ANTICIPATION OF KNOWLEDGE OF SUCCESS AND PROBLEM-SOLVING

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

John N. Marr

1960

ANTICIPATION OF KNOWLEDGE OF SUCCESS AND PROBLEM-SOLVING

By

John N. Marr

AN ABSTRACT

Submitted to the College of Science and Arts
Michigan State University in partial
fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1960

Approved _____

ABSTRACT

In research on problem-solving behavior, experimenters usually give a problem to subjects with instructions on what the subject is to do. But there are implicit assumptions that both the experimenter and the subject make about one another's behavior which are not included in the instructions. S may believe that E wants him to follow the instructions, that E will give him credit for participation in the experiment, and that he will find out whether or not he was correct at the conclusion of the experiment. This study explored the effects of violating one of these beliefs at the beginning of the experiment.

One group of thirty subjects was instructed that they would not be told the correct solution when they finished working on the problem (Non-Anticipatio Group). The other group of thirty subjects was instructed that they would be told the correct solution when they finished working on the problem (Anticipation Group). The problem was the Joe Doodlebug No-Canopy Problem.

The groups did not differ significantly in analysis time, synthesis time, solution time, time to finish after solving the problem, rate of appeals for help or confirmation, and rate at which they made hypotheses about the solution. When they finished the first problem, half of each group were told the correct solution to the problem. The groups were then given a second problem to solve. (The Joe Doodlebug Canopy Problem.)

Although the mean solution time for the Anticipation Group was five minutes less than that of the Non-Anticipation Group, the groups did not differ significantly on any of the dependent variables. A savings

ratio was obtained for each subject by dividing the solution time on the second problem by the solution time on the first problem. An analysis of variance design revealed F ratios too small to be significant for the Anticipation variable or the interaction between Anticipation and Confirmation.

It was suggested that the lack of a significant difference between groups could be accounted for by many factors. The following were felt to be especially tenable:

1. Violation of this belief does not affect the behavior measured in these problems.
2. Subjects in both groups were so ego-involved by the description of the problems as intelligence tests that any differences produced by anticipation instructions were masked.
3. By the time the subjects have analyzed the problem, they have forgotten the anticipation instructions.
4. Although the Non Anticipation Group were told at the beginning of the experiment that they would not receive confirmation, hints were given at five minute intervals which were a type of confirmation.

ANTICIPATION OF KNOWLEDGE OF SUCCESS AND PROBLEM-SOLVING

By

John N. Marr

A THESIS

Submitted to the College of Science and Arts
Michigan State University in partial
fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1960

ACKNOWLEDGMENTS

The author wishes to express his most sincere appreciation and thanks to Dr. Milton Rokeach whose friendly guidance and understanding helped make this study possible; to the members of his committee, Dr. Paul Bakan and Dr. Frank Restle for their advice and assistance; and especially to his wife, Jo, whose support, understanding, and assistance was, and is, invaluable.

****

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

Previous research on problem-solving behavior has generally concerned itself with the cognitive activity involved or the influence of different personality variables on the solution of problems. (Duncan, 1959, Rokeach, 1960.) Little work has been done on the nature of experimenter-subject relationship. However, Block and Block (1952) investigated one aspect of this relationship in their study on the experimenter as an authority figure for the subject.

Generally, experimenters give a problem to subjects with instructions on what the subject is to do. There are, however, some implicit assumptions that both the experimenter and the subject make about one another's behavior which are not included in the instructions. For example, the experimenter assumes that S will follow his instructions and S assumes that the experimenter wants him to follow the instructions. If S volunteered to participate in the research in order to obtain required credit in his psychology course, he assumes that E will give him credit for participation upon completion of the experiments. And many subjects assume that they will know how they have done when they have finished with the problem. When the experiment is over and the ambiguity or difficulty of the problem prevents them from knowing how well they have done, they frequently ask the experimenter.

The assumptions that the experimenter and subject make about each other are beliefs. S believes that the experimenter wants him to follow the instructions, that E will give him credit for participation in the experiment, and that he will find out whether or not he was correct at the conclusion of the experiment. What happens if S is told at the

beginning of the experiment that one of his beliefs is false? This research explores the results of violating the belief about knowledge of results.

It is reasonable to suppose that violation of this belief would result in a loss of efficiency in problem-solving behavior. In Rokeach's terms, this is equivalent to the violation of a primitive belief (1960). Rokeach has specified a belief-disbelief system in which all thinking takes place. Within this system, there is a central region of beliefs and disbeliefs around which all information about the nature of the physical and social world is organized. Any change in the central region could result in a reorganization of the whole system and, therefore, is resisted. All information from the external world is first checked with the central region of beliefs and disbeliefs before assimilation. If assimilation requires a change in the system, the new information would have to be rejected or distorted to fit the present organization. This processing and coding of information results in the learning of what types of information are threatening and what types of situations should be avoided--cognitive narrowing takes place by restricting one's activities to people, places, and events where the minimum of threat is encountered.

