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A Study of Schizophrenic Thinking in Problem Solving Tasks

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A STUDY OF SCHIZOPHRENIC THINKING IN PROBLEM SOLVING TASKS

by

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CHAPTER I

INTRODUCTION

Schizophrenia is one of the greatest challenges to scientists occupied with understanding human pathology. It is a psychosis which has been studied in a variety of fields such as psychiatry, psychology, sociology, neurology, anthropology, etc. Although advancement has been made in understanding this complex disease, many aspects of the condition are still not clearly understood, for instance, the thinking process. This is a very important aspect of this illness, since it is generally accepted that disruption in thinking characterizes the schizophrenic and differentiates him from those who have functional and organic diseases. Bleuler (1950) characterizes schizophrenics in terms of their alteration in thinking, feeling, and relation to the external world. From the psychological point of view, Arieti (1955) considers that the basic process of schizophrenia consists of different degrees of impairment in the ability to abstract.

This study will investigate the thinking process of schizophrenics when solving problems with different structures and different contents. According to Rimoldi, Haley, Fogliatto, Erdmann (1963) "---By structure is meant the formal properties or schema of the problem expressed in terms of a basic set of relationships. These 'schemata' are the logical frames on which various types of content

or objects may be superimposed. By changing the formal properties, various levels of complexity can be defined." In this study, contents of different degrees of concreteness are superimposed on the same structure.

CHAPTER II

STATEMENT OF THE PROBLEM

A considerable number of studies concerned with the problem of schizophrenic thinking have been made. The general consensus seems to be that schizophrenic thinking differs from "normal" thinking. However, the results of previous research do not always agree with the basic elements involved in the differences between "normal" and schizophrenic thinking. These differences could be due to the methodology employed to study thinking, to the design of the experiment, or to the subjects used.

Results of studies concerned with schizophrenic thinking seemingly classify it in one of two orientations. Goldstein and Scheerer (1941), Bolles and Goldstein (1938), Vigotsky (1934), Kasanin (1954) studied and discussed schizophrenic thought in terms of a loss of ability to conceptualize on an abstract level and a tendency toward increased concreteness.

Another orientation, which includes Cameron (1938), Rappaport (1953), Whiteman (1954), Mc Gaughran and Moran (1956), characterizes schizophrenic thinking as a disorder in social communication. These investigators have pointed out that schizophrenics perform poorly on conceptual tasks because of behaviorial tendencies which interfere with their thinking, but not because of inability to think conceptually.

The tendency is to speak of "impairment" rather than a "loss" of ability to conceptualize.

The purpose of this research is to study and compare the thinking process of a group of schizophrenic patients and a "normal" control group when solving a series of problems, each of which has a definite structure and a definite content. Analyses will be made of the subject's performance when solving problems with structures that differ in complexity. Analyses will also be made of the performance of the subjects on problems that differ in content.

An important feature of this study is that performance will be studied in terms of the process followed by each subject when solving the problems.

CHAPTER III

REVIEW OF THE RELATED LITERATURE

Results of studies on schizophrenic thinking vary, depending on the specific aspects of thinking studied, as well as on the method and the sample used. One of the aspects of thinking with which much of the literature was concerned, around 1940, was whether the disturbance of thinking found in schizophrenia is an actual deterioration, or whether it is a disorder in social communication, which affects thinking. Today, there is a rather general consensus that the disruption in the thinking of schizophrenics is not accompanied by a deterioration.

Many studies discuss schizophrenic thinking in terms of the ability to conceptualize on an abstract level. Bolles and Goldstein (1938), Bolles, Rosen and Landis (1938), Goldstein (1939), and Goldstein and Sheerer (1941), studied thinking in schizophrenics by using a group of sorting tests. Some of these are the Color Sorting Test, Color-Form Sorting Test (Weigl), the Object Sorting Test (Weigl) and Goldstein's block test. The authors mentioned above conclude that schizophrenics think concretely and are unable to conceptualize on an abstract level. Goldstein (1959) restates his position by saying that in schizophrenics abnormally concrete behavior is not manifested under all circumstances. It seems to be a protective mechanism against anxiety and its manifestation depends on the demands made upon the

patient. It is a secondary phenomenon and not the result of an organic defect or a loss of the ability to abstract. It is a manifestation of a restriction in the use of the abstracting capacity.

Vigotsky (1934) presented the patient with a problem to solve which required the formation of artificial concepts. The patient was given what appeared in the beginning to be meaningless syllables chosen at random. He had to learn to associate these with certain definite concepts. For example, "bik" meaning large and small, "log" meaning large and tall. Vigotsky observed in his schizophrenic subjects certain characteristic forms of association which resulted in the formation of ideas rather than concepts. The associations were concrete and mechanical in contrast to associations made in concept formation. In the latter there is a general and abstract principle on the basis of which the conceptual associations are formed. He observed, "that the patient with schizophrenia, confronted with the experimental problem, is not able to solve it, but that in the attempt to solve it, he exhibits characteristic and significant forms of thought."

Kasanin (1954), used a method which requires the classification of objects of different sizes, shapes, and colors. This allows the testing of the theories that the subject develops when asked to place the blocks in four different ways. He found that schizophrenics

think in more concrete, realistic, matter-of-fact terms than do normals. They give a personal rather than a symbolic value.

Rappaport (1953), used two batteries of tests which most adequately reflected areas in which psychotic patients may show an intellectual deficiency. Battery I tests include Information, Recall I, Digits Forward, Memory for Designs Test, Word Pairs I, Vocabulary, Sorting Test, Word Pairs II and the Cube Test. He found that schizophrenics manifest behavioral inaccessibility primarily instead of intellectual deficit.

Rappaport and Webb (1950), found that the loss of intellectual functioning on intelligence tests was related to such factors as lack of attention and concentration, negativism, preoccupation and apathy.

Binder (1956), using the Science Research Associates Tests of Primary Mental Abilities, found an over-all deficit in schizophrenic functioning, but there was no significant difference in the decrement for each of the factors studied. The patients did not show a greater impairment in tasks that require abstraction and generalization than in tasks that require only ability to reproduce material.

Mc Gaughran and Moran (1957), as the result of an object-sorting situation and a language usage test, found extreme differences in conceptual behavior between schizophrenic and brain damaged patients. They suggested that the two groups cannot be represented as showing

the same type of conceptual disorder.

Mc Gaughran (1954) found that groups are consistently different in concept formation, as appraised in an object sorting situation, and also differ in their language usage.

Epstein (1953) tested patients with an Inclusion Test and found that schizophrenics as a group overincluded more than do normals.

Mc Gaughran and Moran (1956) have an excellent study in which they used a modification of the Goldstein-Gelp-Weigl Object-Sorting Test. They concluded that "... 1. the schizophrenic group demonstrated a loss of social communication without evidence of impairment in abstractive ability. Differences in conceptualization in the object-sorting task were clearly more closely associated with estimated tests of intelligence and education than the presence or absence of schizophrenia."

Whiteman (1954) used a social concept test and found significant differences between a schizophrenic and a control group. When he used a formal concept test consisting of verbal analogies and picture reasoning, the differences between a schizophrenic and a control group are partialled out.

Cavanaugh (1958) used Whiteman's concept formation tests, and found that under usual testing conditions, schizophrenics performed at a level significantly below that of normals. Under conditions of

increased motivation, schizophrenics attained the performance level of normals on both social and formal test materials.

Cameron reported, in a book edited by Kasanin (1954) that schizophrenic thinking did not follow the pattern of common deterioration nor the thinking pattern of the normal child. He concludes that schizophrenic thinking is characterized by asyndetic thinking, metonyms, and interpretation of themes, stating: "It is our view that disorganized schizophrenics are persons who never have developed very adequate role-taking skills and have, therefore, not been able to establish themselves firmly in their cultural pattern."

Bellak (1958) reported the results of studies conducted by Brecher, Garfield, and Harper who found group differences in test patterns between schizophrenics and other groups on the Wechsler-Bellevue Test of intelligence. However, these pattern differences are not adequate to make individual diagnosis. Boehm and Sarason, Rappaport and others have not found a characteristic pattern of schizophrenic mental functioning, according to Bellak (1958).

Simkin (1951) did a factor analytic study of intelligence on a schizophrenic population and on a normal one. The results indicated the same general factor in each group and additional factors which differentiated the groups. He concluded that there are differences in the intellectual structures of normal adults and schizophrenics

matched for age and education. Cohen (1952) found three factors in the schizophrenic group: verbal, non-verbal organization, and freedom from distraction which are also common to psychoneurotic and brain damaged patients. The inconsistency between the findings of Cohen's study and Simkin's study leaves open the question as to the nature of the intellectual structure in schizophrenics.

Mason (1956) found that catatonics and paranoid schizophrenics scored close to the average level of intelligence, but the other schizophrenic subtypes functioned below the average level of intelligence. Bellak (1958) says that Rabin reported similar findings in an unpublished manuscript. Hunt and Cofer (1944) report that Hebephrenics show the largest deficit and that the catatonic and paranoid subtypes show the least deficit.

Crupton (1963) found that schizophrenics continue a response after it becomes ineffective to a greater degree than do normals and that the persistence of the response is a function of the severity of the illness.

Some of the studies reported here used sorting tests or a test which requires the subject to complete a task. These tests evaluate responses in terms of the kind of content which the subject generates. The advantage of these tests is that the performance of the subject can be qualitatively studied. However, the disadvantage is that the

results of many of these tests cannot be quantified.

Other reported studies used intelligence tests to evaluate performance. The results of these can be quantified, but usually only the response of the subject is studied. On intelligence tests, the individual performance is evaluated by comparing it to group norms.

The study herewith presented differs in various ways from those reported. The main difference is in the technique used to study thinking, which is based on a method first devised by Rimoldi (1955). This method makes it possible to study and compare the process followed by each subject in the solution of the problem presented.

Using the Rimoldi method different types of problems have been developed. The type of problems used in this study has the advantage that the properties of the problems have been established before administration. As a result, the performance of each subject may be evaluated in terms of the logical properties of the problem.

The process followed by each subject can be studied independently of group norms. But these can be established if one wants to compare the individual with the group. The performance of the subject can be studied quantitatively and statistical analysis can be made.

Using the Rimoldi method various techniques or types of problems, ways of analyzing the data and various applications have evolved. Some of the studies which have contributed to the development of the method have been: Rimoldi (1960) on the process; Rimoldi, Devane, and Haley (1961) on approaches to characterize the process; and Rimoldi, Haley, and Fogliatto (1962) on selection and evaluation of medical students. Applications of the method have been made by Tabor (1959) on Rorschach interpretation; Mohrbacher (1960) on organic pathology in child guidance; Gunn (1961) on appraisal of personality parameters; and Rimoldi, Fogliatto, Haley, Reyes, Erdmann, and Zacharia (1962) on problem solving training.

An attempt has been made in this study to correct some of the methodological flaws reported in the literature. For example, Guertin (1956) reports that inadequate control of age, sex and length of hospitalization account for some of the inconsistent findings concerning schizophrenic intellectual patterning. The above factors have been controlled in this study.

Rabin, King and Erdmann (1955) mention the fact that contradictory results in the evaluation of vocabulary performance of schizophrenics can be related to the lack of precision found in the usual descriptions of schizophrenic samples.

In this study, a precise effort was made to select schizophrenic

patients who were diagnosed according to Bleuler's (1950), and Garmezy and Rodnick's (1959) definition of schizophrenia. The social history and other information found on the patient's chart served to check the diagnosis made by the psychiatrist.

CHAPTER IV

PROCEDURE

A. Subjects:

The subjects used in this study are fifteen male process-type schizophrenic patients from the Illinois State Psychiatric Institute. The diagnosis of each was made by the chief psychiatrist and the resident treating the patient. In addition, the experimenter read the history and psychological report, when available, with the purpose of using these data to confirm the diagnosis. If there was any question as to the diagnosis, the experimenter discussed the patient with the psychiatrist. The sympton which necessarily had to be present was a disturbance in thinking. Bleuler's (1950) definition of schizophrenia was used to define it. He characterizes the disturbance in thinking in the following manner: It consists of ideas wich are partially worked out, fragments of ideas which are connected in an illogical way to constitute a new idea, and incomplete concepts. Therefore, the process of association is often made with mere fragments of ideas and concepts. The results are associations which appear incorrect, bizarre, and unpredictable.

The process-reactive continuum discussed by Garmezy and Rodnick (1959), Becker (1959), Kantor and Winder (1959), Phillips (1953), Kantor, Wallner and Winder (1953), and Goldman (1962) is a common

concept used to describe schizophrenic patterns. In the present study, Garmezy and Rodnick's (1959) description of process type schizophrenia is used. According to them, the process type serves "to describe a patient who has exhibited a poorly integrated prepsychotic personality, characterized by marked sexual, social and occupational inadequacy, a lack of emotional responsiveness, and social isolation. The slide into psychosis, for this patient, is usually insidious and without pertinent stress and most frequently occurs in late adolescence. The disorder is made manifest by the gradual onset of emotional blunting, withdrawal from daily activities, apathy and indifference, somatic delusions, and marked disturbances in thinking --a pattern which may be maintained through long years of hospitalization." This characterization, together with Bleuler's definition of schizophrenia, was used to select the sample.

The lack of emotional responsiveness and social isolation is obvious in the history of these patients. For example, there are statements in the histories such as, "He has been functioning as a rather schizoid personality throughout all his life, never had any friends, especially girls, adjusting marginally and making the best adjustment in the army, probably because everything was structured for him." The history of another patient said, "He became withdrawn and uncommunicative."

TABLE I

MARITAL STATUS, RELIGION AND RACE OF EXPERIMENTAL AND CONTROL SUBJECTS

	Experimental Subjects (Frequency)	Control Subjects (Frequency)
	Marital	
Single	14	6
Married	1	9
Total	15	15
	Religion	
Protestant (not specified)	4	1
None	4	2
Catholic	3	10
Methodist	1	0
Lutheran	1	0
Presbyterian	1	0
Jewish	1	1
Quaker	0	1
Total	15	15
	Race	
Caucasian	13	14
Negroid	1	1
Oriental	1	0
Total	15	15

Subjects were not controlled for marital status, religion, or race. The large number of Catholics in the control group is due to the fact that most of the subjects were attending a Catholic University.

The mean age of the experimental subjects is 27.2 years. The mean age of the control subjects is 27.4 years. In both groups the age range is between 18 and 34 years of age.

The experimental group has a mean of 4.00 years of education after high school. The control group has a mean of 4.40 years of education after high school. The range of education is from one semester to eight years after high school. Two patients have a Bachelor of Arts degree, four patients have a Master of Science or Master of Arts degree, and one patient has a law degree (Tablas 2 and 3). Other personal data, such as marital status, religion and race appear in Table 1.

It is very difficult to select a group of schizophrenic patients not taking drugs and who also meet the criteria for this study. Therefore, patients who were taking a mild or medium dosage were selected. Exactly what the effects of drugs is on problem solving is not known. Until more knowledge is obtained on the effects of these drugs, all that can be done is to state the drugs which the subjects are taking. The highest dosage taken by our subjects is Stelazine 15 mg. per day or Thorazine 800 mg. per day (Table 4). The usual oral dose for adults

with major psychosis is 50 mg. of Stelazine daily and may be increased to 150 mg. daily. The range of Thorazine doses is 30 mg. to 2700 mg. daily, according to New and Nonofficial Drugs (1963).

The length of the present hospitalization and their number of hospitalizations appear on Table 4. Some of the patients have had only one hospitalization. All of them had been making poor adjustments to life and many had been in therapy before the present hospitalization.

Each experimental subject was matched with a control subject who participated voluntarily in the study. The control group is composed of subjects who have never been hospitalized in a psychiatric hospital and who did not manifest extreme psychiatric symptoms during the testing sessions. Matched subjects are of the same sex and in the same field of education. Their chronological age and years of education do not differ by more than two years. See Tables 2 and 3. Intelligence was not used as a variable for matching subjects because the validity of I. Q.'s obtained from an intelligence test after the onset of the illness is questionable.

B. Methodology:

The technique used in this study is based on a method first devised by Rimoldi (1955). It consists of presenting the subject with a problem and a set of cards which contain questions that the

Table 2

AGE, YEARS OF EDUCATION AFTER HIGH SCHOOL, DEGREE ATTAINED AND FIELD OF EDUCATION FOR THE EXPERIMENTAL AND CONTROL GROUPS

EXPERIMENTAL GROUP

Subjects	Age (Years)	Years of Education After High School	Degree Attained	Field
1	27	3.0	None	business
2	25	4.0	B.A.	english
3	28	8.0	M.S.	engineering
4	31	1.0	None	liberal arts
5	31	8.0	M.S.	chemistry
6	26	1.0	None	liberal arts
7	20	1.5	None	liberal arts
8	19	.5	None	teaching
9	30	7.0	Law	law
10	32	6.0	None	theology
11	28	4.0	B.A.	philosophy
12	22	1.0	None	liberal arts
13	28	3.0	None	psychology
14	33	7.0	M.A.	sociology
15	28	5.0	M.S.	mathematics

CONTROL GROUP

1	28	3.5	None	business
2	27	5.5	B.A.	english
3	26	6.0	M.S.	engineering
4	32	3.0	None	liberal arts
5	33	8.0	Ph.D.	chemistry
6	26	1.5	None	liberal arts
7	19	1.0	None	liberal arts
8	18	0.0	None	liberal arts
9	30	8.0	Law	law
10	33	8.0	B.A.	philosophy
11	28	4.5	B.A.	philosophy
12	22	.5	None	liberal arts
13	27	5.0	B.A.	psychology
14	33	6.5	M.A.	sociology
15	28	6.0	M.S.	mathematics

TABLE 3

MEAN, MEAN DIFFERENCES, STANDARD DEVIATIONS OF DIFFERENCES AND "t" VALUES BETWEEN EXPERIMENTAL AND CONTROL GROUPS FOR AGE AND YEARS OF EDUCATION AFTER HIGH SCHOOL

	Mean					
	Experimental Group	Control Group	Mean Difference	Standard Deviations of Differences	"t"	Significance at the .05 l. of c.
Age	27.20	27.40	.20	1.265	.613	none
Years of Education after High School	4.00	4.46	.46	1.157	1.54	none

TABLE 4

DRUGS TAKEN AT TIME OF TESTING, DOSES OF DRUGS PER DAY, LENGTH OF PRESENT HOSPITALIZATION AT TIME OF TESTING AND NUMBER OF HOSPITALIZATIONS FOR EACH EXPERIMENTAL SUBJECT

Subjects	Drugs Taken at Time of Testing	Doses of Drugs Per Day	Length of Present Hospitalization at Time of Testing	Number of Hospitalizations
1	No medication		4 months	2
2	Thorazine Artane	600 mg. 1 mg.	3 months	1
3	Aluminum Hydroxide	variable	2 months	1
4	Thorazine Artane	600 mg. 4 mg.	2 months	7
5	Thorazine Artane	300 mg. 4 mg.	2 months	2
6	No medication		2 months	3
7	Thorazine Artane	800 mg. 4 mg.	6 months	1
8	Thorazine Stelazine Artane	300 mg. 15 mg. 4 mg.	6 months	1
9	Thorazine	75 mg.	1 month	1
10	Stelazine	6 mg.	2 months	1
11	No medication		1 month	1
12	Thorazine	800 mg.	3 months	3
13	Stelazine	10 mg.	7 days	4
14	Thorazine	300 mg.	1 month	1
15	Stelazine Cogentin	15 mg. 4 mg.	1 month	1

subject may ask to solve the problem. The answer to each question is written on the reverse side of the card. The problem itself is stated on a separate card. The subject is instructed to select those questions which he considers will give him the necessary information to reach a solution to the problem. He may select any question in any order. This makes him free to adapt the method to his own individual style of solving problems. He stops selecting cards when he thinks he has sufficient information to solve the problem and then he gives his solution. The experimenter records the order in which the questions were asked and the solution given. Rimoldi (1955) says of this method "the main purpose being to analyze the process of thinking rather than its end product as indicated by a certain answer."

Rimoldi and Haley (1962) point out that, "a process is experimentally characterized by the sequence of questions asked by the subject. Any characterization of the process should include at least the number of choices made, types of choices, and their order. The same question may have an entirely different meaning depending on the questions previously asked. It is assumed that at every successive step the problem changes, and that what the subject knows and what he may still want to know is not a fixed property of the problem but varies as the solution develops."

This method allows to study each individual's tactic, that is the sequence of questions asked to reach a solution to the problem. Individuals may follow different tactics and arrive at the same solution, or following the same or nearly the same tactic, arrive at different solutions. Some individuals begin solving a problem using a "good tactic", but then become random in performance. With this method, these and other aspects of problem solving can be analyzed for the study of individual differences in problem solving.

