; Berkowitz, 1957).

The method of problem-solving analysis chosen for this research was the Rimoldi Technique. This method seemed particularly suitable because

it permits maximum freedom to be given the subject in solving the problem and allows the experimenter to analyze the data in a variety of ways.

The real-life problem and the Modified REP Test were administered to 52 subjects, all female students in the Loyola University Nursing Extension Program. The students were divided into two groups on the basis of the Modified REP Test scores. Those with high scores on the test were considered complex subjects and those with low scores were simple subjects. The real-life problem was scored on the basis of number of questions asked, usefulness of information and sequence. Means and standard deviations were computed and t-tests applied.

The results of the study indicated that there were no differences in problem-solving approaches between the two groups of subjects, reflected in any of the three measures of problem-solving behavior.

Solutions to the problems were then rated on a five point scale. Two of the categories were considered positive solutions and three were essentially negative. A biserial correlation of .31 was found between the scores of the Modified REP Test and the rating of the adequacy of solution. This was significant at the .05 level of confidence.

It was suggested that although problem-solving information obtained was similar, the ways the subjects used the information differed. The complex individuals offered more mature, insightful solutions to the problems. Thus, in addition to problem-solving processes and solutions, a consideration of how material is integrated seems important.

Suggestions for future research were offered.

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APPENDIX I

Real-Life Problem

Problem B: An individual's wife is threatening to leave him, and the person desperately desires to prevent this for he is very content with his wife. In fact, he cannot understand why this should be happening to him.

Task - Your task is to discover what is behind the threat of separation, and offer a tentative solution.

Suppose - To do this, suppose you are a good friend of the person with the difficulty, and that he has come to you seeking your help.

Procedure - In order for you to discover what is behind the difficulty, you may gather information by asking any of the questions in any order that you want. Ask only those questions which you feel will provide the necessary and sufficient information so that you may solve the problem. Answers are on the reverse side of each card.

BEFORE YOU BEGIN, READ OVER ALL OF THE AVAILABLE QUESTIONS

Fill in the question number in the order of selection below:

| | | | | | |
|---|-------|---|-------|---|-------|
| a | _____ | m | _____ | y | _____ |
| b | _____ | n | _____ | z | _____ |
| c | _____ | o | _____ | A | _____ |
| d | _____ | p | _____ | B | _____ |
| e | _____ | q | _____ | C | _____ |
| f | _____ | r | _____ | D | _____ |
| g | _____ | s | _____ | E | _____ |
| h | _____ | t | _____ | F | _____ |
| i | _____ | u | _____ | G | _____ |
| j | _____ | v | _____ | H | _____ |
| | | | | I | _____ |

APPENDIX II
MODIFIED REP TEST

Name _____

1. Your Name _____
2. Your sister closest you in age. _____
3. Your closest boy friend _____
4. The most successful person whom you know personally _____
5. Someone you personally admire _____
6. Someone you know personally you'd like to help or that you
feel sorry for _____

ALIKE

OPPOSITE

| | | |
|-------|----------|-------|
| 1,2,3 | a. _____ | _____ |
| 1,2,4 | b. _____ | _____ |
| 1,2,5 | c. _____ | _____ |
| 1,2,6 | d. _____ | _____ |
| 1,3,4 | e. _____ | _____ |
| 1,3,5 | f. _____ | _____ |
| 1,3,6 | g. _____ | _____ |
| 1,4,5 | h. _____ | _____ |
| 1,4,6 | i. _____ | _____ |
| 1,5,6 | j. _____ | _____ |
| 2,3,4 | k. _____ | _____ |
| 2,3,5 | l. _____ | _____ |
| 2,3,6 | m. _____ | _____ |
| 2,4,5 | n. _____ | _____ |
| 2,4,6 | o. _____ | _____ |
| 2,5,6 | p. _____ | _____ |
| 3,4,5 | q. _____ | _____ |
| 3,4,6 | r. _____ | _____ |
| 3,5,6 | s. _____ | _____ |
| 4,5,6 | t. _____ | _____ |

APPROVAL SHEET

The thesis submitted by Eileen Meyer has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

May 25, 1965
Degree

Frank J. Koble
Signature of Adviser