On this basis, cognitive narrowing should take place if the belief that is violated is centrally located in the system. An example of such a primitive belief would be the causuality belief discussed by Piaget (1954). The child learns that his limbs can cause certain things to happen in the external world and that other people cause other things to happen. Another example is the concept of the body image as discussed by Fisher and Cleveland (1954) and Fisher and Fisher (1958). Some people believe that their body boundaries are "definite and firm" while others believe that their body boundaries are "indefinite and vague." Fisher and

Cleveland believe that the boundaries provide a stable frame of reference for behavior just as Rokeach believes that the central region provides a frame of reference for thinking and behavior.

In this experiment, the belief violated is one concerning knowledge of results. People do seem to learn very early in life that they can find out answers to their problems from some authority somewhere whether it be a parent, teacher, or book.

The violation of this belief should result in cognitive narrowing--an avoidance of involvement in the situation. Any disturbance in problem-solving behavior will be taken as evidence that violation of this belief does interfere with behavior. If there is no disturbance of behavior, this will be evidence that violation of the belief does not affect the behavior measured in this experiment or that anticipation of knowledge of success is not a belief that is located centrally in the individual's belief-disbelief system.

It is hypothesized that people who are told not to anticipate knowledge of success will not solve the problem as fast as people who are told to anticipate knowledge of success. Furthermore, since people tend to avoid involvement in situations where their primitive beliefs are violated, the non-anticipation group may have difficulty in overcoming any sets which prevent their reaching the solution (analysis), or they may have difficulty in organizing any new beliefs necessary for solution (synthesis).

Analysis time, synthesis time, and solution time have been used as dependent variables in much of the research reported by Rokeach and his associates (1960). For the type of problem used in their research the subject often makes hypotheses about the nature of the solution to the problem before he has overcome the sets. It is necessary for the experimenter to show the subject why his hypotheses are wrong or else he may quit the problem believing that he has arrived at the correct solution. During the problem solving process, the subject asks the experimenter

questions and makes hypotheses about the solution. In this experiment, the hypotheses and questions of the subjects are also recorded. Since the Non-Anticipation subjects in this experiment were expected to avoid becoming involved in the problem, it was expected that they would make fewer hypotheses and ask more questions than the Anticipation subjects.

The experimental design is not an easy one because not only must the subjects be instructed that they will not know whether or not they are successful but they also must not be permitted to see any possibility of gaining such knowledge. The experiment designed for this purpose had three characteristics devoted to removing the possibility of gaining knowledge of success from the situation.

1. An ambiguous problem. The problems selected were the Joe Doodlebug problems developed by Rokeach and his associates (1960). The solutions can be reached in a logical manner but there is no clear method of checking the answer such as in a math problem where 15 - 8 equals 7 and the answer can be checked by 7 plus 8 equals 15.

2. The authority on the problem was removed from the experimental situation as much as possible. All instructions came from a tape recorder--an authority who gave orders but who could not be asked question. If the experimenter had given the instructions to the subjects, the possibility would always be present that he was only fooling when he said that they would not be told what the correct answer is. If he was fooling or even if he was just present, the possibility remained that he might tell them if requested, what the correct answer to the problem is.

3. Wrong solutions to the problem were rejected by a person whom the subject thought of an another subject. As was mentioned above, previous research had found it necessary to reject wrong solutions by subjects or else they would quit the problem without having even analyzed the problem. For the reason mentioned in 2, above, the experimenter could not reject wrong solutions. A confederate, posing as another subject, served this function.

METHOD

Before starting the first problem, Ss in the Anticipation Groups were told that they would be told the correct solution to the problem when they had finished the problem. Ss in the Non-Anticipation Groups were told that they would not be told the correct solution to the problem when they had finished the problem. Ss then started the 1st problem.

After finishing the problem, half of the Anticipation Group (A-C) and half of the Non-Anticipation Group (NA-C) were told the correct solution. The other halves of both groups were not confirmed (A-NC and NA-NC). They were instructed that they would not be told the correct solution.[1]

All four groups were then given the second problem. The time to solution and time at which S declared he was finished was recorded in both problems. All Ss' comments were recorded by a tape recorder while Ss were solving the problems.

Subjects

Sixty-one male students, mainly sophomores, enrolled in an introductory psychology course at Michigan State University during Winter, Spring, Summer, and Fall terms, 1958, were used as the sample from which each was randomly assigned to one of four groups (15 per group). One of the students could not be used in the final analysis of the data because he finished the first problem with the wrong solution.