C. Problems:

All the problems in this study are controlled in terms of structure and content. Rimoldi, Haley, Fogliatto, Erdmann (1963) define structure in the following manner: "By structure is meant the formal properties or schema of the problem expressed in terms of a basic set of relationships. These 'schemata' are the logical frames on which various types of content or objects may be superimposed. By changing the formal properties, various levels of complexity can be defined." The "intrinsic" difficulty of the problem is defined in terms of the relationships which make up the structure (schema) of the problem. Problems 31A, 31B, 31D, and 31C have the same structure. (See Appendix I to IV.) These problems had been constructed for a previous study by Rimoldi, Fogliatto, Haley, Reyes, Erdmann and Zacharia (1962). Figure 1 shows the structure corresponding to

Problems of schema 31. In problem 31 B there are fifty objects called C. These are divided into 30 objects called (B) and 20 called (G). The B objects are further divided into 20 R objects and 10 T objects. The 20 G objects are divided into 15 R objects and 5 T objects. On the right hand side of Figure 1 another interpretation of the same problem is given. A two by two matrix based upon the structure of problem 31B in Figure 1 can be seen in Figure 2. The schema and the matrix are two different ways of presenting the same problem, the relationships being describable in either way.

The second set of problems used in this study are 35A, 35B, 35D, and 35C. They all have the same structure, which is more complex than the structure of problem 31. Two different interpretations of the structure corresponding to these problems is presented in Figure 3. A three by three matrix of the structure of Problem 35B can be seen in Figure 4. All 31 and 35 type problems are presented in Appendices I to VIII. These problems had been constructed for a previous study by Rimoldi, Fogliatto, Haley, Reyes, Erdmann and Zacharia (1962).

In this research, the objects (content) used to realize the problems consists of words, numbers, letters, and negative statements. Problems 31A and 35A have concrete and familiar content which consists of words without a personal reference. Problems 31B and 35B consists of letters which are symbolic, abstract, and presumably more unfamiliar

than words. The answers to the questions in Problems 31B and 35B are in numbers. In problems 31D and 35D the answers are given using letters. Negative, symbolic, abstract content is imposed on the structure of Problems 31C and 35C. The answers to the questions in Problems 31C and 35C are numbers.

A 31P problem was constructed specifically for each subject in this study. A total of 30 such problems, one per subject, was developed. One of these 31P problems can be seen in Appendix IX. The structure of these problems is the same as the structure of Problems 31A, 31B, 31D and 31C. The content of each 31P problem is related to the personal difficulties of each subject. In contrast to Problem 31A which is made up of words that are concrete, familiar and without a personal reference, the content of Problem 31P is concrete, familiar and with a personal reference.

In order to construct this problem, each experimental and control subject was given a list of 20 statements indicating difficulties that some people encounter in life, for example: (1) feeling that what I do and say is wrong; (2) getting along with my mother. (See Appendix X for the complete list). Each subject was instructed to place a (1) in front of the area representing his greatest difficulty and a (2) in front of the area representing his second greatest difficulty.

In the case of the experimental subjects the psychiatrist of each

patient was given a list parallel to the one previously discussed. He was instructed to check what he considered to be the patient's greatest difficulty and the patient's second greatest difficulty. See Appendix XI for this list. An interview was held with the psychiatrist to discuss the items he and the patient had checked.

In the case of the control subjects, an interview was held with each subject and during the interview the difficulties he checked on the list were discussed.

Problem 31P was administered approximately one month after Problem 31A. The problems were administered individually in the following order: 31A, 31B, 31D, 31C, 35A, 35B, 35D, 35C, and 31P. The number of problems administered in each testing session varied depending on the conditions of the subjects.

D. Instructions to Subjects:

Each subject was handed a card containing the statement of the problem and in front of him were placed cards containing questions. The answer which appears on the reverse side of the card was seen by the subject after selecting the card. The subject was instructed to select only those questions which were necessary to reach a solution to the problem and to select them in the order that he was going to use them. There was no time limit. The subjects were free to use paper and pencil. In most cases and whenever possible, the subjects

were asked to explain the rational for their selection of questions. Some were able to offer irrational but understandable explanations, but others were not able to give any explanation. In other instances, the proper solution was obtained without using all the necessary cards.

CHAPTER V

ANALYSIS OF THE DATA

A. Relevant Questions, Irrelevant Questions, and Total Number of Questions:

Relevant questions are those whose answers give helpful information to the solution of the problem. They form part of a correct sequence of questions. Irrelevant questions are those whose answers do not give any valuable information to the solution of the problem. When relevant questions are used, but not in the most logical order, there is a reversal. The number of relevant questions, the number of irrelevant questions, and the total number of questions asked by each group on each problem and on each content was analyzed. A "t" test, for matched groups, between experimental and control groups for each problem in each variable was performed.

B. Correct Solutions:

The number of correct solutions is an index of the subject's performance in integrating the necessary information and arriving at the proper solution. The number of correct solutions is given for each group on each structure, on each content and for each problem. Fishers' Exact Probability Test was performed to compare groups in terms of the number of correct answers on each problem.

C. Schema Method:

Scores based on the schema method evaluate an individual's performance in terms of the logical relationships of the problem which can be graphically presented by a schema. See Figures 1 and 3. A problem with a definite structure or schema allows to establish one or more ideal sequences of cards which should be followed in the solution of the problem. Ideal sequences indicate the order in which each question should be selected according to the schema. These ideal sequences are used as a norm for scoring individual sequences. These norms are referred to as schema norms. On the basis of the schema it is possible to establish the frequency with which each card should be selected in a given order. For instance, in the case of problem 31, as shown in Figure I, card B could be chosen in second or third order. A detailed description of this approach is given in Rimoldi, Haley, Foglíatto, Erdmann (1963). Also questions not asked can be considered. This has been called the zero order. This manner of procedure allows to establish norms based on the structure of the problems. The performance of each subject can be scored by giving him for every card he selects a value determined as indicated above. Individual scores are determined by adding the proportional values assigned to the questions as used by the subject in his attempt to reach a solution to the problem. In this manner, each subject was given a

score on each problem. This is called the schema score. A score obtained by using this method has the advantage that it is not a relative score depending on group norms.

Another matrix of proportions was constructed. This one was based on the assumption that every card in each order was selected randomly. In an unpublished study by Rimoldi and Georgas, probability values for the occurrence of a specific question in a specific order according to the random hypothesis have been calculated. Each subject was scored for randomness.

For the comparison of structure 31 and structure 35, schema scores were equated by making the maximum score possible under an ideal sequence equal to one. The final score of an observed individual sequence was then expressed as a percentage of the maximum score. These scores were used when computing "t" tests to test the significance between structure 31 and structure 35 for the experimental group and for the control groups separately.

D. Pulling Out Method:

The pulling out method was described by Erdmann (1963) as follows:

"This technique uses the same norms as the schema method and differs from it only in the application of the norms to the individual observed sequence. This method attempts to account for any restructuring or "late" understanding of the nature of the problem by the performer. In other words the benefit of the doubt is given to the subject in the evaluation of his performance.

"The procedure involves a kind of matching of the observed sequence with one of the ideal sequences. That is, the scorer determines the ideal sequence which best approximates the observed sequence and will therefore maximize the evaluation of the performance. Obviously there are certain rules according to which this is done.

"The first step is to remove all the irrelevant (as far as the ideal sequence is concerned) questions from the observed sequence. It is important to maintain the order of the questions as selected by the subject.

"What results may be a complete or partial ideal sequence. In order to be complete, the order of the relevant observed questions must duplicate the ideal sequence. If this occurs, then one finds the value of the ideal sequence which would maximize the score for the observed sequence. This completes the second step in the determination of a final score for the pulling out method. The third and final step is to divide the value, found at the completion of the second step, by the number of questions of the original observed sequence, i.e., before any pulling-out of irrelevant questions.

"The sequence resulting from the pulling-out of irrelevant questions, however, may only partially duplicate an ideal sequence. In this case credit is given for the partial sequence. This value is again divided by the number of questions of the original observed sequence to determine the final score.

"An example of the technique is in order to clarify the application. Suppose the observed sequence 1, 6, 3, 8, 2, 10. Assume that the ideal sequence of the problem are 6, 3, 10 and 10, 3, 6. Pulling-out the irrelevant questions leaves 6, 3, 10 for the observed sequence. This exactly duplicates the ideal sequence 6, 3, 10 so the final score is the value of the 6, 3, 10 sequence in the schema norms divided by 6 (the number of questions from the original observed sequence.) Had the original sequence been 1, 10, 8, 3, 2, 6, then the ideal sequence 10, 3, 6 would have been duplicated with results exactly as above.

"In most instances the ideal sequences will not be exactly dupplicated. Assuming the observed sequence 1, 6, 7, 8, 2, 3, 5, the ideal sequence approximating it best is 6, 3, 10. However, there is only partial approximation here, namely 6, 3. The final score is, therefore, the value of 6, 3 in the schema norms, divided by 7 (in this case). The remnants of the observed sequence following the pulling-out of irrelevant questions must follow the order of one of

the ideal sequences so that an observed sequence without 3 and 6 in it would obtain no value at all. If either occurred at the end of the sequence only that question would contribute any value. For instance the observed sequence 1, 3, 8, 4 would have zero as a final score. The sequence 1, 3, 6, 5, 7 would have the value of 6 in the first position in the schema norms divided by 5.

"This technique, in summary, works to the advantage of the subject by giving him the benefit of the doubt as far as the occurrence of restructuring or reshaping the problem is concerned. It also incorporates the advantages of the schema method and adds the feature of differentially penalizing the subject for the prodigal selection of cards."

The subject's performance was also scored by using the Pulling-Out Method. Using Pulling-Out Scores "t" tests for matched groups, were run between experimental and control groups on all problems.

E. Performance Curves:

For each experimental and control subject a graph was constructed. The number of questions selected on each problem is placed on the abscissa and the schema scores on the ordinate. A curve is obtained by plotting the cumulative scores of the subject. The curve indicates the subject's approach to the problem. On the same graph was plotted the subject's performance scored in terms of randomness. The distance at each point between the two curves indicates how much the performance varies from random performance. The performance curves of matched subjects were compared. Examples of these graphs can be seen in Appendix XII.

F. Convex Sets:

Convex sets, as discussed by Rimoldi and Haley (1962), were obtained for each problem by plotting on the same graph, each experimental and control subject in terms of his schema and schema minus random scores. The schema scores are placed on the abscissa and the schema minus random score on the ordinate. Lines were drawn to connect the points plotted on the extremities of the distribution, thus forming a polygonal convex set. For each group in each problem, the corresponding convex set was drawn. The convex sets were studied in terms of how individual experimental subjects performed on all problems, taking into consideration not only the position of the subject on the convex set, but also the order of questions asked, reversals, the number of relevant and irrelevant questions, and the number of correct answers.

G. Individual Subjects:

After the performance of the subjects had been analyzed in terms of the tactics used to solve the problem, the number of questions selected, the number of correct solutions, and their position in the convex sets, the subjects were classified into three groups. Group X is composed of those subjects who tend to use the most logical tactics to solve the problems, select the least number of questions, obtain the highest number of correct answers, and are

located on the upper right hand side of the convex sets. Group Z is formed by those subjects who tend to use an illogical tactic to solve the problems, select the greatest number of questions, obtain the least number of correct answers, and are positioned on the lower left hand side of the convex sets. Group Y is composed of subjects whose performance is between Group X and Group Z.

After the experimental and control subjects were separately classified in Group X, Y or Z the mean number of correct solutions and the mean number of questions selected for each group was obtained and compared.

CHAPTER VI

RESULTS

The results of the statistical analysis will be reported for the experimental and the control group separately and then compared. The results obtained on Problem 31P will be reported separately from those of the other problems. A description of each convex set of the experimental and control groups will be made in this chapter. A discussion of the results of individual subjects will also be included.

A. Experimental Group:

1. Schema Scores and Pulling Out Scores:

The result of a "t" test indicated no significant difference at the .05 level of confidence in Equated Schema Scores between schemata 31 and schemata 35. See Appendix XIII. There is a trend which indicates a higher score on schemata 35 than on schemata 31.

Performance analyzed in terms of the content of the problems indicates that the highest Mean Pulling Out Scores are obtained on problems with an A content. There is a sharp decrease in the Mean Pulling Out Scores of problems with a B content, compared to problems with an A content. Problems with a B, D, and C content have similar mean Pulling Out Scores. See Figure 5.

2. Relevant, Irrelevant and Total Number of Questions Asked:

The total number of questions selected on Problems with

schema 31 is 255, two hundred, (78%), of which are relevant questions and 55 (22%) irrelevant.

The total number of questions selected on Problems with schema 35 is 397, three hundred and twenty eight, (82%) of these are relevant questions and 89, (18%) irrelevant. The number of relevant questions and irrelevant questions selected on each problem is reported in Table 5.

The number of relevant questions and the number of irrelevant questions selected on each content is reported in Table 6. The total number of questions selected on each problem is shown on Figure 6.

3. Number of Correct Solutions:

The experimental group gave a total of 59 correct answers. Table 7 reports the number of correct answers given for each structure. The number of correct answers given for each content is reported on Table 8 and Figure 7. The number of correct answers given on each problem appears on Table 9 and Figure 8.

4. Analysis of Problems 31A and 31P:

A comparison of Problems 31A and 31P using a "t" test indicates no significant difference at the .05 level of confidence in the Pulling Out Scores. See Appendix XIV. On Problem 31P the group selected a total of 53 questions as compared to 60 questions selected on Problem 31A. There is no significant difference in the number of

TABLE 5

RELEVANT, IRRELEVANT AND TOTAL NUMBER OF QUESTIONS SELECTED ON EACH PROBLEM BY THE EXPERIMENTAL AND CONTROL GROUPS

Problems	Relevant Questions		Irrelevant Questions		Total	
	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group
(1)	(2)	(3)	(4)	(5)	(6)	(7)
31A	55	52	5	0	60	52
31B	51	55	22	15	73	70
31D	57	66	22	15	79	81
31C	37	53	6	1	43	54
35A	89	83	9	11	98	94
35B	90	90	29	6	119	96
35D	71	90	18	20	89	110
35C	78	89	13	8	91	97
Total	528	578	124	76	652	654

TABLE 6

RELEVANT, IRRELEVANT AND TOTAL NUMBER OF QUESTIONS SELECTED ON EACH CONTENT BY THE EXPERIMENTAL AND CONTROL GROUPS

Content	Relevant Questions		Irrelevant Questions		Total	
	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group
(1)	(2)	(3)	(4)	(5)	(6)	(7)
A	144	135	14	11	158	146
B	141	145	51	21	192	166
D	128	156	40	35	168	191
C	115	142	19	9	134	151
Total	528	578	124	76	652	654

TABLE 7

NUMBER OF CORRECT SOLUTIONS OBTAINED ON EACH SCHEMATA BY THE EXPERIMENTAL AND CONTROL GROUPS

Structure (1)	Experimental Group (2)	Control Group (3)
31	26	45
35	33	46
Total	59	91

TABLE 8

NUMBER OF CORRECT SOLUTIONS OBTAINED ON EACH CONTENT BY THE EXPERIMENTAL AND CONTROL GROUPS

Content (1)	Experimental Group (2)	Control Group (3)
A	18	26
B	14	20
D	12	21
C	15	24
Total	59	91

TABLE 9

NUMBER OF CORRECT SOLUTIONS OBTAINED ON EACH PROBLEM BY THE EXPERIMENTAL AND CONTROL GROUPS

Problems (1)	Experimental Group (2)	Control Group (3)
31A	8	14
31B	5	9
31D	6	10
31C	7	12
35A	10	12
35B	9	11
35D	6	11
35C	8	12
Total	59	91

correct answers given on each problem. See Figure 8.

5. Summary:

The results of the experimental group are the following:

a. There is no significant difference in the results between Schemata 31 and Schemata 35.

b. The analysis of the performance in terms of content shows that the highest scores are obtained on Problems with an A content.

c. A greater percent of relevant questions were selected on structure 35 than on structure 31. An analysis of relevant and irrelevant questions selected in terms of content shows that the highest number of relevant questions was selected on problems with an A content and the highest number of irrelevant questions selected was on problems with B content.

d. The results of the analysis of correct solutions shows that a higher number of correct solutions were obtained on Schema 35 than in Schema 31; a higher number of correct solutions were obtained on problems with content A as compared to other contents; and more correct solutions were obtained on Problem 35A as compared to other problems.

e. There is no difference in the performance of Problem 31A and Problem 31P.

B. Control Group:

1. Schema Scores and Pulling Out Scores:

The result of a "t" test indicates no significant difference at the .05 level of confidence in Equated Schema Scores between schemata 31 and schemata 35. There is a trend which indicates a higher score on schemata 35 than on schemata 31. (See appendix XIII).

When performance is analyzed in terms of the content of the problems, the highest Mean Pulling Out Scores are obtained on Problems with an A content. There is a sharp decrease in mean Pulling Out Scores from Problems with an A content to problems with a B content. There is an increase in mean Pulling Out Scores from content B to content D and a further increase in Problems with content C. See figure 5.

2. Relevant, Irrelevant and Total Number of Questions Asked:

The total number of questions asked by the control group in schema 31 is 257, 88 per cent of which are relevant and 12 per cent of which are irrelevant. The total number of questions asked by the control group in problems 35 is 397, of which 89 per cent are relevant and 11 per cent are irrelevant. See Table 5 and Figure 6

for an analysis of questions asked on specific problems. See Table 6 for an analysis of questions asked on specific contents.

3. Number of Correct Solutions:

The control group obtained a total of 91 correct answers; 45 in Problems 31 and 46 in Problems 35. An analysis of the number of correct solutions on each structure, content and problem appears on Tables 7, 8, and 9 respectively. Figures 8 and 7 show the number of correct solutions obtained on each problem and on each content respectively.

4. Analysis of Problems 31A and 31P

A comparison of Problem 31A and 31P indicates no significant difference at the .05 level of confidence in mean Pulling Out Scores. See Appendix XIV. On problem 31A the control group obtained 14 correct solutions and on Problem 31P, 9 correct solutions.

5. Summary

The result of the control group are the following:

a. There is no significant difference between schemata 31 and schemata 35.

b. The analysis of the performance in terms of content shows that the highest Mean Pulling Out Scores are obtained on Problems with an A content.

c. The number of relevant questions asked is about the same on schemata 31 and on schemata 35.

d. More questions were asked on problem with a D content than on problems with an A, B, or C content.

e. The results of the analysis of correct solutions shows that about the same number of correct solutions were obtained on schemata 31 as compared to schemata 35; a higher number of correct solutions were obtained on problems with content A as compared to other contents; and more correct solutions were obtained on Problems 31A as compared to other problems.

f. There is no significant difference in Mean Pulling Out Scores between Problem 31A and Problem 31P but the group obtained more correct solutions on Problem 31A as compared to Problem 31P.

C. Comparison of Experimental and Control Groups:

1. Pulling Out Scores:

Results obtained from "t" tests between the experimental and the control groups indicate a significant difference in favor of the control group at the .01 level of confidence on Problems 31A, 31D, 31C and 35B scored by the Pulling Out Method. See Appendix XV. A "t" test between experimental and control groups was performed for each structure and another "t" test was performed for each content.

A comparison between control and experimental subjects was performed between all the problems corresponding to Structure 31, regardless of their content. The results showed a significant difference at the .01 level in favor of the control group (Appendix XVI).

No significant difference between groups was found on Structure 35. A significant difference at the .01 level was found between groups on all problems with content A and C. There was no significant difference between groups with a B and D content. See Apprendix XVI.

2. Relevant, Irrelevant and Total Number of Questions Asked:

The experimental group asked a total of 652 questions on Problems 31 and 35 combined, compared to 654 questions asked by the control group. The difference in total number of questions selected by these groups is not significant.

The experimental group asked a total of 124 irrelevant questions and the control group asked a total of 76 irrelevant questions. The experimental group asked a total of 528 relevant questions and the control group asked a total of 578 relevant questions.

Tests of significance, ("t"), between experimental and control groups on the mean number of relevant questions and on the mean number of irrelevant questions selected indicated that there is a significant difference at the .05 level between the number of relevant questions asked on Problems 31C and 35D and on the number of irrelevant questions asked on Problem 35B. See Appendix XVII. The control group selected more relevant questions on Problem 31C and on Problem 35D and more irrelevant questions on Problem 35B.

3. Number of Correct Solutions

The control group obtained a total of 91 answers as compared to 59 correct answers obtained by the experimental group, considering their performance in all the problems. Using Fisher's Exact Probability Test, a significant difference between groups on the number of correct answers was found only on Problem 31A. See Appendix XVIII.