---

[1]The effects of the confirmation variable, telling one-half of each group the correct answer to the first problem, are not presented in this paper, but are discussed in a separate paper by Hoppe (1960).

The students volunteered for the experiment by placing their names on a sign-up sheet that was posted outside their classrooms. The sign-up sheet contained the following information, "Male students wanted for participation in a Group-Dynamics experiment. Approximately two hours long."

	NAME	INSTRUCTOR
Monday, February 31, 3 PM	1. John Doe	Skittigs
	2.	
8 PM	1. Tom Smith	Merryman
	2.	

All sign-up sheets were posted with the number 1 lines already filled in so that two students could not sign up for the same time and so that the confederate's presence could be accounted for.

Problems

The problems used as cognitive tasks were the Denny Doodlebug Canopy and No-Canopy problems used in much of the research reported by Rokeach (1960). The problems are presented to the subjects on a typed sheet of paper as follows:

No-Canopy Problem

The Conditions:
Joe Doodlebug is a strange sort of imaginary bug. He can and cannot do the following things:

1. He can jump in only four directions--north, south, east or west, not diagonally. (Not southeast, northwest, etc.)

2. Once he starts in any direction, that is, north, south, east, or west, he must jump four times in that same direction before he can switch to another direction.

3. He can only jump, not crawl, fly or walk.

4. He can jump very large distances or very small distances, but not less than one inch per jump.

5. Joe can not turn around.

The Situation:
Joe has been jumping all over the place getting some exercise when his master places a pile of food three feet directly west of him. Joe notices that the pile of food is a little larger than he. As soon as Joe sees all this food he stops dead in his tracks facing north. After all this exercise Joe is very hungry and wants to get to the food as quickly as he possibly can. Joe examines the situation and then says, "Darn it, I'll have to jump four times to get the food."

The Problem:
Joe Doodlebug was a smart bug and he was dead right in his conclusion. Why do you suppose that Joe Doodlebug had to take four jumps, no more and no less, to reach the food?

Three hints are given to S while he is solving the problem.

1. Joe does not have to face the food in order to eat it.
2. Joe can jump sideways and backwards as well as forwards.
3. Joe had already taken one jump East when his master placed the food down.

The correct solution to the problem is that Joe had to take exactly four jumps because he had already taken one jump East when the food was placed down. So he had to take three more jumps East before he could change directions (this is required by Condition number 2). He then takes one jump to the West, lands on top of the food, and eats.

The Canopy Problem differed from the No-Canopy Problem only in that the food was covered by a canopy in the former. Also, the sixth condition of the Canopy Problem had already been given to Ss as the second hint in the No-Canopy Problem.

Canopy Problem

The Conditions:
Joe Doodlebug is a strange sort of imaginary bug. He can and cannot do the following things:

1. He can jump in only four different directions; north, south, east, and west. He cannot jump diagonally (e.g., southeast, northwest, etc.).

2. Once he starts in any direction, that is north, south, east or west, he must jump four times in that same direction before he can switch to another direction.

3. He can only jump, not crawl, fly, or walk.

4. He can jump very large distances or very small distances, but not less than one inch per jump.

5. Joe cannot turn around.

6. Joe can jump sideways and backwards as well as forwards.

The Situation:
Joe has been jumping all over the place getting some exercise when his master places a pile of food three feet directly west of him. Joe notices that the pile of food is a little larger than he. As soon as Joe sees all this food he stops dead in his tracks facing north. After all his exercise Joe is very hungry and wants to get to the food as quickly as he possibly can. Joe examines the situation noticing that there is a low canopy over the food, then says, "Darn it, I'll have to jump four times to get the food."

The Problem:
Joe Doodlebug was a smart bug and he was dead right in his conclusion. Why do you suppose Joe Doodlebug had to take four jumps, no more and no less, to reach the food?

The hints given to S while he is solving the problem are:

1. Joe must face the food in order to eat it.
2. Joe had already taken one jump West when his master placed the food down.

The solution to the Canopy Problem is that since Joe has already taken one jump West, he must take three more jumps West before he can change directions. At the end of the sequence of jumps West, he lands on the canopy and then takes one jump backwards, South.

The last hint in both problems were different from the last hints in the problems used in previous research (Rokeach, 1960). In past

research, the last hint in both problems was, "Joe was not necessarily at the beginning or end of a series of jumps. He may have been somewhere in the middle of a series of jumps." The change was made to make the problems easier because none of the students used in the pilot study could solve the original problem in less than forty-five minutes. The changed hint was similar to that used in research reported by Rokeach and Vidulich (Rokeach, 1960, Ch. 10).

Procedure

S enters the experimental room and takes one of the chairs at the table. Conferedate (C) arrives five minutes after S and asks E if this room is where the Group-Dynamics experiment is to take place. E tells C to take the remaining chair. C makes no response towards S but looks around the room. If S introduces himself, C responds in a friendly manner but gives a fictitious name that corresponds to the fictitious name on the sign-up sheet.

E starts tape-recorder A and then picks up a newspaper, book, or magazine and begins to read. The following instructions are heard over the tape recorder,

> Let me have your attention. This is an experiment in verbal communication. I will give you all instructions. The machine operator is present only to operate the tape recorder and will pass out written instructions when I tell him. He is a paid assistant and knows nothing about the research. During the experiment you must stay in your chairs. You are going to be given a newly devised test of general intelligence which you will work on together. The problem is not a simple one but the solution can be reached through good logical analysis. The machine operator will now pass out the problem. Let him know when you have finished reading the problem.

E follows orders and passes out the No-Canopy problem and then continues reading. C reads intently until S tells E that he has finished reading at which time C also says that he has finished. If S finishes

reading and then indicates, by comment, question, or action, that he is working on the problem, E asks both if they are finished reading the problem. If S takes excessively long to read the problem C tells E that he, C, has finished. E turns tape recorder A on and resumes reading. Tape recorder A then says,

> Now let us read the problem over together. (No-Canopy problem read aloud by voice on tape recorded.) There are no tricks necessary to reach the solution. You may talk as much as you want. In fact it would be to your advantage to discuss the problem and your ideas on its solution. When you tell the machine operator that you have finished, I will (not) tell you what the correct answer is so you will (not) know whether you are right or wrong. You may now begin.

The word "not" is inserted in the instructions for the Non-Anticipation Group. When tape recorder A says "You may now begin" E starts tape recorder B recording and surreptitiously starts the stop watch. C then says, "He said we would (not) be told the correct solution when we finish."

Five minutes after the problem begins, the voice on tape recorder A says, "Machine operator, pass out the hint." E passes out Hint number 1 and the voice on the recorder reads the hint out loud. In the same manner, Hint number 2 is passed out at 10 minutes and Hint number 3 at 15 minutes.

Immediately after tape recorder A reads the third hint aloud, E turns it off. If S asks E a question during the problem, E answers "I don't know" or "I don't care," whichever is appropriate. When S reaches the solution to the problem, E surreptitiously records the time. When S tells E that he or they have finished the problem, E surreptitiously stops the stop-watch, starts tape recorder A and stops tape recorder B from recording. Depending upon which group S is in, tape recorded A says, "I will tell you what the correct answer is so you will know what the correct answer is. The correct answer is (Solution to No-Canopy problem is given)," or "I will not tell you what the correct answer is so you will not know whether you are right or wrong."

For all four groups, tape recorded A goes on to say,

> Here is another problem, it is not a simple one but the solution can be reached through good logical analysis. The machine operator will now collect the other written instructions and pass out the problem. Let him know when you have finished reading the problem.

After S has indicated that he has finished reading the problem, the tape recorder says, "Not let us read the problem over together.

> (Canopy Problem is read out loud.) There are no tricks necessary to reach the solution. You may talk as much as you want. In fact it would be to your advantage to discuss the problem and your ideas on its solution. Tell the machine operator when you have finished. You may now begin."

Five minutes after the problem begins, the voice on tape recorded A says, "Machine operator, pass out the hint." E passes out the first hint for the Canopy Problem and the voice on the recorder reads the hint out loud. In the same manner Hint number 2 is given at ten minutes.

Immediately after tape recorder A reads the second hint aloud, E turns it off. When S reaches the solution to the problem, E records the time. When S tells E that he or they have finished the problem, E stops tape recorder B from recording, starts Tape Recorder A, and records the finish time. Tape Recorder A then says, "Now that you have finished you can call me at my home if you would like. My name is McKeever. My telephone number is Ed 70624. I repeat 70-624." All telephone calls that S made were recorded.

Like the research reported by Rokeach (1960), this procedure allowed a measure of the total time taken by the subject to solve the problem, measures of the time taken to overcome the individual beliefs (analysis) and measures of the time taken to solve the problem after overcoming the individual belief (synthesis). Three other kinds of measures were made in this experiment in order to analyze the problem solving processes, measures which were felt to be useful in analyzing the effect

of the anticipation variable. (1) The time taken to report having finished the problem after the solution was reached. For example, S might spend five minutes after reaching the solution in checking his hypothesis, in attempting to get confirmation from the confederate, or in testing other hypotheses.