4. Convex Sets

A description of the performance of each group and a comparison of groups on each problem can be made by looking at the convex sets which appear on Figures 9 to 16. The sequence of questions asked by each subject on each problem is found in Appendix XIX to XXI. The most logical sequences of questions for each problem appear in Appendix XXII. A general description applying to all the convex sets follows: The subjects who are on the upper right hand corner of the convex set are those who selected only the correct questions and in the most logical order. The subjects who are plotted on the right hand side of the convex set begin solving the problem in the most logical manner, but the further down on the convex set the subject is located, the more random is his performance or the more reversals he has. The subjects who are plotted on the lower left hand corner of the convex set have from the beginning, selected incorrect questions.

The subjects who are plotted on the left hand side of the convex set have from the beginning selected incorrect questions and the further down on the convex set they appear the more random is their performance or the more reversals they have.

The convex set of Problem 31A which appears on Figure 9, demonstrates that two experimental subjects and eight control subjects are plotted on the upper right hand corner of the convex set. Eight experimental subjects and three control subjects are plotted on the lower left hand corner of the convex set. Only five irrelevant questions were selected by the experimental group and no irrelevant questions were selected by the control group. Therefore it can be said that both experimental and control subjects are divided into two groups: those who selected the correct questions in the right order and those who mainly selected the correct questions but in the wrong order.

Performance on Problems 31B and 31D, which appear on Figures 10 and 11 respectively, shows that there are fewer subjects plotted on the corners of the convex sets than on Problem 31A. On Problem 31B only control subject 14 selects a perfect sequence of questions and on Problem 31D only control subjects 14 and 15 select a perfect sequence of questions. On these two problems the groups are not as clearly divided in two subgroups as they are on Problem 31A. The

experimental subjects selected 22 irrelevant questions on Problem 31B and 22 irrelevant questions on Problem 31D. The control group selected 15 irrelevant questions on Problem 31B and 15 irrelevant questions on Problem 31D.

In the convex set of Problem 31C, Figure 12, there are six control subjects at the upper right hand corner of the convex set and only one experimental subject. There are four experimental subjects at the lower left hand corner of the convex set and only one control subject. Convex sets of Problem 31C are similar to convex sets of Problem 31A. The experimental subjects selected six irrelevant questions and the control subjects selected 1 irrelevant question. One unique aspect about the performance on Problem 31C is that four experimental subjects selected no questions.

The Convex Set of Problem 35A is shown in Figure 13. Notice that the convex set of the control group falls within the upper right hand part of the experimental group's convex set. The performance of the experimental group on Problem 35A is similar to its performance on Problem 31A, in that the group may be divided into two subgroups. There are subjects who are clearly on the upper right hand corner of the convex set and others clearly on the lower left hand corner of the convex set. The performance of the latter is basically characterized by the selection of relevant questions in the wrong order.

Performance on Problem 35B, seen on Figure 14, shows more control subjects than experimental subjects on the upper right hand side of the figure. Six control subjects and five experimental subjects solved the problem in the most logical manner. Two experimental subjects 12 and 13 performed at random on this problem. Experimental subject 12 selected 15 questions when only 5 questions are necessary to solve this problem.

The convex set of Problem 35D can be seen on Figure 15. It demonstrates that the experimental group has 1 subject and the control group has two subjects who have a perfect sequence of questions. Most of the subjects are dispersed throughout the convex set of each group. The convex sets coincide quite closely.

The convex sets of each group on Problem 35C also coincide. This can be seen on Figure 16. However, there are 7 control subjects as compared to 4 experimental subjects on the upper right hand corner of the convex set. There are 2 control subjects as compared to 3 experimental subjects on the lower left hand corner of the convex set.

5. Results of Individual Subjects:

The performance of individual subjects was studied and each subject was classified in one of three groups. Group X is formed by those subjects who tend to use the most logical tactic to solve the problems, select the least number of questions, obtain the highest

number of correct solutions, and are on the upper right hand side of the convex sets.

Experimental subjects who form Group X are subjects 5, 6, 3, and 15. Control subjects who form Group X are 1, 3, 12, 14, 15, 5, and 11.

Group Z is defined by those subjects who tend to use an illogical tactic to solve the problems, selected the most number of questions or do not attempt to solve the problem, obtain the least number of correct solutions and are on the lower left hand side of the convex sets. Experimental subjects who form Group Z are subjects 13, 4, 12, 14, 7, and 9. Control subjects who form Group Z are subjects 2, 4, 8, 9 and 10.

Group Y is defined by those subjects whose performance is between the performance of those in Group X and those in Group Z. Experimental subjects in Group Y are subjects 10, 8, 1, 2, 11. Control subjects in Group Y are subjects 6, 7, 13.

The mean number of questions asked and the mean number of correct solutions for each group are on Table 10. Table 11 contains personal information about the subjects in each group.

TABLE 10

MEAN NUMBER OF CORRECT SOLUTIONS AND MEAN NUMBER OF QUESTIONS ASKED BY EXPERIMENTAL AND CONTROL GROUP IN GROUP X, GROUP Y AND GROUP Z[1]

	EXPERIMENTAL GROUP		
	GROUP X	GROUP Y	GROUP Z
Mean Number of Correct Solutions	7.25	3.80	1.83
Mean Number of Questions Asked	43.00	48.40	48.30[2]
	CONTROL GROUP		
Mean Number of Correct Solutions	7.00	6.66	4.80
Mean Number of Questions Asked	39.43	48.30	56.00

[1] An explanation of these groups can be found in Chapter IV.

[2] In this group, no questions were selected on five problems.

TABLE 11

EXPERIMENTAL SUBJECTS IN GROUP X, GROUP Y AND GROUP Z. TYPE OF SCHIZOPHRENIA, AGE, YEARS OF EDUCATION AFTER HIGH SCHOOL, FIELD OF EDUCATION, DEGREE ATTAINED, NUMBER OF HOSPITALIZATIONS AND LENGTH OF HOSPITALIZATION AT TIME OF TESTING OF EACH EXPERIMENTAL SUBJECT.

Patient	Type of Schizophrenia	Age (Years)	Years of Education After High School	Field of Education	Degree Attained	Number of Hospitalization (months)	Length of Hospitalization at Time of Testing (months)
				Group X			
15	Paranoid	28	5.0	Natural Science	M.S.	1	1
6	Paranoid	31	8.0	Natural Science	M.S.	2	2
6	Catatonic	26	1.0	Liberal Arts	None	3	2
3	Paranoid	28	8.0	Natural Science	M.S.	1	2
				Group Y			
10	Catatonic	32	6.0	Liberal Arts	None	1	2
8	Paranoid	19	.5	Liberal Arts	None	1	6
1	Paranoid	27	3.0	Social Science	None	2	4
2	Paranoid	25	4.0	Liberal Arts	B.A.	1	3
11	Undifferentiated	28	4.0	Liberal Arts	B.A.	1	1

TABLE 11 - Continued

Patient	Type of Schizophrenia	Age (Years)	Years of Education After High School	Field of Education	Degree Attained	Number of Hospitalization (months)	Length of Hospitalization at Time of Testing (months)
				Group Z			
9	Paranoid	30	7.0	Social Science	Law	1	1
13	Paranoid	28	3.0	Social Science	None	4	1/4
4	Paranoid	31	1.0	Liberal Arts	None	7	2
12	Paranoid	22	1.0	Liberal Arts	None	3	3
14	Undifferentiated	33	7.0	Social Science	M.A.	1	1
7	Heperfrenic	20	1.5	Liberal Arts	None	1	6

CHAPTER VII

DISCUSSION AND CONCLUSIONS

The results indicate that there is a consistent difference in performance between the experimental and control groups. The difference may in some cases be statistically significant, depending on problems, methods of scoring, etc. Scored by the Pulling Out Method, significant differences between groups were found in favor of the control group on Problems 31A, 31D, 31C, 35B, content A, and content C. Figure 5 shows that the control group obtained a higher Mean Pulling Out Score than the experimental group on contents A, B, D, and C. When the problems were scored by the Pulling Out Method, significant differences between groups were found on Structure 31, but not on Structure 35. There is also a significant difference in the number of relevant questions asked on Problem 31C and on Problem 35D as well as in the number of irrelevant questions asked on Problem 35B. The control group selected more relevant questions and less irrelevant questions than the experimental group.

An analysis of the number of correct solutions indicates a significant difference only in Problem 31A. However, Figure 8 shows that the control group obtained more correct solutions on each problem than the experimental group.

A study of the performance curves also shows a difference between the control and the experimental groups. Appendix XII is an

example of the performance curves of experimental and control subjects 3 and 12.

The difference between the groups support the results found by Cavanaugh (1953), Binder (1956), Hunt and Cofer (1944), Chapman (1956) and Tutko and Spence (1962).

Under overpowering anxiety, some people break with reality and adopt intellectual mechanisms different from the mechanisms used in ordinary logic. This is what happens to the schizophrenic. He regresses and adopts an archaic form of rationality. As Arieti (1955) says, the thought of the schizophrenic is not illogical, but it follows a different system of logic, leading to deductions different from those usually reached by a healthy person. Von Domarus' principle stated in Arieti (1955) explains quite well what goes on in schizophrenic thinking: "Whereas the normal person accepts identity only upon the basis of identical subjects, the paleologician accepts identity based upon identical predicates. The predicate is, by definition something which concerns the subject. The predicate which is selected in the process of identification is the identifying link, and the selection of a certain predicate is associated with emotional needs." Arieti (1955) discusses another important aspect of paleologic thought. Whereas the healthy person in a wakened state is mainly concerned with the connotation, that is the meaning of a term, the

denotation, or object meant, and the verbalization of a word or symbol, he is capable of shifting his attention from one to another of the three aspects of a symbol. The person who thinks paleologically is mainly concerned with the denotation and the verbalization, but experiences a total or partial impairment of his ability to connote. Therefore, he will have difficulty in solving problems not only with abstract content, but also with content that is concrete.

Comparing performance in problems of the 31 and 35 type, it was found that the experimental subjects improved more than the control subjects in the 35 type problems. One interpretation of these results is that it takes the schizophrenic more practice and familiarity with a task to function at his maximum capacity. It should be remembered that problems of the 35 type were administered after those of type 31. This supports the findings of Cameron (1938), Mc Gaugran and Moran (1957), Whiteman (1954), and Arieti (1955), who say that there is not a deterioration in schizophrenic thinking, but rather an impairment.

Although the performance of the experimental and control groups differentiate them, there are similarities between the groups. In each group there is no significant difference on mean Pulling Out Scores between Schemata 31 and Schemata 35. However, there is a trend of higher mean Pulling Out Scores on Structure 35, compared to mean Pulling Out Scores on Structure 31. Analysis of the problems by

content indicates no significant difference between groups on problems with a B and D content. Both groups obtained the highest number of correct answers and the highest mean Pulling Out Scores on Content A. (See Figures 7 and 5). There was no significant difference between the groups on Problems 31B, 35A, 35D and 35C scored by the Pulling Out Method.

The curves on Figures 8 and 6 obtained using the number of correct answers on each problem and the number of questions asked on each problem, respectively, follow the same general trend in both groups.

After a study of the performance of each individual subject and their classification into three groups, 7 control subjects and 4 experimental subjects are in Group X, 3 control subjects and 5 experimental subjects are in Group Y, and 5 control subjects and 6 experimental subjects are in Group Z. Notice that there are 3 more control subjects than experimental subjects in Group X. The control subjects and the experimental subjects who are in Group X obtain almost the same mean number of correct solutions. However, the control subjects in Group Y and in Group Z obtain more correct solutions than the experimental subjects in Group Y and in Group Z.

The similarities of problem solving performance may be influenced by inherent similarities within each group. For example,

the groups were matched for years of education, field of education, age and sex. Although the experimental group was composed of schizophrenics, 10 were diagnosed as paranoid type. Arieti (1955) says, "In the paranoid type of schizophrenia a peculiar situation occurs: Aristotelian thought is preserved to a considerable extent, but as we shall see later in detail, it is often strangely used to support the conclusions reached by paleologic thought. This situation is, to a certain degree, reminiscent of those defenses of the ego which in many neuroses protect or reinforce unconscious complexes." Simkin (1951) found that despite differences in the intellectual structures, normal adults and schizophrenic adults, matched for age and education, have a general factor an a verbal factor in common.

Both the control and experimental groups have a lower Pulling Out Score on Problem 31P compared to Problem 31A. However, in the experimental group the number of correct answers is the same for Problems 31A and 31P. In each problem the group obtained a total of eights correct answers. The control group decreases its number of correct answers from 14 in Problem 31A to 9 in Problem 31P. This seems to indicate that the control group has more difficulty than the experimental group in solving problems having an emotionally laden content compared to the problems with a neutral content. These data could also be interpreted in terms of the frequency with which a

person has to confront his personal difficulties. Most of the experimental subjects have daily confrontations in therapy, ward meetings, and other situations within the hospital. Thus, the presentations of their difficulties in a problem solving situation, was not a new experience. The subjects of the control group are probably very seldom confronted with their difficulties in such a direct, concrete situation.

However, when the experimental subjects are confronted with their problems it does not mean that they accept them. The emotional withdrawl of the patients from reality may have made them insensitive to the personal content of Problem 31P. Most of the control subjects remarked that the problem was related to them and some reacted with strong emotion to the problem. Only one experimental subject reacted with emotion to Problem 31P.

Although, the experimental and control groups are too small to subdivide, certain trends were noted which should be mentioned and perhaps followed up in future studies.

The three experimental subjects who have a Master's Degree in the natural sciences, are in Group X. This may indicate that performance is highly influenced by years of education and field of education. This supports the findings of Mc Gaughran and Moran (1956) who found that differences in conceptualization were more closely associated

with estimated tests of intelligence and education than the presence or absence of schizophrenia. However, it is important to note that, in some cases, there are unique characteristics in their performance. For example, experimental subject 5 obtained a perfect sequence on three problems, and 7 correct answers. His tactic to solve the problems which can be seen in Appendix XIX shows that his performance is not random on Problems 31A, 31B, 31D and 31C. However, his performance on Problem 35A is random. It appears he has some difficulty in shifting from solving problems with structure 31 to solving problems with structure 35.

Another example is experimental subject 15 who solved only Problem 31A using the most logical sequence of questions. He obtained 7 correct answers in all the problems. The sequence of cards used to solve Problems 31B, 31D, and 31C is confused. On each problem of the 35 series, he uses a perfect sequence of questions with one exception; he consistently selects the first card last. This may have resulted from a negative reaction to following instructions. The subject criticized the problems, and made remarks such as "I find this insufferably tedious. I have trouble concentrating these days. I wasn't cut out to be a mathematician. Now I'm just interested in working with people. My delusional system is interfering; sometimes I get caught up in something malicious and this seems to be a part of it." He wrote an equation

using the cards he needed, and he placed the first card first, but then consistently selected it last. This is probably an example of how emotional aspects of the personality affect intellectual performance.

The four experimental subjects who were classified in Group X solved Problem 31P correctly and selected a logical sequence of questions. Of the five experimental subjects in Group Y, two used a logical tactic to solve Problem 31P; and three subjects of this group obtained a correct solution. In Group Z one of the 6 experimental subjects used a logical tactic to solve Problem 31P, and 1 subject solved the problem correctly. Therefore, in the experimental group performance on a problem with a personal content seems to be a function of the ability to solve problems in general.

This does not seem to be the case in the control group. In group X, 4 of the 7 subjects solved Problem 31P using the most logical tactic and obtained a correct solution. In group Y, 2 of the three subjects solved Problem 31P using the most logical tactic and obtained a correct solution. In group Z two of the five subjects use the most logical tactic to solve Problem 31P, and three obtained a correct solution.

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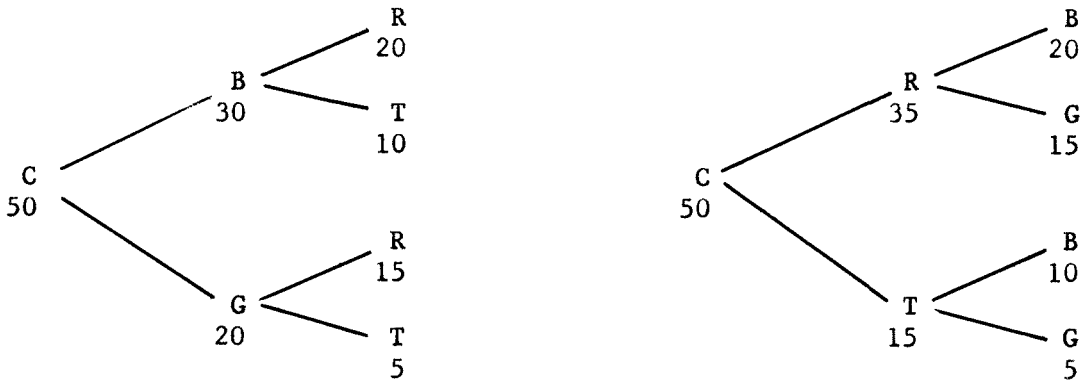


Fig. 1 The Structure and Content of Problem 31 B

	B	G	
R	20	15	35
T	10	5	15
	30	20	50C

Fig. 2 A Two by Two Matrix of the Structure and Content of Problem 31 B

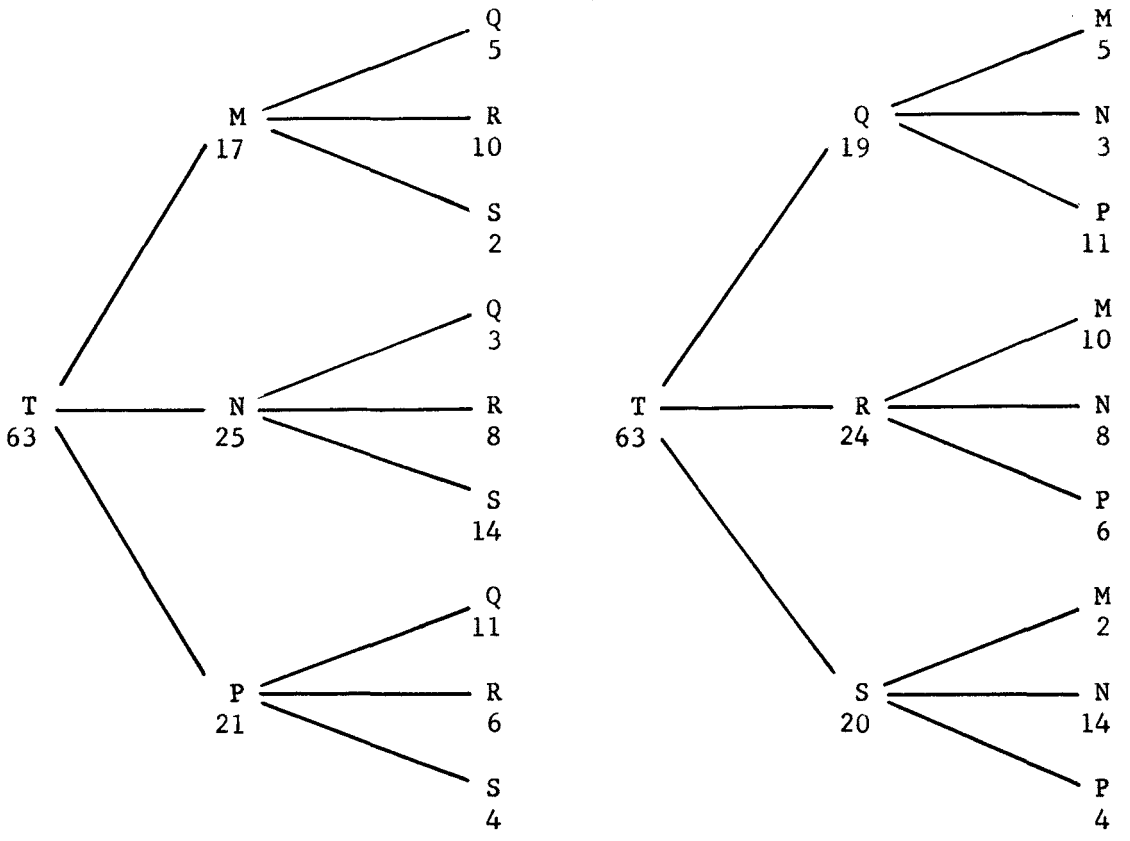


Fig. 3 The Structure and Content of Problem 35 B

	M	N	P	
Q	5	3	11	19
R	10	8	6	24
S	2	14	4	20
	17	25	21	63T

Fig. 4 A Three by Three Matrix of the Structure and Content of Problem 35 B

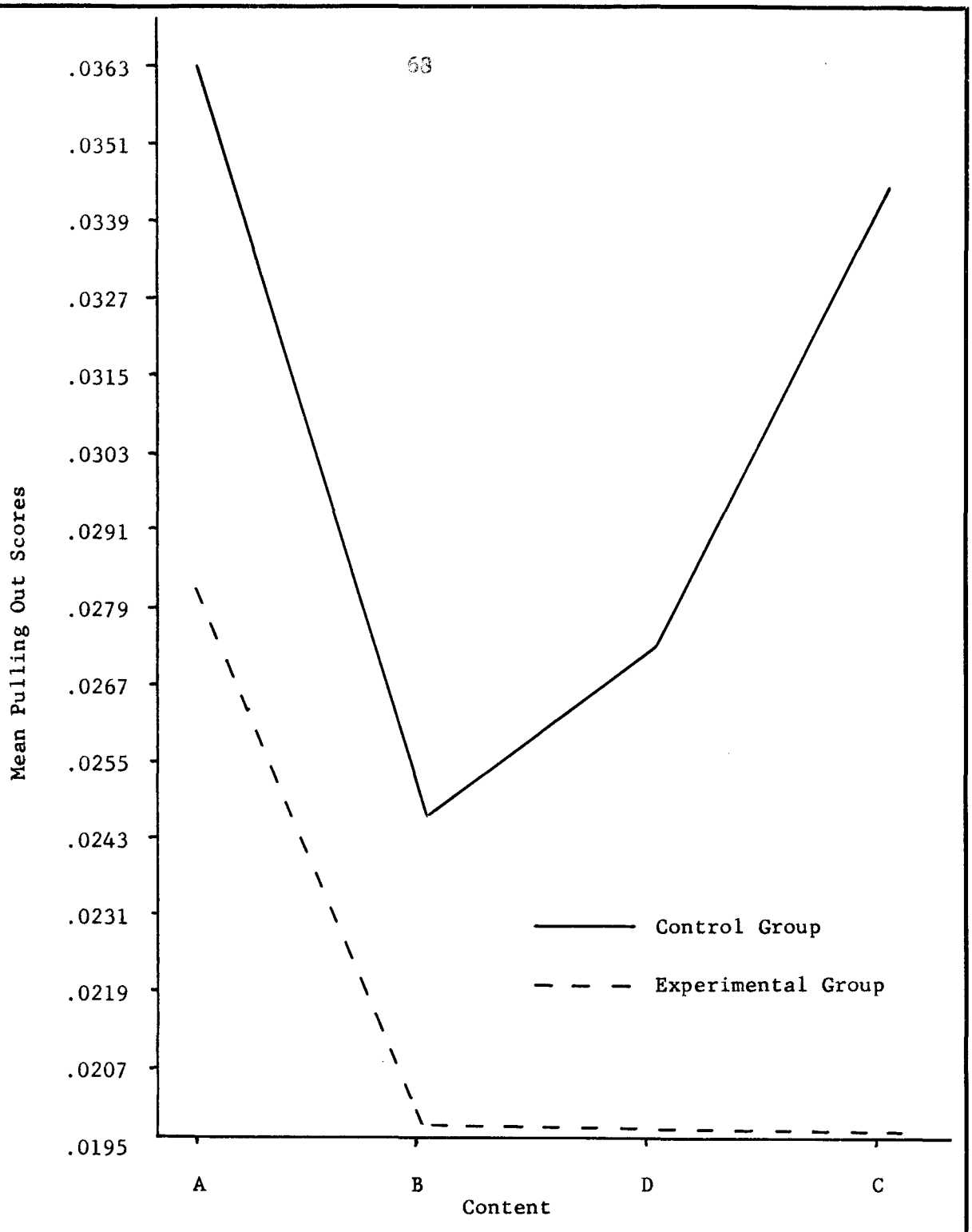


Fig. 5 Performance on Content (structure combined) for Experimental and Control Groups

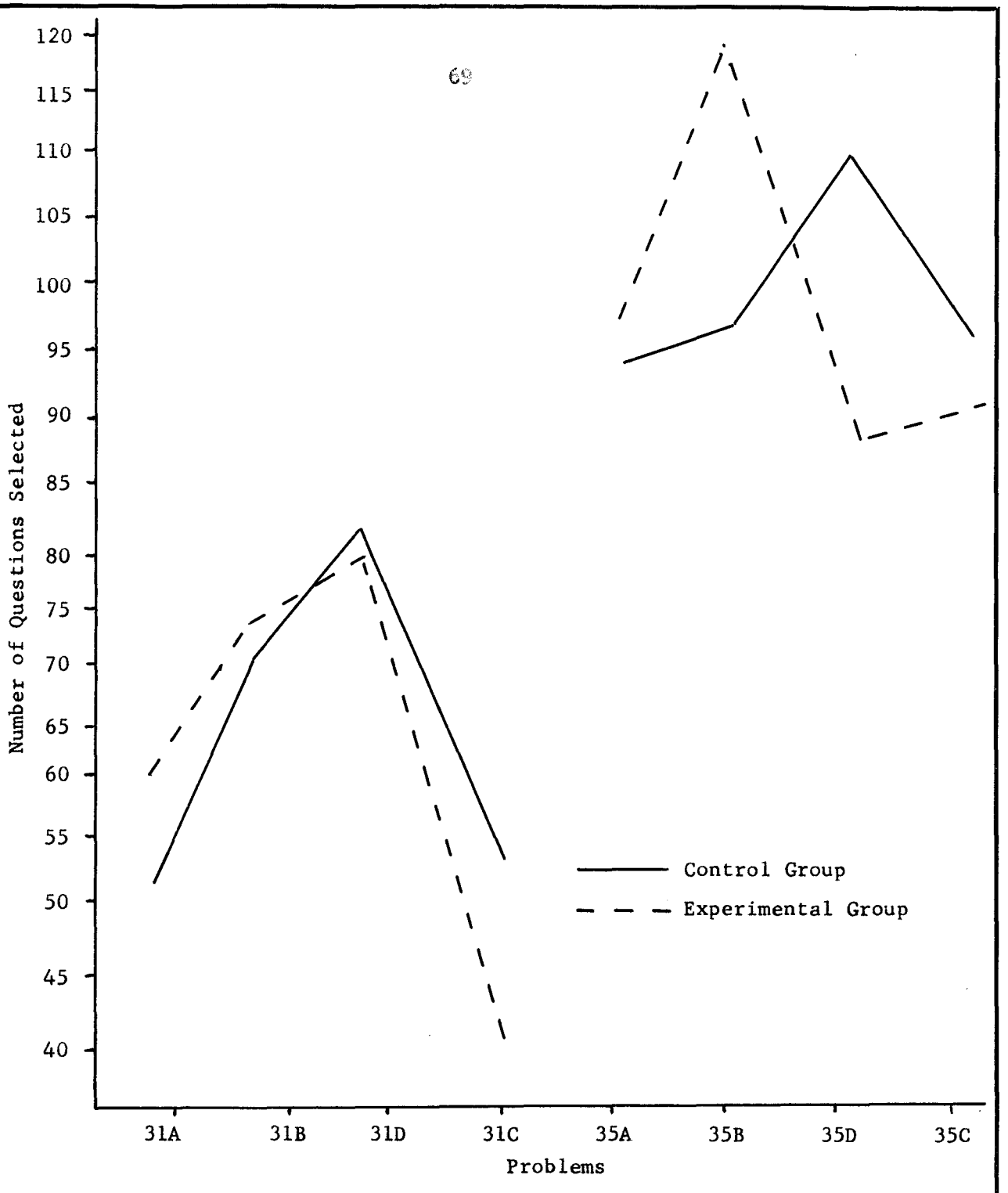


Fig. 6 **Total Number of Questions Asked on Each Problem for the Experimental and Control Groups**

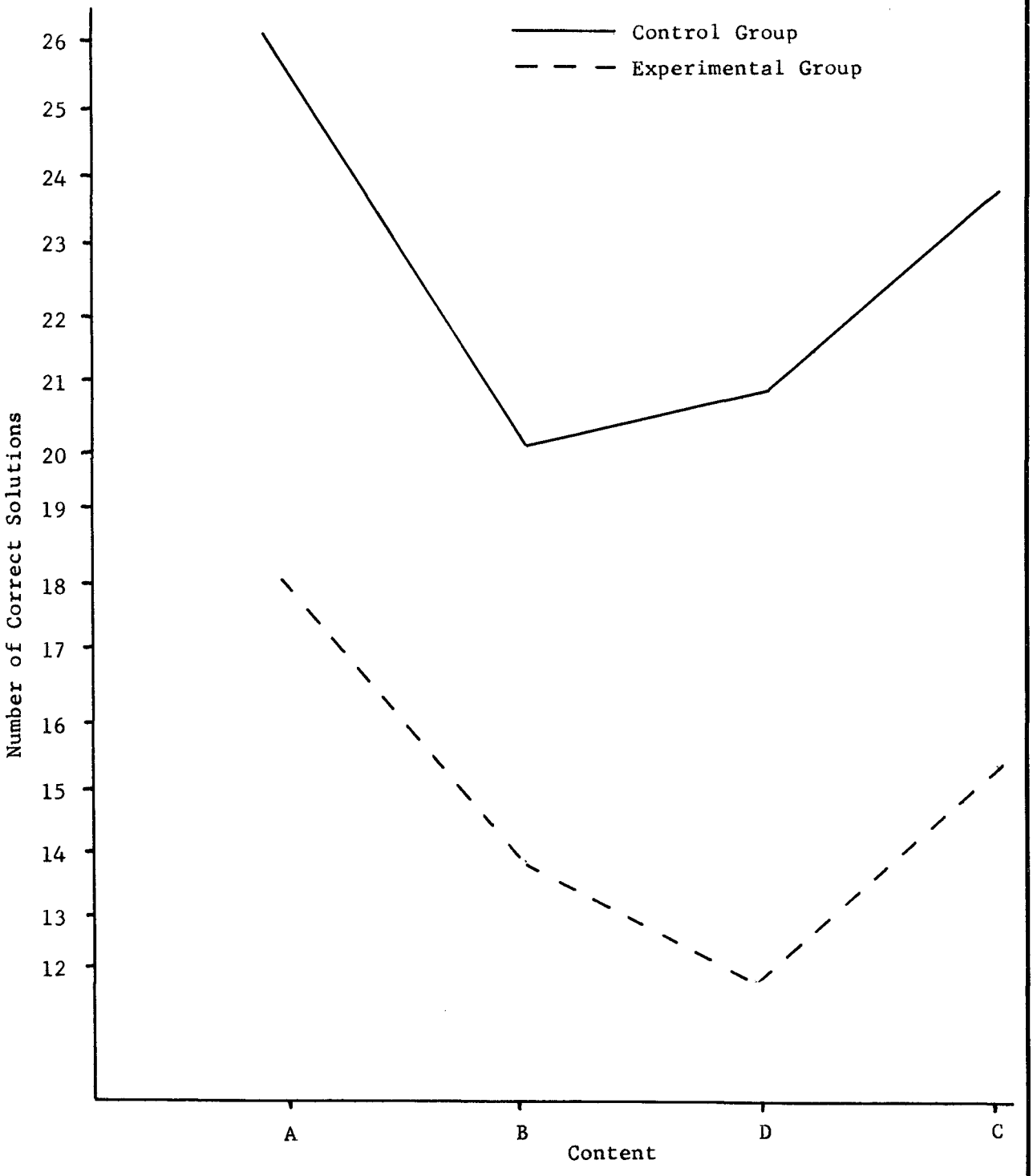


Fig. 7 Number of Correct Solutions on Each Content for the Experimental and Control Groups

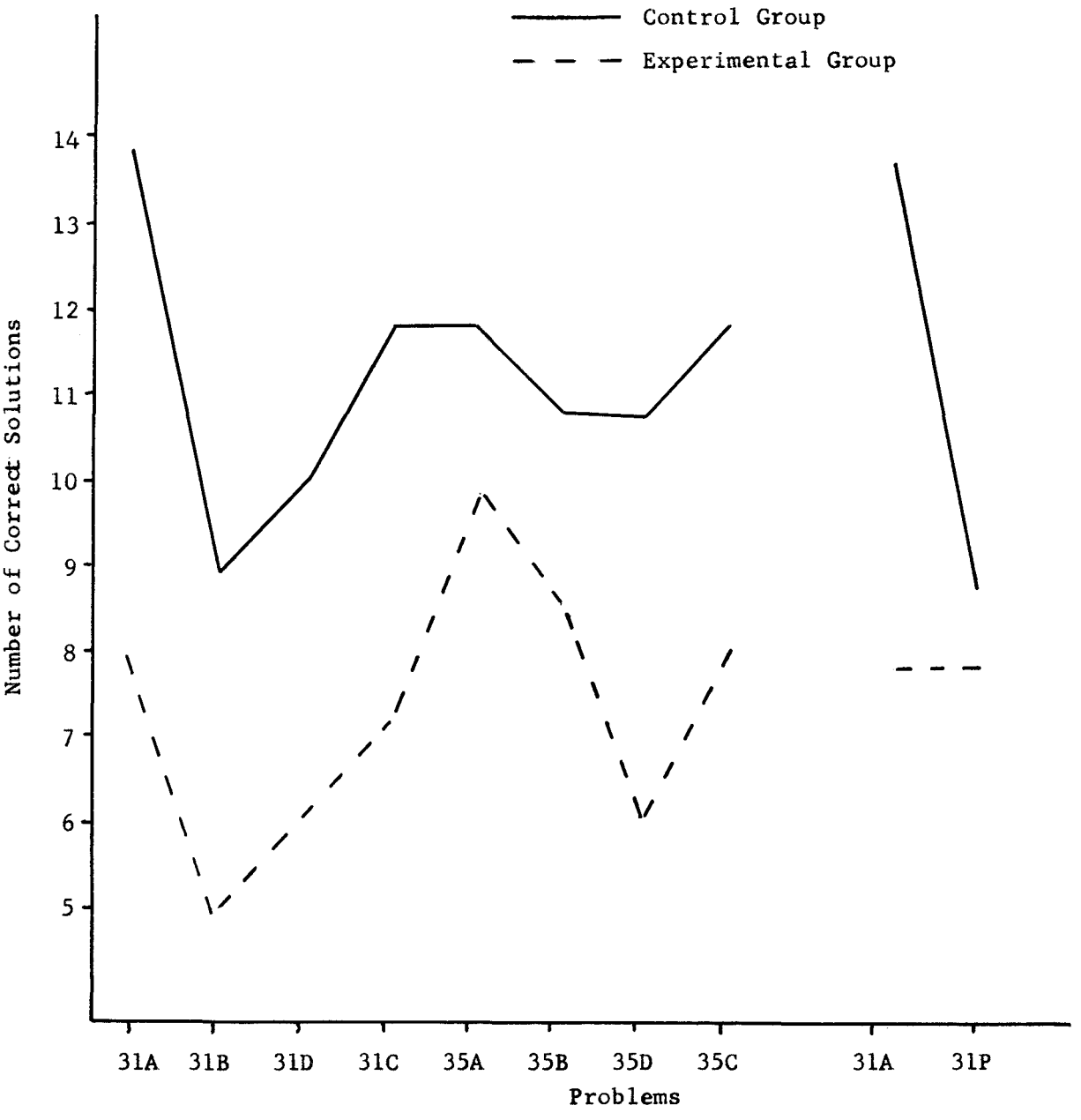


Fig. 8 Number of Correct Solutions on Each Problem for the Experimental and Control Groups