Since the conversations during problem solving were tape recorded, a content analysis of the recording was possible. Tapes were coded so that (2) the number of different kinds of hypotheses offered by S could be counted, and (3) the number of appeals for assistance and/or confirmation which were made could be counted. Any statement that the S made which was an attempt to get the bug to the food and which had not been suggested previously by S was considered as one hypothesis. For example; Joe takes four jumps West, Joe takes two jumps North, Joe takes two jumps South, Joe jumps past the food and then back to it, Joe jumps around the world, Joe had stopped at the North Pole are all counted as different hypotheses. Since a person who solved a problem in five minutes would not likely make as many hypotheses as a person who took forty minutes to solve, the hypothesis rate for each S was determined by dividing the number of hypotheses by the solution time.

An appeal rate was derived from each tape by dividing the number of appeals by the solution time. Any attempt to obtain help from the confederate or machine operator or to obtain confirmation from the confederate was counted as an appeal. For example, "What do you think?" "Do you have any ideas?", "What do you think of four jumps West as a solution?", "I don't think the damn bug ever gets to the food, do you?" were all counted as appeals. A comment such as the following, "Maybe he just jumped west--what do you think?" would be counted as one hypothesis and one appeal.

RESULTS

None of the distributions of the dependent variable measures was normal. As a result, it was necessary to employ distribution-free statistical techniques throughout most of the analyses. White's rank test for the significance of the difference between two groups described by Edwards (1954) was used whenever possible. This statistic tests the null hypothesis that two sets of observations are from a common population without any assumption being made concerning the distribution of the measures in the population. A normal curve approximation with corrections for continuity was used. If there were too many tied ranks to use White's rank test, the median test also discussed by Edwards (1954) was used. In this technique, the proportion of cases of each group that was above the combined group median was determined. The hypothesis tested was that the proportions of cases above the median were equal.

Table I shows the results obtained for the Anticipation and Non-Anticipation Groups in both problems. None of the differences between groups were statistically significant. The following points are noted:

1. Analytic thinking as measured by the time to overcome the various beliefs was essentially the same in both problems. Although N = 30 in each group, the tape recordings for some Ss were faulty and could not be coded. As a result analysis and synthesis mean times are based on 25 and 23 cases in problems 1 and 2, respectively, for the Anticipation Group, and 24 cases in both problems for the Non-Anticipation Group. The Median test was used for the tests of significance.

2. Synthesis in thinking as measured by the time to solve the problem after overcoming the beliefs was also essentially the same for both groups in problem 1, the no-canopy problem. Although synthesis

TABLE I

MEAN TIMES TAKEN TO ANALYZE, SYNTHESIZE, SOLVE, AND FINISH THE PROBLEMS

Groups	Problem	Analysis: Mean Time to Overcome: First Belief	Analysis: Mean Time to Overcome: First Two Beliefs	Analysis: Mean Time to Overcome: All Three Beliefs	Synthesis: Mean Time to Solve After Overcoming: First Belief	Synthesis: Mean Time to Solve After Overcoming: First Two Beliefs	Synthesis: Mean Time to Solve After Overcoming: All Three Beliefs	Solution Time	Finish Time
Anticipation	1	3.73	7.37	13.57	17.51	13.87	7.68	21.10	2.78
Non-Anticipation	1	4.10	7.37	12.60	16.74	13.71	8.29	20.54	3.61
Anticipation	2	3.07	7.04		17.36	13.39		19.42	3.86
Non-Anticipation	2	2.94	6.12		24.68	21.15		24.96	2.28

in the Anticipation Group appears to take less time than in the Non-Anticipation Group in the second problem, the difference was not significant as tested by White's rank test. ($z = 1.31$ and $z = 1.31$.)

3. Solution time as measured by the time to reach the correct solution was approximately the same for both groups in the first problem. Normally the time to overcome a belief (analysis) and the time to solve the problem after overcoming the belief (synthesis) should, when added together, equal the solution time. In Table I this is not the case because the solution times were recorded while Ss were solving the problems but analysis and synthesis were obtained from the tape recordings. Some of the analysis and synthesis times were not obtainable because the tape recorder did not record some of the subjects. The mean solution times are based on N's of 30 in each group while the mean analysis and synthesis times are based on N's of less than 30 (see 1 and 2 above).

In the second problem the Anticipation Group reached the solution approximately five minutes faster than the Non-Anticipation Group. Neither difference was significant, however, when tested by White's rank test since two-tailed tests of significance found p less than .35 for problem 1 and p less than .16 for the second problem.

In order to control for the time taken to solve the first problem, the solution times of the second problem were divided by the subjects' solution times on the first problem to obtain a savings ratio for each subject. The mean savings ratio for the Anticipation Group was .942 and for the Non-Anticipation Group was 1.368. The difference was not significant when tested by White's rank test ($p < .14$).