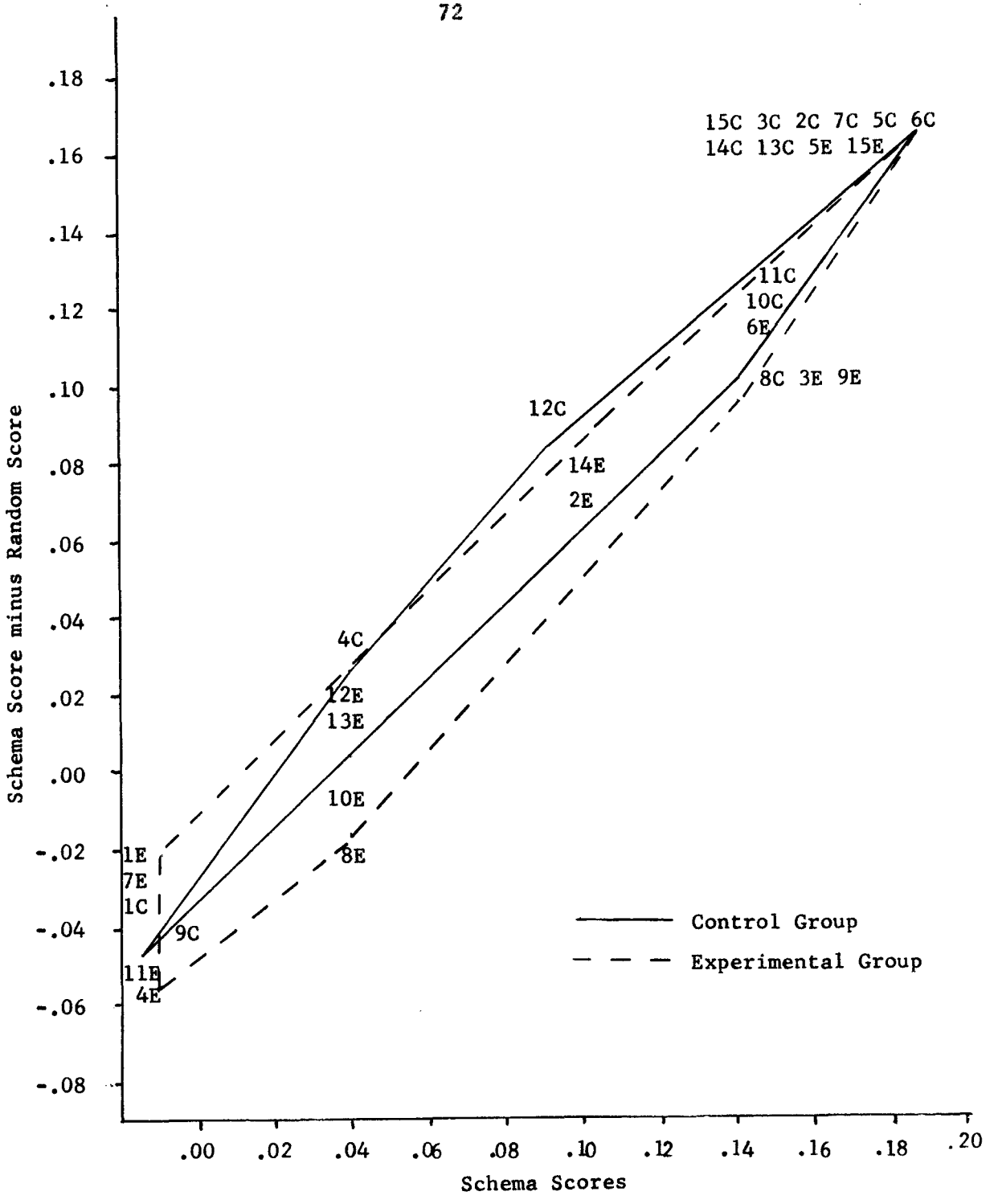


Fig. 9 Convex Set of Problem 31A, for the Experimental and Control Groups

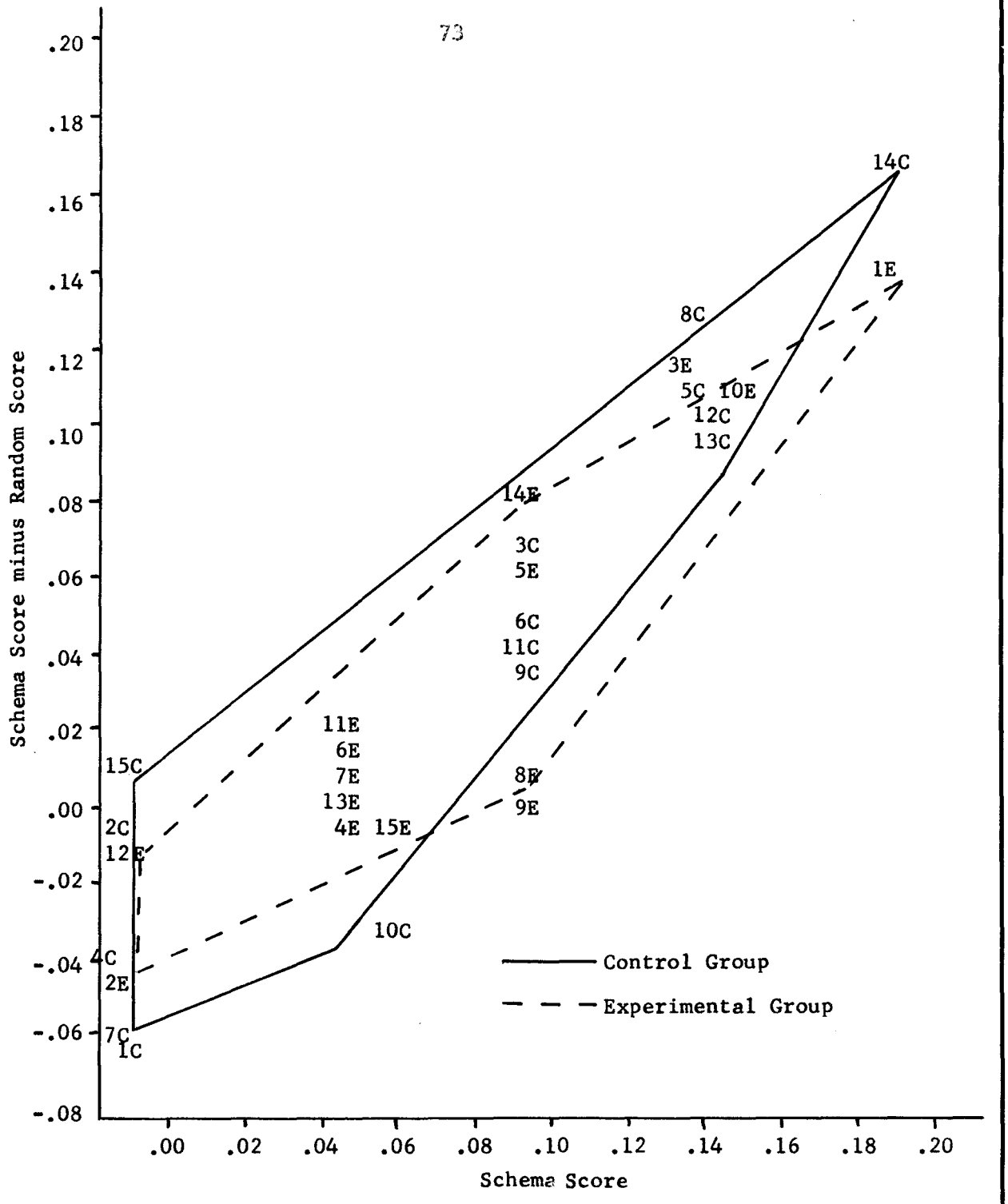


Fig. 10 Convex Set of Problem 31 B, for the Experimental and Control Groups

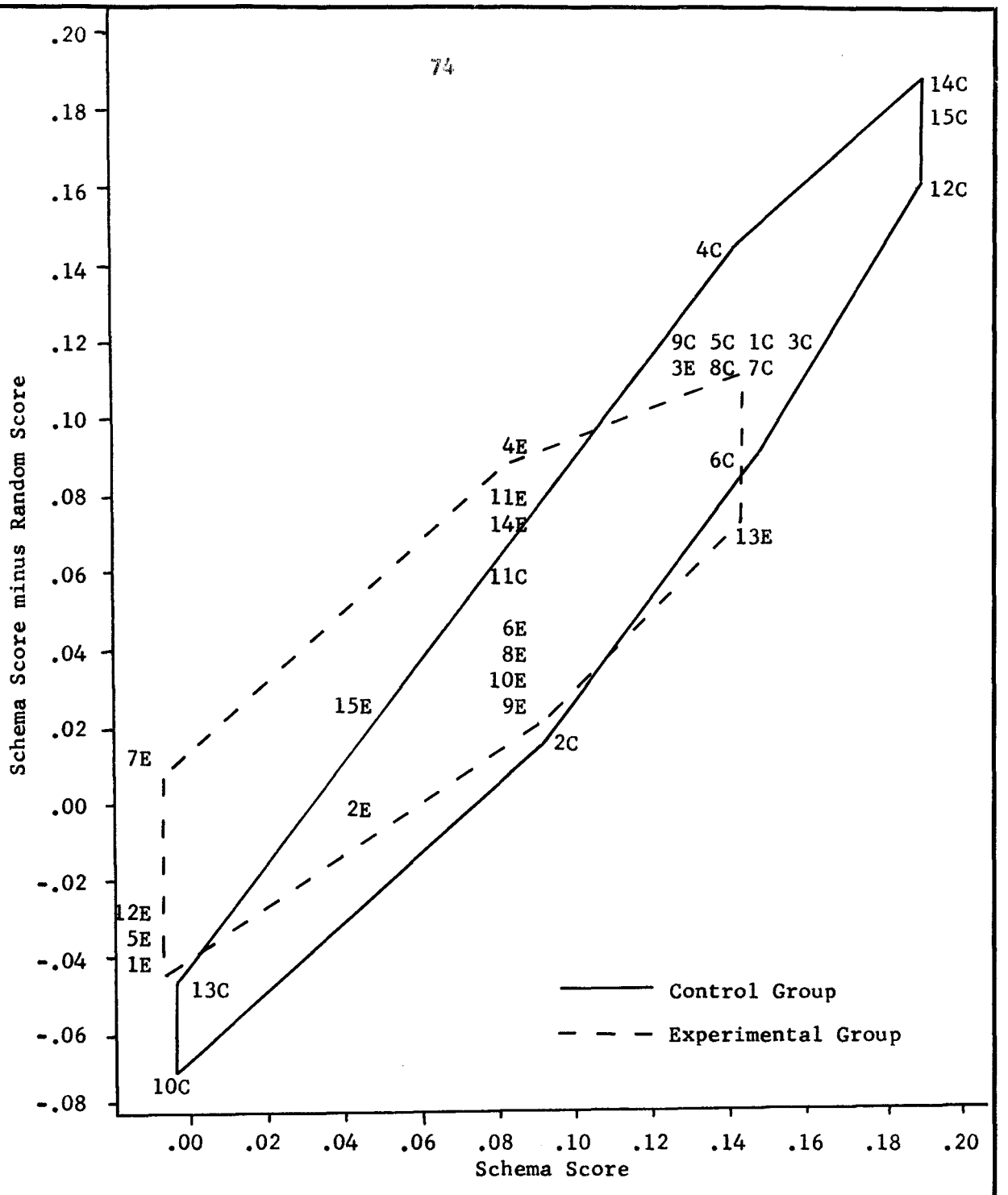


Fig. 11 Convex Set of Problem 31 D, for the Experimental and Control Groups

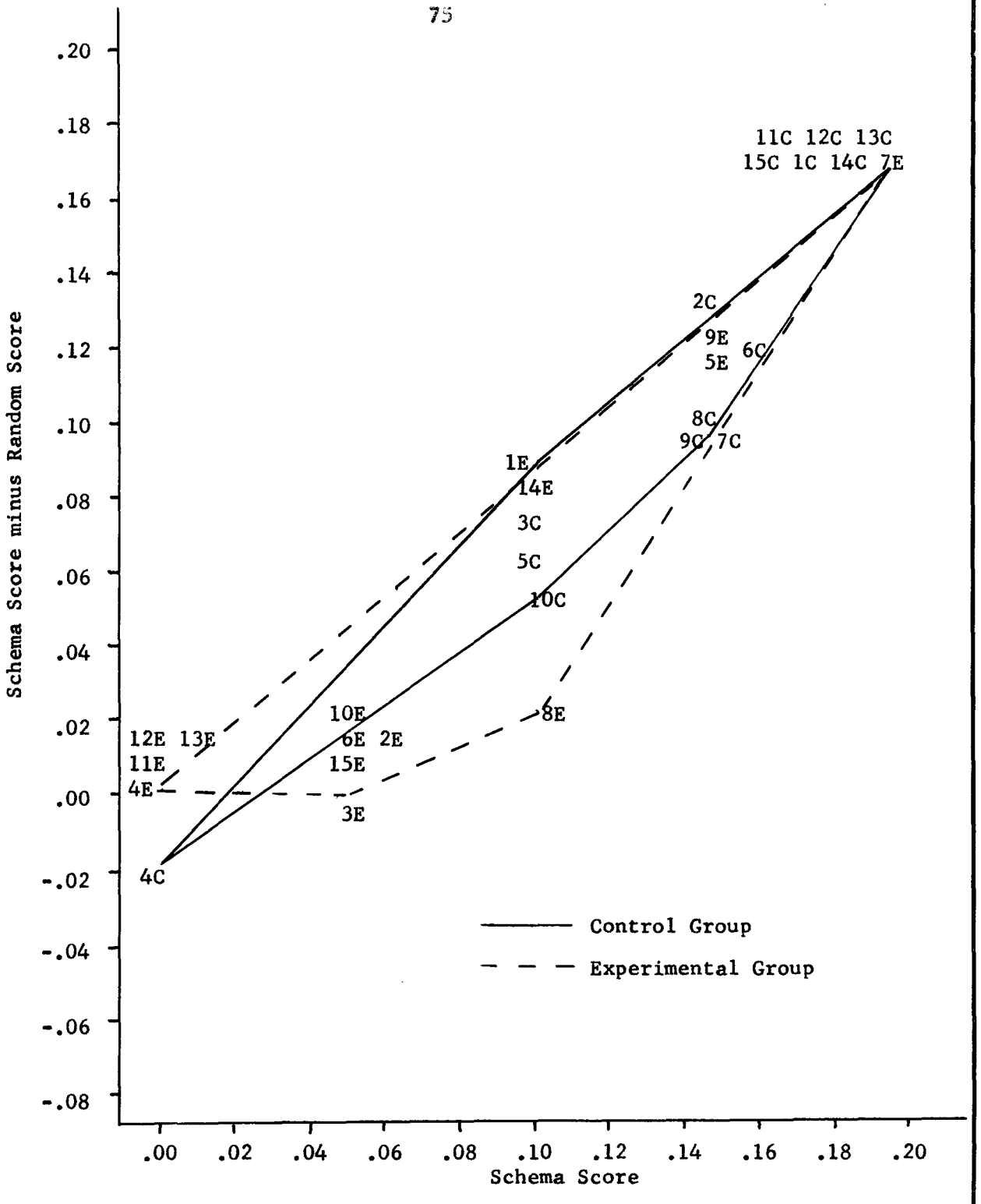


Fig. 12 Convex Set of Problem 31 C, for the Experimental and Control Groups

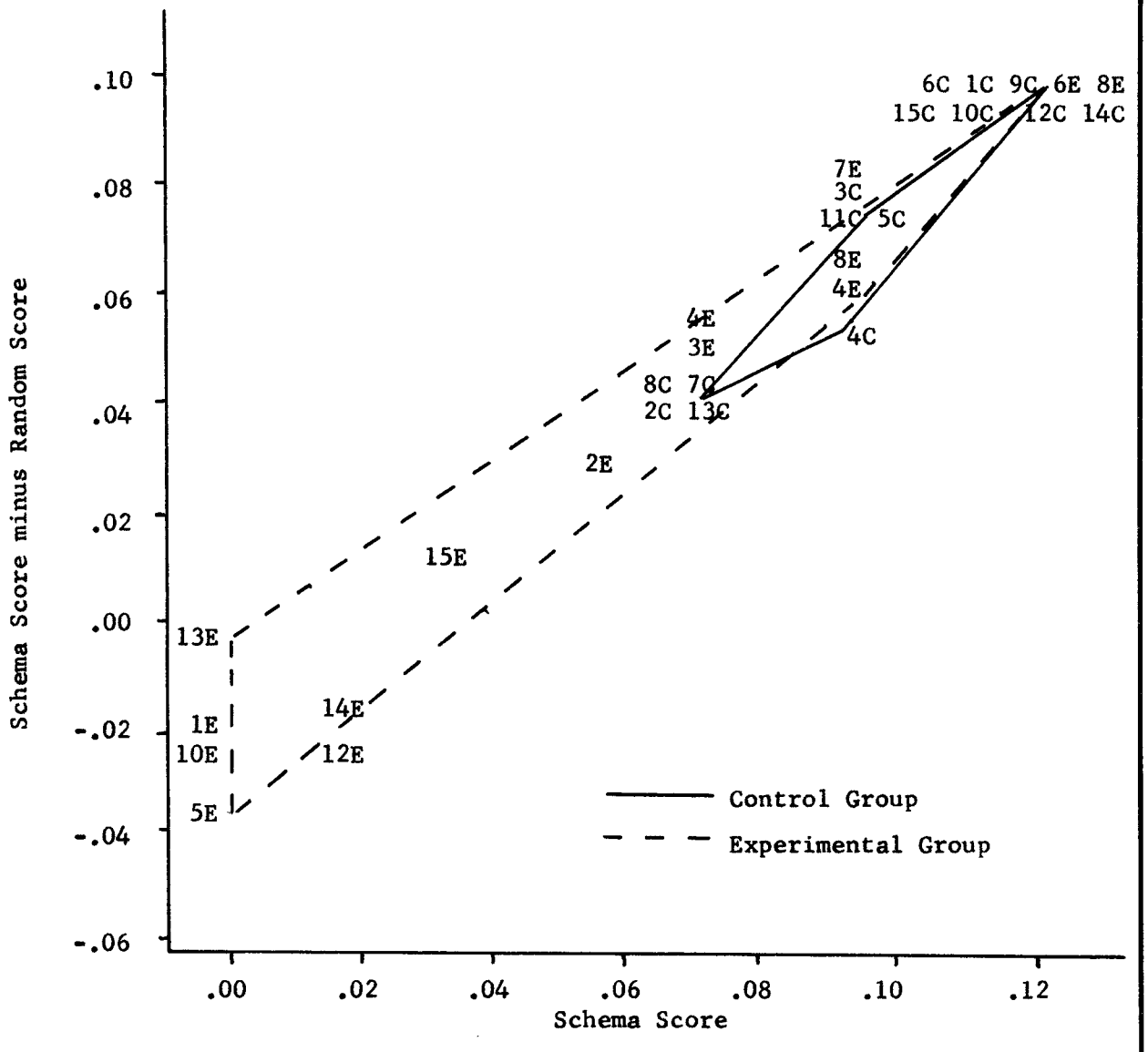


Fig. 13 Convex Set of Problem 35 A, for the Experimental and Control Groups

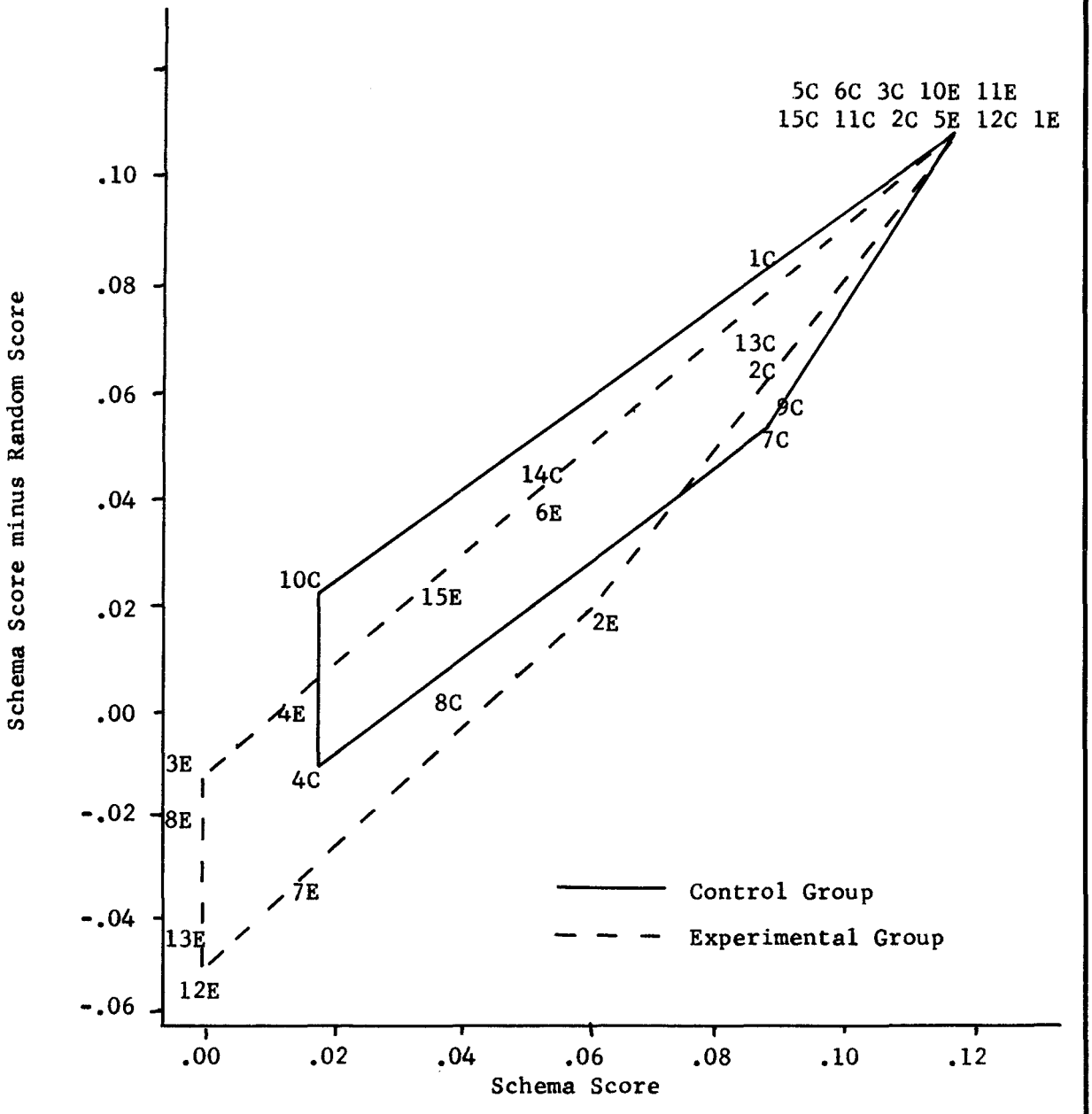


Fig. 14 Convex Set of Problem 35 B, for the Experimental and Control Groups

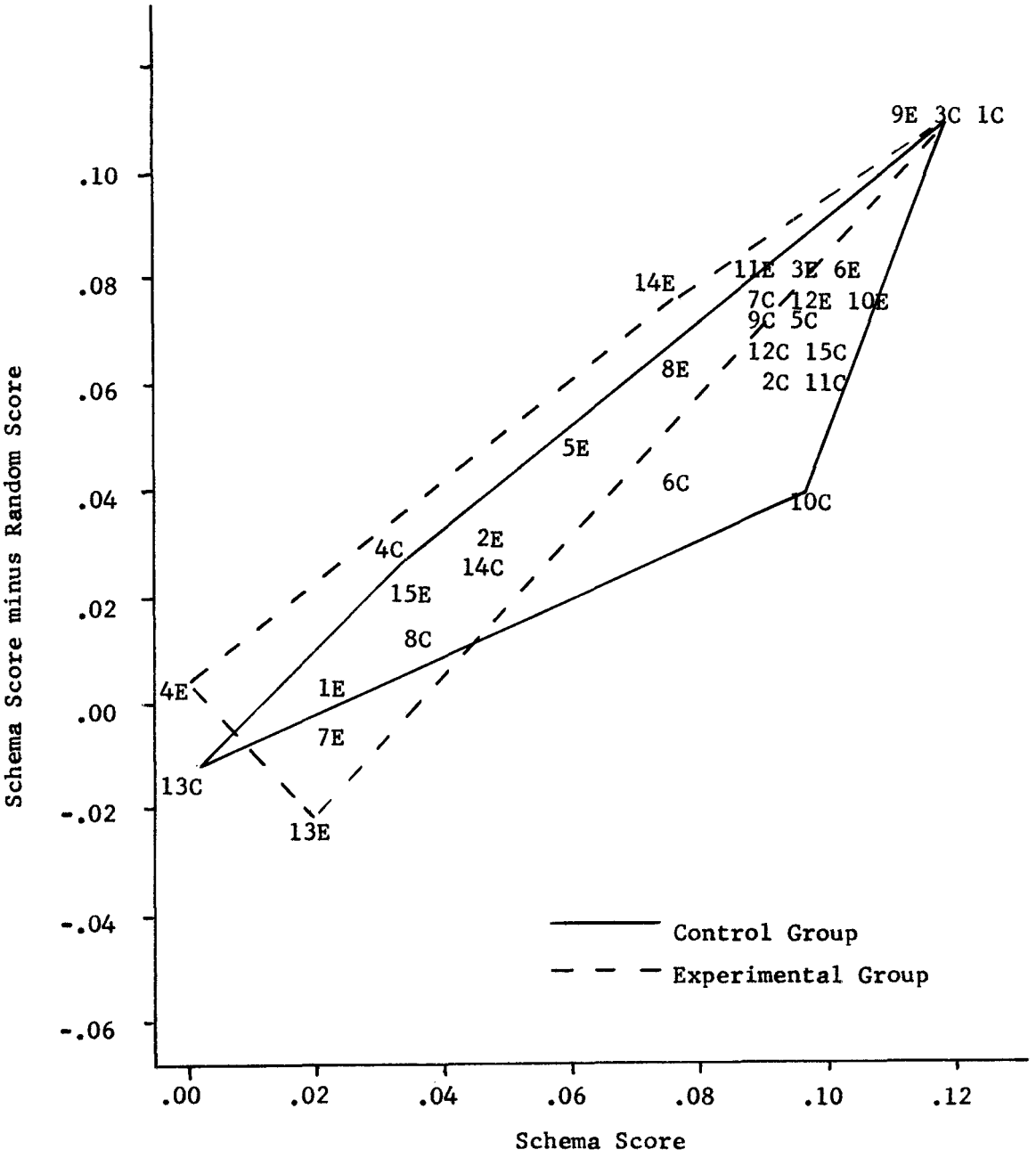


Fig. 15 Convex Set of Problem 35 D, for the Experimental and Control Groups

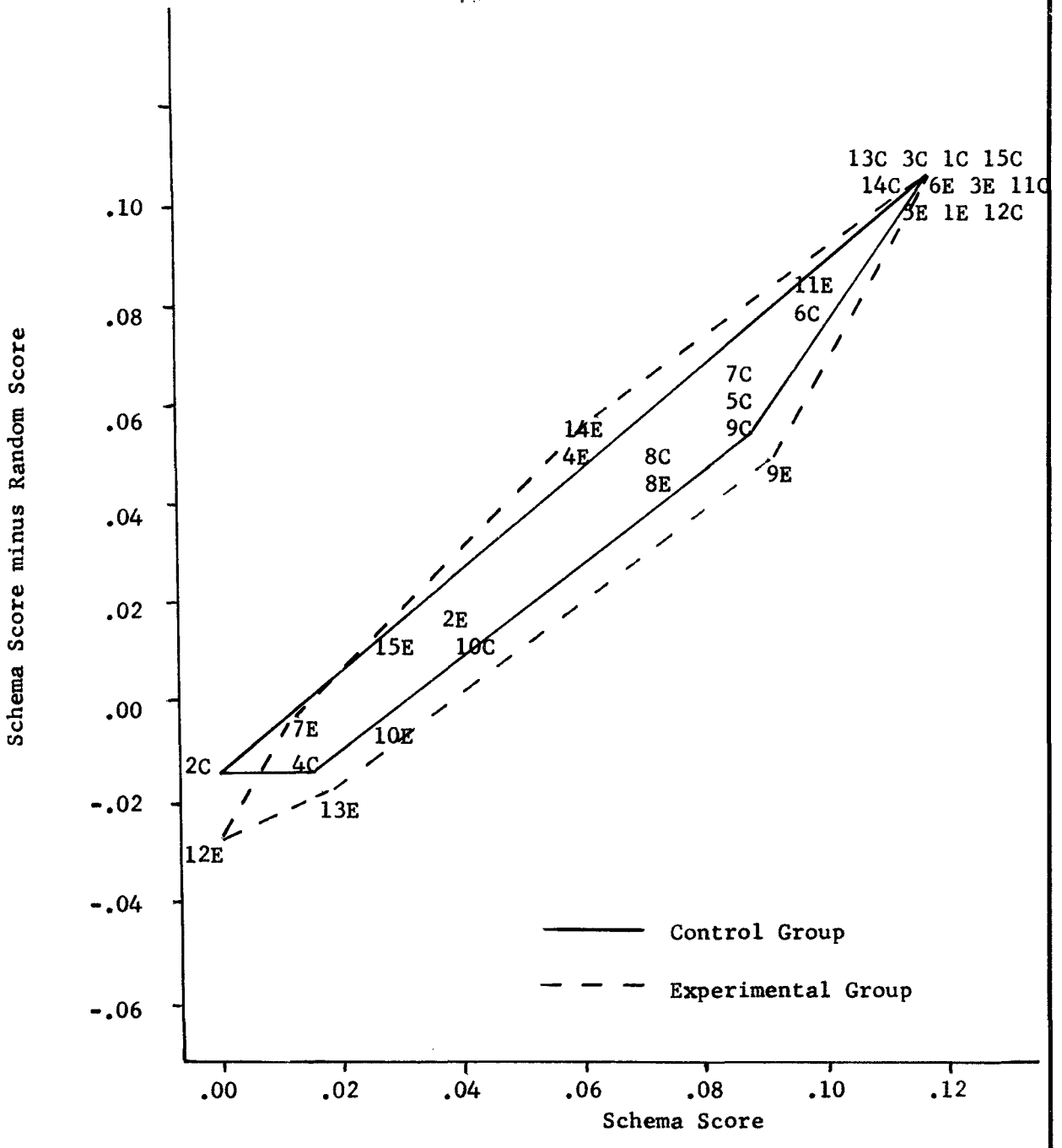


Fig. 16 **Convex Set of Problem 35 C, for the Experimental and Control Groups**

APPENDIX I

Problem 31 A

Instructions and Corresponding Questions and Answers

At Spencer High School the annual fall dance is about to be held. A dance committee has been selected to make the necessary arrangements. Both boys and girls are on the committee. A part of the committee is to take care of the refreshments for the evening and another part will look after the sale of the tickets for the dance. The list of the girls on the dance committee involved in the sale of tickets has been lost. From the other information available, which you will find in the questions, your object will be to discover the number of girls involved in the sale of tickets.

Questions	Answers
1. Is Spencer High School the only coeducational school in the city?	1. No.
2. How many boys attend Spencer High?	2. 240 boys attend Spencer High.
3. How many boys are on the dance committe?	3. 10
4. Are there more girls than boys at this school?	4. Yes.

5. How many students on the dance committee are assigned to supplying the refreshments?	5. 14.
6. What is the total number of students on the fall dance committe?	6. 25.
7. How much time would the committee as a whole spend in preparation for the dance?	7. 275 hours.
8. How much time would the average committee member contribute?	8. 11 hours.
9. How many boys on the committee are involved in the sale of tickets?	9. 6 boys.
10. How many girls are on the refreshment part of the dance committee?	10. 10 girls.

Solution: 5 girls.

APPENDIX II

Problem 31 B

Instructions and Corresponding Questions and Answers

We have a certain number of objects, M, a part of which, for lack of a better name, will be called C's. The C's are composed of B's and G's. No B is a G and vice versa. Some of the C's also are R's and some others are T's. No R is a T and vice versa. How many G's are also T's?

Questions	Answers
1. Are there C's that are not B's and G's?	1. No
2. How many B's are C's?	2. 30.
3. How many B's are M's?	3. 120.
4. How many C's are R's?	4. 35.
5. Are there more G's than B's among the M's?	5. Yes.
6. What is the value of k times the C's?	6. 550.
7. What is the total number of C's?	7. 50.
8. How many B's that are C's are also T's?	8. 10.
9. How many G's that are C's are also R's?	9. 15.
10. What is the value of k?	10. 11.

Solution: 5 G's.

APPENDIX III

Problem 31 D

Instructions and Corresponding Questions and Answers

From R objects L have been selected. These objects are formed by A and B objects. No A can also be a B and vice versa. Some of the L objects are also M and some others N. No M can also be an N and vice versa.

How many N's are also B's?

Questions	Answers
1. How many A's are R's?	1. W.
2. What is the total number of L's?	2. E+F+H+I = X+Y = P+Q = L
3. How many L's are M's?	3. E+F = X
4. How many A's are L's?	4. E+H = P
5. Are there more B's than A's among the R's?	5. Yes.
6. Are there L's that are not B's and A's?	6. No.
7. How many B's that are L are also M?	7. F
8. How many A's that are L are also N?	8. H
9. What is the value of k?	9. T
10. What is the value of k times the L's?	10. Z

Solution: I

APPENDIX IV

Problem 31 C

Instructions and Corresponding Questions and Answers

Assume that X, A, D, P, and S, represent properties among F objects. Not-X, not-A, and so on represent lack of these properties. Out of F objects some of them are X's and some not-X's. The not-X's are formed by not-A's and not-D's. A not-A can not be a not-D and vice versa.

Some of the not-X's also are not-P's and some others are not-S's. A not-P can not be a not-S and vice versa.

How many not-D's are also not-S's?

Questions	Answers
1. Are there not-X's that are A's and D's?	1. No.
2. How many not-A's are F's?	2. 100.
3. Are there more not-D's than not-A's among the F's?	3. Yes.
4. How many not-A's are not-X's?	4. 14.
5. What is the total number of not-X's?	5. 40.
6. How many not-X's are not-P's?	6. 24.
7. What is the value of 1 times the not-X's?	7. 440.
8. What is the value of 1?	8. 11.
9. How many not-D's that are not-X's are also not-P's?	9. 20.
10. How many not-A's that are not-X's are also not-S's?	10. 10.

Solution: 6 not-D's.

APPENDIX V

Problem 35 A

Instructions and Corresponding Questions and Answers

A college choral group is composed of freshmen, sophomores and juniors. The chorus has three voices or parts which are high, medium, and low. The questions and answers below give vital information concerning the group. From these facts you are to find the number of juniors singing the middle or medium part.

Questions	Answers
1. How many Juniors are in this college?	1. 1567
2. How many Freshmen are in the chorus?	2. 23
3. How many Sophomores are in the middle voice?	3. 10
4. How many chorus members are there?	4. 76
5. How many girls are in the chorus?	5. 45
6. How many sophomores are in the chorus?	6. 28
7. How many juniors sing the high voice?	7. 7
8. How many freshmen are in this college?	8. 1848
9. How many freshmen sing the high voice?	9. 8
10. How many low voice members are there?	10. 28
11. How many sophomores sing the high part?	11. 9

12. How many pianos does the chorus have?	12. 3
13. How many freshmen sing the low voice?	13. 9
14. How many chorus members sing the high voice?	14. 24
15. How many juniors are in the low voice section?	15. 10
16. How many freshmen sing the middle voice?	16. 6
17. How many sophomores sing the low part?	17. 9

Solution: 8 juniors

APPENDIX VI

Problem 35 B

Instructions and Corresponding Questions and Answers

T objects are composed of M, N, and P types. Each of these latter three types may or may not also be Q's, R's and S's. From the questions and answers you can discover the various relationships of these objects. Make use of this available information to determine how many T objects are N's and also S's.

Questions	Answers
1. How many S's are A's?	1. 350
2. How many Q's are there among the T's?	2. 19
3. How many G's are there among the T's?	3. 43
4. How many R's are also N's?	4. 8
5. What is the total number of T objects?	5. 63
6. How many P's are there among the T's?	6. 21
7. How many R's are there among the T's?	7. 24
8. How many Q's are also M's?	8. 5
9. How many R's are also M's?	9. 10
10. How many S's are also M's?	10. 2

11. How many Q's are A's?	11. 400
12. How many R's are also P's?	12. 6
13. How many Q's are also N's?	13. 3
14. How many S's are also P's?	14. 4
15. How many M's are among the T's?	15. 17
16. How many Q's are also P's?	16. 11
17. How many H's among the A's?	17. 2

Solution: 14 T objects are N's and also S's

APPENDIX VII

Problem 35 D

Instructions and Corresponding Questions and Answers

A group of L objects taken from a larger group of M objects is composed of objects of the kind A, B, and C. If an object is an A, it can not be a B or C. If an object is a B, it can not be an A and/or C. If an object is a C, it can not be a B and/or A. That is, A, B, and C, are mutually exclusive. The same L objects also have properties D, E, and F which are mutually exclusive.

From the questions below you are to find how many of the B's are also F's.

Questions	Answers
1. How many F's are in J?	1. U
2. How many L's are D's?	2. M + N + O = X
3. What is the number of L's?	3. M+N+O+R+Q+P+S+T+V = X+Y+Z = G+H+I = L
4. How many E's are B's?	4. Q
5. How many L's are K's?	5. W
6. How many D's are in M?	6. X - M + O
7. How many L's are E's?	7. R + Q + P = Y

8. How many F's are A's?	8. S
9. How many E's are A's?	9. R
10. How many D's are A's?	10. M
11. How many L's are C's?	11. O + P + V = I
12. How many F's are C's?	12. V
13. How many L's are A's?	13. M + R + S = G
14. How many D's are C's?	14. O
15. How many U's are M's?	15. U - J
16. How many D's are B's?	16. N
17. How many E's are C's?	17. P

Solution: T of the B's are also F's

APPENDIX VIII

Problem 35 C

Instructions and Corresponding Questions and Answers

A class of objects is distinguished by calling some B's and some other not-B's depending on the possession or non-possession of a certain property. The not-B's are further distinguished into not-X's, not-Y's, and not-Z's. Each of these latter may also be a not-D, not-E, or not-F. From the accompanying questions and answers you can discover the relationships that exist between these objects. Make use of the information available to determine how many not-B objects are not-Y's and also not-F's.

Questions	Answers
1. How many not-D's are not-A's?	1. 150
2. How many not-F's are also not-X's?	2. 7
3. How many not-E's are there among the not-B's?	3. 15
4. How many not-G's are there among the not-B's?	4. 30
5. What is the total number of not-B's?	5. 45
6. How many not-E's are also not-Y's?	6. 6

7. How many not-D's are there among the not-B's?	7. 6
8. How many not-F's are not A's?	8. 100
9. How many not-E's are also not-Z's?	9. 5
10. How many not-D's are also not-Y's?	10. 2
11. How many not-F's are also not Z's?	11. 9
12. How many not-X's are there among the not-B's?	12. 12
13. How many not-D's are also not-Z's?	13. 3
14. How many not-H's are there among the not-A's?	14. 2 log cos 30
15. How many not-E's are also not-X's?	15. 4
16. How many not-Z's are there among the not-B's?	16. 17
17. How many not-D's are also not-X's?	17. 1

Solution: 8 not-B objects are not-Y's and also not-F's.

APPENDIX IX

Example of a 31 P Problem

In the hospital there are a group of patients who are very intelligent. Some of these patients have very serious problems in interpersonal relationships. These problems consist of not getting along with their mothers or not getting along with the people for whom they work. Some of these patients also have difficulty in becoming independent financially and emotionally, while the rest have difficulty in feeling accepted. From the information available, which you will find in the questions, your object will be to discover the number of patients who have serious problems in interpersonal relationships with their mothers and in becoming independent financially and emotionally.

Questions	Answers
1. Is this hospital the only hospital in the city?	No
2. How many patients are there in this hospital?	240
3. How many patients with serious problems in interpersonal relationships cannot get along with the people for whom they work?	10

4. Are there more patients with serious problems in interpersonal relationships that cannot get along with their mothers as compared to those that cannot get along with the people for whom they work?	Yes
5. How many patients who have serious problems in interpersonal relationships have difficulty in feeling accepted?	11
6. What is the total number of patients who have very serious problems in interpersonal relationships?	50
7. How much time do the patients usually stay at the hospital?	About 3 months
8. How much time does it take most patients to get a job after discharge?	1 or 2 years
9. How many patients with very serious problems in interpersonal relationships do not get along with the people for whom they work and also have difficulty in becoming independent financially and emotionally?	10
10. How many patients who have very serious problems in interpersonal relationships do not get along with their mothers and also have difficulty in feeling accepted?	5

APPENDIX X

Subject's Check List of Personal Difficulties

Most people have difficulties in some area or another. For example, some have difficulty in getting along with other people, others have difficulties in school. I would like you to read all the following statements and then place a (1) in front of the area which seems to give you the most difficulty and a (2) in front of your area of second difficulty.

1. Feeling that what I do and say is wrong
2. getting along with my mother
3. controlling my temper
4. getting along with people of my own sex
5. getting along with people of the opposite sex
6. accepting my looks
7. getting along with my wife
8. accepting myself as I am
9. getting along with my father
10. getting along with teachers
11. my school work
12. sex

13. getting hurt very easily
14. getting along with my sister
15. getting along with my brother
16. feeling unaccepted by others
17. religion
18. getting along with my husband
19. getting along with people for whom I work
20. getting myself in trouble with the law

Name:

Floor:

Date:

APPENDIX XI

Psychiatrist's Check List of Subject's Difficulties

Following is a list of areas in which most people have difficulties. I would like you to place a (1) in front of the area which seems to give your patient _____ the most difficulties and a (2) in front of the area of his (her) area of second difficulty.

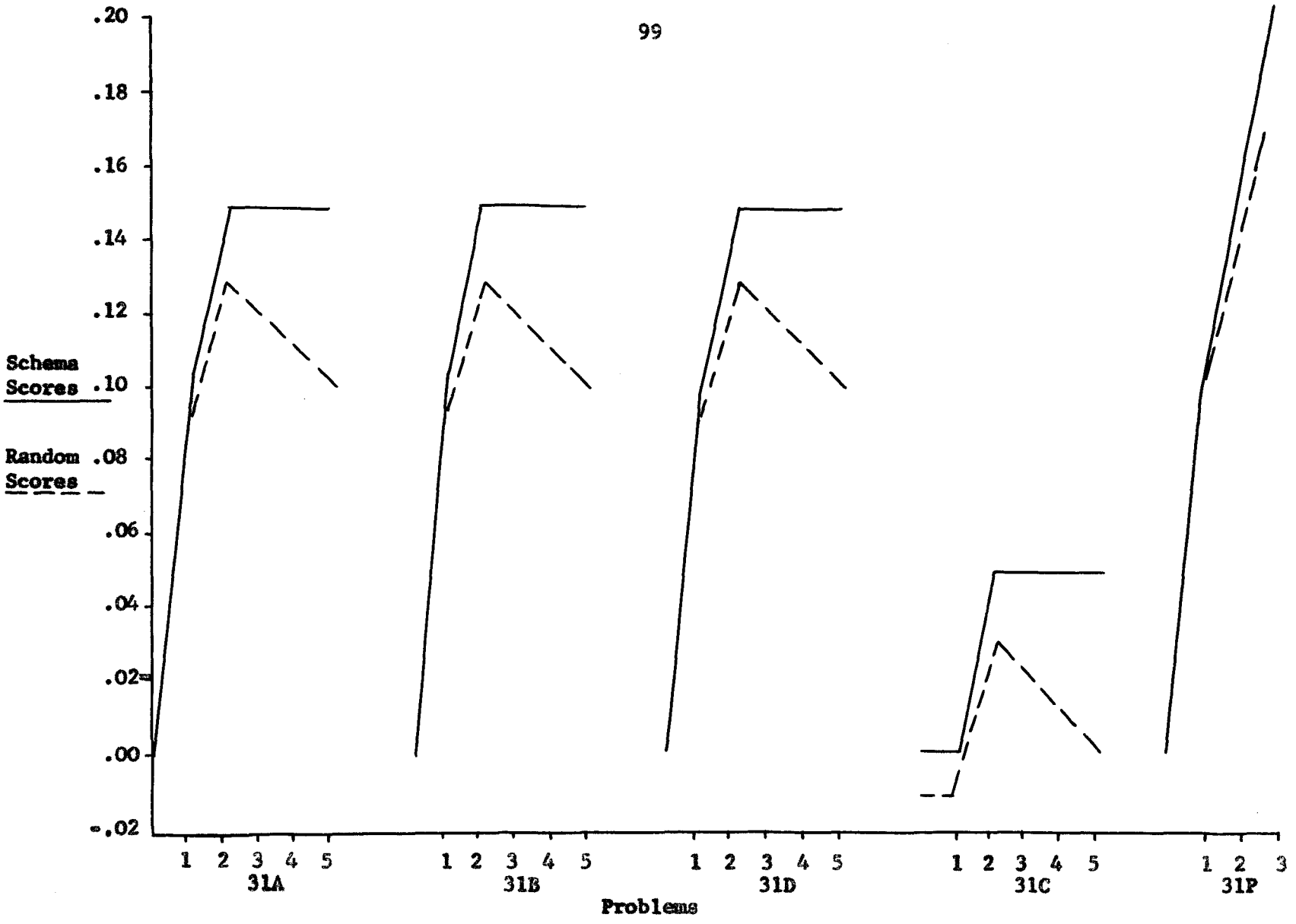
1. Feeling that what he (she) does and says is wrong
2. getting along with his (her) mother
3. controlling his (her) temper
4. getting along with people of his (her) own sex
5. getting along with people of the opposite sex
6. accepting his (her) looks
7. getting along with his wife
8. accepting himself (herself) as he (she) is
9. getting along with his (her) father
10. getting along with teachers
11. school work
12. sex
13. getting hurt very easily

14. getting along with his (her) sister
15. getting along with his (her) brother
16. feeling unaccepted by others
17. religion
18. getting along with her husband
19. getting along with people for whom he (she) work
20. getting himself (herself) in trouble with the law