The comparison of the groups in the second problem or in savings ratios does not tell what the effect of non-anticipation is when the groups are confirmed or not confirmed. A statistical technique such as analysis of variance was needed to test such an interaction. An analysis of

variance design suggested by Lindquist (1953, pp. 220-230) was applied to the data. Besides permitting a test for interaction of anticipation and confirmation, this allowed a comparison of the Anticipation Group and the Non-Anticipation Group with the variance due to the Confirmation variable and due to the Confederate variable accounted for.

The variances of the distributions of solution times was tested for heterogeneity and found to be not significantly different even though the solution times in both problems were not normally distributed. When the solution times in the two problems were converted to savings ratios, the distribution of ratios was more normal than the distributions of solutions times. However, the savings ratios of the combined groups were still not normally distributed. A more conservative level of significance was chosen for the analysis of variance test as suggested by the Norton study (Lindquist, 1953, pp. 78-90) when the normality assumption is violated. For this analysis p less than .03 was selected. Table II shows the results of the analysis. The F of 4.34 that was found for the Anticipation variable would occur by chance less than 5% of the time, but more than 3% of the time, and thus did not meet the level of significance selected. Furthermore, an examination of the mean square of the interaction between anticipation and confirmation (AxC) reveals a value so low as to make an F test unnecessary.

It is noted that the interaction between the Confederate and Confirmation variable was also significant at the .05 level. Although this too does not meet the level of significance set prior to analysis, it is indicative that the difference in confederates may affect confirmation. This is discussed in another paper on this research by Hoppe (1960).

4. The Finish time was obtained by subtracting the solution time from the time at which S told the Machine Operator that he had finished the problem. Since these times were recorded during the problem solving sessions and not recorded from the tape recordings, there was

TABLE II

ANALYSIS OF TOTAL TIME SAVINGS
PROBLEM 2/PROBLEM 1

Source	df	MS	F
A-Anticipation	1	3.148	4.34*
B-Confederates	1	1.003	1.38
C-Confirmation	1	.384	
AB	1	.065	
AC	1	.184	
BC	1	3.248	4.48*
ABC	1	.051	
Error	52	.725	
Total	59		

*$p < .05$ but not significant since .03 level required due to violation of the assumption of normally distributed data.

an n of 30 in each group. There were no significant differences between groups on either problem when tested by White's rank test. Similarly, a White's rank test of a savings ratio, Finish time in problem 2 divided by Finish time in problem 1, revealed no difference ($z = 1.17$). The apparent increase in Finish time from problem 1 to problem 2 for the Anticipation Group was partially caused by one S taking 23 minutes to finish the second problem after solving the problem.

The results reported thus far have consisted of the various times taken to overcome beliefs, to integrate beliefs, to solve the problems, and to finish the problems after reaching the correct solution. These results do not show S's interaction with the confederate as a result of the experimental conditions. The tape recordings had been coded for hypotheses S suggested to the confederate and for appeals for help that the S made. This permitted the determination of an appeal rate and a hypothesis rate for each S on each problem (number of appeals or number of hypotheses/solution time). Table III shows the mean rates for each group in the two problems. Essentially there was no difference between groups in either problem in relation to the rate at which they made appeals or the rate at which they made hypotheses as to the solution to the problem (White's rank test).

The appeal rate in problem 1 was subtracted from the appeal rate in problem 2 in order to get a rate change for each S. This permitted a comparison of the Anticipation and Non-Anticipation Groups in respect to the change in appeal rates over the two problems. Again there was no significant difference between groups when tested by White's rank test ($z = .68$).

In the same way, a change in the rate in which Ss made hypotheses was computed so that the groups could be compared. The difference was not significant when tested by White's rank test ($z = .87$).

TABLE III

MEAN APPEAL AND HYPOTHESIS RATES
IN THE TWO PROBLEMS*

Problem	Appeal Rate		Hypothesis Rate	
	1	2	1	2
Anticipation	.470	.440	.231	.378
Non-Anticipation	.423	.455	.226	.312

*The mean rates in this table are presented for comparison purposes only and were not used in the statistical analysis of the data.

One other comparison was made on the S's interaction with the confederate. Since the Anticipation Group had been instructed that they would be told whether or not they were correct after they reached a solution while the Non-Anticipation Group had been instructed that they would not be told whether or not they were correct, it was felt that there might be a difference in the number of attempts the groups would make to get confirmation from the confederate. This data was available from the tape recordings. Since there were too many tied ranks to use a White's rank test, a Median test was used to test the difference. The X^2 of .24 was not significant (Edwards, 1954).