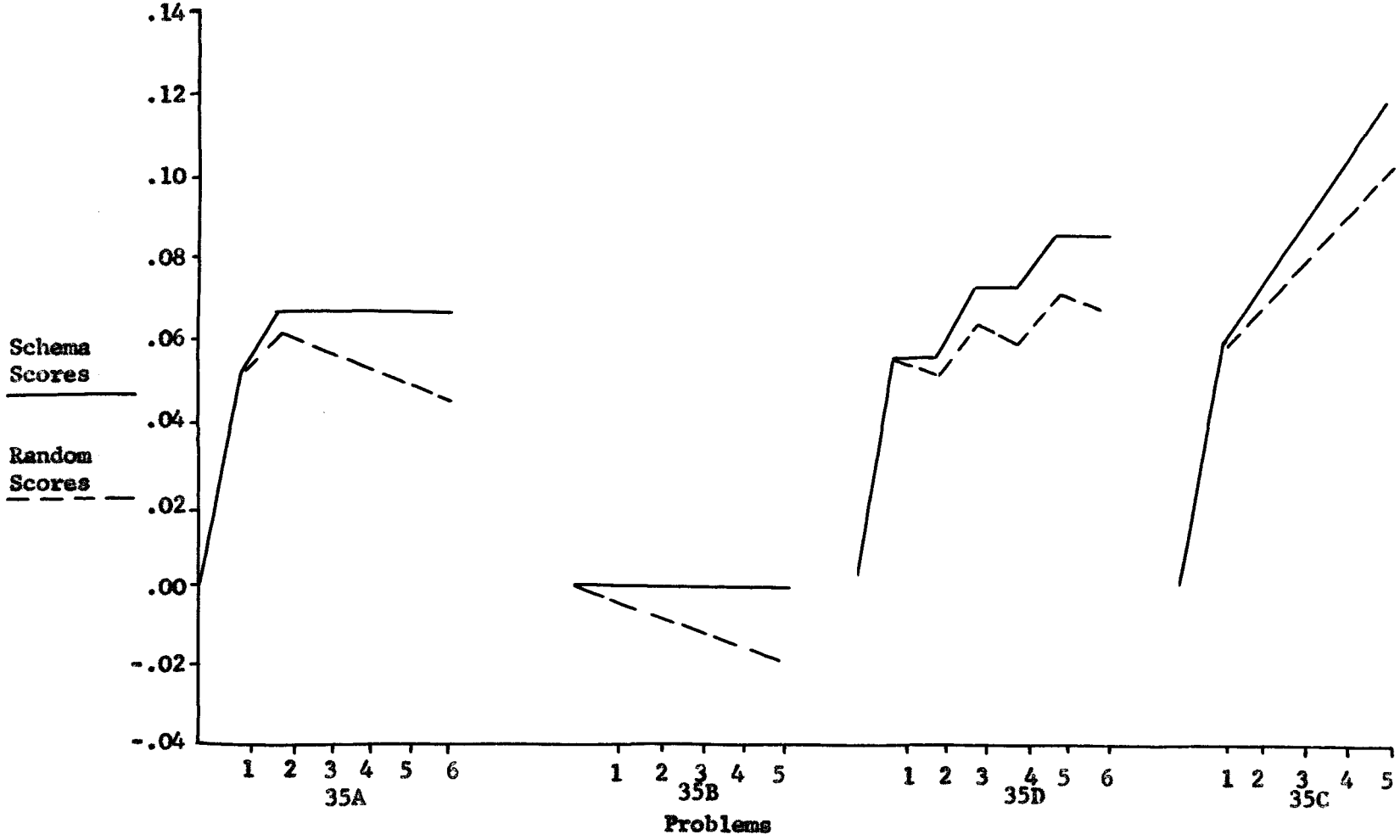
Name:

Floor:

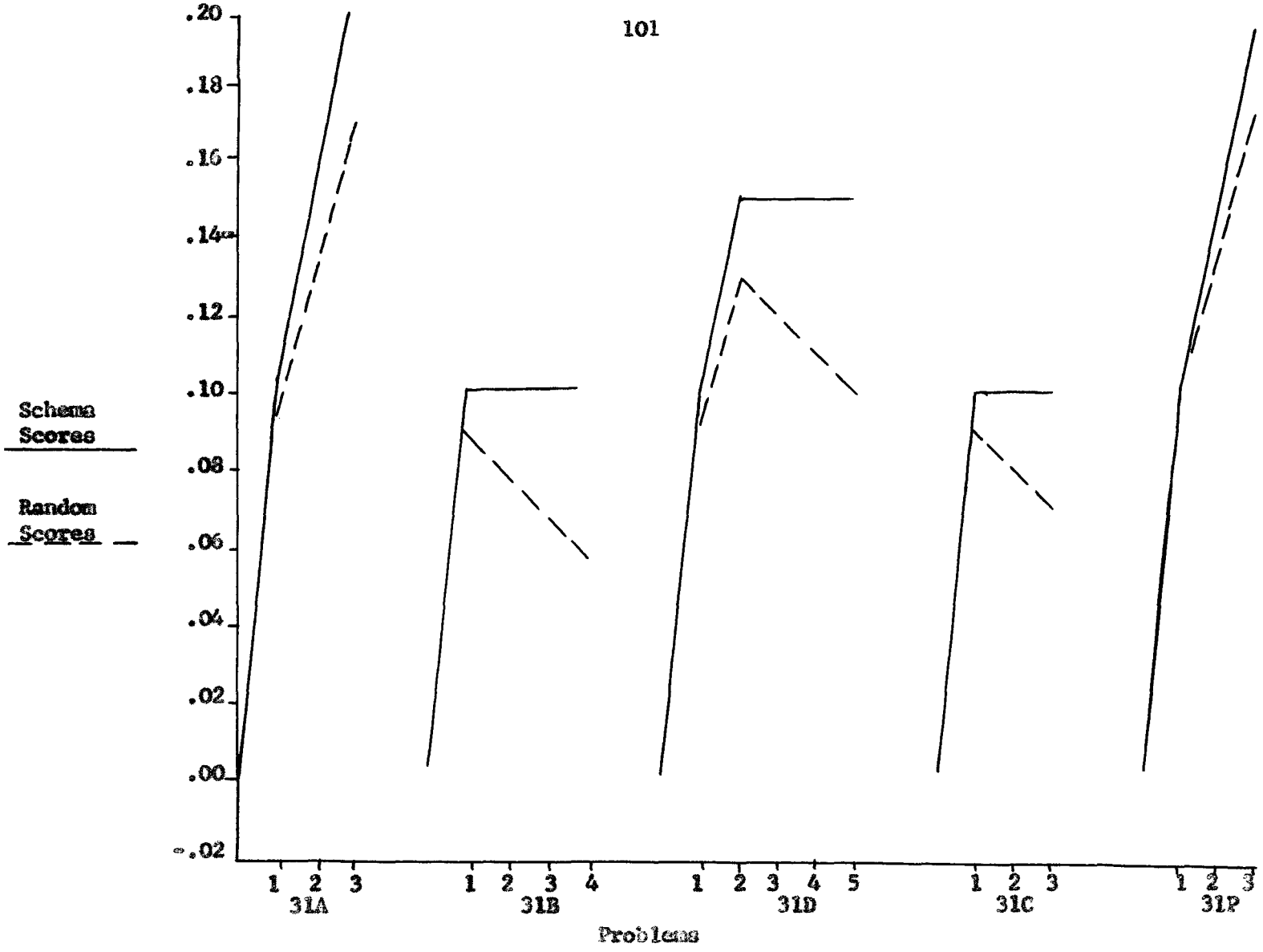
Date:



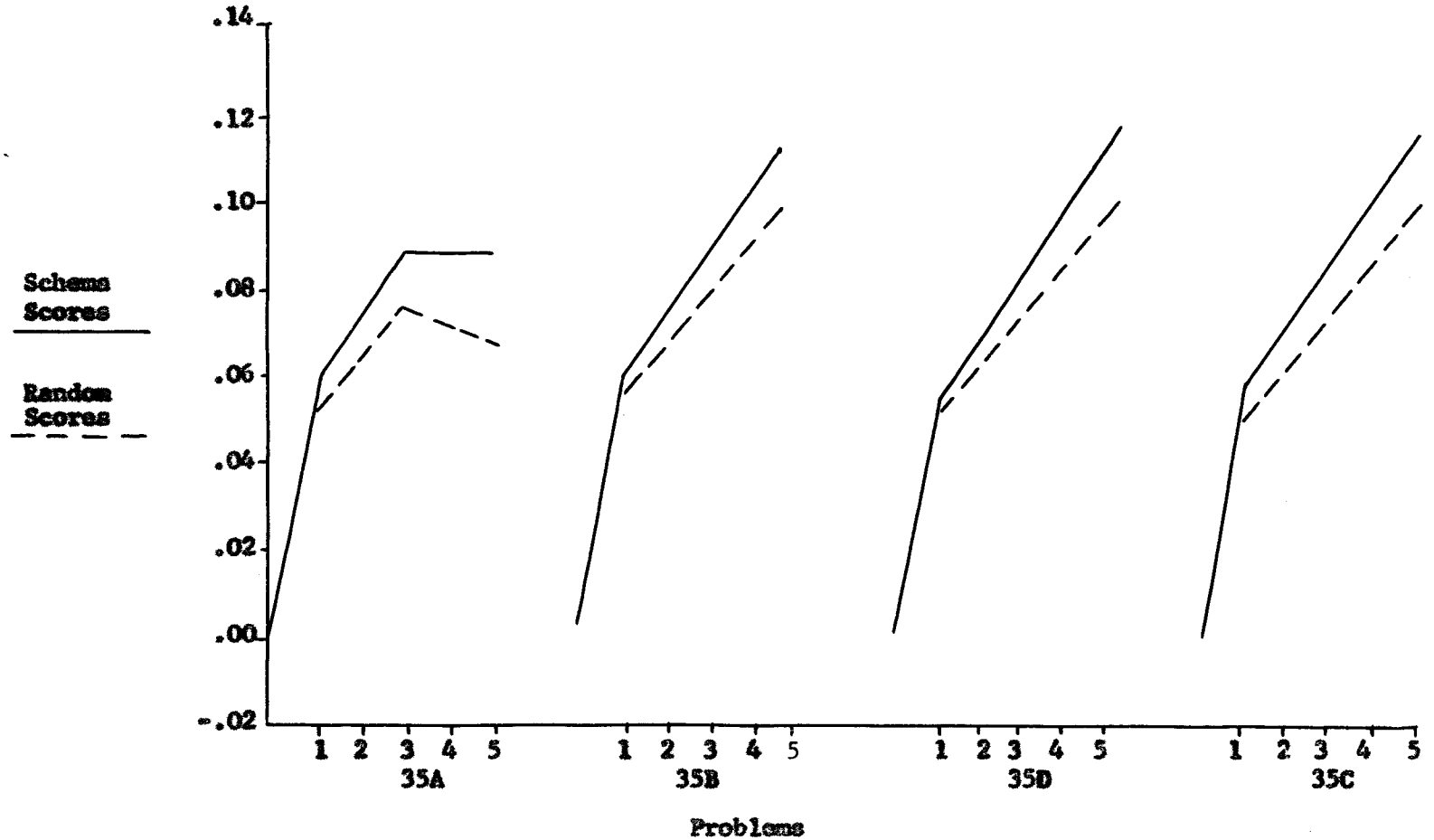
APPENDIX XII. Performance Curves of Experimental Subject 3.



APPENDIX XII. Performance Curves of Experimental Subject 3.



APPENDIX XII. Performance Curves of Control Subject 3.



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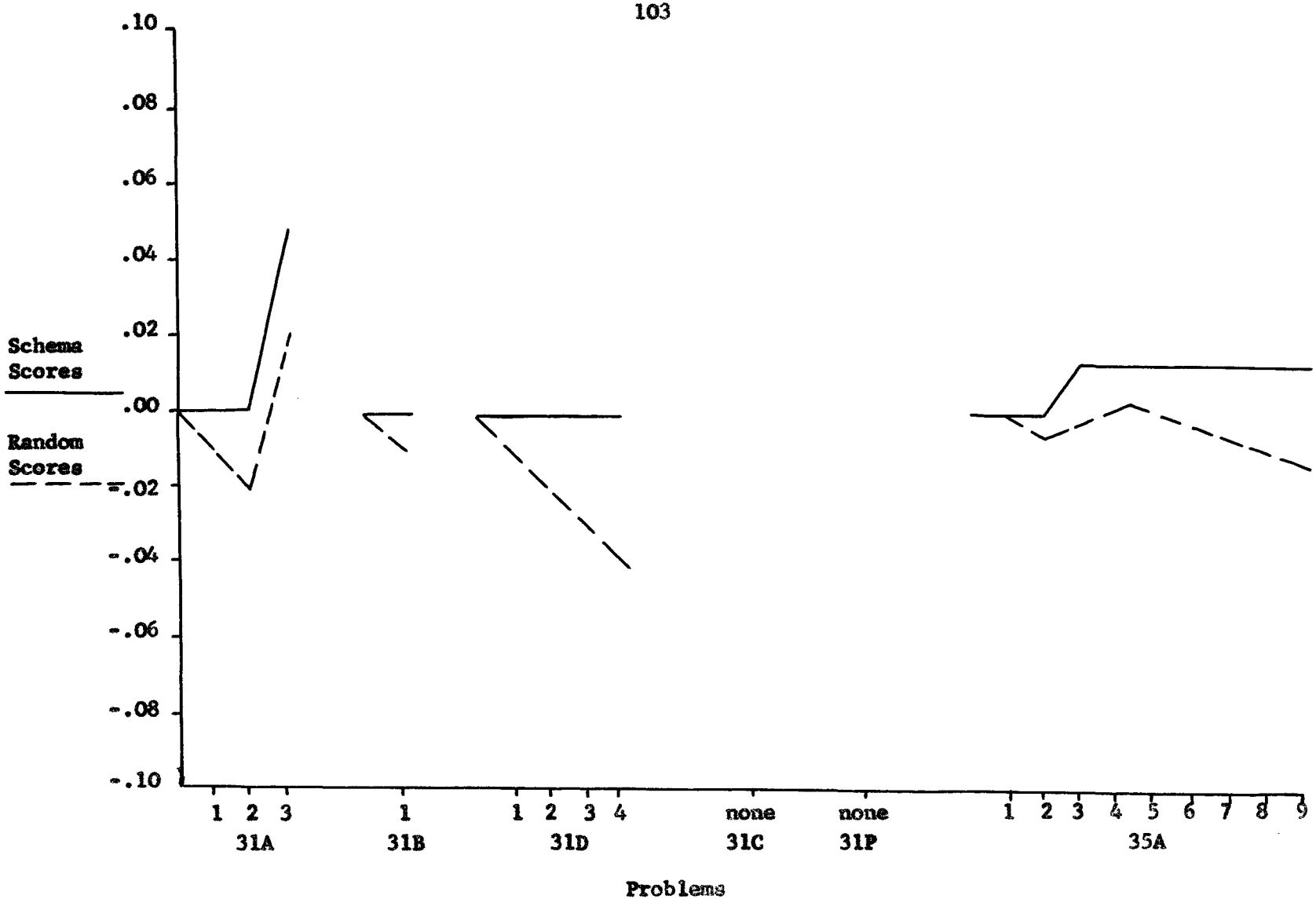
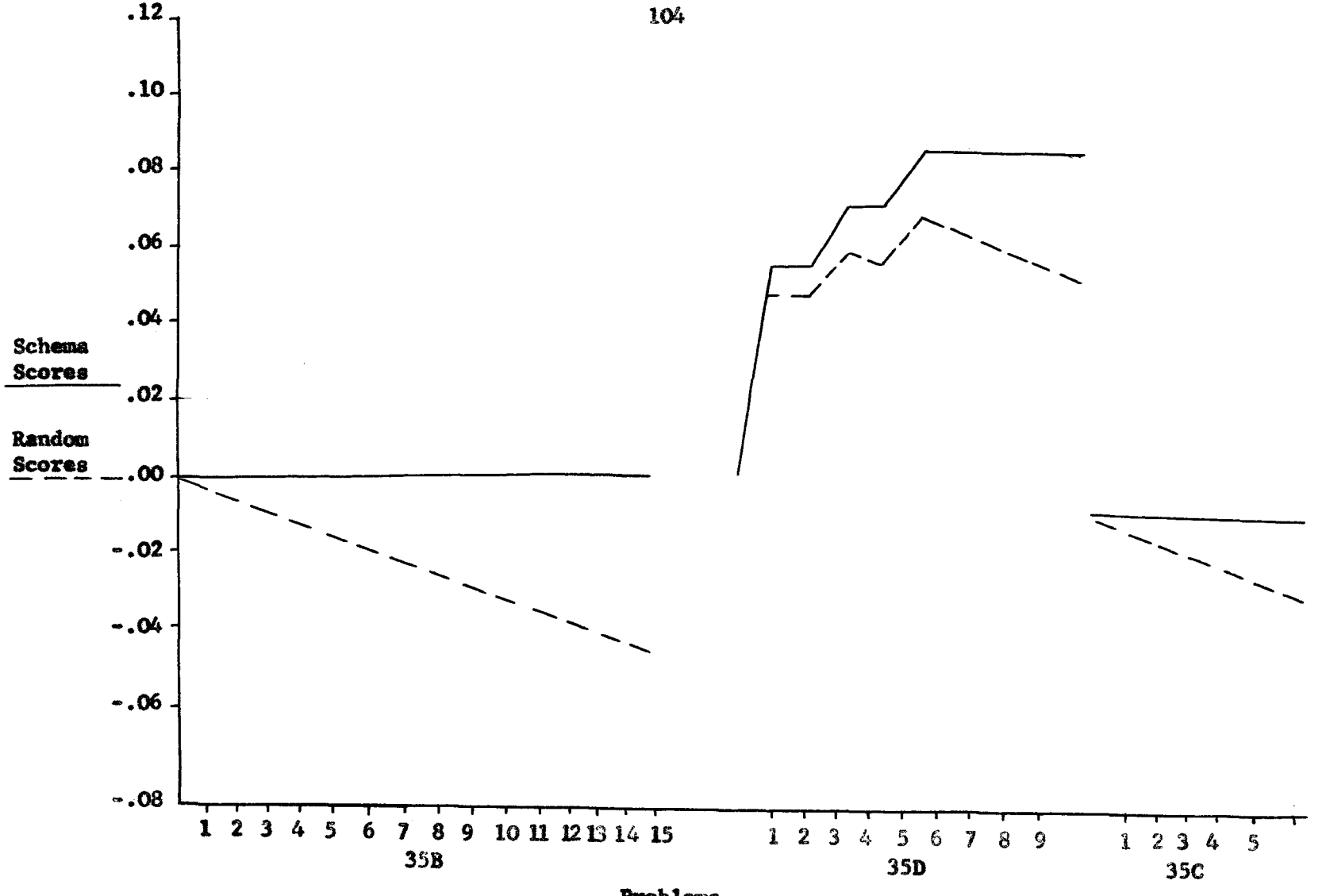
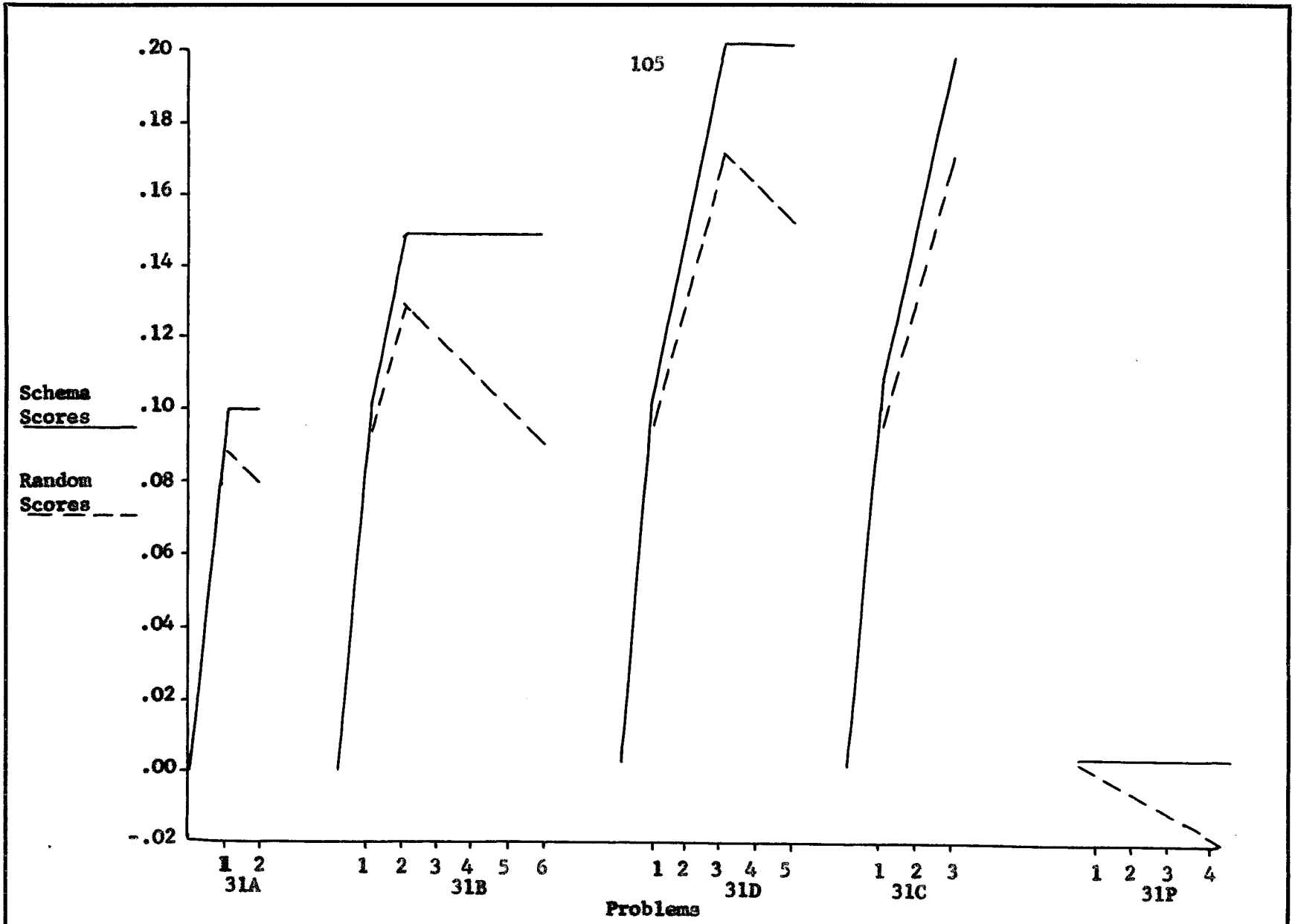