Finally, the correlations between solution time, appeal rate and hypothesis rate were determined. These correlations are presented in Table IV. There was essentially no correlation between the time it took the sixty individuals to solve the first problem, the no-canopy problem, and the time it took them to solve the second problem, the canopy problem. On the other hand, the rate at which Ss appeal to the confederate for help or confirmation in the first problem was highly correlated with the appeal rate on the second problem. Likewise the rate at which Ss made hypotheses on the first problem was significantly correlated with the hypothesis rate on the second problem. These two significant correlations may indicate that the rates at which an individual makes appeals and hypotheses are characteristics of his personality.

In the first problem, the appeal rate was significantly correlated with solution time but there was essentially no correlation between solution time and hypothesis rate. However, in the second problem the slight positive correlation between solution time and appeal rate disappears while a large negative correlation appears between solution time and hypothesis rate. This would suggest the hypothesis that the faster an individual makes hypotheses the faster he solves this type of problem. Finally it is noted that the correlation between appeal rate and hypothesis rate was constant but not significant over the two problems.

TABLE IV

CORRELATIONS BETWEEN MEASURES IN BOTH PROBLEMS

Comparison		Correlation	Correlation Method
Between Problems	Solution Time	.00	Phi Coefficient
	Appeal Rate	.74**	Product-Moment
	Hypothesis Rate	.38**	Product-Moment
Problem 1	Solution Time and Appeal Rate	.29*	Point Biserial
	Solution Time and Hypothesis Rate	-.04	Point Biserial
	Appeal Rate and Hypothesis Rate	.23	Product-Moment
Problem 2	Solution Time and Appeal Rate	-.13	Point Biserial
	Solution Time and Hypothesis Rate	-.56**	Point Biserial
	Appeal Rate and Hypothesis Rate	.24	Product-Moment

*Significant, $p < .05$

**Highly significant, $p < .01$

DISCUSSION

The hypothesis that the Non-Anticipation Group would not solve the problems as fast as the Anticipation Group was not supported by this experiment. It would appear that if people are instructed before solving a problem that they will not be told the correct solution to the problem when they have finished, their ability to solve the problem is not impeded as measured by the time to reach the correct solution. Furthermore, it appears that their ability to analyze and synthesize are not affected by these instructions, nor do they take more time to check their solution or look for other solutions after they have reached the correct solution.

When a content analysis was done on the tape recordings of the problem solving sessions, it was also found that the groups did not differ in the rate at which they made hypotheses or the rate at which they appealed to the confederate for help or confirmation.

The similarity of the groups on all dependent variables could be due to many things. The following ideas are felt to be especially tenable.

1. The theory on which the prediction was made is at fault. A disturbance of the Central region of the Belief-Disbelief System does not affect behavior and/or does not disturb the intermediate and peripheral regions. This reason, however, is suspect because other research give evidence that the regions are interrelated (Rokeach, 1960, Chs. 12 and 13). Another reason might be that the anticipation of knowledge of results is not a primitive belief, it is not a belief which resides in the central region of the Belief-Disbelief system and upon which other beliefs and behaviour are dependent. That is people do not always believe that they will find out whether or not they are successful in the

problems they work on. If this belief is not basic, this experiment is not an adequate test of the theory.

2. The independent variable did not take. S's were specifically told before they began to work on the problem, "When you have finished, I will not tell you what the correct answer is so you will not know whether or not you are correct." Since it had been found in the pilot study that some individuals had not heard this statement or could not remember hearing the statement, the confederate would state at the beginning of the problem, "He said that we would not be told the correct answer when we have finished." Although the confederates repetition of the statement followed the tape recorder's statement by no more than 30 or 40 seconds, two individuals in the Non-Anticipation Group denied this or doubted it, or stated that they hadn't heard it. In no case did an S in the Anticipation Group deny or state that he hadn't heard the anticipation instructions when the confederate said "He said that he would tell us the correct answer when we have finished." This behaviour on the part of the Non-Anticipation Group is predicted by Rokeach's theory,

> All information impinging upon the person from the outside must be processed or coded in such a way so that the information is either rejected or else somehow fitted into the belief-disbelief system. It is this processing-coding activity which we call thinking, and it must be within some context like the belief-disbelief system within which thinking must take place.
>
> It is far from clear how the processing-coding of new information proceeds. But as a first approximation--and in order to guide our empirical research--it will be assumed that this operation begins with the person first screening the new information for compatibility with the primitive beliefs (central belief region). The initial screening may lead to the rejection or narrowing out of new information so that nothing further need be done with it. In this way there is selective avoidance of contact with stimuli, people, events, books, etc., which threaten the validity of one's belief system or which proselyte for competing disbelief systems. (Rokeach, 1960, pg. 47)

3. The high degree of ego-involvement of S's in both groups masked the effects of the different instructions. Research by Lewin and his associates (1951) and Sarson, Mandler, and Craighill (1952) have demonstrated that motor and cognitive tasks are affected by the degree to which the individual is ego-involved in the situation. Each S was told in this experiment that he was going to be given a newly devised test of general intelligence. This information may have so threatened the Ss that they didn't hear the instructions which introduced the independent variable, and therefore prevented the predicted difference.