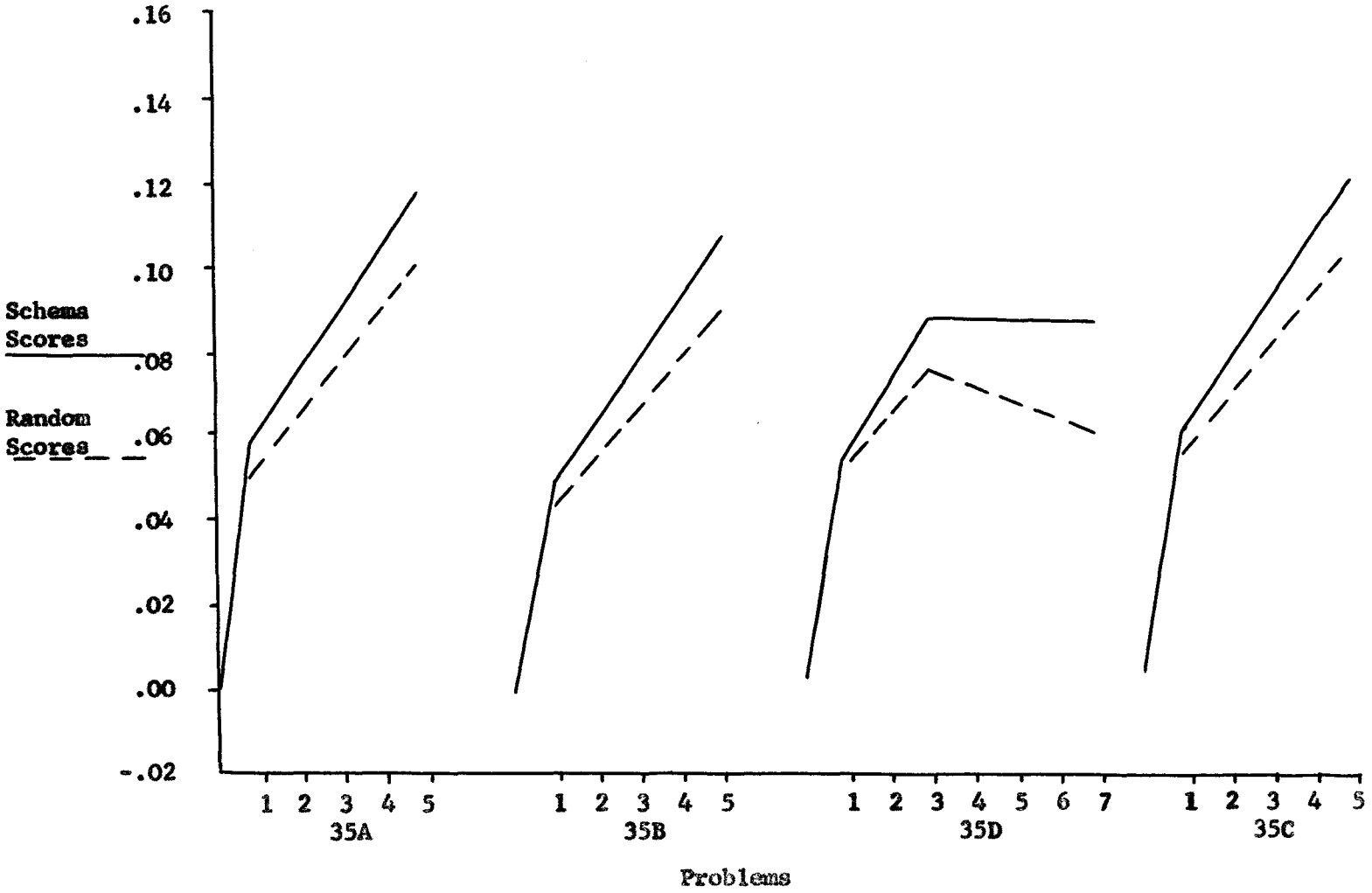
APPENDIX XII. Performance Curves of Experimental Subject 12.



APPENDIX XII. Performance Curves of Experimental Subject 12.



APPENDIX XII. Performance Curves of Control Subject 12.



APPENDIX XII. Performance Curves of Control Subject 12.

APPENDIX XIII

Mean Differences, Standard Error of the Differences, "t" Values and Levels of Significance For Equated Scores on Schemata 31 and 35, For the Experimental and Control Groups

Mean Difference	Standard Error of the Difference	"t" Value	Significance at the .05 l of c
Experimental Group			
.3917	.2160	1.81	none
Control Group			
.4000	.2337	1.71	none

APPENDIX XIV

Mean Differences, Standard Error of the Differences, "t" Values and Levels of Significance for Problems 31A and 31P for the Experimental and for the Control Groups

Groups	Mean Differences	Standard Error of the Differences	"t" values	Significance at .05 l of c
Experimental	.0056	.0073	.7671	none
Control	.0033	.0058	.5172	none

APPENDIX XV

Mean Differences, Standard Error of the Differences, "t" Values and Levels of Significance for Each Problem Based on Pulling Out Scores Between Experimental and Control Groups

Problem	Mean Difference*	Standard Error of the Difference	"t" Value	Significance
31 A	.0135	.0037	3.65	.01
31 B	.0051	.0052	.98	none at .05
31 D	.0158	.0037	4.27	.01
31 C	.0221	.0063	3.51	.01
35 A	.0027	.0027	1.00	none at .05
35 B	.0054	.0018	3.00	.01
35 D	.0034	.0026	1.31	none at .05
35 C	.0028	.0024	1.17	none at .05

*The difference was computed using control group minus experimental group.

APPENDIX XVI

Mean Differences, Standard Error of the Differences, "t" Values and Levels of Significance for the Experimental and Control Group on Each Schemata and on Each Content

Schemata	Mean Difference	Standard Error of the Difference	"t" Value	Significance
31	.0602	.0124	4.85	.01 1 of c
35	.0102	.0068	1.50	none at .05 1 of c
Content				
A	.0162	.0037	4.38	.01 1 of c
B	.0094	.0052	1.81	none at .05 1 of c
D	.0153	.0058	2.64	none at .05 1 of c
C	.0307	.0082	3.74	.01 1 of c

APPENDIX XVII

Mean Differences, Standard Error of the Difference, "t" Values and Levels of Significance for the Experimental and Control Group on the Number of Relevant Questions and the Number of Irrelevant Questions Asked on Each Problem

Problem	Mean Differences	Standard Error of the Difference	"t" Values	Level of Significance
		Relevant Questions		
31A	.2000	.2959	.6759	none
31B	- .2667	.5975	- .4464	none
31D	- .6000	.3492	- 1.7180	none
31C	- 1.0667	.4080	- 2.6145	.05 1 of c
35A	.4000	.4451	.8987	none
35B	.0000	.0000	.0000	none
35D	- 1.2667	.5021	- 2.5228	.05 1 of c
35C	.6667	.4848	- 1.3752	none
		Irrelevant Questions		
31A	.3333	.2323	1.4348	none
31B	.4667	.5423	.8606	none
31D	.4667	.5244	.8900	none
31C	.3333	.2109	1.5804	none
35A	.1333	.5153	- .2587	none
35B	1.5330	.6240	2.4567	.05 1 of c
35D	.1333	.5764	- .2313	none
35C	.3333	.5493	.6068	none

APPENDIX XVIII

Fishers Exact Probability Test on Number of Correct Answers Between Experimental and Control Groups

Problem	Figure				Degree of Freedom	Significance at .05 level
31 A		-	+		1	significant
	C	1	14	15		
	E	7	8	15		
		8	22	30		
31 B		-	+		1	not significant
	C	6	9	15		
	E	10	5	15		
		16	14	30		
31 D		-	+		1	not significant
	C	5	10	15		
	E	9	6	15		
		14	16	30		
31 C		-	+		1	not significant
	C	3	12	15		
	E	8	7	15		
		11	19	30		

Continuation APPENDIX XVIII

Problem	Figure				Degree of Freedom	Significance at .05 level
35 A		-	+		1	not significant
	C	3	12	15		
	E	5	10	15		
		8	22	30		
35 B		-	+		1	not significant
	C	4	11	15		
	E	6	9	15		
		10	20	30		
35 D		-	+		1	not significant
	C	4	11	15		
	E	9	6	15		
		13	17	30		
35 C		-	+		1	not significant
	C	3	12	15		
	E	7	8	15		
		10	20	30		

APPENDIX XIX

TABLE OF TACTICS USED BY EACH EXPERIMENTAL SUBJECT IN GROUP X AND THE TACTICS USED BY EACH MATCHED CONTROL SUBJECT

Problems	Experimental Subject 5	Control Subject 5
31A	6,5,9	6,5,9
31B	7,8,2,9	7,4,2,8,9
31D	4,7,6,2,3	2,8,7,3
31C	5,6,4,9	5,9,6,10
35A	2,16,3,4,6,7,9,10,11	4,10,14,15,7,2,6
35B	5,6,15,4,13	5,15,6,13,4
35D	2,7,3,8,12	3,13,11,2,7,16,4
35C	5,12,16,6,10	5,16,12,7,3,10,6
31P	6,3,9,5	6,9
	Experimental Subject 6	**Control Subject 6**
31A	6,3,9,5	6,5,9
31B	4,7,8	7,1,4,9,8
31D	2,8,3,4,7	2,4,3,6,7,8,5,1
31C	9,4,6,5	5,4,6,9
35A	4,10,14,16,3	4,2,6,15,7
35B	15,6,5,4,13	5,15,6,4,13
35D	3,8,12,4,16,6,7,10	3,2,13,11,7,10,9,8,14,12,17
35C	5,12,16,6,10	5,3,7,12,16
31P	4,6,3,10	6,5,4

APPENDIX XIX - Continued

Problem	Experimental Subject 3	Control Subject 3
31A	6,3,9,10,5	6,3,10
31B	7,4,9,8,2	7,1,2,4
31D	2,4,8,7,3	2,4,3,7,8
31C	4,6,9,10,5	5,9,4
35A	4,2,16,3,10,14	4,2,6,3,16
35B	4,13,5,8,15	5,15,6,13,4
35D	3,10,13,11,16,4	3,11,13,4,16
35C	5,12,16,6,10	5,12,16,6,10
31P	6,3,10	6,5,9
	Experimental Subject 15	**Control Subject 15**
31A	6,3,10	6,3,10
31B	1,9,8,4,2,7	9
31D	3,7,8,2	2,3,8
31C	6,9,10,5	5,6,10
35A	4,2,6,7,15	4,2,6,15,7
35B	5,15,6,13,4	5,6,15,13,4
35D	3,13,11,4,16	3,13,11,2,7
35C	5,12,16,10,6	5,12,16,6,10
31P	6,3,10	6,5,9

APPENDIX XX

TABLE OF TACTICS USED BY EACH EXPERIMENTAL SUBJECT IN GROUP Y AND THE TACTICS USED BY EACH MATCHED CONTROL SUBJECT

Problems	Experimental Subject 1	Control Subject 1
31A	3,6	10,6,5,9,3
31B	7,4,8,9,15	8,9,1,7,4,2
31D	3,8,5,2,4,7	2,7,8,3,4
31C	5,10	5,6,10
35A	3,15,7,4,10,16,14	4,2,6,15,7
35B	5,6,15,13,4	5,2,7
35D	2,7,4,16,11,13	3,13,11,16,4
35C	5,12,16,10,6	5,12,16,10,6
31P	3,6,9,5	6,3,10
	Experimental Subject 11	**Control Subject 11**
31A	3,9,6,5,10	6,5,3,9
31B	5,3,8	7,8,4,9,1,2
31D	2,8	2,6,3,7,8
31C	no card	5,4,9
35A	4,2,6,16,3,7,15	4,6,2,16,3
35B	5,6,15,4,13	5,6,15,4,13
35D	3,11,13	3,13,11,2,7,8,12
35C	5,3,7,6,10	5,16,12,10,6
31P	6,3,10	2,5,6,3

APPENDIX XX - Continued

Problems	Experimental Subject 2	Control Subject 2
31A	6,10,3	6,3,10
31B	4,5,7,8	9
31D	8,3,4,1,2,6,7,5	2,8,10,9,1,4,5,7,6,3
31C	5,4,6,9	5,4,6
35A	4,15,7,10,14,16,3	4,14,9,7,11,16,3,13,15,17
35B	5,14,13,12,6,7,8,9,10,4,2,15,16	5,15,6,2,7,10,14
35D	2,7,3,8,12	3,2,7,10,9,8,16,4,14,17,12
35C	3,5,7,11,2	12,5,14,17,15,10,6,11
31P	6,5,9	6,3,5,10
	Experimental Subject 8	**Control Subject 8**
31A	2,3,4,5,10,9,6,1	6,3,9,5,10
31B	7,1,5,10,6,4,3,8,9	7,2
31D	8,4,7,3,2,1,6	2,4,8,7,3
31C	5,7,4,2,6,8,10,9	5,4,6,10,9
35A	4,6,2,7,15	4,7,9,11,3,16,13,15,17
35B	2,3,5,6,7,15	2,7,15,6,13,4,14,10,5
35D	3,2,4,13,11,16	8,9,10,16,4,12,14,17
35C	5,2,3,6,7,9,10,12,16	5,16,7,3,12,2,11,6,10
31P	6,10,9,5	6,3,10
	Experimental Subject 10	**Control Subject 10**
31A	9,6,10,3,5	6,3,5,9
31B	7,2,8,5,4	1,7,8,10,5,6,2,4,3,9
31D	2,7,1,6,4,9,10,5	1,2,3,6,7,8,9,10,4,5
31C	3,2,10	5,1,4,6,9
35A	1,7,15,4,6,2	4,2,6,15,7
35B	5,15,6,13,4	5,6,15,2,7,10,14
35D	3,13,11,8,12,14,17,10,9,16	3,2,13,11,12,8,14,10,4,2,7,14,9,17,16
35C	6,10,5,11,2,7,3,12,16	5,17,10,13,15,6,9,2,11
31P	9,5	3,5,9,10,6

Note: Refer to footnote in Appendix XIII.

APPENDIX XXI

TABLE OF TACTICS USED BY EACH EXPERIMENTAL SUBJECT IN GROUP Z AND THE TACTICS USED BY EACH MATCHED CONTROL SUBJECT

Problem	Experimental Subject 13	Control Subject 13
31A	3,6,10,5	6,3,10
31B	4,2,1,9,7	7,4,2,8,1,9
31D	2,3,4,6,7,8,1,5,9	7,2,3,8,6,4
31C	no card	5,4,9
35A	2,3,4,6,14,15,16,10	4,2,17,3,11,15,7
35B	2,4,5,6,7,8,10,12,13,14, 15,16,17	5,15,16,14,10,4,13
35D	2,3,10,4,8,14,6,11,13,16,17	10,14,3,13,11,2,7
35C	2,5,6,9,10,11,12,13,17	5,12,16,6,10
31P	3,4,9,10	6,3,10
	Experimental Subject 4	**Control Subject 4**
31A	2,4,6,9,10	3,6,10
31B	1,2,3,4,7,9	8,5,4,9
31D	2,8	2,3
31C	no card	4,9
35A	4,2,3,16,6,15	4,3,2,6,7,9,10,14,16
35B	4,13,8,9,10,2,7	4,2,5,8,9,13,16,12,14
35D	no card	7,11,13
35C	5,8,6,16	3,5,7,12,6,9,10,11
31P	7,1,5,6	9,10

APPENDIX XXI - Continued

Problem	Experimental Subject 12	Control Subject 12
31A	5,6,9	6,10
31B	10	7,2,3,4,8,9
31D	1,7,4,8	2,4,7,8,3
31C	no card	5,4,9
35A	15,13,10,7,14,11,16,3,4	4,2,6,7,15
35B	2,13,8,16,12,14,5,15,7,11, 6,10,4,9,1	5,6,15,4,13
35D	3,12,11,14,4,9,17,13,15	3,11,13,8,12,4,16
35C	7,13,10,12,15,11	5,12,16,6,10
31P	no card	10,9,2,6
	Experimental Subject 14	**Control Subject 14**
31A	6,10	6,3,10
31B	7,10	7,2,9
31D	2,7,6	2,4,7
31C	5,9	5,4,9
35A	5,10,15,7,6,2,4	4,14,10,16,3
35B	5,6,7,15	2,7,5,14,10
35D	3,13,8	2,7,3,8,12
35C	5,2	5,7,3,2,11
31P	10,9	6,5,9
	Experimental Subject 7	**Control Subject 7**
31A	9,6,5	6,3,10
31B	4,7,8,10	3,8,7,2,5
31D	3	2,3,4,7,8
31C	5,4,9	5,4,10,6,9
35A	5,4,9	4,3,6,16,2,15,7
35B	9,8,10,5,14,12,16,7,6 15,13,11,7,1,2,3,4	5,6,15,10,14,7,4,12,9,2
35D	2,16,1,8,14,12,17	3,2,7,13,11
35C	7,12,6,1,16,11	5,12,16,3,7,2,11
31P	2,9,10,13,4,5,7,6,8	6,3,10

APPENDIX XXI - Continued

Problem	Experimental Subject 9	Control Subject 9
31A	6,5,10,3,9	5,9,3,10,6
31B	7,8,2,1,3,10,6,4,5,9	7,1,2,4,8,9
31D	2,1,3,4,5,6,7,8,9,10	2,4,3,7,8
31C	5,4,6,9	5,4,6,9,10
35A	4,10,9,7,16,6,11,17	4,2,6,7,15
35B	5,8,9,10,15,14,7,13,16	5,6,15,2,7,10,14,4,13
35D	3,11, 13,16,4	3,13,11,2,7,8,12,4,16
35C	5,12,16,3,4,5,6,9,13,11,15,17	5,12,16,7,3,11,2,10,6
31P	6,5,9	6,3,10

APPENDIX XXII

TABLE OF MOST LOGIC TACTICS TO SOLVE EACH PROBLEM

Problem 31A	Problem 31B
6,3,10	7,2,9
6,5,9	7,4,8
Problem 31D	**Problem 31C**
2,4,7	5,4,9
2,3,8	5,6,10
Problem 35A	**Problem 35B**
4,2,6,7,15	5,2,7,10,14
4,6,2,7,15	5,7,2,10,14
4,2,6,15,7	5,2,7,14,10
4,6,2,15,7	5,7,2,14,10
4,14,10,3,16	5,15,6,4,13
4,14,10,16,3	5,6,15,4,13
4,10,14,3,16	5,15,6,13,4
4,10,14,16,3	5,6,15,13,4
Problem 35D	**Problem 35C**
3,13,11,4,16	5,7,3,2,11
3,13,11,16,4	5,3,7,2,11
3,11,13,4,16	5,7,3,11,2
3,11,13,16,4	5,3,7,11,2
3,2,7,8,12	5,12,16,6,10
3,2,7,12,8	5,12,16,10,6
3,7,2,8,12	5,16,12,6,10
3,7,2,12,8	5,16,12,10,6
Problem 31P	
6,3,10	
6,5,9	

APPROVAL SHEET

The dissertation submitted by Ada Elsa Izcoa has been read and approved by five members of the Department of Psychology.

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

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

May 4/65
DATE

SIGNATURE OF ADVISER