4. The beliefs introduced as hints during the problem may have contradicted the non-anticipation instructions. For example, the second belief is that the bug could jump sideways and backwards as well as forwards. Some Ss had overcome this belief prior to the time that the tape recorder instructed the machine operator to pass out the second hint. As a result, when S had already overcome the belief and then heard the machine say it, he was confirmed. He could interpret this as evidence that he had the right approach to the problem. Occasionally one of the Ss was heard to say to the confederate, "I already knew that" or "I told you that a few minutes ago, remember?"

In this experiment the authority was removed from the experimental situation. All instructions came from the tape recorder, an authority to which there can be no appeal for help or confirmation. This was the reason for having the mechanical authority tell Ss that the Machine Operator knew nothing about the experiment but was only a paid assistant. And this was the reason for giving S the impression that the confederate was just another student who had volunteered to participate in the experiment. The lack of significant differences in the results does not invalidate the design developed in this study as an extremely

useful technique for studying human behavior, especially beliefs about the nature of authority.

Evidence that the technique for removing authority had an effect was given by the observation that the pilot-study students directed all questions about the problem to the experimenter but Ss in the experiment averaged no more than one question to the Machine Operator in a two hour period. When they did address the Machine Operator, it was to ask such questions as "Do you know if he (voice on tape recorder) is going to give us any more hints?" or "What are we supposed to do when we have finished the problem?" (they had forgotten that the Voice had instructed them to tell the Machine Operator that they were finished). On occasion Ss would make fun of the Machine Operator to the confederate by making statements to the effect that the Machine Operator had a soft job--getting paid for turning the machines on and off, that the Machine Operator was asleep and would fall off his chair, etc.

Finally, the reasons presented above for the lack of differences between groups have suggested another study. A modified design is being used to study the effects of non-anticipation on problem-solving. The anticipation variable is again introduced in the instructions but also written at the bottom of the problem sheet. Also, neither the anticipation or non-anticipation groups are being told that the Doodlebug problems are intelligence tests. Under these conditions, it is expected that the anticipation group will solve the problems faster than the non-anticipation group.

SUMMARY

One group of thirty subjects was instructed that they would not be told the correct solution when they finished working on the problem (Non-Anticipation Group). The other group of thirty subjects was instructed that they would be told the correct solution when they finished working on the problem (Anticipation Group).

The groups did not differ significantly in analysis time, synthesis time, solution time, time to finish after solving the problem, rate of appeals for help or confirmation, and rate at which they made hypotheses about the solution. When they finished the first problem, half of each group were told the correct solution to the problem and half of each group was not told the correct solution to the problem. The groups were then given a second problem to solve.

Again the Anticipation Group did not differ significantly from the Non-Anticipation Group on the dependent variables. A savings ratio was obtained for each subject by dividing the solution time on the second problem by the solution time on the first problem. An analysis of variance design revealed F ratios too small to be significant for the Anticipation variable or the interaction between Anticipation and Confirmation.

REFERENCES

Block, Jeanne, and Block, J. An interpersonal experiment on reactions to authority, Human Relations, 1952, 5, 91-98.

Duncan, C. P. Human problem solving. Psychol. Bull., 1959, 56, 397-429.

Edwards, A. L. Statistical Methods for the Behavioral Sciences, New York: Rinehart, 1954.

Fisher, S. and Cleveland, S. E. Body Image and Personality, Princeton, N. J.: D. Van Nostrand, 1958.

Fisher, S. and Fisher, Rhoda L. A developmental analysis of some body image and body reactivity dimensions. Child Development, 1959, 30, 389-402.

Hoppe, R. Confirmation and Transfer in Problem Solving, Unpublished Master's Thesis, Michigan State University, 1960.

Lewin, K. Field Theory in Social Science, New York: Harper Bros., 1951.

Lindquist, E. F. Design and Analysis of Experiments in Psychology and Education, Boston: Houghton Mifflin, 1953.

Piaget, J. The Construction of Reality in the Child, New York: Basic Books, 1954.

Rokeach, M. The Open and Closed Mind, New York: Basic Books, 1960.

Sarason, S. B., Mandler, G., and Graighill, P. G. The effect of differential instructions on anxiety and learning, J. Abnorm. Soc. Psychol., 1952, 47, 561-565.